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The implementation of national and European environmental legislation in Germany: Three case studies

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FOREWORD

This report is an outcome of *The Implementation of EU Environmental Policies: Efficiency Issues* (IMPOL) project. The IMPOL project involved four research institutes (CERNA, Ecole des Mines de Paris, SPRU – Science and Technology Policy Research Unit, University of Sussex, CSTM, University of Twente, UFZ-Centre for Environmental Research Leipzig-Halle), and was funded by the European Commission's DGXII under its Environment and Climate Programme (contract ENV4-CT97-0569) and national institutions (including ADEME, the French environmental agency). As its name suggests, the project concerned the implementation of EU environmental legislation. It sought to answer questions such as:

- Does implementation result in the attainment of the environmental goals set out in EU Directives?
- How does implementation affect the cost effectiveness of a particular environmental policy?

The core of the project consisted of the *ex post* evaluation of the implementation outcomes of selected pieces of EU legislation in four Member States (France, Germany, the Netherlands and the United Kingdom). Three cases studies were evaluated: the Directive regulating emissions from existing municipal waste incinerators (89/429); the Directive on emissions of SO_2 and NO_x from large combustion plants (88/609); and, the Council Regulation on the Eco-Management and Audit Scheme (1863/93) or EMAS. This research report contains the case studies on the implementation of EMAS as well as European and national legislation for emissions from existing municipal waste incinerators and large combustion plants in Germany. The studies describe the way the various pieces of legislation were implemented and assess the outcomes in terms of effectiveness and efficiency. They were used as inputs for comparative analyses of the implementation in the four countries.

IMPOL research reports are available at http://www.cerna.ensmp.fr/Progeuropeens/IMPOL.

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CASE STUDY I

The Implementation of the European EMAS Regulation in Germany

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List of abbreviations

BDI	Bundesverband der Deutschen Industrie (Federation of German Industries)
BFB	Bundesverband der Freien Berufe (Federal Association of Independent Professions)
BMU	Bundesministerium für Umwelt (Federal Ministry of the Environment)
BMWi	Bundesministerium für Wirtschaft (Federal Ministry of Economics)
DAU	Deutsche Akkreditierungs- und Zulassungsgesellschaft für Umweltgutachter mbH (German Environmental Verifiers Accreditation Company)
DGB	Deutscher Gewerkschaftsbund (German Trade Union Federation)
DIHT	Deutscher Industrie- und Handelstag (Umbrella organisation of the German chambers of industry and commerce)
EMAS	Eco-management and audit scheme
HwK	Handwerkskammern (Chambers of craft)
IdU	Institut der Umweltgutachter und -berater (Institute of accredited environmental verifiers and environmental consultants)
IHK	Industrie- und Handelskammern (Chambers of industry and commerce)
ISO	International Organization for Standardization
SME	Small and medium-sized companies
TGA	Trägergemeinschaft für Akkreditierung (business organisation which mainly accredits verifiers for ISO-norms)
UAG	Umweltauditgesetz (Environmental Audit Act)
UBA	Umweltbundesamt (Federal Environmental Agency)
UGA	Umweltgutachterausschuß (Environmental Verifiers Committee)
ZdH	Zentralverband des deutschen Handwerks (umbrella organisation of the German chambers of craft)

1 Introduction

The "Council Regulation (EEC) No 1836/93 of 29 June 1993 allowing participation by companies in the industrial sector in a Community eco-management and audit scheme" (EMAS Regulation) is directly binding on all member states. Thus a translation into national law was not necessary. However, the EMAS Regulation calls upon Member States to establish a system of institutions and organisations necessary to register participating companies and to ensure that they meet the provisions of the Regulation. The system had to be "fully operational within 21 months following the date of entry into force of this Regulation" (Art. 6). The design of the system was left to Member States.

This report traces the implementation of the EMAS Regulation in Germany,[1] i.e. it describes what kind of an institutional setting was chosen, in what way it was established and how it is working in practice. Moreover, the outcome of the implementation process is analysed in terms of efficiency and environmental effectiveness. To gain the relevant data and information we conducted expert interviews, reviewed the relevant literature and carried out a questionnaire survey.

Chapter 2 provides some background information about EMAS, including the main contents of the EMAS Regulation and the political process that preceded the adoption of the EMAS Regulation and the implementation requirements imposed on the Member States. Chapter 3 describes the implementation of the EMAS Regulation and companies' motives to participate in the scheme. In chapter 4 the outcome of the implementation process is assessed in terms of the attainment of the Regulation's environmental goals and efficiency. To this end the criteria of efficiency (allocative, productive and administrative efficiency) and environmental effectiveness are adapted to the case of EMAS and indicators are developed for their assessment.[2] Finally, data for the indicators are provided for Germany. Chapter 5 develops some hypotheses on how goal attainment and efficiency have been influenced by specific features of the implementation process.

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[1] A comparative analysis of the EMAS implementation processes in the four case-study countries is carried out in Wätzold/Bültmann 2000b.

[2] The definition of goal attainment and efficiency with respect to EMAS has been developed in co-operation with Matthieu Glachant and Simone Schucht (CERNA).

2 Background of the EMAS implementation process

To gain a better understanding of the EMAS implementation process in Germany, an explanation of the main elements of EMAS and a short overview of the political process which preceded the adoption of the European EMAS Regulation in 1993 are required. We will also briefly recall the tasks the EU Member States had to fulfil to implement the EMAS Regulation.

2.1 EMAS explained

The EMAS-Regulation is a site related[3] environmental management standard for companies in the industrial sector.[4] In contrast to other standards, EMAS requires companies to publish an environmental statement and provides for a certification system with independent environmental verifiers and registration bodies. Participation in EMAS is voluntary, but once a company has decided that it wants a site to get registered with EMAS, it has to meet the provisions of the Regulation, i.e. it must go through the procedure shown in figure 1.

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[3] So far it is only possible to register individual sites. The current proposal for a revision of the EMAS-Regulation (common position adopted by the EU Council) opens EMAS to all kinds of orgnisations that have their own functions and administration. This means that not only sites, but also entire companies as well as parts or combinations thereof can be registered.

[4] The Regulation enables Member States to open the system for non-industrial sectors on an experimental basis. The current proposal for a revision of the EMAS-Regulation (common position adopted by the EU Council) generally includes non-industrial sectors.

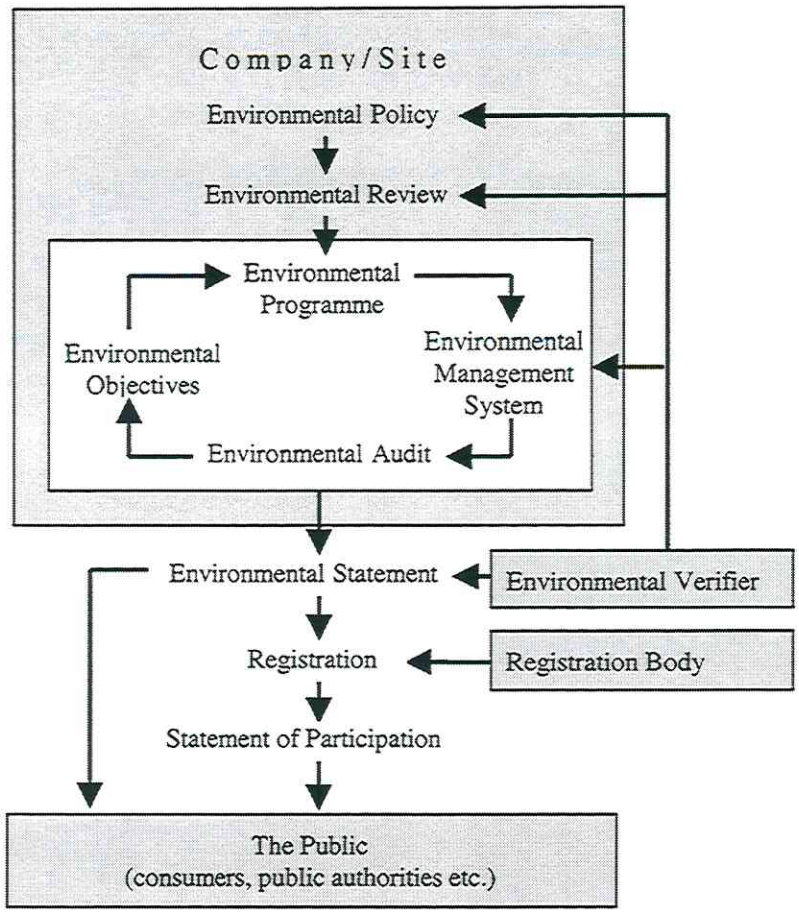

Figure 1: Procedure of participation in EMAS

At first, the company must adopt an environmental policy in which its overall environmental aims and principles of action are fixed. In the policy the company commits itself to comply with all relevant environmental regulations and to continuously improve its environmental performance. Afterwards an environmental review is conducted. This is an initial comprehensive analysis of the environmental issues, impacts and performance which are related to the activities of the site to be registered.

On the basis of the general goals of the environmental policy and the results of the environmental review, an environmental programme is introduced. The programme describes specific goals as well as measures and deadlines for their realisation. Furthermore, an environmental management system has to be established which encompasses the organisational structure, responsibilities, procedures and resources of the site's environmental activities. Once the system is implemented, an environmental audit is performed which evaluates whether the system is suited to secure compliance with all relevant regulations and the company's own environmental goals. In the light of the findings of the audit, appropriately corrective actions are taken and new environmental objectives are set.

In order to inform the public about the environmental activities of the company respectively the site, an environmental statement is prepared. The statement shall include a description of the environmental policy, programme and management system as well as an assessment of all significant environmental issues related to the activities of the site. If appropriate, the environmental issues shall be presented in the form of quantitative figures on pollutant emissions, waste generation, energy consumption etc.. Finally the company has to commission an indpendent environmental verifier with the examination of the environmental policy, programme, management system, review or audit procedure and the validation of the environmental statement. Afterwards the company respectively the site can apply for being registered with EMAS.

When registration is granted, the company has the right to use a so-called statement of participation and employ it for advertising purposes. However, the statement may not be used for direct product marketing. Registration is granted for three years. If the company respectively the site wants to remain registered, it has to repeat the environmental audit, to update the environmental statement and to arrange for another examination and validation by an environmental verifier.

2.2 The political evolution of EMAS

The first idea of a European Eco-Management and Audit Scheme emerged in the Commission in 1990.[5] It led to the publication of a consultation document in December 1990 which called for the mandatory participation of companies in the scheme. Industry responded sharply and homogeneously. It targeted its main criticism at the mandatory approach as it felt this was undue interference on the part of the government to prescribe the management tool a company should use. The strong resistance of industry led the Commission to accept a voluntary approach and it published a new proposal in the EU's Official Journal on 27 March 1992. Industry's position changed in two ways. Firstly, while industry on the whole was less interested in the political process, lobbying by British and especially German industry was still considerable. Secondly, while the German industry (and Government) continued to oppose the scheme, the attitude of industry in general was now co-operative, with the UK being the most active supporter.

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[5] The description of the political evolution of EMAS is based on Franke and Wätzold (1996).

German industry continued to oppose EMAS for several reasons: The scheme does not take into account the different emission standards required by different Member States. It was perceived as unfair that a company which has to comply with high environmental standards (and German companies believed that German standards were high) would receive the same logo as a company in another country with lower standards. In addition, the approach of German industry towards environmental problems was different from that in EMAS. EMAS is management-oriented. The idea is to improve the environmental performance of a company by implementing management tools. By contrast, German industry was 'engineer-driven'. To improve environmental performance, typical German companies tried to develop or install a new technology. The EMAS culture was therefore alien to German companies. Furthermore, German companies felt they they would be compelled to take part in the scheme due to high public pressure in environmental matters in Germany.

The strategy chosen by German industry was not merely to reject EMAS, but also to push for environmental measures at a European level that were already present in Germany. It suggested implementing the German "Betriebsbeauftragtenwesen" at a European level instead of EMAS.[6] It also lobbied for the harmonisation of environmental standards in the EU at a high level. At this time, in many fields German environmental standards were the most stringent in the EU. Therefore, the other standards would have had to be raised to the German level. As it became clear that Germany could not prevent EMAS, it tried to introduce a clause into the regulation demanding the use of the best available technology. The reasons were that German companies are required by environmental laws to use the best available abatement technologies and, furthermore, the best available technology clause was in line with the German engineer approach. As a result, the requirement of an "economically viable" application of best available technology was integrated into the EMAS Regulation.

By contrast to German industry, British industry supported EMAS and adopted a strategy of co-operation. The general reason was that British industry hoped to gain a competitive advantage. The UK was the first country to develop an environmental management system standard (BS 7750) and experience with the standard had been good. At this time there were already a high number of companies working to implement the standard. The UK government

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[6] German companies must appoint a "Beauftragten" (an environmental officer) when certain levels of waste or emissions into water and air are exceeded. This person is responsible for the corresponding areas and it is expected to act as the 'conscience' of the company.

also supported EMAS. Apart from supporting UK industry, the government felt that giving the public access to environmental information was in line with the policy of open government.

The Netherlands were very active in promoting EMAS, too[7]. Their views were similar to those from the UK. Dutch companies had gathered considerable experience with environmental management systems, many of them using BS 7750. France supported EMAS as well, although it kept a low profile during the political process.

At the Environment Council Meeting in March 1993 it became clear that all members except Germany were in favour of the regulation. Germany knew that it could only delay but not prevent EMAS, as the final ratification of the Maastricht Treaty would enable EMAS to be ratified by majority voting. Therefore, it gave in to the pressure of the other Member States and EMAS was adopted at the Environmental Council Meeting in June.

2.3 Implementation Requirements

As a Regulation, EMAS is directly binding on all member states. Therefore, translation into national law is not necessary. However, national authorities shall:

- establish a system for the accreditation of independent environmental verifiers and for the supervision of their activities (Art. 6(1));
- ensure that these systems are fully operational within 21 months following the date of entry into force of the EMAS-Regulation, i.e. by April 1995 (Art. 6(2));
- establish, revise and update a list of accredited environmental verifiers and communicate this list every six months to the Commission (Art. 7);
- designate a competent body which is responsible for registering the sites participating in EMAS, giving them a registration number and updating the list of registered sites annually (Art. 8);
- communicate the lists of registered sites to the Commission before the end of each year (Art. 9);

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[7] For more information on the involvement of countries other than the UK and Germany, see Franke and Wätzold 1995, p.39-42.

- ensure that the competent bodies for carrying out the tasks provided for in the EMAS-Regulation are designated within 12 months of the entry into force of the EMAS-Regulation, i.e. by July 1994 (Art. 18);
- take appropriate legal or administrative measures in the case of non-compliance with the provisions of the EMAS-Regulation.

Additionally, the following points are mentioned, but explicitly left open in the EMAS-Regulation. Member States may:

- set up a system of fees for the administrative costs incurred in connection with the registration procedures for sites and the accreditation of environmental verifiers and the promotional costs of the scheme (Art 11),
- promote companies' participation in EMAS, especially the participation of small and medium sized companies (SME) (Art 13),
- apply provisions, on experimental basis, analogous to EMAS outside industry, e.g. the distributive trades and public services (Art 14).

3 The Implementation of the EMAS Regulation in Germany

We will now describe the EMAS implementation process in Germany. We have divided the process into the following five phases (sub-processes): agreement on the accreditation, supervisory and registration system, passing of the legal regulations, interim solution, norm specification and norm realisation. Within the individual phases we shall give information about the actors involved, the story of the respective sub-process and the outcome. The story is largely recounted chronologically, but this is not always possible since some phases overlapped.[8]

3.1 Phase 1: Agreement on the structure of the accreditation, supervisory and registration system

The first phase of the implementation process was characterised by a conflict over the amount of influence industry should have in the accreditation, supervisory and registration system. It ended with a proposal for a system which was finally supported by all relevant groups.

3.1.1 The actors, their motives and strategies

The public debate was dominated by two opposing parties, i.e. the Federal Ministry of the Environment (Bundesministerium für Umwelt – BMU) and environmental groups on the one hand, and business associations and the Federal Ministry of Economics (Bundesministerium für Wirtschaft – BMWi) on the other hand.

Federal Environment Ministry

Whenever legal regulations are enacted by the federal government, there is always one Federal department in overall charge, i.e. it is responsible for preparing a draft bill. With respect to environmental matters (such as EMAS), this is the Federal Environment Ministry.

The BMU wanted public authorities to have decisive influence on the whole system. The Ministry regarded EMAS as an instrument of public environmental policy. It was convinced that the credibility and acceptance of the system would be diminished if it was organised by

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[8] The information on the implementation process is mainly based on expert interviews we conducted with representatives of registration bodies, the DAU, the UGA, the BMU, the BMWi, environmental verifiers, companies participating in EMAS as well as environmental groups and business associations. The interviews were conducted between autumn 1998 and September 1999.

business associations. It believed that business associations were likely to come into role conflicts if they had to control their own members. In order to ensure the nation-wide uniform treatment of environmental verifiers and companies, the BMU demanded that the tasks be carried out centrally by one body. It considered the Federal Environmental Agency (Umweltbundesamt – UBA) the most appropriate one.

The BMU knew that the success of EMAS was highly dependent on its acceptance by companies and the public. Therefore it was interested in developing a solution in agreement with all relevant social groups, especially the business community. The first concept presented by the BMU allowed for the accreditation and supervision of environmental verifiers to be carried out jointly by the UBA and a business body. Additionally, the formation of an advisory council was proposed in which all relevant groups were to be represented.

Environmental groups

The environmental groups (BUND, DNR and NABU) pursued similar ideas to the BMU, but went even further. They were of the opinion that matters of substantial public interest had to remain in the area of responsibility of public authorities. They hence fought for the 'public authority model', which placed accreditation and supervision as well as registration into the UBA's hands. They wanted to keep business organisations out of the system, because they feared for its independence, transparency and credibility.[9]

Although there was a large degree of consensus between environmental groups and the BMU, they did not form a strict alliance. Environmental groups tried to convince the BMU of their concept, but the Ministry spoke just as often with business associations, (environmental) consultants and representatives of the German states.

Federal Ministry of Economics

The BMWi was deeply involved in the debate about the implementation of EMAS in Germany, not least at the business associations' urging. It declared itself to favour a model with as little state influence as possible, and argued against comprehensive legal regulations and new

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[9] Cf. e.g the press release of the Deutscher Naturschutzring 32/94 vom 10/28/94 with the title "Deutscher Naturschutzring wirft DIHT, ZDH und BDI Verwässerung der Öko-Audit-Verordnung vor".

bureaucracy. Already existing business organisations were proposed as accreditation, supervisory and registration bodies.

The BMWi emphasised that against the background of voluntary participation in EMAS, a system had to be developed which considered the companies' interests and set incentives for getting registered with EMAS. Therefore the Ministry was a strong supporter of placing the onus on business organisations and opening up opportunities for deregulation. The BMWi regarded itself as the advocate of business within the Government and thus represented business interests particularly vis-à-vis the BMU.

Business associations

The business associations' opinions were generally congruent to those of the BMWi. They were of the opinion that if participation in EMAS is voluntary and if the system was to be promoted as a business initiative, business organisations had to be responsible. They argued that the idea of environmental audits was originally developed by industry and thus responsibility for its realisation had to remain with industry. Many companies feared that EMAS would be turned into an instrument which enabled the state to (additionally) interfere in business affairs.[10] When the companies claimed that public authorities must neither have detailed knowledge about nor influence or regulate their management, it became obvious that fundamental views on the role of the state were involved.

Several business organisations presented their own concepts of how to implement EMAS in Germany.[11] All these concepts can be regarded as counterproposals to the BMU's concept, insofar as they all exclusively advocated commissioning business bodies with accreditation, supervision and registration. However, they differed in details and all brought in different organisations. To strengthen their position in the debate with the BMU, leading business organisations managed to agree on one concept, the Federation of German Industries (Bundesver-

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[10] Cf. e.g. the press release of BDI, BFB, DIHT and ZDH of 10/27/94 with the title "Spitzenverbände der Wirtschaft präsentieren Modell zur Umsetzung der EG-Öko-Audit-Verordnung" and the article "Umweltprüfungen privat organisieren. Umsetzung der Öko-Audit-Verordnung / Vorstellungen der Wirtschaft" in Frankfurter Allgemeine Zeitung of 10/28/94.

[11] Since they did not manage to prevent EMAS, business organisations obviously tried to get a system best suited to their ideas at least. That they got involved in EMAS at all might be explained by the follwing two reasons. Firstly, many companies felt that the important role environmental issues played in Germany compelled them to participate in EMAS. Secondly, the potential alternative, ISO 14001, was not yet popular in Germany (neither with the public nor with business).

band der Deutschen Industrie – BDI) and the umbrella organisation of the German chambers of industry and commerce (Deutscher Industrie- und Handelstag – DIHT) being the driving forces.

The business associations publicly promoted their concepts in articles and press features etc. And since the BMWi served as their spokesperson, they were also able to introduce their ideas in internal Government discussions. They sought to push through their concepts by mentioning that should responsibility be placed on public authorities, EMAS would not be accepted by companies and participation rates would remain low.

3.1.2 Description of the process

Shortly after the EMAS-Regulation was adopted by the Environment Council in March 1993, the responsible BMU department organised a meeting at which it introduced the EMAS Regulation to representatives of relevant groups such as business and environmental organisations. The meeting also served to touch on the different options for the implementation in Germany. The BMU made the 'mistake' of encouraging the business associations to see whether they could carry out accreditation, supervision and registration on their own.

The business associations took this invitation seriously and in the following months they presented a number of implementation models. The DIHT and BDI were the first to publish their concepts. Whereas the DIHT wanted the (regionally organised) chambers of industry and commerce (Industrie- und Handelskammern – IHK) to be responsible for the accreditation, supervision, and registration, the BDI suggested the TGA (Trägergemeinschaft für Akkreditierung, a business organisation which mainly accredits verifiers for ISO-norms) as accreditation body). The BDI concept also provided for a pluralistic committee to assist the accreditation and supervision of environmental verifiers. The BDI was rather indifferent as far as registration was concerned.

At the same time three important environmental groups (DNR, BUND, NABU) proposed that the UBA be made the accreditation, registration and supervisory body. In October 1993 the BMU published its first model. It suggested that the responsibility for the accreditation and supervision of environmental verifiers be shared between a body of industry, e.g. the TGA, and the UBA as the Government representative. While the industry body was to examine the competence of the applicant environmental verifiers, the UBA was responsible for their offi-

cial accreditation and sanctioning in the case of non-compliance. It was planned to form a council in which all relevant social groups were represented and which had to be integrated in the choice of examiners and the formulation of examination guidelines. The BMU wanted to commission the German states to carry out registration, because certified sites had to comply with environmental law and the German states were responsible for the execution of legal regulations anyway (cf. Waskow 1997, pp.111/112). The BMU did not conceive its proposal as a compromise between the positions of business associations, environmental groups and German states, but claimed this was the model the Ministry itself regarded as the most suitable, at that time.

Because the BMU pointed out it could hardly consider business positions when it was confronted with different ideas from different business associations, the BDI and DIHT merged their proposals into one concept. Under this concept, the TGA was to be commissioned with examining and supervising environmental verifiers, while one central IHK was to be responsible for their official accreditation and also the registration of sites. The concept also provided for a pluralistic committee that served to set up a list of examiners (cf. Waskow 1997, p. 112). The responsibility for the quasi-sovereign tasks was to be placed on the chambers of industry and commerce as quasi-public bodies already in existence. The TGA was to be brought in, to make use of its experience of the accreditation and supervision of ISO norm verifiers, especially the norm for quality management systems. The business associations argued that it was useful to involve the organisational structures established for the quality management systems, to take into account the fact that many companies combine quality and environmental management.

This BDI/DIHT model was rejected by the German Trade Union Federation (Deutscher Gewerkschaftsbund – DGB) and environmental groups. In a joint declaration the DGB, environmental groups, ecologically oriented business associations and environmental research institutes repeated the call to make the UBA responsible for accreditation, supervision and registration.[12]

Although the BDI/DIHT concept influenced public discussion for a long time, a number of modifications became necessary because some substantial objections were raised. The two

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[12] The statement was documented in Informationsdienst Chemie und Umwelt 1/1994, S. 13-17.

most important objections came from the BMU and a legal report commissioned by the BMWi to check the legal validity of the business associations' concept. The report came to the conclusion that placing responsibility on one central chamber of industry and commerce would contradict the chambers' regional structure. The BMU complained that the chambers of industry and commerce are only responsible for industrial companies and not for craft enterprises which come under the responsibility of the chambers of craft (Handwerkskammern - HwK) (cf. Waskow 1997, p. 113, 115). In order to integrate the chambers of craft, the BDI and DIHT contacted the umbrella organisation of the German chambers of craft (Zentralverband des deutschen Handwerks – ZdH), which had in the meantime presented its own implementation concept. After the Federal Association of Independent Professions (Bundesverband der Freien Berufe – BFB) had also joined the club, the four business organisations published their final proposal in June 1994. In this decentralised model all IHK and HwK were to be entitled to carry out both registration and accreditation, although a certain possibility of concentrating the tasks on some chambers was provided. The TGA and the pluralistic committee retained their roles (cf. Waskow 1997, p. 115/116).

In August 1994 the BMU presented a draft version of an EMAS implementation act, which did not modify the Ministry's original proposal, but instead augmented it. The draft specified the tasks of the pluralistic council, which was now called UGA (Umweltgutachterausschuß, Environmental Verifiers Committee). The committee was not only to provide a list of examiners and guidelines for the accreditation and supervision of verifiers, but also served to appoint members of the Objection Committee which was to be formed to rule on objections raised against official accreditation and supervisory acts by the UBA. Additionally, the draft included a (quite general) description of the demands concerning the competence of the environmental verifiers, the application process, and the documents and information applicants had to submit (cf. BMU 1994).

At the end of 1994 the concepts of the business associations (supported by the BMWi) on the one side and the BMU on the other side were incompatibly opposed. Neither side was willing to make any (further) concessions, and the discussion process was stopped. This situation could not be overcome until the Federal Minister of the Environment changed in November 1994. The new Minister (Angela Merkel) quickly recognised that the success of EMAS depended on its acceptance by companies, and that it was thus necessary to approach the business organisations. In December 1994 dialogue between BMU and BMWi was relaunched.

The talks were soon joined by representatives of business organisations, the German states, environmental groups, trade unions, and (potential) environmental verifiers. This informal round table was set up to discuss the implementation concepts and to find a solution based on a broad consensus. Since all parties were interested in forming such a forum for discussions, ex post it is difficult to determine who gave the decisive impetus.

The informal discussion group met several times at various venues (most meetings took place at the BDI and the BMU), and finally managed to reach a compromise on the accreditation, supervisory and registration system in early 1995. Of course, the group was not entitled to take legally binding decisions, but the concept it developed formed the basis for the draft bill that was introduced into the Parliament and is largely identical with the system currently existing in Germany.

3.1.3 The outcome

Although all concepts presented by the various parties proposed commissioning already existing organisations (UBA, TGA, IHK, HwK) with the accreditation and supervision of environmental verifiers, it was decided to found a totally new body, because it was not possible to agree on one of the proposed organisations. The compromise reached by the informal round table provided for the foundation of a limited company known as the DAU (Deutsche Akkreditierungs- und Zulassungsgesellschaft für Umweltgutachter mbH, German Environmental Verifiers Accreditation Company) in the hands of business associations (BDI, DIHT, ZdH, BFB).

To support and to control the DAU, a pluralistic committee, the UGA, was to be established (at the BMU). After serious disputes, it was decided to fill the UGA with representatives of business associations (6), environmental verifiers (4), federal environmental administration (2), federal economic administration (1), state environmental administration (4), state economic administration (2), environmental organisations (3) and trade unions (3). The criterion for the allocation of seats was the degree to which the individual groups were affected by EMAS. Whether the UGA was to be designed as an advisory council or endowed with more competence was also intensely discussed at the round table. In the end the idea of giving the UGA a strong position in the execution of the system was successful. Thus it was made responsible for providing the DAU with guidelines for the interpretation and application of the relevant legislation and lists of examiners to make up the Examination Committee. Further-

more, it was to propose members of the Objection Committee and act in an advisory capacity to the Federal Ministry of the Environment. Besides, the BMU's suggestion to form an Objection Committee to rule on objections raised against official acts of the accreditation and supervision body was accepted. It was planned to link the Objection Committee to the DAU.

The responsibility for the registration of sites was placed on the chambers of industry and commerce for industrial and the chambers of craft for craft sites, but registration activities were allowed to be centralised. The registration procedure required the chambers to inform the relevant enforcement agencies of the German states and to give them an opportunity to intervene in the event the site does not comply with environmental legislation.

3.2 Phase 2: Passing of the legal regulations (Acts and ordinances)

Once a compromise on the accreditation, supervisory and registration system had been reached at the round table, the results had to be put in a law. The draft bill was prepared by the BMU, then discussed with the other federal departments, and finally introduced in the "Bundestag" and the "Bundesrat" (the two houses of the German Parliament).[13]

3.2.1 The actors, their motives and strategies

The members of the round table (BMU, BMWi, business and environmental groups etc.)

The members of the round table were mainly interested in putting through the compromise concept they had reached with as few modifications as possible. They also intended to bring the legislative process to an end as soon as possible in order to meet the time limit set in the EMAS Regulation.

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[13] If laws are enacted at the federal level, the relevant Federal ministry formulates a draft bill which is then discussed with the other departments. When the government has reached a consensus on the draft bill, it is introduced into the "Bundestag", the lower house of the German Parliament, which is responsible for formally passing the act. Besides the Federal Government, "Bundestag" members and the "Bundesrat" also have the right to introduce draft bills (Kösters 1997, p.102). The legislative procedure stipulates that a draft bill must be debated in the "Bundestag" (twice) as well as by expert committees, before a ballot takes place. In many cases, "Bundesrat" approval is required as well. The "Bundesrat", the upper house of the German Parliament, consists of selected members of the state governments. Whether its approval is necessary depends on the relevance the act has for the German states. In the past roughly 50% of Federal laws have required "Bundesrat" approval (Müller-Brandeck-Bouquet 1996, p.127).

The other federal departments

While most of the other departments were rather indifferent towards the EMAS legislation, the Ministry of the Interior and the Ministry of Justice intensively participated in the debate. They doubted that the draft bill in which private and semi-private bodies were commissioned with carrying out sovereign tasks complied with the Constitution. Therefore they wanted to strengthen the influence and competence of public authorities within the accreditation, supervisory and registration system.

"Bundestag" and "Bundesrat"

Because the ruling parties account for the majority of members of the "Bundestag", the lower house of the German Parliament usually follows Government's positions. As mentioned above, the "Bundesrat" consists of delegates from the German states. Since consensus did not exist among the states, it is hardly possible to speak of *the* "Bundesrat" position. Nevertheless, it could be observed that the view of the "Bundesrat" was marked by environmental concerns and administrative aspects.

3.2.2 Description of the process

In preparing the draft bill, the BMU closely followed the concept developed by the round table; the Ministry merely put the concept into a more concrete and legally correct form. The draft was then discussed with the other Federal departments. Only the Ministry of the Interior and the Ministry of Justice firmly insisted upon modifications. They had doubts that an organisational structure which commissions a private company (DAU) and semi-private bodies (IHK, HwK, UGA) with sovereign tasks was in line with the German Constitution. Since the BMU and the BMWi also wanted to have a legally valid draft bill, it was relatively quickly agreed to endow public authorities (BMU) with more competence, e.g. regarding the supervision of the DAU.

Parallel to the inner-governmental discussions, copies of the draft bill were sent to state authorities, business associations, environmental groups etc., who were explicitly asked for comments (an obligatory part of the German legislative procedure). The official hearing took place at the end of March 1995. Because all relevant groups had long been integrated in the development of the accreditation, supervisory and registration system, the hearing went off smoothly. As a consequence, the draft for an "Umweltgutachterzulassungs- und Stand-

ortregistrierungsgesetz" (Act on the Accreditation of Environmental Verifiers and the Registration of Sites) was adopted by the Federal Government just a few days later.

The draft then entered the parliamentary discussion process (Bundestag) and was simultaneously introduced into the "Bundesrat". The latter gave a negative statement on 2 June. After some minor changes had been made, the draft bill was passed by the "Bundestag" on 22 June as "Gesetz zur Ausführung der Verordnung (EWG) Nr. 1836/93 des Rates vom 29. Juni 1993 über die freiwillige Beteiligung gewerblicher Unternehmen an einem Gemeinschaftssystem für das Umweltmanagement und die Umweltbetriebsprüfung (Umweltauditgesetz-UAG)"[14]. When the UAG was introduced into the "Bundesrat" it was rejected again, because there were still a number of areas of dispute. Therefore the UAG was passed on to the "Vermittlungsausschuß" (mediation committee), a committee which is summoned to find a solution if the "Bundesrat" has rejected a draft bill for the second time.

The main aspect that prevented the majority of German States from agreeing to the draft bill was that it only obliged environmental verifiers to check whether sites complied with legal regulations (acts and ordinances), while administrative guidelines (Verwaltungsvorschriften) were ignored.[15] Many German States were of the opinion that administrative guidelines could not be separated from acts and ordinances. They argued that sites that do not comply with these regulations cannot be said to show legal compliance. The German States wanted to prevent the control scope of environmental verifiers being different from those of state authorities, not least because this would leave no room for deregulation. It was hoped that environmental verifiers could partly substitute the controls of public authorities.

Now it was up to the mediation committee to find solutions. In fact the committee was very quick to come up with results (for a detailed description of the outcome see the next section). The compromise it reached was smoothly adopted by both the "Bundestag" and the "Bundesrat", enabling the UAG to finally come into force on 15 December 1995, more than half a year after the time limit set in the EMAS Regulation.

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[14] The UAG was not only accepted by the ruling parties, i.e. the conservative parties (CDU/CSU) and the Free Democrats (FDP), but also by the Social Democratic Party (SPD). The Green Party did not vote for it (cf. Waskow 1997, p. 118).

[15] Administrative guidelines do not have the official character of acts or ordinances and are thus not legally binding. They are used to specify acts and ordinances in order to support the execution of regulations.

Simultaneously to the enactment of the UAG, amending ordinances were prepared. In order to reduce the complexity of laws, in Germany many details are left to be regulated through ordinances enacted by the Federal Government or the competent ministry. In the UAG (draft version) the Federal Government or the BMU were entitled to specify accreditation and examination requirements (§4(5), §11(5) UAG) as well as supervisory procedures (§20 UAG). Additionally, the authorisation of the accreditation and supervisory body (§28 UAG) and the integration of non-industrial branches (§3 UAG) remained for ordinances.[16]

The first three ordinances, the "UAG-Zulassungsverfahrensverordnung" (Ordinance on the Accreditation Procedure), the "UAG-Gebührenverordnung" (Fees Ordinance), and the "UAG-Beleihungsverordnung" (Authorisation Ordinance) were swiftly prepared during summer 1995. Because the highly disputed structure of the accreditation, supervisory and registration system was already determined in the UAG itself, the enactment of the ordinances went off smoothly and without any public discussions. In all three cases "Bundesrat" approval was not necessary, and so the ordinances came into force almost simultaneously with the UAG on 18 December 1995.[17] The fourth ordinance on the integration of non-industrial branches, the "UAG-Erweiterungsverordnung" (Extension Ordinance) was not enacted until February 1998. It was the only ordinance that required "Bundesrat" approval. As a result of the "Bundesrat" resolution, EMAS was opened to more sectors than originally intended in the draft proposal prepared by the BMU.

The Fees Ordinance has already been modified twice. While the first modification only meant a few minor changes, the second modification of May 1998 augmented the ordinance by adding fees for the supervision of environmental verifiers. Because some groups, especially environmental verifiers, regarded these supervision fees to be too high, the second modification of the fees ordinance faced strong opposition among both the public and the UGA. However, the

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[16] German laws usually are formulated in a rather general manner and contain a number of indefinite terms which remain to be clarified in ordinances (and administrative guidelines). This is especially true for environmental legislation. The "Bundestag" is entitled to empower the Federal Government or individual Federal ministries to enact ordinances. This means that the "Bundestag" delegates its regulatory competence (Bönker 1992, p.808). Therefore it is not necessary to introduce ordinances into the "Bundestag". Nevertheless, "Bundesrat" approval is frequently required (Laufer 1991, p.127).

[17] In the UAG paragraphs that empower the Federal Government or the BMU to enact ordinances, it is laid down that the UGA must be given a hearing. However, in the regulations dealing with the interim period (§38 UAG) it was laid down that the ordinances could be enacted before the UGA had been formally set up on 20 December 1995. The ordinances were discussed in the so-called "pre-UGA", a committee founded on the basis of the concept developed at the round table. Its make-up was similar to that of forthcoming UGA, but its members were not yet officially appointed.

BMU and DAU insisted the fees were necessary to meet the DAU's costs and that the total revenue from fees could not be reduced. Nevertheless, the BMU agreed to modify the structure of the fees, i.e. to vary the fees depending on the size of the verified sites and the administrative efforts.

3.2.3 The outcome

Accreditation and supervision of environmental verifiers

According to the UAG (§28), the Federal Environmental Ministry has enacted the Authorisation Ordinance which officially authorises the DAU to accredit and supervise environmental verifiers. The DAU was founded back in March 1995. As a limited liability company in the hands of business associations (BDI, DIHT, ZdH, BFB), it is associated with the DIHT. Due to the concerns of the Ministry of the Interior and the Ministry of Justice, the BMU's supervision of the DAU was widened. Now the Ministry not only verifies whether the DAU acts in accordance with relevant legal regulations, but also checks whether certain decisions are correct in terms of content. The latter is mainly directed at cases in which the DAU revokes or temporarily suspends accreditation (§29 UAG).

The German accreditation procedure follows the concept of individual environmental verifiers. This means that not organisations but individuals are accredited, who can then agree to form organisations or case-by-case co-operations.[18] In addition, the UAG provides for the accreditation of "Fachkenntnisbescheinigungsinhaber". These are people who have only passed (or have only enrolled for) parts of the exam and then received a certificate which states that they have demonstrated their competence in these particular fields. They are not allowed to validate sites autonomously, but only in co-operation with an accredited environmental verifier. "Fachkenntnisbescheinigungsinhaber" must also prove their reliability and independence.

The UAG (§§5-7) does not only take up and specify the demands of the EMAS Regulation (Annex III(A)) regarding the verifiers' reliability, independence and competence, but also im-

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[18] Whereas organisations have to be accepted by the DAU, case-by-case co-operation is only based on individual contracts. The UAG does not encompass many prescriptions for verifying organisations. The most important ones are that the persons who actually validate the site have to be accredited environmental verifiers, "Fachkenntnisbescheinigungsinhaber", or must present equivalent qualifications.

poses additional requirements. For example, applicants must have a university degree and at least three years' practical experience. To test the applicants' qualification the DAU holds oral exams (§11(2) UAG). The exams are conducted by an examination committee that consists of 3–5 examiners and is individually constituted for each exam. The DAU chooses the examiners from the UGA list depending on the scope the examinee is applying for (§12 UAG). On the basis of the examination procedure described in the Ordinance on the Accreditation Procedure (§§5–7), the examiners autonomously carry out the exams (§4). Applicant environmental verifiers who fail the exam can only resit it twice (§8). Accredited verifiers, i.e. applicants who have passed, can always enlarge their scope. To this end they have to pass further exams to prove that they also have the necessary sector-specific knowledge for the additional sectors. In any case accredited environmental verifiers are obliged to continue their training by attending appropriate courses.

If the applicant meets all the requirements, the DAU grants accreditation. According to §14 UAG, the accreditation body is obliged to keep a register of accredited environmental verifiers. An updated list is communicated, via the Federal Environmental Ministry, to the EU Commission every six months, as well as to the UGA, the relevant enforcement agencies of the German states, the chambers of industry and commerce, and the chambers of craft. Moreover, German legislation entitles anyone else to inspect the register.

Accredited environmental verifiers and "Fachkenntnisbescheinigungsinhaber" are subject to the DAU's supervision. Whether they work in accordance with the relevant requirements and still meet the accreditation conditions has to be verified regularly, at least every 36 months. These checks also include quality controls of the validation activities they have performed (§15(1) UAG). For this purpose, environmental verifiers are obliged to keep copies of the documents and papers related to the validation of a site (agreement on subject and scope of validation, reports on site inspections etc.) (§15(2),1 UAG) and must permit the supervisory body access to their offices during opening hours (§15(4) UAG). Following the compromise reached by the mediation committee, the UAG now demands that environmental verifiers validating a site must also consider administrative guidelines enacted by Federal or state authorities (§15(2),5 UAG). If the DAU discovers non-compliance with requirements imposed in the relevant legislation or by itself, it can revoke or temporarily suspend accreditation (§§16-17 UAG). The DAU has to revoke accreditation particularly if environmental verifiers do not or no longer show reliability or independence.

§36 UAG states that fees are charged for official acts related to accreditation, supervisory and registration activities to cover the expenses incurred. The fees arising in the context of the accreditation of environmental verifiers are exactly fixed in the Fees ordinance. Fees are charged for the act of accreditation and the oral exams. Extra fees arise if an exam has to be repeated or if the accredited scope is extended. Since its second modification, the fees ordinance now also covers supervision fees. The fee for regular supervision consists of a general fee and an extra fee for every validated site. Under this system, the overall fee environmental verifiers have to pay varies considerably. Fees for verifier organisations that have performed many validations can easily amount to hundreds of thousands of Deutschmarks.[19] The Fees Ordinance also determines fees for controls performed in case misconduct by an environmental verifier is suspected, as well as the fees charged if a protest raised against official acts of the DAU is dismissed by the Objection Committee.

The establishment of a committee to rule on objections raised against official acts of the accreditation and supervisory body was already agreed at the round table. However, due to the concerns of the Ministry of the Interior and the Ministry of Justice, it was not, as originally envisaged, linked to the DAU itself, but was associated with the BMU (§24(1) UAG). The committee consists of one chairperson and two assessors. They work in an honorary capacity and are not subject to directives. The chairperson has to be a member of the federal environmental administration (BMU) (§24(2) UAG). The BMU appoints the chairperson as well as the assessors, but the latter must be taken from a list provided by the UGA. The assessors are called in from case to case depending on the protesting verifiers' scope and on a rotating basis (§24(3) UAG). Under German law, only those persons addressed by official actions are entitled to protest against them, i.e. in this case only environmental verifiers.

With respect to the UGA, the round table compromise did not only provide for its formation, but also laid down its tasks and seating. These regulations were integrated into the UAG (§§21–22). Additionally the UAG determines that the DAU has to provide the UGA with half-yearly reports on its accreditation and supervisory activities. Particular emphasis is placed on

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[19] The fees the DAU charges have to conform to the German "Verwaltungskostenrecht" (law on administrative costs), which prescribes that in total the fees must equal the actual costs and that public authorities must charge those who actually used the public good. Additionally the fees have to follow the economic value the provision of the public good means for the particular users. In searching for an indicator for the economic value the supervision and accreditation activities mean to environmental verifiers, the DAU decided to take the number (and size) of validated sites.

information about the supervisory measures taken, the appropriateness of the guidelines and the need for further regulations (§21(2) UAG). The members of the UGA (as well as their representatives) are proposed by the corresponding groups and officially appointed by the BMU for three years (§22(3) UAG). Analogous to the Objection Committee, the members of the UGA work in an honorary capacity and are not subject to anybody's directives (§22(1) UAG). Apart from voting procedures (§23 UAG), the development of operational rules is left to the UGA itself. That the UGA's decisions and guidelines are legally valid is supervised by the BMU, which also publishes the guidelines in Germany's official journal. If the UGA does not fulfil its tasks properly, e.g. if it is unable to agree on an administrative guideline, the BMU is entitled to dissolve the UGA. Last but not least, the UAG provides for establishing the "UGA-Geschäftsstelle" (UGA office) to provide administrative support, i.e. organising the UGA meetings, typing guidelines etc. The UGA was founded on 20 December 1995, with the office being operational since October 1995.

Registration of sites

Responsibility for the registration of sites was awarded to the chambers of industry and commerce and the chambers of craft (§32 (1) UAG), which are entitled to delegate the task to one chamber (§32(3) UAG). According to the EMAS Regulation (Art 8(1)), the chambers register a site once they have received a validated environmental statement as well as the registration fee, and are satisfied that the site meets all the conditions of the EMAS Regulation. The chambers of industry and commerce and the chambers of craft are obliged to appoint a body to keep a register of all validated sites. At the end of each year an updated version is sent via the Federal Environmental Ministry to the European Commission. It is also communicated to the DAU and the UGA. The environmental agencies of the German states receive a list of all sites registered in the respective state (§32 (2) UAG). Moreover, German legislation ensures that anyone else is entitled to inspect the register of sites.

The UAG lists cases which particularly hinder compliance and thus registration, e.g. if the environmental statement has been signed by a verifier who is not accredited at all or does not have the necessary scope (§33(1) UAG). However, before a site is registered, the chambers have to inform the competent enforcement authorities of the German states and give them an opportunity to intervene if the site does not comply with environmental legislation. Authorities have to submit a statement on the registration of a particular site within four weeks. If

they do not respond, this is regarded as approval. If the agency finds that the site contravenes legal regulations (including administrative guidelines) and the company objects, the registration procedure is stopped (i.e. registration is not yet refused) until the public authorities and the company have reached an agreement (§33(2) UAG). The formulation of detailed rules on registration procedures and fees is left to the chambers (§35, §36(3) UAG).

Since the chambers are generally subject to the supervision of the Ministries of Economics of the German states, this holds true for the registration activities as well. However, supervision is restricted to the approval of rules governing registration procedures and fees as well as agreements on the delegation of registration activities and reaction to complaints raised against decisions passed by the chambers. If a ministry decides to take action against a chamber, it can only do so in agreement with the environmental ministry of the respective state (§32(1) UAG).

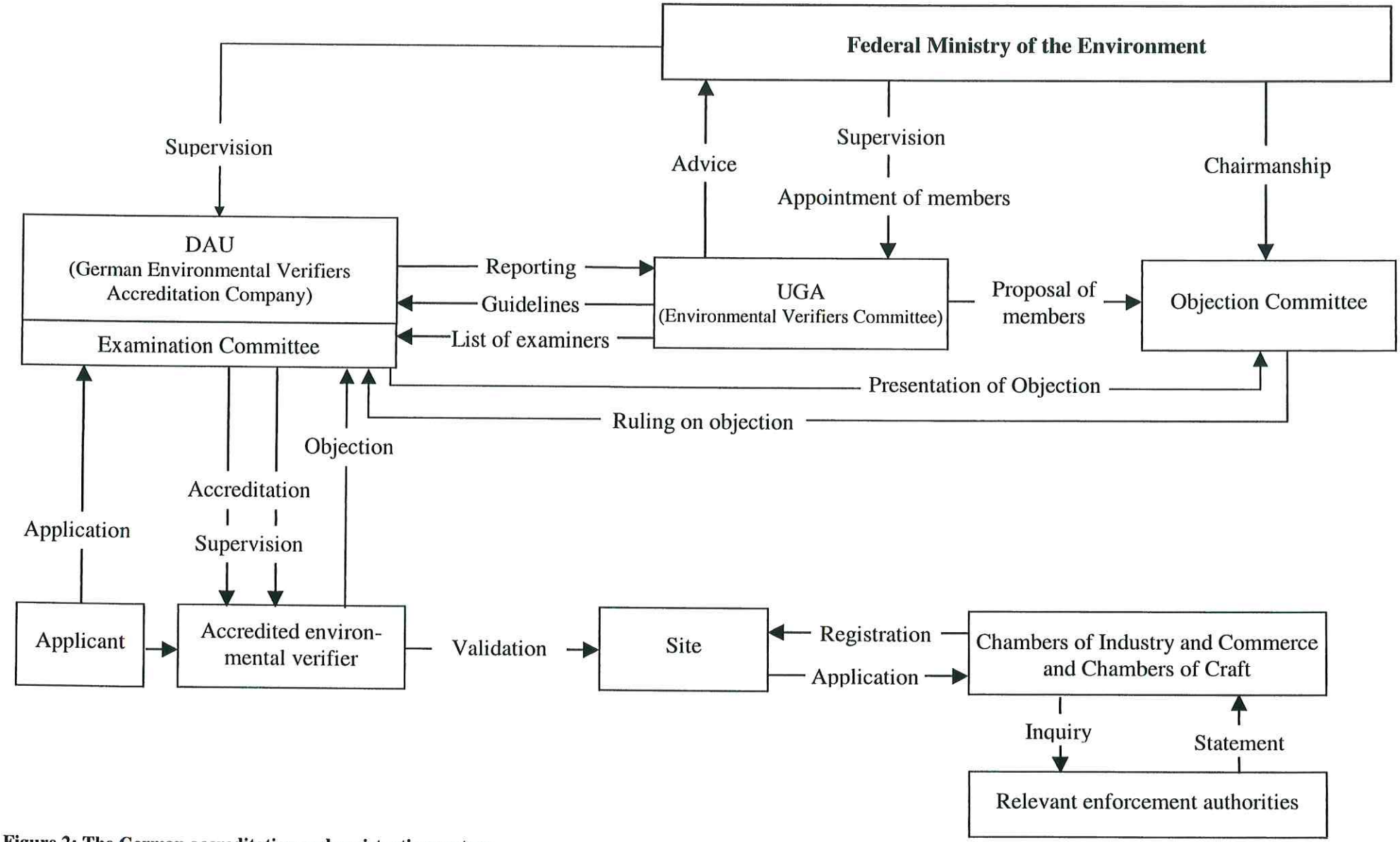

Figure 2: The German accreditation and registration system

Integration of non-industrial sectors

In the Extension Ordinance that came into force on 10 February 1998, the German EMAS system was extended to selected non-industrial sectors. The main ones are transportation, restaurants and hotels, banks and insurance companies, as well as the distributive trades and local government. Parallel to the enactment of the ordinance, preparations were made to accredit environmental verifiers whose scope includes the newly integrated sectors, so that the first verifiers allowed to validate non-industrial branches were accredited shortly after the ordinance was enacted. Meanwhile a number of non-industrial sites have been registered. The integration of non-industrial sectors does not mean any changes to the registration procedure. It affects the registration bodies only insofar as they cannot rely on experience and precedence cases, which is particularly important with respect to the definition of sites.

Administrative offences and fines

§37 UAG lists cases of non-compliance with EMAS-related legal regulations that are treated as administrative offences,[20] and fines associated therewith. The cases mainly address environmental verifiers and, for example, include environmental verifiers that bear the title "accredited" without having accreditation, or accredited environmental verifiers that validate a site without having the necessary scope. The only case that aims at companies covers sites that use the EMAS certificate without being registered or employ it in product-marketing. The fines due can be up to DM 50,000 (= € 25,565). The BMU is the body responsible for ruling on administrative offences.

3.3 Phase 3: Interim solution

Although the EMAS Regulation requires Member States to have a fully operational accreditation, supervision and registration system in place by April 1995, the UAG and the related ordinances were not enacted before December 1995. Therefore a solution had to be found for the interim period.

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[20] Administrative offences are acts that contravene the law but are not regarded as criminal. Therefore they are not dealt with as criminal acts, but can be fined. Additionally the German penal code provides for the prosecution of severe criminal acts directed against the environment.

3.3.1 The actors, their motives and strategies

In general, all actors were interested in having an operational accreditation, supervisory and registration system set up within the time limit set in the EMAS Regulation. Therefore they all were willing to co-operate and to do their share.

Federal Government and the German states

The enactment of regulations that served to implement the EMAS Regulation in Germany, was incumbent on the Federal Government, but because the Federal Government did not yet make use of its legislative competence the German states were in charge. Germany could have waited with the establishment of an accreditation, supervisory and registration system until December 1995 without fearing any sanctions from the European Commission. However, the responsible Federal and state authorities had several motives for establishing an interim solution. On the one hand they wanted to have an operational system installed in time in order to defend Germany's reputation as one of the European eco-pioneers. On the other hand, and this is the more substantial reason, EU regulations are directly binding on the Member States. This meant that potential environmental verifiers and sites willing to participate would have had the suable right to be accredited or registered. And in fact, it could be foreseen that both environmental verifiers and sites would have gone to court, because they were deeply interested in having the same chance to take part in EMAS as their European competitors.

DAU

The compromise reached at the round table and thus the draft bill of the UAG already mentioned the DAU as the accreditation and supervisory body. But although the DAU was founded in March 1995, it could not be made the official accreditation body during the interim period, because it could not be officially authorised before the UAG was in force. The DAU could only act as an assistant to public authorities.

Chambers of industry and commerce/chambers of craft

What has been said about the DAU also holds true for the chambers of industry and commerce and the chambers of craft. Although it was planned to make them responsible for the registration, they needed to be formally commissioned on the basis of the UAG, otherwise they could do no more than assist public bodies.

3.3.2 Description of the process

In spring 1995 the bodies involved (especially the DAU, the chambers, Federal and state authorities) met in order to deliberate on how to proceed. At this time essential decisions regarding the accreditation, supervisory and registration system had already been made, i.e. a draft bill of the UAG had been formulated, the DAU had been founded in March, and even the "pre-UGA" existed. The German states agreed to take responsibility for the system, while the DAU and the chambers were willing to provide support. Because all parties aimed to have the system established in time, the decision-making process and the agreed procedures were rather pragmatic. How the bodies actually carried out their tasks was widely left to their discretion.

3.3.3 The outcome

During the interim period the German states were responsible for both the accreditation and registration. However, the states could rely upon the assistance of the DAU and the chambers; for this purpose service contracts were agreed. With respect to registration, the chambers actually kept the register, while the official decision about registration was limited to state authorities (cf. Waskow 1997, p. 154). During the interim period, the German states registered 35 sites.

A similar division of tasks was established between state authorities and the DAU regarding accreditation. The DAU checked whether the applicant environmental verifiers met the requirements set up in the EMAS Regulation and the UAG (draft version), and tested their competence in oral exams. Afterwards the state authorities were provided with the results and the DAU's recommendation on whether the applicant should be granted accreditation. The formal decision was again taken by state authorities. By the time the UAG had come into force, the German states had accredited 51 environmental verifiers (plus two from other European countries).

Because there was no UGA that could provide examination guidelines and lists of examiners, the DAU itself had to find examiners and procedures. Working in co-operation with experts, (potential) examiners and relevant state authorities, the DAU developed preliminary examination guidelines which were then discussed with business associations, environmental groups, and (potential) environmental verifiers etc. (pre-UGA). When searching for examiners, mainly business associations (the partners of the DAU) and state authorities were asked to help. In order to pinpoint the most competent or most suitable examiners, the DAU screened the quali-

fication profile of the persons considered by means of a questionnaire. The examination guidelines, the questionnaire and the list of examiners was later passed on to the official UGA, which used them as a basis for its official guidelines.

The UAG encompasses regulations on how to treat environmental verifiers accredited during the interim period (§38 UAG). It was ensured that their accreditation remained valid for 6 months following the official authorisation of the DAU. Environmental verifiers had to apply for a second time to the DAU, but they merely submitted the application form and documents, and did not have to pass another oral exam.

3.4 Phase 4: Norm specification (regulations sub-ordinate to acts and ordinances)

In the context of the implementation of the EMAS Regulation, the Federal Government delegated the competence to enact administrative guidelines to the UGA. The transfer of regulatory competence to a pluralistic committee is a novelty in Germany. The guidelines the UGA develops almost exclusively address the DAU and do not require "Bundesrat" approval.

3.4.1 The actors, their motives and strategies – the UGA as the central actor

On the basis of the UAG, the UGA is the official body responsible for adopting administrative guidelines. Although the UGA is a pluralistic committee consisting of different groups that sometimes pursue contrary goals, it can be observed that the common interest in the successful implementation of the EMAS Regulation mostly wins out over particular interests when it comes to important decisions such as the adoption of guidelines.

3.4.2 Description of the process - adoption of administrative guidelines by the UGA

The UGA can formulate guidelines either on its own initiative or because the DAU indicates a need for further regulations. The guidelines are adopted by the plenum (the 'real' UGA), although they are actually prepared by sub-committees[21] and worked out by the UGA office.[22]

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[21] To be able to carry out its tasks effectively, the UGA formed four sub-committees which preliminarily discuss the guidelines and prepare drafts to be debated in the plenum. Each sub-committee deals with a specific aspect (tasks of environmental verifiers, accreditation and examination, supervision, European directives and standardisation). The sub-committees are filled with members of the UGA; every member is free to participate.

According to the voting procedures laid down in the UAG (§23), a two-thirds majority of UGA members is necessary to decide on the guidelines. This means that neither the environmental side (environmental administration and environmental groups) nor the business side (economic administration and business associations) can be outvoted. So far, all guidelines have been adopted by a large majority of UGA members (UGA 1999, p.1). None of the groups represented in the UGA seems to be heading for a confrontation. No stable coalitions between environmental administration and environmental groups or economic administration and business associations have been observed. In order to ensure transparency, the plenum meetings are open to the public.

So far, the UGA has adopted five guidelines. Three of them followed papers that had already been prepared by other bodies before the UGA came into being. The "Fachkunderichtlinie" (guideline on oral exams to test the competence of environmental verifiers) of June 1996 was developed from the DAU's preliminary examination guideline. The "Prüferrichtlinie" (guideline on examiners) is also based on preparations of the DAU (as is the list of examiners). In June 1998 the "Zertifizierungsverfahrensrichtlinie" (guideline on validation procedures) was published which is largely identical with a paper the BMU had prepared months before for the European Commission (in the context of Article 12 of the EMAS Regulation).

Only the "Aufsichtsrichtlinie" (supervisory guideline) of 11 December 1996 and the "Lehrgangsrichtlinie" (guideline on courses for prospective environmental verifiers) of 29 March 1998 are original UGA guidelines. The former was initiated by the UGA; a need for the latter became apparent, against the background that a number of environmental verifiers would have completed their first three years at the end of 1998 and thus would have to be subjected to the supervision of the DAU. In addition the UGA developed "Leitlinien zu den Aufgaben der Umweltgutachter" (guiding principles on the tasks of accredited environmental verifiers) and the so-called "Handreichung zur Erstellung einer Umwelterklärung nach EMAS I" (guiding principles for preparing environmental statements under EMAS I).

The BMU supervises the legal validity of the UGA's decisions and guidelines and publishes them in Germany's official journal. A representative of the Ministry (in addition to the official

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[22] The UGA office not only works out UGA guidelines, but also provides the UGA with all kinds of administrative support. The office is linked to and financed by the BMU. A private organisation "Verband der Technischen Überwachungsvereine" (Association of Technical Inspectorates), was commissioned to run the office.

member of the committee) takes part in most UGA meetings. If he doubts that a certain regulation complies with the law, he says so immediately. So far, all complaints by the Ministry were rather easily rectified.

3.4.3 The outcome

The guideline on oral exams specifies the demands on the environmental verifiers' competence listed in the EMAS Regulation (Annex III (A)) and repeated in the UAG (§7(2)). For example, what the "relevant technical knowledge of the activity subject to verification" encompasses is specified. Not only the examinees but also the examiners have to meet special requirements. These are laid down in the guideline on examiners. The guideline on validation procedures describes the German accreditation and validation procedures. In Germany, public authorities do not provide any training for becoming an environmental verifier, and only a few privately organised courses exist. The UGA gives its ideas on how courses should be conducted to optimally prepare environmental verifiers for their job (and their exams) in the guideline on courses.

The presumably most important guideline is the one that deals with the DAU's supervision of environmental verifiers. The guideline distinguishes between "Regelaufsicht" (regular supervision) and "Anlaßaufsicht" (suspicion supervision; controls conducted in the event misconduct is suspected). It is stated that regular supervision should be carried out every 36 months to comply with the EMAS Regulation. However, the supervisory body is free to reduce this time span if it believes this necessary. As mentioned above, the UAG requires environmental verifiers to preserve documents and papers related to the validation of a site such as agreements on the subject and scope of the validation, reports on site inspections etc. These now form the basis for regular supervision. The documents and papers of at least two validations have to be examined in detail in order to ascertain whether the environmental verifier has taken into account all legal regulations and all environmental effects relevant for the particular site (quality of validation activities). In addition the DAU alternately conducts witness or office audits.[23] Because the DAU does not have enough personnel to perform supervision, it is supported by externs who have to fulfil similar requirements as the examiners. Besides regular

[23] A witness audit means that a supervisor accompanies a verifier validating a site. An office audit means that the supervisor investigates the relevant documents in the verifier's office.

supervision, a particular environmental verifier can be subjected to controls if the DAU suspects he has acted with impropriety. To take action, the DAU has to have concrete indications or to have received substantial complaints about the verifier's validation practice from third parties. The verifier is then informed that he is believed to have violated legal requirements and given an opportunity to explain.

If the DAU discovers misconduct of a verifier either in the context of the regular or the suspicion supervision, the guideline provides various options for the DAU to react. They depend on the significance of the misconduct and range from admonition to revocation of accreditation. The decision on whether misconduct is proven and what measures are to be taken is largely left to the DAU's discretion. The guideline only emphasises the facts that constitute non-compliance with the requirement of an environmental verifier's independence.

3.5 Phase 5: Norm realisation

3.5.1 The actors, their motives and strategies

Both EMAS and the German regulations address a number of different actors. On the one hand there are the private and public bodies that form the accreditation, supervisory and registration system (DAU, UGA, IHK etc.). On the other hand there are the final norm addressees, namely environmental verifiers and participating companies.

Since the purpose of the project is to analyse how the Member States implement EU legislation, we shall concentrate on the first category of actors and their conduct towards final norm addressees. Although the behaviour of the bodies involved in the accreditation, supervisory and registration system is largely determined by the legal regulations and administrative guidelines described above, a few matters are left to their discretion. How these discretionary powers are used in practice is outlined below.

DAU/the chambers

The role business organisations are supposed to play in the implementation of EMAS was intensely discussed in Germany. Nowadays the accreditation and supervision of environmental verifiers as well as site registration are carried out by business bodies. The DAU and the chambers appear to aim to carry out their tasks properly, largely because their competence and objectivity has frequently been questioned. They know that how they do their job is not only important for the success of EMAS, but will also be cited when it comes to future 'experiments' dealing with a new division of responsibilities between public and private (business) bodies. Additionally, companies and their representatives are aware that an EMAS certificate that is not accepted by the public, consumers or public authorities is useless.

BMU/enforcement agencies of the German states

The public authorities involved in the implementation system ensure final public supervision and thus give the system credit. On the other hand, they know that they must not deter sites (and environmental verifiers) from participation through over-extensive control activities. And against the background of the rising number of environmental legal regulations which tend to overburden enforcement agencies, it can be assumed that public authorities are also interested in the success of EMAS as a system that backs responsibility and self-control-mechanisms of private actors.

UGA

The fact that the atmosphere in which UGA decision-making processes take place is rather pragmatic does not just result from the consensus-oriented voting procedures. Since all groups now represented in the UGA were already involved in the development of the accreditation, supervisory and registration system, they all feel responsible for its success. A pluralistic committee being empowered to perform sovereign tasks is a novelty in Germany. The groups represented in the UGA understand that it is up to them whether the UGA serves as an example for the foundation of further such committees.

Another, presumably the most important, factor is the balance of power that exists among the relevant groups. While companies (and environmental verifiers) depend on environmental groups and public authorities to help EMAS gain credibility and acceptance, environmental groups and public authorities rely on the participation of companies (and environmental verifiers).

3.5.2 Description of the process

Accreditation and supervision of environmental verifiers

The DAU has developed the following accreditation procedure: Applicant environmental verifiers ask the DAU for an application form, return the completed form on which they inter alia indicate the scope they apply for, and provide additional documents such as their curriculum vitae and diplomas. What documents they have to submit is exactly laid down in the ordinance on the accreditation procedure. The DAU checks the documents for completeness and organises the exams. The applications are collected until it is possible to form groups of 3–5 applicants who have indicated similar scopes. These 3–5 applicants are then examined on one day, one after the other. The DAU assembles examination committees for each particular examination day. The examiners must be taken from the list supplied by the UGA. By September 1999 it encompassed 155 examiners. Those examiners are chosen from this list whose expertise matches the scope for which the applicant environmental verifiers are applying. The examination procedure and the type of knowledge the examiners have to test are laid down in the ordinance on the accreditation procedure and the UGA guideline on oral exams. The percentage of applicants who fail the exam is relatively high (about 60%). Moreover, numerous applicants are only accredited for part of the scope they have applied for.

By September 1999, the DAU performed 556 accreditation procedures. They led to the accreditation of 209 German environmental verifiers (plus 12 foreign verifiers, 30 verifier organisations and about 95 "Fachkenntnisbescheinigungsinhaber").[24] The first 51 verifiers were already accredited during the interim phase in 1995, 43 followed in 1996, along with 73 in 1997 and 33 in 1998. In the first nine months of 1999 another 9 verifiers were granted accreditation. This means that the number of accreditations decreased drastically since 1997.

The DAU carries out the regular supervision every three years. In September 1999 the first 110 environmental verifiers had been subjected to the supervisory procedure. The DAU developed a questionnaire the verifiers have to answer. It includes questions regarding the verifiers' reliability and independence as well as the qualification and training activities they have performed during the last three years. The latter are designed to assess the verifiers' compe-

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[24] By September 1999 nine individual verifiers returned their accreditation, thus the actual number of accredited environmental verifiers in Germany was 212 (incl. foreign verifiers).

tence. Additionally, the verifiers are posed questions on each validation they have performed, e.g. regarding the size of the companies, the number of days spent at the site etc. On the basis of this information, the DAU chooses two validations of each verifier to be examined in more detail. This entails analysis of the documents and papers related to these cases. From this, the DAU concludes the quality of the environmental verifiers' validation activities. Last but not least, a witness audit is carried out (with an office audit being conducted next time). The day on which the witness audit takes place is previously arranged. So far the regular supervision produced only two cases in which the DAU did not find any faults. There was a wide range of mistakes: verifiers did not conduct the on-site staff interviews in the appropriate way or validated environmental statements that did not contain quantitative figures of pollutant emissions etc. However, most cases of misconduct appeared to be a result of misinterpretations of the EMAS Regulation rather than deliberate disregard of the requirements.

Besides the regular supervision, the DAU has instituted 74 cases of suspicion supervision by September 1999. Most of these arose from an agreement that exists between the DAU and the registration bodies. Under this agreement the chambers inform the DAU if they are noticed by enforcement agencies that a site violates environmental regulations. The DAU then starts the supervision procedure in order to find out, whether the environmental verifier who has validated the site ought to have noticed this non-compliance had he done his job properly. Moreover, the DAU traced a few complaints from third parties such as verified companies or competing verifiers. In the beginning of the supervision procedure, the environmental verifier is informed that he is suspected of having misconducted and is given the chance to present his opinion on the suspicion. On the basis of this exchange and further investigations the DAU decides whether the verifier actually misconducted. By September 1999 the DAU had concluded approximately half of the 74 cases of suspicion supervision. In most of the cases it turned out that the verifier had made a mistake.

So far, the DAU imposed relatively mild sanctions in the context of both regular and suspicion supervision. In most cases the environmental verifiers escaped with an admonition or a caution, i.e. the mildest possible sanctions. The verifiers were informed about the misconduct and were told that they had to expect more severe sanctions if they made the same mistake again. Sometimes the admonition or caution was combined with the obligation to undertake corrective actions, i.e. to revise the environmental report. In a few cases a renewed verification of the site was ordered and accompanied by a witness-audit. The most severe sanction,

revocation of accreditation, was not applied at all. There were only a handful of cases in which the DAU notified the BMU of a potential administrative offence (Ordnungswidrigkeit). The DAU charges fees for its supervision activities. The minimum fee is DM 200 (= € 102) , but if the DAU thinks it necessary to carry out a witness audit or to commission expert opinions, the fee can easily amount to a few thousand Deutschmarks. These fees also function as a sanction.

The accreditation and supervisory activities of the DAU are influenced by the bodies which control its activities. As already mentioned, the DAU is supervised by the BMU.[25] So far there has been no official intervention. The BMU's supervision of the DAU takes place in a rather informal way. Representatives of both bodies regularly meet, so that a continual flow of information is ensured. If any problems arise they are directly discussed, often via telephone. The Objection Committee which rules on objections environmental verifiers raise against official acts of the DAU also serves as a kind of control organ. By September 1999, 43 objections were raised. With one exception, the verifiers exclusively complained about accreditation decisions, i.e. decisions in which they were not granted accreditation at all or only for parts of the scope they applied for. While some verifiers based their protest on procedural matters, e.g. that the examination time had been exceeded, most verifiers simply felt that they were treated unfairly. Most objections were dismissed; just 3-4 were decided in favour of the verifier. In these cases the DAU was ordered to let the verifier repeat the examination for free.

Registration of sites

Because the chambers of industry and commerce and the chambers of craft are largely autonomous in their decisions, it was up to the individual chambers whether they made use of the possibility to centralise the registration activities. In most German states the chambers agreed to commission between one and three individual chambers with the work. However, in a few states the chamber of industry and commerce did not realise such co-operations, and so each chamber maintains its own register. Altogether there are 65 registration bodies in Germany (44 chambers of industry and commerce, and 21 chambers of craft). The responsibility for combining all sites registered in Germany in one list was awarded to the DIHT.

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[25] The UGA supplies the DAU with administrative guidelines and receives reports from the DAU, but neither directly controls nor sanctions the DAU.

If a site wants to be registered, it has to contact the competent chamber to get a registration form, return the completed form, and provide a description of its environmental management system and auditing programme. When the chamber receives the application, it checks whether the site has been defined correctly and belongs to a sector that is entitled to become registered with EMAS, and whether the environmental verifier has the necessary scope. Then the chamber informs the relevant enforcement agencies and examines the documents, especially the environmental statement. It checks whether the stipulations in the EMAS Regulation concerning content are met, whether the environmental management system is described correctly, and whether the environmental programme contains enough quantified goals. If the chamber's checks indicate that the site meets all the registration requirements, the site can be registered as soon as the statements from the enforcement agencies have been received, provided they are positive. If an enforcement agency does not respond within four weeks, it is assumed that it approves registration. What enforcement agencies are relevant depends on the town or city where the site is located and the branch of industry to which it belongs, e.g. there are special agencies for mining and the food industry. On average three agencies have to be contacted.

So far, the registration of most sites has gone off smoothly. Registration has almost never been prevented by complaints from the chambers or enforcement agencies. Whenever a chamber saw obstacles to registration (e.g. the environmental programme depicted in the environmental statement did not contain enough quantified goals), this was always rectified, for instance by revising the environmental statement. Whenever enforcement agencies intervened, sites and agencies normally managed to agree on a so-called "Sanierungsplan (redevelopment plan) requiring the company to take measures to end non-compliance within a certain time and to ensure that it cannot occur again. Adherence to the plan is monitored by the relevant agency. If such a redevelopment plan is arranged, the chamber can immediately register the site. Although the chambers do not take part in the negotiations between agencies and sites, they sometimes serve as a kind of mediator.

UGA activities

The main tasks of the UGA – the formulation of administrative guidelines, the provision of the list of examiners and the proposal of Objection Committee members – have already been described. In addition, the UGA acts in an advisory capacity to the BMU. This means that the Ministry can request a paper if it wants to know what the pluralistic committee thinks of a particular matter. For example, the BMU asked for the UGA's opinion on the integration of non-industrial sectors. These expressions of the UGA's will are not binding on the BMU, but are nevertheless considered in the decision-making process. The UGA also informs the Ministry of its position without waiting to be asked. For example, the committee formulated a paper concerning the revision of the EMAS Regulation. The UGA communicates its papers not only to the BMU, but also to the public. In fact it is quite active in the field of public relations, publishing press items and organising conferences etc.

3.5.3 The outcome

So far, all the actors involved in the implementation process seem to be content with the implementation system (they have created). The close co-operation between public and private bodies seems to ensure both practicability and legal validity. Acceptance among sites (and environmental verifiers) is also relatively high (for detailed information on participation, please see chapter 4.1.1). The control mechanisms and sanctions provided for seem to be working relatively well (please see chapter 4.1.3.3).

3.6 Why do companies participate in EMAS?

The aim of this chapter is to analyse why companies decide to get registered with EMAS. This decision is influenced by advantages that companies hope to gain from participation, the promotion of companies' participation (e.g. information, advice and subsidies), and the regulatory relief granted to EMAS participants. Additionally we analyse the reasons that influence the choice of companies between EMAS and ISO 14001.

3.6.1 Advantages companies expect from EMAS participation

Companies expect a number of advantages from their participation in EMAS. Figure 3 shows what benefits German companies hope to gain.

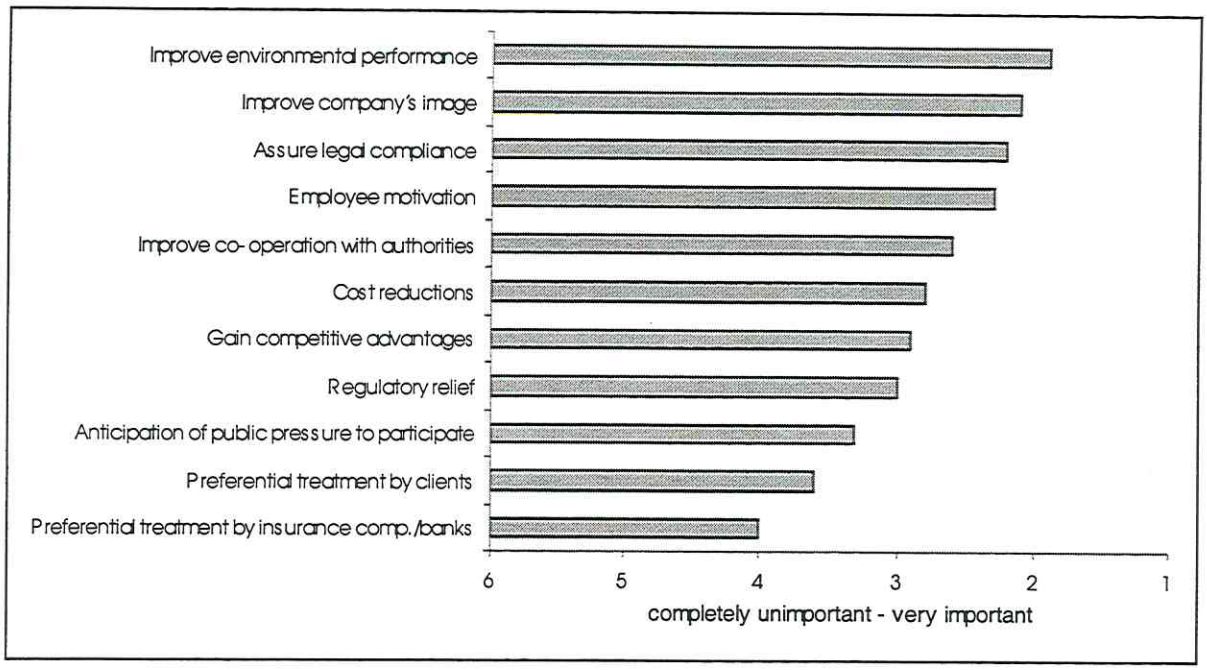

Figure 3: Reasons for participation in EMAS
Source: Unternehmerinstitut e.V. 1997, annex Fig.A48

The most important reason why German companies took part in EMAS was to improve their environmental performance (grade 1.9 on a scale from 1, very important, to 6, completely unimportant). Slightly less important reasons were image improvement (2.1), to ensure legal compliance (2.2), and employee motivation (2.3). Reasons of medium importance were better co-operation with public authorities (2.6), cost reduction (2.8), expectations of regulatory relief (e.g. less stringent reporting requirements) (3.0), and anticipation that the company will be compelled to participate in the future (3.3). A minor role was played by preferential treatment by clients (e.g. more orders) (3.6), and preferential treatment by insurance companies and banks (4.0). However, it appears that some large companies asked their suppliers to register with EMAS.

According to our interviews as well as recent surveys, corporate expectations seem to have been partly disappointed. Companies said that they received little response from stakeholders with respect to their EMAS participation (please see also chapter 4.1.3.2). However, they emphasised the usefulness of EMAS in improving their environmental management and in gaining certainty that the company complies with legal requirements (please see chapter 4.1.3.1).

3.6.2 Promotional activities

The EMAS Regulation (Art 13) explicitly mentions that the EU Member States may promote the participation of companies in EMAS. In Germany, promotional measures were widespread.[26] They were mainly undertaken by the ministries of economics and environmental ministries of the German states, as well as the chambers. The chambers have a particular interest in high participation rates, because they have invested in equipment and personnel to prepare for their registration activities. In order for these investments to pay off, it is necessary that many companies ask for being registered and pay the registration fee. Moreover, the chambers would like to demonstrate that a system in which business organisations play a central role is actually taken up by companies.

The survey we conducted among state ministries and chambers revealed that all ministries of economics and chambers of industry and commerce as well as more than 90% of the environmental ministries and the chambers of craft contributed to the promotion of EMAS.[27] While the chambers concentrated on the provision of information and advice, the state ministries also offered financial support. They did so either in the form of subsidies for pilot projects (73.3% of ministries) and/or general subsidies for EMAS participants (53.3% of ministries). Pilot projects have been supported with an average of DM 78,463 (= € 40,118), while general subsidies have amounted to an average of DM 38,386 (= € 19,627) per company receiving financial support. Each ministry financially supported an average of 7 pilot projects and 70 other participants. Extrapolating these figures for Germany would mean that approximately 60% of all EMAS participants received financial subsidies. However, Unternehmerinstitut e.V. (1997, annex Figure A13) estimated that the figure is only approx. 30%. The promotional activities based on information and advice included the distribution of brochures, the organisation of conferences and workshops etc.

Promotional activities started early: 10.5% of the organisations that provided information and advice began doing so back in 1993; the first pilot projects were funded in 1991 and the pro-

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[26] The information given in this chapter is based on a survey we conducted among the 16 state ministries of economics, the 16 state ministries of the environment, the 79 chambers of industry and commerce, and the 64 chambers of craft. A total of 46.9% of the organisations responded to the questionnaire. More results of the survey are presented in Bültmann/Wätzold (1999).

[27] Although we assume that the answers provide a representative sample, we should bear in mind that organisations that have been active in the promotion of EMAS are more likely to answer the questionnaire than organisations which have not. The figures which result from this survey might therefore be too optimistic.

motion by general subsidies started in 1995. In order to find out to what extent the promotional measures influenced companies' decisions to participate in EMAS, we asked the ministries and chambers about the feedback they got from firms. They reported that many companies that received subsidies indicated that they would not have participated in EMAS without this financial support. Even the distributed information and advice appears to have convinced a number of companies to get registered with EMAS (Bültmann/Wätzold 1999, pp.24-25).

Apart from the direct support, participation in EMAS can be subsidised indirectly by lowering the fees for the services the companies have to employ in order to get EMAS registered. These services are the registration carried out by the chambers and the inspection/validation performed by the environmental verifier. The chambers fix the registration fees according to their true costs, i.e. they do not subsidise participation in EMAS. The prices for the inspection/validation are individually negotiated between environmental verifiers and companies. As the prices the verifiers offer include the accreditation and supervision fees they pay the DAU, these fees might also constitute a subsidy. However, the fees the DAU charges were also calculated on the basis of the true costs. Therefore, in Germany no indirect subsidisation of EMAS participants exists.[28]

3.6.3 Deregulation for EMAS participants[29]

Companies quickly called for deregulation in return for their participation in EMAS. Some German states have taken the initiative and opened options for deregulation at the state level. Bavaria has been the pioneer with the "Umweltpakt Bayern" (Bavarian Environmental Pact) which was adopted on 23 October 1995. Meanwhile others followed, including Saxony with its "Umweltallianz Sachsen" (Saxon Environmental Alliance) of June 1998 and NRW.[30]

In Bavaria and Saxony, options for regulatory relief for EMAS participants were integrated into comprehensive (voluntary) agreements between state government and business representatives entailing obligations for both parties. The companies involved have guaranteed,

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[28] For more information on accreditation and supervision fees please see chapter 4.2.2.

[29] A comparative analysis of deregulation approaches in the four case-study countries can be found in Wätzold et al. 2000.

[30] The current proposal for a revision of the EMAS Regulation encourages Member States "to consider how registration under EMAS (...) may be taken into account in the implementation and enforcement of environmental legislation in order to avoid unnecessary duplication of effort by both organisations and competent enforcement authorities" (common position adopted by the EU Council, Art. 10).

for example, to reduce emissions, to increase the share of products they transport by rail, and to intensify participation in EMAS. In Bavaria a total of 500 registrations is to be reached by October 2000, with the figure in Saxony being 200 by the end of 2002. In return, the state authorities have promised to support the application of environmentally friendly technology and the introduction of environmental management systems, and to provide a lighter regulatory touch for EMAS participants. Individual deregulation measures have not been included in the "Umweltpakt Bayern". Instead a catalogue of measures (Substitutionskatalog) has been developed separately in close co-operation between the Bavarian government and industry. In Saxony, a detailed list of deregulation measures has been attached directly to the "Umweltallianz Sachsen". Both Saxony and Bavaria base their deregulation options on the principle of functional equivalence (funktionale Äquivalenz), i.e. the companies' measures do not have to be exactly identical to those of public authorities, but must be comparable with respect to scope and quality. Regulatory relief in both states applies to reporting, documentation and control duties, and covers the fields of waste, water and pollution control law. All in all, the Bavarian deregulation measures go beyond those of Saxony.

NRW did not grant regulatory relief to the same extent as Bavaria (and Saxony); nor did it integrate its deregulation measures into some kind of 'alliance', but instead enacted the "Substitutionserlaß" (substitution directive) in May 1998. This directive deals exclusively with pollution control law and instructs the relevant agencies to use their discretionary powers to substitute companies' self-control mechanisms for public measurements and controls, and to substitute documentation and information provided for in the EMAS Regulation for those required by the pollution control law. It is too early to assess the extent to which the deregulation measures have influenced companies in their decision to participate in EMAS.

3.6.4 EMAS and ISO 14001

In April 2000 1,950 German companies were certified with ISO 14001 and 2,432 were registered with EMAS. Apart from Austria, Germany is the only country with more EMAS than ISO 14001 participants.[31] The dominance of EMAS in Germany mainly results from its first-mover-advantage over the ISO standard. The way German companies used to deal with envi-

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[31] The world-wide total of EMAS registrations amounts to 3,325 compared to 15,772 ISO 14001 certifications.

A regularly updated list of the number of companies participating in EMAS and ISO 14001 can be found on the internet at http://www.iwoe.unisg.ch/News/index.html.

ronmental problems was more technology than management oriented (unlike, for example, the UK with its BS 7750). Therefore, German companies lagged behind in the field of environmental management and the adoption of the EMAS Regulation made them realise this deficit. When ISO 14001 was published by the International Standardisation Organisation in October 1996, many firms had already registered with EMAS, were in the process of doing so or intended to do so. The position of EMAS in the competition with ISO 14001 was additionally strengthened by the fact that EMAS registered sites were provided with more information and financial support than ISO certified companies and that regulatory relief was exclusively granted to EMAS participants.

However, recently ISO 14001 has become more popular among German companies. The main reason is that ISO 14001 is a world-wide accepted standard whereas EMAS is restricted to Europe. Moreover, ISO 14001 is closer to ISO 9001, a system with which many companies are familiar, and finally ISO 14001 is less costly than EMAS because it does not require the publication of an environmental statement (IÖU 1998, p.6). It may well be that in the future ISO 14001 certifications will overtake EMAS registrations also in Germany.

4 A framework for assessing the implementation process

The purpose of this chapter is to assess the environmental effectiveness as well as the allocative, productive and administrative efficiency of the implementation process. These evaluation criteria (especially environmental effectiveness and allocative efficiency) have been developed in the literature with respect to traditional instruments (taxes, tradable permits, standards). Therefore, as a first step we will adapt them to EMAS. Secondly, we will develop indicators to assess the implementation process according to the different criteria. Finally, we will provide data for the indicators for Germany.

4.1 Environmental effectiveness

An environmental policy, like a piece of legislation, is effective if the environmental goal it pursues is actually achieved. The EMAS Regulation (Art.1 (2)) states that the objective of the scheme is to promote continuous improvement in the environmental performance of industrial activities. In analysing whether or to what extent this goal has been achieved, various factors and causalities have to be taken into account (see Figure 4).

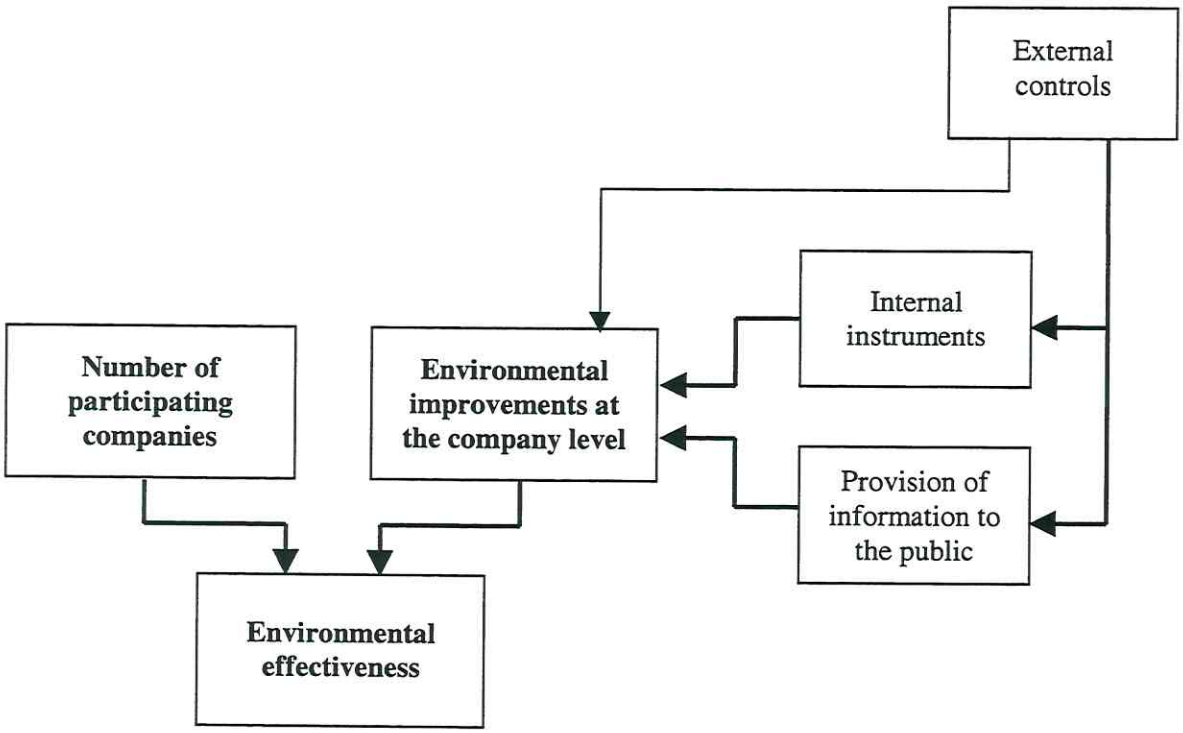

Figure 4: Factors and causalities influencing the environmental effectiveness of EMAS

Because participation in EMAS is voluntary, the overall environmental improvement brought about by EMAS, i.e. its environmental effectiveness, depends on two factors. These are the number of participating companies and the environmental improvements generated at the company level. To realise improvements in companies' environmental performance, the EMAS Regulation provides for the following means: (a) company internal instruments[32] such as environmental policies, programmes, management systems, and audits; (b) the publication of information about the companies' environmental performance (in the form of an environmental statement); and (c) external controls. The external controls mainly serve to ensure that the companies actually employ the internal instruments and publish environmental statements as prescribed by the Regulation. We will start our analysis by giving data on the participation rate.

4.1.1 Number of participating companies

Participation in EMAS is relatively easy to assess as all participating companies are registered.[33] In order to be able to compare the number of German participants with participants in other EU Member States, we have to normalise the figures. We have to take into account that because the countries vary in size and industrial structure, the number of firms, i.e. the number of potential participants, is different. Therefore, we relate the number of participating companies to the number of companies that could possibly take part in EMAS and for which data is available for all the four countries analysed in the IMPOL project. These are the companies from the manufacturing sector with more than 20 employees.[34]

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[32] Instruments that are directed towards companies' internal organisation and management.

[33] A regularly updated list of German registered sites is available on the internet at http://www.ihk.de/oekoaud/diht545.htm. The regularly updated numbers of EMAS-registered sites in all European countries is available at http://www.ecology.or.jp/isoworld/english/analy14k.htm.

[34] The number of possible participants might be higher as smaller companies can also participate. However, so far participation has largely been restricted to companies with more than 20 employees.

	Number of potential participants*	Number of industrial sites registered with EMAS (April 2000)**	In % of potential participants
France	24,671	33	0.15
Germany	37,413	2,432	6.50
Netherlands	6,404	26	0.41
UK	29,608	73	0.25

Table 1: EMAS-registered sites in relation to the number of sites from the manufacturing sector
Sources: * Eurostat – New Cronos Datenbank 12/98
**** http://www. ecology.or.jp/isoworld/english/analy14k.htm (16 June 2000, 10:29)**

In Germany, companies from certain non-industrial sectors are entitled to participate in EMAS. In May 1999, 249 non-industrial were registered. As the four countries under review currently do not have equivalent rules on opening EMAS to non-industrial sectors, we only compare the number of registered industrial sites.[35]

Table 1 shows that Germany has by far the most EMAS registrations, both in absolute and relative terms. This holds true not only for the four IMPOL countries, but also for all European countries. In April 2000, Germany accounted for almost three quarters of the total number of EMAS registrations throughout Europe (2,432 out of 3,325).

4.1.2 Direct assessment of environmental improvements realised at the company level

The aim of EMAS is to improve the environmental performance of a company. While measuring improvements in a company's environmental performance is complicated, it is unfeasible to quantify the extent to which EMAS is responsible for these improvements. The reason is that it is hardly possible to disentangle EMAS from other factors such as existing or expected environmental legislation, technological change and pressure from stakeholders that also affect the environmental performance of a company. In order to cope with the disentanglement problem, we rely on companies' opinions on whether EMAS has helped to improve

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[35] The current proposal for a revision of the EMAS Regulation (common position adopted by the EU Council) opens the scheme to all kinds of non-industrial organisations.

their environmental performance. As indicators we use the results of a company survey which asked about the measures that have been introduced in the context of EMAS and their relevance with respect to environmental improvements.

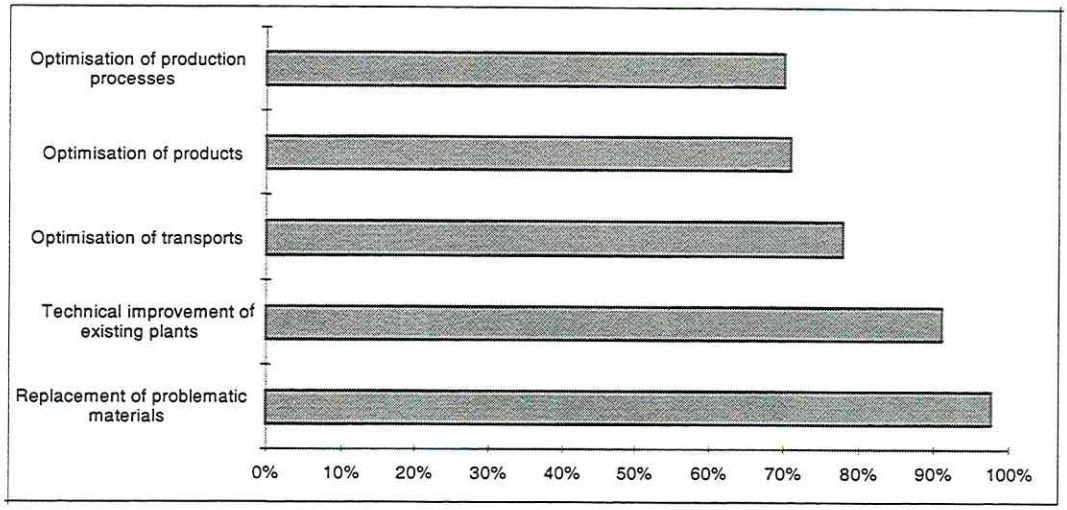

Figure 5: Measures companies have undertaken or intend to undertake in the context of their EMAS participation (percentage of companies)
Source: Unternehmerinstitut e.V. 1997, annex Fig. A27

Figure 5 gives the results of a survey on measures companies have undertaken or intend to undertake to improve their environmental performance in connection with their EMAS participation.[36] As many as 97.5% of companies are planning or have already undertaken the reduction or replacement of problematic materials, 91% of companies carried out or intend to carry out technical improvements at existing plants, and 78% are planning to or have already optimised their transportation under environmental aspects. The complete change of production processes and the ecological improvement of products play the least important role (72.5%). Obviously, taking part in EMAS has led the companies to carry out a number of different measures. An assessment of the environmental effects of these measures is given in Figure 6.

[36] The study of the Unternehmerinstitut e.V. also included some companies that only implemented ISO 14001 (15% of the total companies surveyed). However, according to one of the authors of the study there was no significant difference in the measures undertaken by EMAS and ISO 14001 participants.

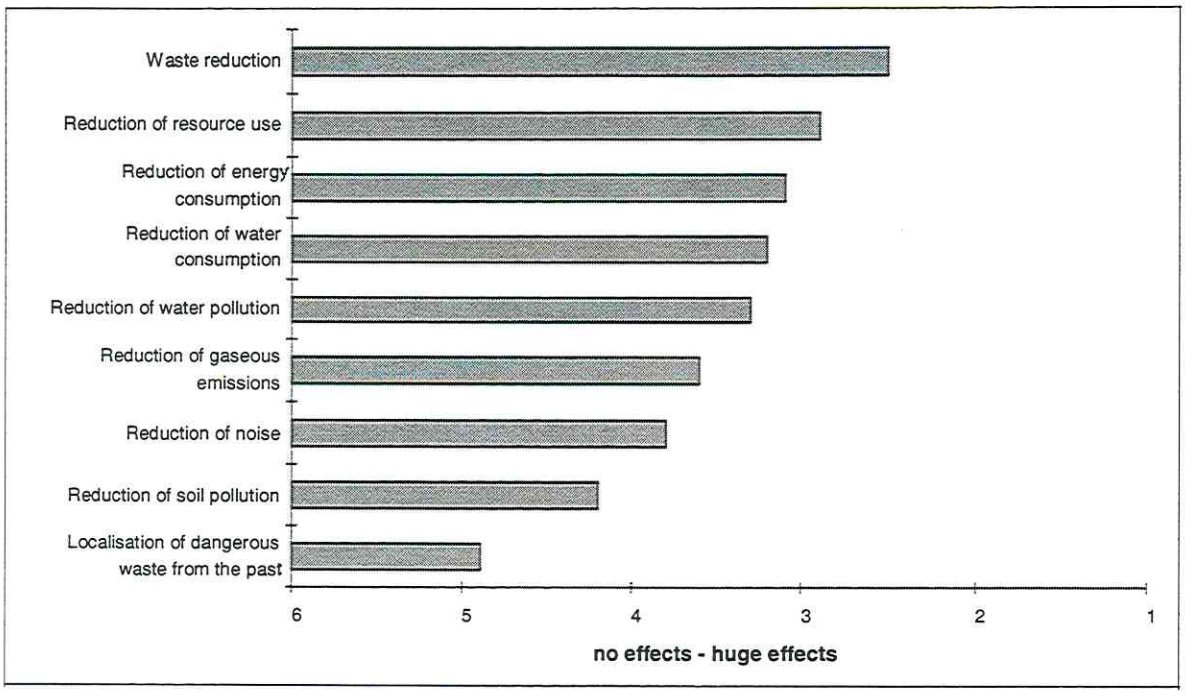

Figure 6: Environmental effects resulting from measures undertaken in the context of EMAS participation, Source: Unternehmerinstitut e.V. 1997, annex Fig. A29

Figure 6 shows that the environmental measures performed in the context of EMAS have caused some effects in all kinds of environmental aspects. With respect to most environmental aspects (reduction of resource use, reduction of energy consumption, reduction of water consumption, reduction of water pollution, reduction of gaseous emissions and reduction of noise pollution), medium effects have been achieved (2.9 to 3.8) on a scale from 1 (huge effects) to 6 (no effects). Merely the effects on waste reduction were ranked higher (2.5). Only little effect has been realised in the fields of soil pollution (4.2) and the localisation of improperly disposed of harmful waste (4.9). All in all, the environmental measures conducted in the context of EMAS participation have led to medium environmental effects.

The interviews we conducted revealed that environmental regulations are still the strongest driver for realising environmental improvements. However, EMAS was regarded as suitable for speeding up environmental improvements, systematising a company's environmental management, making companies aware of legal requirements,[37] and inducing additional environmental improvements.

[37] It was reported that some companies, SMEs in particular, had for the first time an overview of all the relevant environmental laws that they are supposed to follow.

4.1.3 Indirect assessment of environmental improvements realised at the company level – application of means

In the previous chapter we directly assessed the environmental improvements induced by EMAS by relying on estimations by EMAS participants. We shall augment this approach by taking an indirect route, i.e. we will discuss the effectiveness of the means that are expected to bring about the environmental improvements. As already mentioned, the EMAS Regulation aims at realising environmental improvements by (a) the employment of company internal instruments; (b) the publication of information about the companies' environmental performance; and (c) external controls.

4.1.3.1 Company-internal instruments

The existence of the internal instruments (e.g. the adoption of an environmental programme, the environmental audit etc.) only leads to environmental improvements when they are "brought to life". To assess whether this is the case, we consulted a survey that asked EMAS participants to give their opinion on the importance of the different elements of EMAS (they were asked to rank the elements on a scale from very useful (1) to superfluous (6)). Choosing this as an indicator, we assume that the more useful (for whatever reasons) companies regard certain EMAS elements, the higher their commitment to their successful implementation.

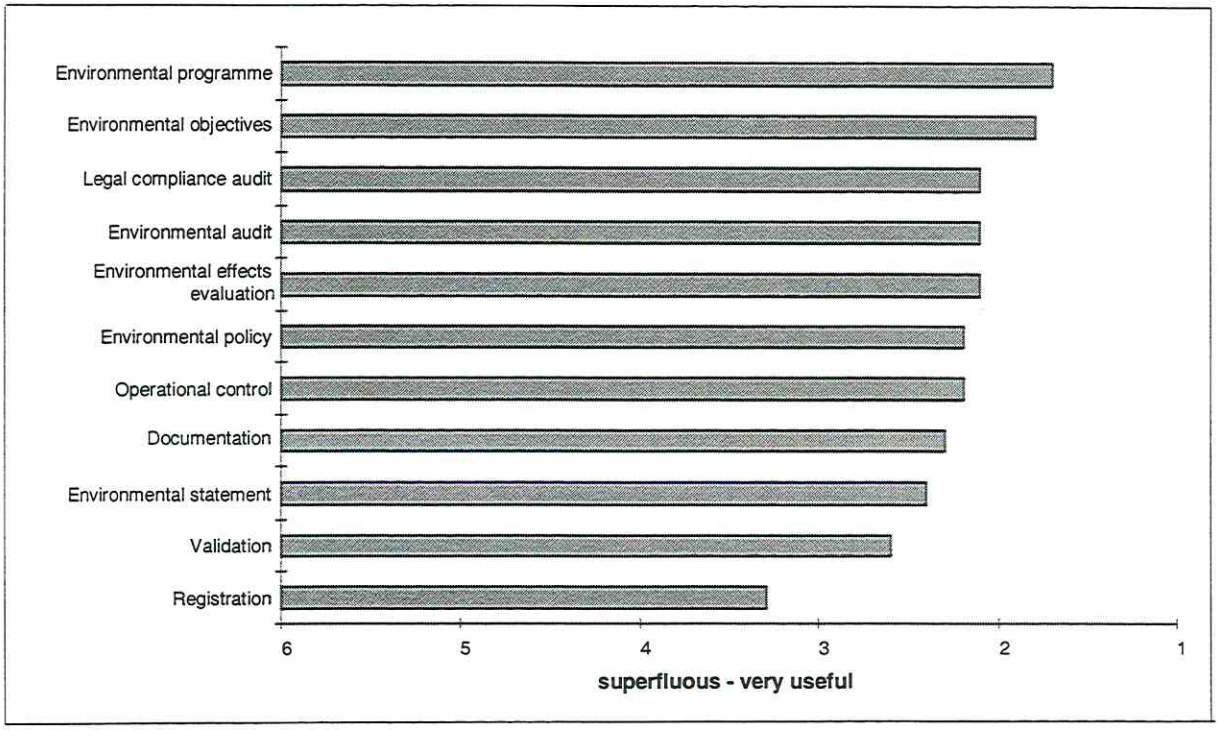

Figure 7: Importance of different elements of EMAS
Source: Unternehmerinstitut e.V. 1997, annex Fig. A49

Figure 7 shows that the internal elements are all regarded as rather important. The formulation of an environmental programme (1.7) and environmental objectives (1.8) are regarded as most useful. The legal compliance audit, the environmental audit and the environmental effects evaluation are ranked as slightly less important, but are clearly regarded as more than averagely useful. The same holds true for the adoption of an environmental policy and the operational control (2.2). The environmental management documentation records was regarded the least useful internal element (2.3).

Companies regard those elements directed at their internal management and organisation as more useful than the external elements, i.e. environmental statement, validation and registration, which come at the bottom of the list. This reveals that the companies have a self-interest in the application of the internal instruments, regardless of public esteem and external controls. Consequently, they can be expected to properly implement environmental policies, programmes, management systems and audits, and thus to realise environmental improvements.

4.1.3.2 Publication of information about the companies' environmental performance

The EMAS Regulation requires EMAS participants to publish environmental statements that provide the public with information about their environmental performance. The idea behind this is that the public rewards companies that can demonstrate a good environmental record and puts pressure on those which do not. Thus an incentive is created for companies to improve their environmental performance. But this mechanism can only take effect if the public takes notice of the environmental statements. To assess whether this is the case, we consulted a survey in which EMAS participants were asked to judge the interest the general public and different groups show in their environmental statements (Figure 8).

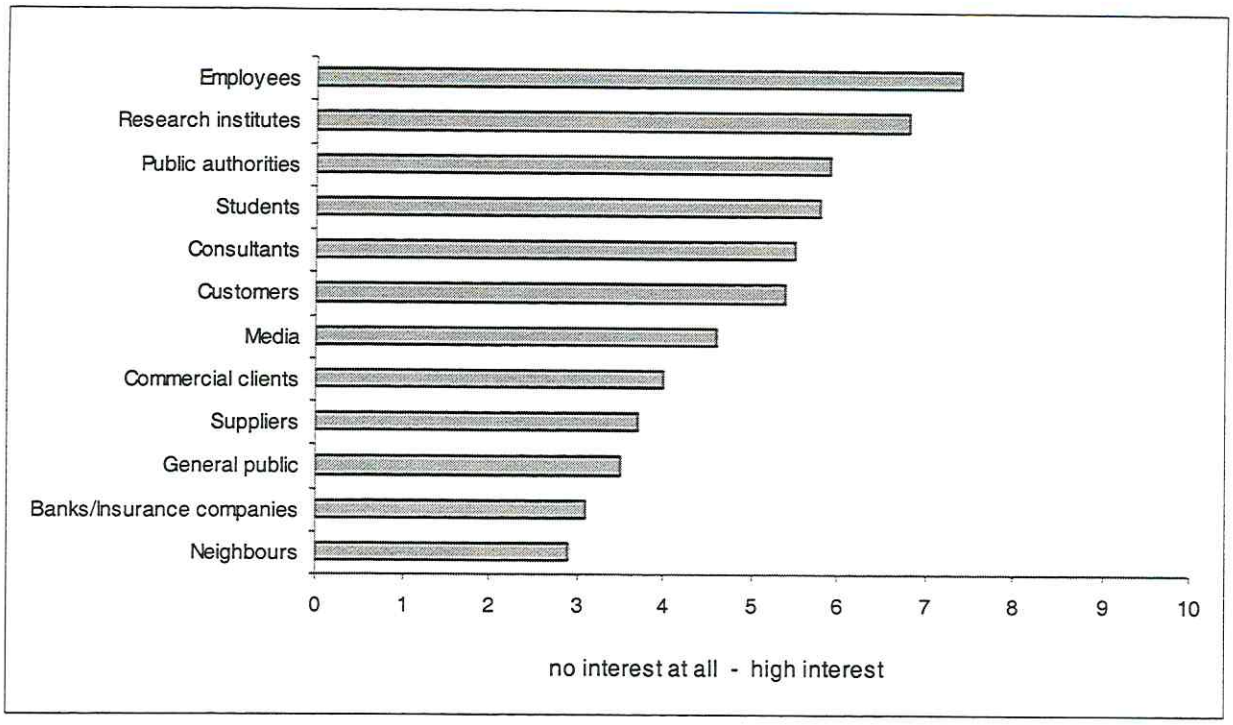

Figure 8: Interest in environmental statements
Source: UBA 1999, p. 42

Figure 8 reveals that all in all, interest in environmental statements is rather low. Even the most interested groups, employees and research institutes were only ranked 7.4 and 6.8 on a scale from 0 (no interest at all) to 10 (high interest). According to the companies the general public has shown very little interest (3.5); banks and insurance companies (3.1) and neighbours (2.9) were regarded as being even less interested in environmental statements. These findings are confirmed by our interviews. The interviewees reported that requests most often came from research institutes, universities and environmental organisations which showed a certain, but still low, interest in environmental statements.

In addition to this, Figure 8 illustrates that those groups which have a great potential to influence the companies' decisions on the realisation of environmental improvements by setting effective positive or negative incentives, e.g. public authorities (5.9), customers (5.4), commercial clients (4.0) or banks/insurance companies (3.1), were ranked as being rather little concerned with environmental statements. Therefore the publication of environmental statements (and the public's reaction to the statements) might have some influence on the companies' decisions, but are currently not the decisive driving force behind environmental improvements. This result corresponds to the above finding that the publication of environ-

mental statements is of relatively little importance to the companies compared to the company internal instruments (Figure 7).

4.1.3.3 External controls

The aim of external controls is to ensure that EMAS participants employ the company-internal instruments and publish information about their environmental performance as required by the Regulation. This chapter deals with the quality and strictness of the external controls and the sanctions provided if companies do not meet the requirements of the EMAS Regulation (and regulations additionally imposed by the Member States). In Germany, participating companies and sites are subject to a number of control mechanisms (Figure 9).

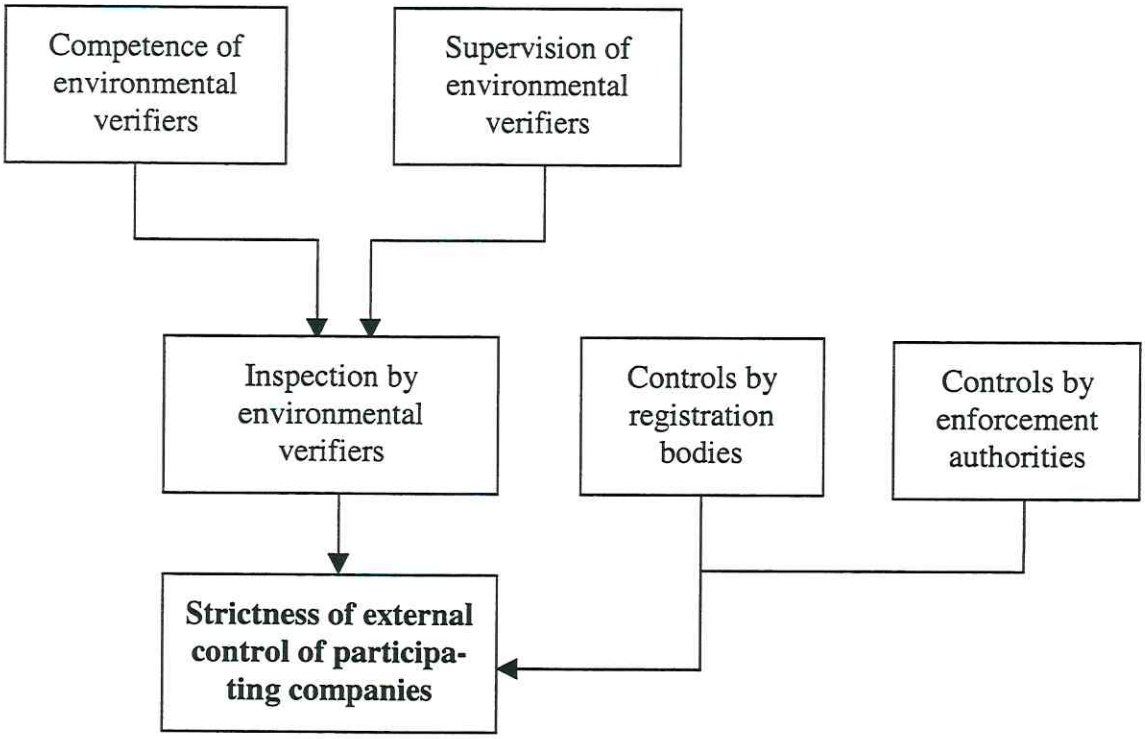

Figure 9: Factors that influence the strictness of the external control of participating companies

The accredited environmental verifiers play the key role in the control system, because it is they who actually inspect the sites. The quality and strictness of the controls performed by verifiers mainly depend on two factors: the competence of the verifiers, i.e. their ability to perform strict controls, and the supervisory procedures to which the verifiers themselves are subject. Besides environmental verifiers, registration bodies and enforcement authorities are involved in the external control of participating companies. In the following we will discuss each aspect of the control system in detail.

Competence of environmental verifiers

We use the qualifications that an environmental verifier must have to be accredited, and the way he has to demonstrate them as an indicator to assess the competence of the verifier. As described in chapters 3.2.3, 3.4.3 and 3.5.2, in Germany legal regulations have been enacted that precisely lay down the qualifications environmental verifiers and "Fachkenntnis-bescheinigungsinhaber", i.e. everybody participating in the validation of sites, must demonstrate. Whether an applicant verifier meets the demands is checked by the DAU, the German accreditation and supervision body. The DAU requires the verifier to hand in the completed application form along with documents that prove that he fulfils the general provisions such as a university degree and reliability. The documents the applicants have to provide encompass, for example, diplomas and a criminal record. The competence of the applicant verifier is tested by means of an oral exam.[38] Once a verifier is accredited, he is obliged to continue his training by attending appropriate courses. The accreditation requirements for environmental verifiers and the way the DAU checks whether they are met by applicants are summarised in Table 2.

Accreditation requirements	Checking procedures
University degree	Application form and documents (e.g. diplomas and criminal record)
Three years of practical experience	
Reliability and independence	
Knowledge about environmental management and audit procedures	Oral exam
Knowledge of environmental regulations	
Sector-specific knowledge	

Table 2: Accreditation requirements for environmental verifiers in Germany

The overall impression of the German accreditation system is that it ensures a high level of knowledge. However, it has been criticised that sector-specific practical experience is not given enough weight in the accreditation requirements.

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[38] Besides the fact that an oral exam is carried out, the strictness of the exam is important as well. An indicator of the strictness is the percentage of applicants who fail the exam. This figure is quite high in Germany: in 1995 it was 30%, during 1996 it doubled, since then it has levelled out at about 60%.

Supervision of environmental verifiers

There are several indicators to assess the strictness of supervision: the supervisory procedure, i.e. the ability to discover inadequate conduct by environmental verifiers, the options available to react to inadequate conduct, and the sanctions actually applied.

As mentioned above, the DAU subjects the environmental verifiers to a regular supervision every three years (see chapters 3.2.3, 3.4.3 and 3.5.2). At the beginning of the procedure the verifier is asked to complete a questionnaire in order to assess whether he still meets the accreditation requirements and to get an overview of the validations he has performed. The quality of the verifier's validation activities is controlled in spot checks: the DAU demands the verifier to supply the documents and papers (reports on site inspections etc.) of two validations and examines them in detail. Finally, the DAU alternately performs a witness audit or an office audit. Table 3 summarises the details of the regular supervision and the supervisory procedures.

Details of regular supervision	Supervisory procedures
Reliability and independence	Questionnaire, written statement of verifier
Training activities	Questionnaire
General information about the validations the verifier has performed, e.g. sector and size of the companies, the number of days spent on site etc.	
Quality of the validations the verifier has performed (especially regarding the sites' compliance with environmental regulations)	Documents of two validations
Continued competence	
Quality of the verifier's work in general	Witness audit / office audit

Table 3: Details on the regular supervision of environmental verifiers

In addition to the regular supervision the DAU conducts controls in the event misconduct of an environmental verifier is suspected. If either the regular or the suspicion supervision reveal misconduct of a verifier, the DAU has a number of different sanctions at its disposal. They range from admonition to revocation of accreditation. By September 1999 the first 110 regular supervision procedures and 74 cases of suspicion supervision have been instituted. In nearly all cases of regular supervision the DAU discovered misconduct of the verifier, but the cases were not regarded as serious and appeared to result from misinterpretations of the EMAS Regulation rather than from deliberate disregard of its requirements. Therefore all verifiers

who had shown misconduct escaped with an admonition, i.e. the mildest possible sanction. By September 1999, the DAU had concluded about half of the 74 suspicion supervision procedures. Although a few cases were quashed, because the verifier demonstrated that he had worked properly, in most of the cases it turned out that the verifier had made a mistake. According to the DAU, none of the cases has been severe enough to justify tough sanctions such as the revocation of accreditation. In the majority of cases the DAU cautioned the verifiers and some escaped with an admonition. Only a handful of cases were passed on to the BMU as (potential) administrative offences. The available and the actually applied sanctions are summarised in Table 4. Besides, the DAU charges fees for its supervision activities which also function as a sanction. The minimum fee is DM 200 (= € 102), but if the DAU thinks it necessary to carry out a witness audit or to commission expert opinions, the fee can easily amount to a few thousand Deutschmarks.

Sanctions available	**Sanctions applied**	
	Regular supervision	**Suspicion supervision**
Admonition	in all cases	in some cases
Caution	—	in the majority of cases
Intensification of supervision	—	—
Temporary prohibition of performing validations	—	—
Restriction of scope	—	—
Abondenment of accreditation	—	—
Revocation of accreditation	—	—
Notification of administrative offences	—	in a handful of cases

Table 4: Santions available and actually applied in cases of misconduct of an environmental verifier

All in all, the DAU appears to try hard to discover all cases of misconduct of environmental verifiers, but only applies mild sanctions. According to the DAU this is justified, because most cases of misconduct appear to result from problems with the interpretation of the EMAS Regulation. To react to this situation the DAU regularly provides all environmental verifiers with "Informationen für Umweltgutachter" (information for environmental verifiers) in which the DAU takes up the problems and explains the correct interpretation as well as the correct conduct of the environmental verifiers. Once a problem has been dealt with in the "Informationen für Umweltgutachter" the DAU does not accept the excuse of unclear legal regulations. Therefore the DAU can be expected to apply tougher sanctions in future.

In Germany the accreditation and supervisory body itself is surrounded by a number of control bodies which influence its activities. As already mentioned, the DAU is provided with administrative guidelines by the UGA and supervised by the BMU. Additionally the Objection Committee which rules on objections environmental verifiers raise against official acts of the DAU serves as a kind of control organ.

Quality and strictness of controls performed by environmental verifiers

As an indicator of the quality and strictness of validation, we use the time verifiers spend doing their job, especially the time spent on the inspection of the site. In order to assess and to compare the time verifiers spend on validation, we developed a virtual example site and asked verifiers in the four case-study countries how much time they would need to validate this site.[39] The answers we obtained from German verifiers are presented in Table 5.

	Preparation of inspection	Inspection of the site	Time needed after inspection	Total
Man-days	3.5	2.25	2.25	8

Table 5: Average time German verifiers would need to validate the example site

For Germany, our interviews suggest that so far the verifiers – in general – take the controls seriously, although the controls do not seem to be particularly strict. But we shall mention that the verifiers do not appear to be under pressure from companies to carry through particularly lax controls. The reason is that most of the companies that have decided to participate in EMAS are seriously trying to implement the EMAS requirements, especially the company-internal instruments (see chapter 4.1.3.1). Some people fear that this might be different, when companies do not voluntarily participate in EMAS, but are compelled to do so by clients or authorities. Companies might then increasingly put pressure on verifiers to carry out lax controls and – given the strong competition among verifiers – they might be inclined to accept such companies' demands.[40]

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[39] The company is medium sized and belongs to the metal processing industry. A detailed description of the example site is given in the annex.

[40] Cf. Müller 1998.

Level of control by the registration body and enforcement authorities

As described in chapter 3.5.2, certain control mechanisms were established in the context of the registration. Before a site is registered, the registration body examines the application form and several documents, including the environmental statement, and asks the competent enforcement authorities to check whether the site complies with the relevant environmental regulations. The registration body can request further documents, demand the revision of the environmental statement, or deny registration. Moreover, it can delete or temporarily suspend the site from the register at any time, if it concludes that the site no longer complies with the EMAS Regulation or if it is informed by the competent enforcement authorities that the site violates environmental regulations. To assess the level of control we use the indicators presented in Table 6.

	in % of total no. of registered sites[41]
Sites where competent enforcement authorities have raised objections against registration	5.9%
Sites where the registration body has raised objections against the registration of sites (excluding objections by enforcement authorities)	5.1%
Sites where registration was refused	< 0.1%
Sites that have been deleted or temporarily suspended from the register	0%

Table 6: Percentage of sites where objections have been raised against registration
Source: Registration body survey (based on information from 35 registration bodies)

In Germany, enforcement authorities raised objections because building regulations were violated, emission limit values were exceeded or requirements set by the permitting authorities were not met. However, not all the objections raised by authorities were justified. In some cases it turned out that the information on which the authority based its objection was incorrect or the authority misinterpreted the requirements of the EMAS Regulation. If the objections of an enforcement authority were justified, an agreement was usually reached between the authority and the company to achieve compliance with the law within a certain period. Once this agreement was set up, registration was granted immediately. Only one case was

[41] The figures were obtained from a questionnaire survey of all German registration bodies we conducted in autumn 1998. The return quota was 53.8%.

reported where a company was not registered due to objections raised by competent enforcement authorities.

There were various reasons why the registration bodies raised objections against the registration of sites. These included failure to meet the EMAS requirements (e.g. the environmental statement was incomplete, the company did not set enough quantified goals in its environmental policy), the definition of the site was incorrect, the environmental verifier was not accredited for this particular sector, or the registration form was incomplete. However, all of these sites were able to solve their problems and were finally registered. By the end of 1998, no site was suspended or deleted from the register owing to a sanction by the registration body.

The relatively high number of objections indicate that the controls by registration bodies and enforcement authorities are carried out seriously. However, in the case of violations, all parties usually try to find a solution to enable the registration of the applicant without applying any sanctions.

All in all, the external controls in Germany appear to be strict enough to make it very unlikely that a site which does not have established an environmental policy, programme, and management system, carried out environmental audits, and published an environmental statement is registered. However, the mere existence of the company-internal instruments and the environmental statement is not sufficient to bring about environmental improvements; the internal instruments must be "brought to life" and the environmental statement acknowledged by the public. Based on our analysis we conclude that the latter condition is not (yet) fulfilled and that it is mainly the internal instruments that trigger improvements in a company's environmental performance.

4.2 Allocative efficiency

Allocative efficiency of pollution abatement means in general that the (aggregated) costs for realising a given goal (e.g. reduction of emissions by 50%) cannot be reduced by reallocating abatement activities between individual polluters. Given the usual textbook assumptions, this implies that the allocation of abatement activities follows the pattern that polluters with lower marginal abatement costs abate more than polluters with higher marginal costs (until all polluters have the same marginal abatement costs).

In trying to apply the concept of allocative efficiency to EMAS, we encountered three important problems in terms of differences between EMAS and traditional ways of pollution abatement. Firstly, the EMAS Regulation does not set an environmental goal in the traditional sense (e.g. an emission limit), but aims at a continuous improvement in the environmental performance of industrial activities (Art. 1(2)). Secondly, participation in EMAS is voluntary. Thirdly, the decision on participation is a "yes or no" and not a "how much" decision, and thus makes a marginal analysis in the traditional sense impossible. Because of these differences, it is not feasible to directly transfer the concept of allocative efficiency to EMAS.

Nevertheless, we can apply the concept of efficiency to the structure of EMAS participants, i.e. we can show that one structure of EMAS participants can be more efficient than another. Against this background we developed the following approach to analyse whether the EMAS implementation process has led to a structure of EMAS participants that is in line with allocative efficiency.

1. Participating in EMAS does not only produce costs for a participant (e.g. for establishing an environmental management system or preparing an environmental statement), but also benefits (e.g. due to reductions in energy consumption). Therefore we look at the net participation costs,[42] which are obtained by subtracting the benefits from the costs.

2. Due to the fact that participation in EMAS is voluntary, we can argue that only those companies participate whose benefits at least equal their costs, i.e. that have negative net participation costs (= net benefits). Moreover, the companies with the least costs (= highest benefits) can be expected to be the first to participate. Thus allocative efficiency is automatically realised, provided that the implementation process does not influence the companies' decisions (and thus the structure of EMAS participants) by changing relative participation costs. According to this line of argumentation, any manipulation of participation costs that makes companies participate which otherwise would not have participated and vice versa would result in allocative inefficiency.

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[42] With respect to participation in EMAS we speak of participation costs instead of abatement costs, because the companies do not (primarily) abate something, but participate in the scheme.

3. However, we have to take into account that the improvement of a companies' environmental performance brought about by EMAS also leads to benefits for society as a whole. In economic terms, participation in EMAS leads to positive externalities. This has to be considered when assessing the allocative efficiency of the manipulation of participation costs. Therefore, in order to assess whether the manipulation of participation costs leads to allocative inefficiency, we also consider whether the companies which due to the change of participation costs decided to participate (not participate) can be expected to realise more (less) environmental improvements. If the increase in environmental improvements over-compensates for the increase in costs, the manipulation of participation costs is in line with allocative efficiency. Given the data constraint, we are unable to assess this in detail. However, we can derive results by making plausible assumptions.

4. There are three ways in particular for the implementation process to change participation costs: promotional schemes, the determination of prices (e.g. for registration), and norms for the application of the instruments that are directed at improving companies' environmental performance (e.g. a special kind of an environmental management system).

In the following we will examine each of these potential sources for inefficiency separately. We will analyse whether there is a change in relative participation costs, whether it actually influences the structure of EMAS participants, and whether it leads to an increase in environmental improvements that could outweigh higher costs.[43]

4.2.1 Promotional schemes

Promotional activities – the provision of financial support as well as the provision of information – reduce participation costs. They can influence the structure of EMAS participants by only granting support to selected companies (e.g. SMEs), or by granting different levels of support to different groups of companies.

As already described in chapter 3.6.2, in Germany measures to promote participation in EMAS are mainly undertaken by the ministries of economics and environmental ministries of the German states, as well as the chambers of industry and commerce and the chambers of craft. While the chambers concentrate on the provision of information and advice, the state

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[43] Our analysis of allocative efficiency is carried further in Wätzold/Bültmann 2000a.

ministries also financially support participation in EMAS. Many of the ministries and chambers that provide information have targeted their information activities at selected groups of companies (between 28.9 and 47.0%, depending on the particular activity). Nearly all ministries offering financial support directed the subsidies towards specific groups of companies (pilot projects 90.9%, general subsidies 100%). The criteria for differentiation are given in Figure 10.

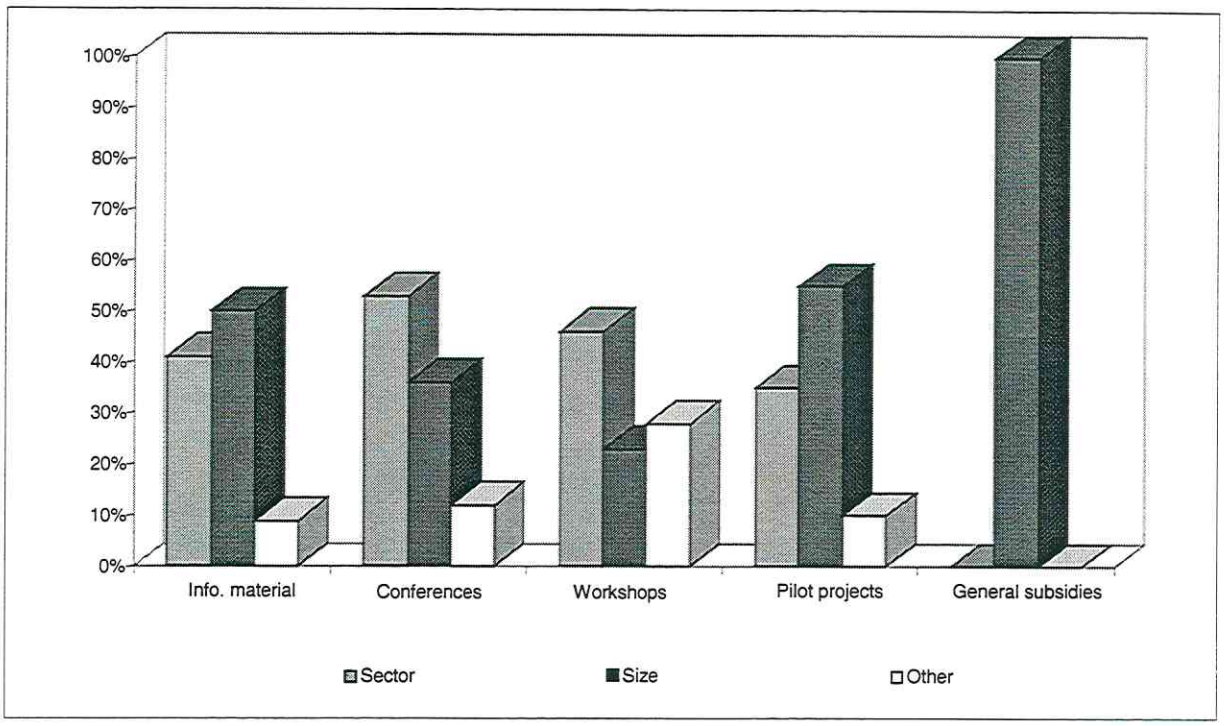

Figure 10: Criteria for directing promotional activities to specific groups of companies
Source: Bültmann/Wätzold 1999, p. 16

84.1 % of the organisations that directed their promotional activities towards selected groups of companies did so by branch or company size. Regarding the branch, no concentration on particular sectors could be observed. With respect to size, the focus of promotional activities was clearly on SMEs. This result reflects Article 13 of the EMAS Regulation which stipulates that Member States give the support of SMEs priority.

The concentration on SMEs leads to a change in relative participation costs, in that participation becomes less expensive for SMEs while costs remain the same for large companies. From our survey (Bültmann/Wätzold 1999) we learned that both financial support and the provision of information 'convinced' companies, i.e. SMEs, to register with EMAS that otherwise would not have participated. Therefore the focus on SMEs actually changed the structure of

EMAS participants, insofar as the number of participating SMEs rose and the number of large companies remained constant.

Regarding an individual SME's contribution to environmental improvements, the following (general) rule applies: small firms only cause little pollution and thus can only produce limited environmental improvements. This suggests that the concentration on SMEs leads to allocative inefficiency and that supporting large companies would be more efficient. However, before we can give a definite answer, we have to take into account that large companies are more likely to benefit from participating in EMAS, i.e. they are more likely to register with EMAS even without subsidies. The reasons are that large companies are generally more prone to environmental pressure than SMEs and the relative costs of participating in EMAS (e.g. expressed as a percentage of the turnover or costs per employee) are higher for SMEs than for large firms. Subsidising large companies thus implies that companies receive money that would have participated anyway. Therefore, by concentrating on SMEs a higher number of additional EMAS participants can be reached (with less environmental improvements at the company level). On the basis of this analysis we have to conclude that it is unclear whether subsidising SMEs actually leads to allocative inefficiency. However, it is not unlikely that the environmental improvements realised by those SMEs that additionally participate in EMAS outweighs the costs incurred in the modification of the structure of EMAS participants.

4.2.2 Determination of prices

There are two services companies have to employ in order to register with EMAS (inspection/validation by environmental verifiers and registration). The prices for both services are directly (registration) or indirectly (inspection/validation) influenced by bodies participating in the accreditation, supervision and registration system. Consequently, there is a potential for the implementation process to cause allocative inefficiency.

The determination of prices can lead to allocative inefficiency if the prices for the services do not reflect true costs, but are reduced or increased for specific companies. This is synonymous with the manipulation of relative participation costs.[44] Whether this is the case with respect to German inspection/validation and registration prices will be analysed in the following.

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[44] This means that charging no fees for a service could lead to allocative inefficiency as well.

Accreditation and supervision fees

In Germany, prices for an environmental verifier's inspection and validation of a site are individually negotiated between verifier and company. Thus the determination of prices is left to market forces. But although the implementation process does not directly interfere in setting examination and validation prices, the prices are indirectly influenced via the accreditation and supervision fees the DAU charges. As described in chapter 3.2, the DAU has to follow the accreditation and supervision fees laid down in the Fees Ordinance enacted by the Federal Ministry of the Environment. The accreditation fee consists of a fee for the act of accreditation of DM 7,000 (= € 3,579), and a fee for the oral exams that varies between DM 1,200 (= € 614) and DM 2,000 (= € 1,023) depending on the number of examiners necessary. Additional fees arise if an exam has to be repeated or if the accredited scope is extended. The fee for the regular supervision is composed of a fixed fee and an extra fee for each site the verifier has examined. The fixed fee consists of a basic fee of DM 3,000 (= € 1,534) and fees for checking the documents (minimum DM 170, = € 87)[45] and for performing office audits or witness audits (minimum DM 1520, = € 777). The fee charged for each examined site varies between DM 300 (= € 153) for small, DM 600 (= € 307) for medium-sized, and DM 1,400 (= € 716) for large sites.

Especially the fee the verifiers have to pay for each examined site is very likely to be directly passed on to the sites. Consequently, the examination/validation price (in tendency) will rise by DM 300 (= € 153) for small sites, DM 600 (= € 307) for medium sites, and DM 1,400 (= € 716) for large sites. While the amount of work necessary to check the validations performed by the verifier might increase with the size of the company, it is questionable whether this happens to the extent suggested by the difference in supervision fees. Therefore accreditation and supervision fees might lead to a change in relative participation costs, in that participation becomes relatively cheaper for small companies.

However, compared to the overall costs necessary for registering with EMAS of on average DM 116,000 (= € 59,310) (cf. UBA 1999, p. 35), the increase in inspection/validation prices caused by accreditation and supervision fees is very low. It will hardly influence the compa-

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[45] The documents verifiers are obliged to keep for each examination they carry out (e.g. reports of site inspections).

nies' decision on participation and change the structure of EMAS participants. Therefore accreditation and supervision fees are unlikely to cause allocative inefficiency.

Registration fees

The registration fees are directly set by the registration bodies. The fees are staggered with respect to company size and the administrative effort needed to register a company.

	Little administrative effort	Average administrative effort	Significant administrative effort
Small enterprise, <50 employees	229	392	554
Medium enterprise, 50 to 250 employees	392	554	712
Large enterprise >250 employees	554	712	877

Table 7: Fees for site registration charged by competent bodies (in €)

Table 7 gives an overview of the fees structure. Differentiation according to administrative efforts (little administrative effort: relevant documents are correct and no objection by regulatory bodies; average administrative effort: incomplete or wrong documents; significant administrative effort: objections by enforcement authorities) is in line with allocative efficiency, because the sites are charged with the costs that they cause. In principle, differentiation depending on size is justified as well, because the checks registration bodies carry out before they register a site take longer for large companies, e.g. because their environmental statements are more extensive. But it is questionable whether the amount of work needed for registration differs to the extent that the fee differs between small, medium-sized and large sites. Therefore registration fees are likely to change the relative participation costs, in that participation becomes relatively cheaper for small companies.

However, compared to the overall costs necessary for registering with EMAS, registration fees are very low. They will hardly influence the companies' decision on participation and change the structure of EMAS participants. Like accreditation and supervision fees, registration fees are unlikely to cause allocative inefficiency.

4.2.3 Norms regarding the application of the means

As already described, the EMAS Regulation provides for the following means to improve the environmental performance at the company level: (a) the employment of company-internal instruments; (b) the publication of environmental statements to provide the public with information about the companies' environmental performance; and (c) external controls. If the implementation process produces obligatory norms that change the way of applying the means, this could be a source of inefficiency. Norms can lead to allocative inefficiency if they increase (or decrease) the costs for applying the means for certain companies only, because this would be a manipulation of relative participation costs. An example of norms that could lead to allocative inefficiency is the prescription of a certain management system or a certain form of environmental statement that might be the best solution for some companies but not suitable for others. With respect to external controls, allocative inefficiency could arise by, for example, requiring verifiers to adopt a standardised examination procedure for all sites which does not take into account particularities arising from, say, the size or ecological relevance of different sites.

In Germany, binding norms (in addition to those laid down in the EMAS Regulation) exist for neither the application of company-internal instruments nor the preparation of environmental statements. The UGA recently published the "Handreichung zur Erstellung einer Umwelterklärung nach EMAS I" (guiding principles for preparing environmental statements), which is designed to help companies in preparing environmental statements, but it is not obligatory. The same holds true for external controls. In Germany, although no legal regulations have been enacted which set detailed requirements for control procedures, there are 'inofficial' guidelines to guide the examination activities of environmental verifiers. The UGA has enacted "Leitlinien zu den Aufgaben der Umweltgutachter" (guiding principles on the tasks of environmental verifiers) and the DAU regularly provides all environmental verifiers with the "Informationen für Umweltgutachter" (information for environmental verifiers). In both cases the guidelines mainly serve to interpret the EMAS Regulation and thus do not mean additional requirements.

To sum up, it can be stated that the German implementation process has not generated binding norms for the application of the means that serve to improve the environmental performance at the company level. Therefore there is no change in relative participation costs and thus no source of allocative inefficiency here.

4.3 Administrative efficiency

In order to assess the administrative efficiency of the EMAS implementation process, we will calculate the amount of administrative costs connected with EMAS. As an indicator of the administrative costs we use the working time needed for running the accreditation, supervision and registration system. This means that neither the costs that occured for establishing the system nor the costs for buildings, equipment etc. are captured. The working time is measured in man-months (mm) and calculated for the five years the accreditation, supervision and registration system has been in practice (April 1995 until April 2000).[46] In the following we present the data for each of the different parts of the accreditation, supervision and registration system and the involved bodies separately.[47]

4.3.1 Costs for the accreditation and supervision of environmental verifiers

As explained earlier the accreditation and supervision of the verifiers is done by the DAU; the accreditation in connection with the Examination Committee. Additionally, the UGA, the BMU and the Objection Committee are involved.

In 1998, the DAU employed four people who spent all their working time on the accreditation and supervision of environmental verifiers. Thus the yearly administrative costs amount to 48 mm. Multiplied by the five years the accreditation, supervision and registration has been in practice, we obtain 240 mm.[48] The Examination Committee carries out the oral exams applicant environmental verifiers are subjected to. On average the committee consists of four people and examines four applicants per day, which makes 1 man-day (= 0.05 mm) per applicant. By September 1999 556 accreditation procedures were performed in Germany, i.e. the total administrative costs for the Examination Committee amount to 27.8 mm.

The administrative costs for the UGA consist of the costs for the UGA office and the meetings of the UGA itself and the subcommittees. In 1998 the UGA office was run by four full-time staff, i.e. produced yearly administrative costs of 48 mm. When we multiply this figure by five

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[46] One man-month consists of 20 man-days.

[47] The data were collected in interviews with representatives of the relevant bodies, i.e. DAU, UGA, BMU, chambers, and enforcement authorities. The interviews were conducted between autumn 1998 and September 1999.

[48] As the number of employees has hardly changed over the five years the multiplication appears to be justified. This holds true for the calculation of the administrative costs of the UGA office and the BMU as well.

we obtain 240 mm. The UGA itself has 25 members and so far has met four times per year. The meetings usually take one day. Thus the administrative costs of the UGA amount to 25 mm. In addition, there exist four subcommittees. On average they consist of ten members and have met five times a year for one-day meetings. Therefore the subcommittees have produced administrative costs of 50 mm.

In 1998 the BMU employed 3.5 people dealing with EMAS, i.e the yearly administrative costs amount to 42 mm. Multiplied by the five years the accreditation, supervision and registration has been in practice, we obtain 210 mm. The administrative costs born by the BMU include the administrative work for the Objection Committee and the provision of the committee's chairman. The chairman is supported by two assessors. By September 1999, 43 objections have been raised. The meetings of the Objection Committee generally take half a day. Thus the Examination Committee accounts for administrative costs of 2.15 mm (excluding the chairman).

4.3.2 Registration costs

As pointed out, in Germany the chambers of industry and commerce and the chambers of craft are responsible for the registration. On average the chambers have spend 6 hours (= 0.75 man-days) on each registration. Furthermore, we have to consider the time the relevant enforcement authorities spend on checking whether the site to be registered is in legal compliance. In general three authorities are involved which each on average spend almost a day for checking the legal compliance of a site (we calculate with 0.95 man-days). Altogether the registration of one site produces administrative costs of 3.6 man-days (= 0.18 mm). Mulitplied by the 2432 sites registered in Germany in April 2000, we obtain 437.76 mm.

The total administrative costs incurred in running the German accreditation, supervision and registration system are summarised in Table 8. In order to be able to compare the administrative costs of the four case study countries, we divide the overall amount of administrative costs by the number of EMAS participants. Although we cannot claim that our figures are absolutely precise, they certainly indicate the correct scale of the administrative costs EMAS has produced in Germany over the last five years.

Costs of the accreditation and supervision system, thereof	767.15
DAU	240
Examination Committee	27.8
UGA, thereof Office Meetings Subcommittees	279 240 25 50
BMU	210
Objection Committee (excluding chairman)	2.15
Registration costs (incl. authorities)	437.76
Total administrative costs	**1204.9**
Administrative costs / registered company	**0.49**

Table 8: Administrative costs incurred in running the accreditation, supervision and registration system from April 1995 to April 2000 (measured in man-months, mm)

In Germany the administrative costs are for the most part paid by environmental verifiers and participating companies through the accreditation, supervision and registration fees. Only the costs for the UGA, the BMU and the Objection Committee[49] are born by the government re-spetively the UGA members which work in an honorary capacity.

The average registration fee has been DM 830 (= € 424). If we assume that the environmental verifiers directly pass on the fee they have to pay for each validation in the context of their supervision (between DM 300 and DM 1400 (= € 153 - 716)), the administrative costs to be born by participants range between DM 1130 and DM 2230 (= € 578 - 1140). Compared to the total participation costs of on average DM 116,000 (= € 59,310), the administrative costs are marginal (between 0.97 and 1.92 %). However, it is not feasible to definitely answer the question whether the German administrative costs are high or low by looking at the German costs alone.

[49] Environmental verifiers participate in covering the costs for the Objection Committee as they are charged a fee in case their objection is dismissed.

4.4 Productive efficiency

In general, productive efficiency means that companies install cost-efficient abatement technologies, i.e. they are able to choose the abatement cost curve that represents minimum costs. With respect to EMAS we modify this definition; productive efficiency is achieved when companies follow the requirements of EMAS such that their costs are minimised without compromising on their ecological achievements. Whether or not companies manage to achieve productive efficiency largely depends on the information they have about existing techniques (methods to install environmental management systems, how to write a report etc.). Therefore, the indicator for productive efficiency is the provision of information about how to participate in EMAS and the related costs and benefits. In Germany, this information is mainly provided by the state environmental ministries, the state ministries of economics, the chambers of craft and the chambers of industry and commerce (see chapter 3.6.2). Our survey has shown that of those organisations that answered the questionnaire all chambers of industry and commerce as well as all ministries of economics, 92.6 % of the chambers of craft and 80% of the environmental ministries have provided information. We asked these organisations to specify their information activities; the results are presented in Table 9.

Type of information	State ministries of economics (in %)*	State environmental ministries (in %)*	Chambers of industry and commerce (in %)*	Chambers of craft (in %)*
Provision of information material; including	100.0	87.5	97.4	100.0
a.) brochures	50.0	50.0	71.8	52.0
b.) guidelines / manuals	66.7	62.5	79.9	52.0
c.) management handbooks	0.0	0.0	15.4	20.0
Informational events	66.7	100.0	100.0	88.0
Workshops to exchange experience among companies	66.7	50.0	69.2	20.0
Assisting a group of companies on their way to EMAS registration (*Verbundprojekte*)	50	50.0	46.2	32.0
Other measures (e.g. individual consultation, articles in publications of the organisation, external presentations)	16.7	25.0	53.8	36.0

Table 9: Information provided by governmental and business organisations
Source: Bültmann/Wätzold 1999, p. 33

*** percentage of those ministries respectively chambers that have reported to provide information, multiple answers possible**

Table 9 suggests that companies have been intensely provided with information about the existence of EMAS and detailed advice on how to carry out EMAS. Depending on the type of promotional activities, they were mostly initiated either by the promotional organisations themselves (provision of information material and informational events) or by promotional organisations and companies together (workshops to exchange experience among companies) (Bültmann/Wätzold 1999, p14). This can be explained by the fact that the former type of promotional activities is targeted more towards initial and general information about EMAS while the latter type is aimed more at company-specific interests. However, the joint initiative of companies and promotional organisations shows that dialogue about the needs of the companies has taken place. Overall, we can assume that productive efficiency has been high in Germany.

5 Links between implementation process and outcomes

The last chapter is devoted to finding causal links between the implementation process and the observed level of performance of the four outcome indicators.

5.1 Environmental effectiveness

As explained in detail in chapter 4.1, environmental effectiveness depends on the participation rate and the environmental improvements achieved at the company level. The participation rate in Germany is comparatively high. We have the following hypotheses to explain this level.

- The integration of business associations in developing and running the accreditation and registration system had a positive influence on the participation rate. It led companies to 'trust' in EMAS. It also caused business associations to actively promote EMAS as they felt they had a certain responsibility to do so. Furthermore, those chambers of industry and commerce and chambers of craft that function as registration bodies have a financial interest in achieving a high number of EMAS participants as they receive the registration fee.

- There was a high amount of financial support available for participants. This significantly reduced participation costs and therefore had a positive influence on participation.

- There was plenty of information available for companies interested in participation. Thus, companies were aware of EMAS and its advantages and how to participate in EMAS.

- Before EMAS was enacted, companies were (in general) not aware of the advantages of environmental management systems (see chapter 2.2). Other environmental management standards were also relatively little known. As EMAS was in the beginning actively discussed by industry and later on actively promoted, it became the dominant environmental management standard. Only recently has more attention been focused on ISO 14001.

The improvements at the company level depend on the means to achieve these improvements, i.e. the employment of company internal instruments, the publication of information about the company's environmental performance and external controls. Based on our analysis we have

concluded that the environmental improvements achieved by German EMAS participants rather result from the application of the company internal instruments than the information of the public. Our hypotheses to explain this are:

- Before EMAS was enacted, German companies were not 'management-oriented' but 'engineer driven' (see chapter 2.2). Thus they stood to gain significant advantages from establishing environmental policies, programmes and management systems. (This explanation, however, is not strictly linked to the implementation process.)

- During the implementation process the public was not well informed about the contents and goals of EMAS. Therefore the public was not very interested in the environmental statements and hardly able to fulfil its function of rewarding those companies that show a good environmental performance and putting pressure on those which do not.

However, external controls are necessary to ensure that the company internal means are actually applied. Our analysis has shown that the controls are reasonably strict in Germany. There might be the following links to the implementation process:

- It was frequently questioned during the implementation process whether business bodies were the right organisations to be commissioned with the accreditation and supervision of environmental verifiers. Now they must prove that these misgivings were unfounded (not least against the background that EMAS might serve as an example for deregulation).[50]

- Furthermore, the accusation of lax controls would devalue the image effect for existing EMAS participants. Additionally, companies' thinking of participation might be deterred.

5.2 Allocative efficiency

As explained in chapter 4.2 there are three ways for the implemenation process to create allocative inefficiency: promotional schemes, accreditation, supervision and registration fees, as well as norms for the application of the means that are directed at improving companies' environmental performance.

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[50] An analysis focused on the business body's role in the accreditation, supervision and registration system is provided in Bültmann/Wätzold 2000.

The German implementation process does not appear to be a significant source of inefficiency, for the following reasons:

- The accreditation, supervision and registration fees are oriented at the true costs of the provision of these services. Although they make participation in EMAS a little bit cheaper for small companies, the change in relative prices is not sufficient to lead to allocative inefficiency.

- There are no binding norms that prescribe how the means that serve to improve companies' environmental performance are to be applied.

- The concentration of the promotional activities on SMEs is the only (possible) source of inefficiency. However, the concentration on SMEs might be justified by the fact that it most likely leads to a higher number of additional participants than a concentration on large companies.

5.3 Productive efficiency

Productive efficiency seems to be fairly high in Germany. Based on our analysis we provide the following explanations:

- The integration of business associations in developing and running the accreditation and registration system made industry feel responsible for the success of the system. This led them to actively promote EMAS.

- The chambers of industry and commerce and the chambers of craft that function as registration bodies have a particular incentive in high participation rates. They have invested in equipment and personnel in order to prepare for their registration activities. Their costs can only be covered when many companies ask for being registered and pay the registration fee.

- Business associations might also be closer to companies than public authorities and therefore, might be better able to take into account companies' needs for information.

5.4 Administrative cost

By looking at the German administrative costs alone, we cannot decide whether they are high or low. However, our analysis enables us to identify certain aspects of the implementation process without which the administrative costs would have been higher/lower. These are:

- The high number of environmental verifiers and EMAS participants in Germany leads to economies of scale in the administrative process (high fixed costs, low variable costs, learning effects) and thus leads to lower administrative costs.

- The decentralised registration system produces higher administrative costs, e.g. because the know-how has to be built up and maintained within many registration bodies.

To sum up, the case study on the implementation of the EMAS Regulation in Germany has clearly shown that the succes or failure of the regulation decisively depends on the way it is implemented in the Member States.

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Richtlinie des UGA nach dem UAG für die mündliche Prüfung zur Feststellung der Fachkunde von Umweltgutachtern und Inhabern von Fachkenntnisbescheinigungen (UAG-Fachkunderichtlinie - UAG-FkR) (guideline on oral exams to test the competence of environmental verifiers) of 27 June 1996

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Verordnung nach dem Umweltauditgesetz über die Erweiterung des Gemeinschaftssystems für das Umweltmanagement und die Umweltbetriebsprüfung auf weitere Bereiche (UAG-Erweiterungsverordnung – UAG-ErwV) of 3 February 1998 (BGBl. I p. 338)

Annex: Description of the example site

Branch:

The company produces standard profiles and special profiles made of strip steel. Computerised roll-forming machines produce profiles from coils by the cold rolling process. The company possesses 20 of such machines. The material is not further treated in the company. If additional treatment (spraying, galvanisation) is needed, this is done by other companies.

The company possesses a design office and a tool room for producing the sector/profile forming tools as well as the tools necessary for the subsequent processing. There also exist 8 motorised (metal-turning) lathe, 3 eroding machines and several milling and grinding machines as well as drills.

The company has no plants which require official authorisation by German law.

Fleet of vehicles:

3 lorries

Size of the company:

Medium sized company with 150 employees. 100 employees work in the production and 50 employees in the administration.

History of the company:

The company was founded in 1978. It started with 10 employees but has grown steadily since then. Some of the first machines are still working whereas others have been replaced by new ones. Altogether the machines are between 2 and 20 years old.

Environmental impact:

The produced strip steel and the products themselves are not harmful to the environment. No relevant emissions exist. Cleansing agent, degreasing agent, cooling agent and lubricants used in the production process are potentially harmful. Cleansing and degreasing agent are only used in small amounts and the cooling agent is recycled. The lubricants are put on the profiles during the production process and remain there. They are therefore problematic.

The production is relatively energy intense.

Waste exists mainly as scrap metal which is partly mixed with lubricants. The waste is disposed by another company and recycled.

Activities to improve the company's environmental performance prior to EMAS participation

So far, there have been no particular activities to improve the company's environmental performance other than those required by legal obligations.

The company is required by law to have a waste management. Therefore, data exists with respect to waste for the last few years. There is no other information available with respect to the environmental impact of the company. The company has also not undertaken any waste reduction measures.

EMAS has led the company to invest only in small improvements. E.g. a collecting device for metal shavings was built.

Management:

The company is still run by its founder.

The company has been certified according to ISO 9001 in 1995.

Size of the company's areal:

The size of the company's areal is approximately 25,000m^2. Buildings cover 15,000m^2.

Environment:

The company is situated in an industrial area in the countryside.

CASE STUDY II

The implementation of national and European legislation on air pollution from municipal waste incinerators in Germany

Table of Contents

List of abbreviations

BMU	Bundesministerium für Umwelt (Federal Ministry of the Environment)
BMWi	Bundesministerium für Wirtschaft (Federal Ministry of Economics)
EFÜ	Emissionsfernüberwachung (system for telemetric transfer of emissions)
EMDA	Emissionsminderungsplan für Dioxine aus Abfallverbrennungsanlagen (Emission Reduction Plan for Dioxins from Waste Incineration Plants)
MURL	Ministerium für Umwelt, Raumordnung und Planung des Landes Nordrhein-Westfalen (Ministry of the Environment, Regional Policy and Planning of North Rhine Westphaliy)
MWI	Municipal waste incinerator
NRW	North Rhine-Westphalia
TA Luft	Technische Anleitung zur Reinhaltung der Luft (Technical Instructions on Air Quality Control)
TE	Toxic Equivalent
UBA	Umweltbundesamt (Federal Environmental Agency)
17. BImSchV	17th ordinance serving the implementation of the German Pollution Control Act, ordinance on waste incinerators

1 Introduction

The "Council Directive on the reduction of air pollution from existing municipal waste-incineration plants" (89/429/EEC) of 21 June 1989 and the "Council Directive on the prevention of air pollution from new municipal waste incineration plants" (89/369/EEC) of 8 June 1989 are not directly binding on EU Member States. According to the EU directives national authorities are obliged to bring into force the laws, regulations and administrative provisions necessary to comply with the directives no later than 1 December 1990.

On 23 November 1990 the German government enacted the Ordinance on Incineration Plants for Waste and Similar Combustible Substances (Verordnung über Verbrennungsanlagen für Abfälle und ähnliche brennbare Stoffe - 17. BImSchV), which concerns both new and existing incineration plants. The German ordinance goes far beyond the EU directives. It regulates more pollutants, sets stricter emission limits, is not restricted to the incineration of municipal waste and also covers combustion plants (mostly from the energy sector and cement industry) which were not solely built to burn waste, but use waste as just one of a number of fuels. In February 1999 some minor aspects of the ordinance were changed in order to incorporate the requirements of the European directive on the incineration of hazardous waste (94/67/EC). Additionally, the emission limit for mercury was tightened (independent from the EU directive). However, even before the special ordinance on waste incinerators was enacted, Germany had regulated emissions from waste incineration. The Technical Instruction on Air Quality Control (Technische Anleitung zur Reinhaltung der Luft – TA Luft), which regulated air pollution from many kinds of plants, imposed emission limits on waste incinerators that were equivalent to those of the European Directives.

This report describes the translation of European directives 89/429/EEC and 89/369/EEC into German law and analyses the implementation of the German regulations. It traces the implementation process and then analyses it in terms of attainment of the ecological goals and efficiency. Emphasis is laid on regulations for existing incineration plants. For reasons of international comparability, the analysis is restricted to the incineration of municipal waste, plants designed to solely burn waste, and certain pollutants. To gain the necessary data and information we reviewed the relevant literature and conducted expert interviews with representatives of government, enforcement authorities, and plant operators.

The report is arranged as follows. Chapter 2 gives some background information on the structure of the German waste sector and German pollution control law. Chapter 3 describes the translation of the European directives 89/429/EEC and 89/369/EEC into German law and the German monitoring and enforcement procedures. An assessment of the outcome of the implementation process is presented in chapter 4 in terms of attainment of the ecological goals, efficiency of pollution abatement and administrative efficiency. Chapter 5 draws some preliminary conclusions regarding links between the outcome and special features of the implementation process.

2 Air pollution from municipal waste incinerators – the German context

2.1 The German waste disposal sector

The German waste disposal sector is generally divided into two sub-sectors, namely public and industrial waste disposal. The latter covers industrial waste for which industry itself is responsible. The public sector mainly deals with municipal waste, which includes domestic waste, commercial waste equivalent to domestic waste, bulky refuse, road sweepings, and waste from markets. In Germany, district and/or local authorities are responsible for the collection and disposal of municipal waste, and households are obliged to let the authorities take care of it and to pay the waste collection fees they fix. Public authorities either run waste disposal facilities themselves or commission private companies. However, it is always the authorities who decide whether the waste is landfilled, incinerated or composted. Within the district or local authority area the municipal waste disposal facilities de facto hold a regional monopoly.

The total amount of municipal waste disposed of in the public sector remained constant during the 1980s at about 30 million tons. Due to German reunification it almost doubled in 1990 (55.2 million t). However, compared to the increase in population, the amount of waste rose disproportionally, with the per capita level of waste increasing too (from ca. 500 to 696 kg). In the early 1990s both the total and the per capita figures decreased and in 1993 the per capita amount of waste was at the same level as it had been during the 1980s (Figs. 1 and 2).

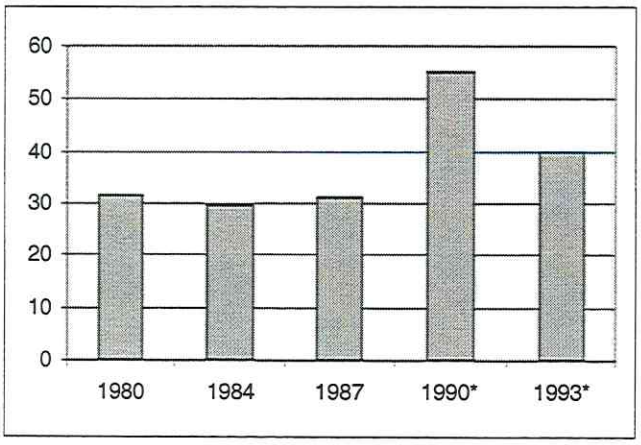

Figure 1: Total amount of municipal waste disposed of in the public sector (in million t)

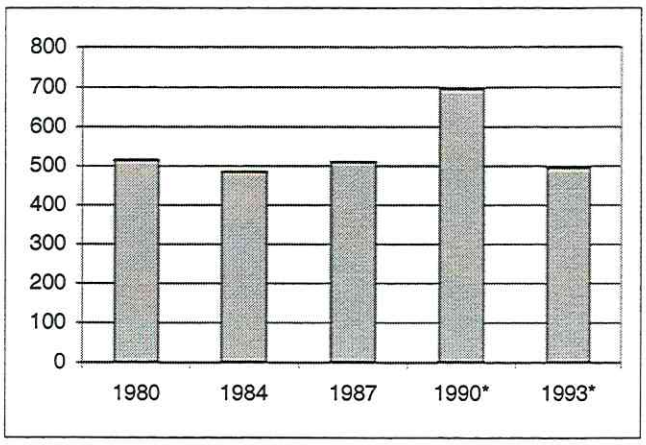

Figure 2: Per capita amount of municipal waste disposed of in the public sector (in kg)

Source: Statistisches Bundesamt 1996, p. 31; * including eastern Germany

In Germany, municipal waste is mainly disposed of by landfilling. However, the share of landfilling in the waste disposal sector decreased over recent years from more than three quarters (78.5%) in 1980 to 69.6% in 1993. That the share rose in 1990 (80.3%) resulted from German reunification, because in East Germany municipal waste was almost exclusively landfilled. The decrease in the landfilling share was accompanied by an increase in incineration and vice versa: the share of waste incineration rose over the 1980s (from 19.7% to 25.4%), decreased in 1990 (15.0%) and then increased again in the early 1990s to 21.4% in 1993. Composting and other waste disposal techniques play an increasing but still minor role. In 1993 the share of composting amounted to 5.6% (Fig. 3).

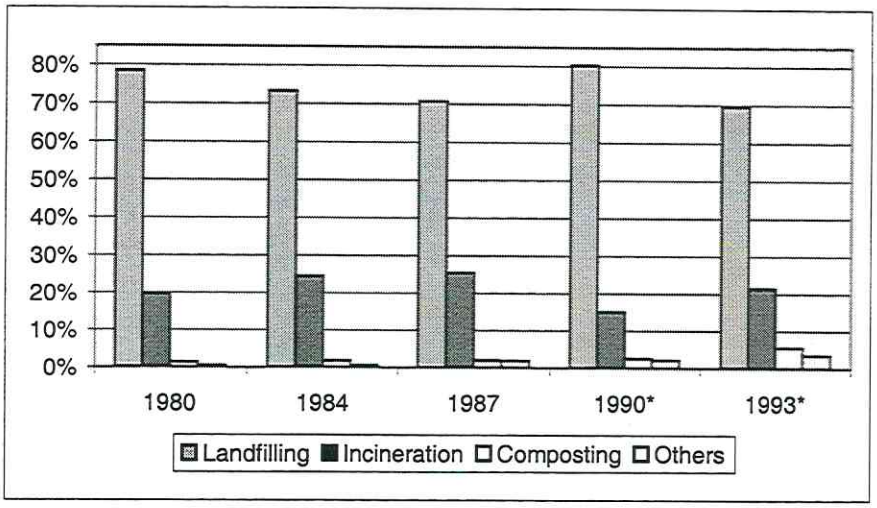

Figure 3: Shares of different techniques in the disposal of municipal waste (in %)
Source: Statistisches Bundesamt 1996, p. 31; * including eastern Germany

The increase in the share of incineration in the waste disposal sector is reflected in the rise in the absolute amount of municipal waste incinerated, which climbed steadily from 6.3 million tons in 1980 to 8.6 million tons in 1993 (Fig. 4). The same holds true for the number of municipal waste incinerators (MWI), whose number increased from 42 in 1980 to 61 in August 1999. In 1990 (the key date which distinguishes between new and existing incineration plants is 1 December 1990) Germany had 48 municipal waste incinerators (Fig. 5). Most German incinerators are rather large. There are only a very few which have a nominal capacity of less than 6 t/h (3 out of 53 in 1994, cf. no author 1995). About 40% of municipal waste incinerators burn more than 200,000 tons of waste per year. In 1992 the average waste throughput was 190,000 tons (cf. Schmitt-Tegge 1993, p. 731).

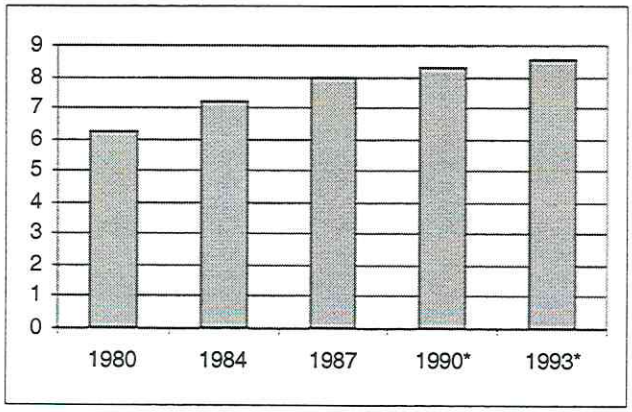

Figure 4: **Amount of municipal waste incinerated (in million t),** Source: Statistisches Bundesamt 1996, p. 31

* including eastern Germany

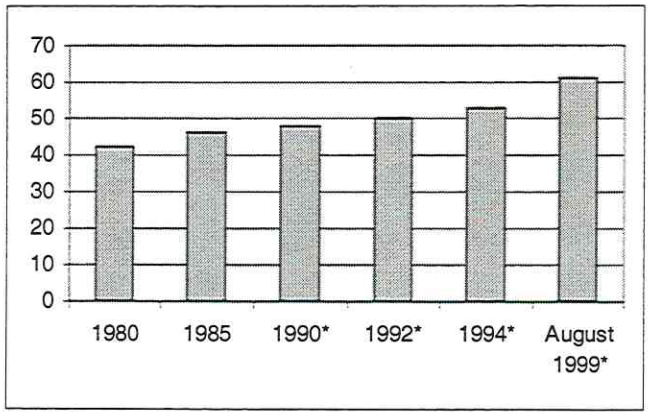

Figure 5: **Number of municipal waste incinerators** Source: Schmitt-Tegge 1993, p. 731, no author 1995, p. 24; UBA 1999, p. 7

The future relevance of waste incineration depends on numerous factors. Besides the development of population figures and consumption patterns, it is influenced by the share of waste that is recycled, the technological development of alternative waste disposal techniques such as composting, and political and legal trends. In this context two recently enacted German waste regulations are particularly relevant, the Waste Management Act of 1994 (Kreislaufwirtschafts- und Abfallgesetz) and the Technical Instruction on Municipal Waste of 1993 (Technische Anleitung Siedlungsabfall). In simplified terms, they lay down rules on how waste is to be treated and disposed of. The two regulations have contrary effects on the future role of waste incineration. The Waste Management Act decrees that priority be given to waste utilisation instead of waste disposal. Consequently, less waste will remain for disposal and thus for incineration. The Technical Instruction on Municipal Waste sets conditions for the quality of the waste to be landfilled that currently can only be met through the thermal pre-treatment of the waste (the conditions are expected to become obligatory in 2005). This tends to promote an increase in the amount of waste incinerated.

As already mentioned, public authorities either run municipal waste disposal facilities themselves or commission private companies. This holds true for waste incineration plants as well. Until the end of the 1980s the overwhelming majority of incinerators were in the hands of public authorities. This began to change in the early 1990s such that by 1993 already half the waste incinerators were run by private companies. However, many of them are limited liability companies in which public authorities hold a majority interest.

2.2 German pollution control law

The German Pollution Control Act of 1974 (Bundesimmissionsschutzgesetz - BImSchG) forms the basis for all German pollution control legislation. The act focuses on industrial plants and technologically oriented measures. It stipulates that plants which represent a high ecological risk, e.g. oil refineries or waste incinerators, require authorisation and have to undergo a special authorisation procedure. The Pollution Control Act has been amended by a number of special ordinances and technical instructions. The ordinances cover a wide range of issues. They list the plants which are regarded as being of high ecological relevance, specify the authorisation procedure, or lay down special requirements for particular plants, such as large combustion plants and municipal waste incinerators. The technical instructions serve to ensure that authorities uniformly interprete and implement legal standards. The two main instructions are the Technical Instruction on Air Quality Control (Technische Anleitung zur Reinhaltung der Luft – TA Luft) and the Technical Instruction on Noise Protection (Technische Anleitung zum Schutz gegen Lärm – TA Lärm).

While ordinances have the same status as acts, technical instructions have the status of administrative guidelines. Therefore they are only binding within the public administration, but do no directly affect citizens and courts. However, for authorities they are binding in the same way as acts and ordinances. As regards the TA Luft and the TA Lärm, it was always controversial to what extent courts were to follow them, because if courts were able to take decisions that deviated from the requirements of the TA Luft and the TA Lärm, the environmental demands put on companies could vary from one court district to another. Meanwhile, it is widely accepted (in legal theory and practice) that courts generally have to include the provisions of the TA Luft and the TA Lärm in their decisions. Nevertheless, they may take differing decisions whenever there are compelling reasons to do so, for example when research produced new knowledge which was not yet adopted by the technical instructions (cf. Kahl/Voßkuhle 1995, pp. 41-42 and 112-114). This implies that courts may always examine the appropriateness of the requirements of the TA Luft and the TA Lärm before they make them the basis of their decisions.

The TA Luft was enacted in 1974. It encompasses detailed requirements, including emission limits (in mg/m^3), for plants requiring authorisation. In 1986 the guideline was significantly tightened. As explained above, the new emission limits were not directly binding on plants. Plants only had to comply with the limits after they had been incorporated in the plants' individual authorisation documents.

The TA Luft was the relevant air pollution regulation for waste incinerators until the special ordinance for waste incineration plants was enacted in November 1990. The emission limits imposed by the 1986 TA Luft are almost identical to those the European Directives 89/429/EEC and 89/369/EEC set for incinerators with a nominal capacity of more than 6 t/h. Table 1 juxtaposes the emission limits of the two legal texts (pollutants in bold type are only included in the TA Luft).

Pollutants	**89/369/EEC**	**1986 TA Luft**
Dust	30	30
Pb+Cr+Cu+Mn+**Sb+CN+F+ Pt+Pd+Rh+V+Sn**	5	5
Ni+As+**Co+Se+Te**	1	1
Cd+Hg+**TI**	0.2	0.2
HCl	50	50
HF	2	2
SO_2	300	100
CO	100	100
Organic compounds	20	20

Table 1: Comparision of the emission limits the European directives and the 1986 TA Luft

Table 1 shows that the emission limits set in the TA Luft are either equal to or stricter than the limits of the European directives 89/429/EEC and 89/369/EEC.[1] Because this holds true for the compliance deadline and the measuring requirements as well, it follows that in Germany the provisions of the European directives were already covered by the 1986 TA Luft.[2] This already indicates that domestic policy reasons were more important for the formulation of the German ordinance on waste incineration plants than the enactment of the European directives.

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[1] The emission limits of the TA Luft count even more, because they must not to be exceeded by any daily average (Sec. 2.1.5), while the limits of the Euorpean directives only have to be met by the moving seven-day averages (Article 5(3)).

[2] Nevertheless, the German government would have had to put the provisions of the directives in the form of an act or ordinance, because the translation of European directives by means of administrative guidelines is not accepted by the European Court of Justice. With respect to the directive 80/779/EEC on air pollution by SO_2 and dust the court decided in 1991 that the TA Luft was not sufficient to translate the directive, because it is only binding for public authorities, but not for third parties. Thus the court did oppose the opinion of most German lawyers.

3 Characterisation of the implementation process[3]

We divided the implementation process into four phases: translation of the European directives 89/429/EEC and 89/369/EEC into German Law, norm specification, retrofitting and authorisation procedures, and monitoring and enforcement. The first phase describes the formulation of the German Ordinance on Incineration Plants for Waste and Similar Combustible Substances which covers both European directives. The second phase deals with norm specification activities (subordinate to acts and ordinances), especially an emission reduction plan for dioxins agreed between the state government and operators of waste incinerators in the state of North Rhine-Westphalia. The third phase describes the installation of abatement equipment and the authorisation procedures to which the equipment was subject. The fourth and last phase analyses how compliance with the emission limits is actually monitored once retrofitting has been completed, and what enforcement instruments are available in the event of non-compliance.

The characterisation of the last three phases concentrates on the state of North Rhine-Westphalia (NRW). Due to the federal structure of Germany, the states are responsible for monitoring and enforcement of the (federal) ordinance on waste incinerators. Although the basic procedures are similar, organisational details and allocation of responsibilities vary from state to state. Therefore we decided to describe the monitoring and enforcement procedures of only one state in detail. We chose NRW as an example, because it accounts for most municipal waste incineration plants (besides Bavaria)[4] and the highest incineration capacity. Moreover, data availability in NRW is relatively good (due to the documentation of the outcome of the emission reduction plan).[5]

Our description of the implementation process is centred upon the actors involved. We analyse their relationships as well as their motives, interests and strategies. Figure 6 gives a schematic picture of the basic actors and the transactions taking place between them.

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[3] The information on the implementation process is mainly based on expert interviews we conducted with representatives of government, enforcement authorities and plant operators. The interviews were carried out at the end of 1999 and the beginning of 2000.

[4] In 1999 NRW had 16 plants (26.2% of the total number of plants and 36.2% of the total incineration capacity in Germany) and Bavaria had 17 plants (27.9% of the total number of plants and 20.1% of the total capacity).

[5] To make sure that NRW's monitoring and enforcement activities and emission reductions do not significantly differ from those of other German states, we additionally investigated the situation in Bavaria. We came to the conclusion that the intensity of monitoring and enforcement activities is higher in NRW, but that comparable emission reductions were achieved (present emission data of some Bavarian incinerators are presented in the annex). In our description of the monitoring and enforcement activities we will complete the description we give for NRW by information about Bavaria, whenever there is discretionary power left to the relevant authorities.

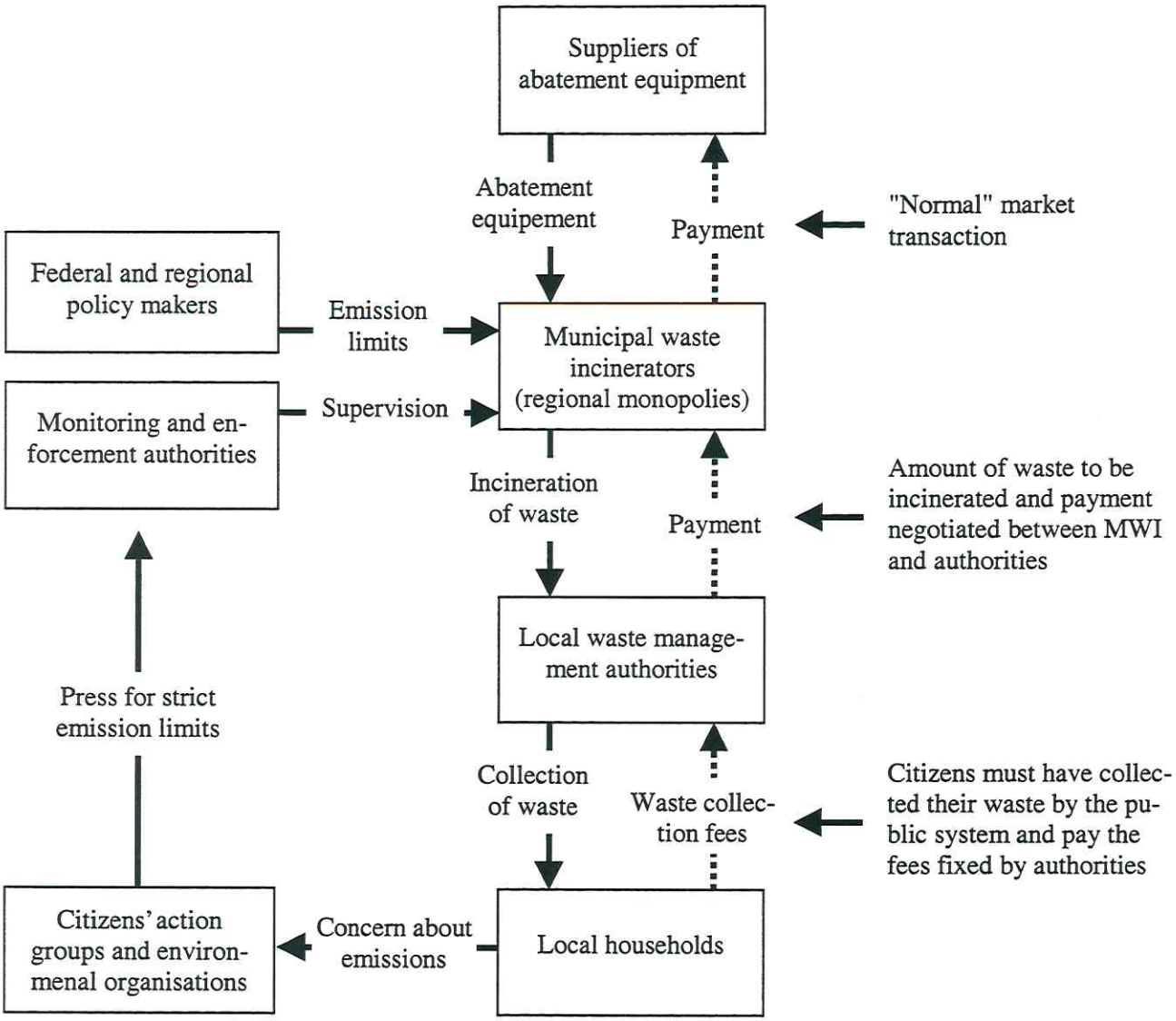

Figure 6: Structure of basic actors and their relationships

The structure of actors and transactions shown in Figure 6 forms the basis respectively the background of the entire implementation process. In the following a more detailed analysis of the relevant actors, their relationships and activities as well as the outcomes of their activities is provided for each of the single implementation phases.

3.1 Phase 1: Translation of 89/429/EEC and 89/369/EEC into German Law - the German Ordinance on Waste Incinerators (17. BImSchV)

The German Ordinance on Incineration Plants for Waste and Similar Combustible Substances (17. BImSchV) which covers both existing and new incinerators was enacted in November

1990. Preparations had begun back in the mid 1980ies. The ordinance was mainly (if not exclusively) formulated for domestic policy reasons, especially to react to the public's high concern about dioxin emissions from municipal waste incinerators. The European directives only led to some minor adjustments; most of their provisions were already covered by the German 1986 TA Luft anyway.[6] Regarding the emission limits, scope, and measuring procedures the German ordinance is much stricter than the EU directives.

3.1.1 The actors, their motives and strategies

Environmental organisations and citizens' action groups

It was back in the mid 1980s, that the German public first became highly concerned about emissions, particularly dioxin emissions, from waste incinerators. Dioxin emissions were believed to have serious impacts on eco-systems and human beings. Although the TA Luft was tightened up in 1986, action groups and environmental organisations were of the opinion that the provisions of the TA Luft were still insufficient to effectively reduce emissions. They criticised the fact that plant operators were only asked to reduce dioxin emissions as far as possible and were not required to meet a certain emission target. Environmental organisations and citizens' action groups insisted on tighter emission limits for existing waste incinerators and wanted to prevent the building of any additional plants. By extensively using their right to raise objections and taking legal action against the authorisation and construction of new incinerators, they literally blocked all authorisation processes. This strategy at least delayed the construction of a new incinerator by 6 to 8 years, even if it could not be completely prevented.[7]

In pressing for tighter emission limits environmental organisations and citizens' action groups obviously accepted that through higher waste collection fees the households (i.e. the people the action groups represent) would have to pay the pollution abatement equipment in the end. Very likely many households did not completely realise that a reduction of the municipal waste in-

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[6] The decision of the European Court of Justice that the German technical instruction are not suitable to translate European directives was taken in 1991, i.e. after the 17. BImSchV had been enacted.

[7] The authorisation procedure layed down in § 10 of the BImSchG provides for a participation of the public. The plant operators apply for authorisation in written form. When the application forms and documents are complete, the permitting authority has to display them publicly. Everybody is entitled to raise objections against authorisation and construction of a plant. If objections were raised they are dealt with in an official discussion between plant operators, authorities and the persons who raised objections. Authorities may or may not consider the objections in their decision on the authorisation. Persons who are directly affected, this may be neighbours, are entitled to take their objections to court.

cinerators' emissions would lead to an increase in waste collection fees. However, there was no considerable resistance of households when waste collection fees climbed as a consequence of the pollution abatement activities of municipal waste incineration plants.

Federal Ministry of the Environment

The Federal Ministry of the Environment (Bundesministerium für Umwelt – BMU) is the ministry responsible for preparing and enacting air pollution control laws. The public's high concern about (dioxin) emissions from waste incineration led the BMU to plan for stricter requirements for waste incinerators. However, the BMU had not only to decide about the requirements to be imposed, but also their legal status, i.e. whether they were to remain in the form of a technical instruction or were to be put in the form of a special ordinance for waste incinerators. The Ministry resolved to enact an ordinance.

The BMU's choice of an ordinance instead of a technical instruction was mainly a result of the blocking of authorisation processes by citizens' action groups and environmental organisations. As public authorities were responsible for the authorisation procedures and the disposal of municipal waste, the BMU (not to mention the German states) was interested in accelerating the procedures. Unlike a technical instruction, an ordinance is strictly binding on the courts. This means that if citizens' action groups or environmental organisations go to court, courts are expected to follow the ordinances' provisions in any case (i.e. without checking their appropriateness). Therefore court decisions (and authorisation procedures) take less time. Moreover, an ordinance prevents that companies in different court districts meet with different environmental demands, which was unlikely but not impossible in case of a technical instruction. Last but not least, an ordinance is also directly binding on plants, i.e. within a certain time (fixed in the ordinance) existing incinerators have to meet the tighter emission limits. Therefore, authorities need not incorporate the new limits in the authorisation documents of each individual plant.

When the BMU began collecting information to prepare preliminary drafts of the ordinance, the Ministry talked to MWI operators, suppliers of incineration and emission abatement technologies, and scientists, because they were believed to have the best knowledge of the technical potential for emission reductions. The BMU also spoke to representatives of the German states as those responsible for monitoring and enforcement. Citizens' action groups and environmental organisations were only involved much later, mainly in the context of the official hearing.

Operators of municipal waste incinerators

Operators of waste incinerators generally welcomed the enactment of the ordinance for waste incineration plants, because they hoped for the acceleration of authorisation processes and certainty about their legal position. However, operators were not happy with the tighter emission limits, which could only be achieved through the installation of costly abatement equipment. Especially the limit for dioxin emissions (0.1 ng TE/m³) encountered stiff resistance on the part of operators. They argued that there was not yet enough experience of the recently developed technologies for the abatement of dioxin emissions to be certain that the techniques were able to meet the limit. Nevertheless, operators realised that stricter limits would improve the image of waste incinerators among the general public, and might make citizens' action groups and environmental organisations refrain from their strategy of blocking authorisation processes.

All in all, MWI operators adopted a rather cooperative strategy for two reasons: public pressure and a market structure (regional monopolies) that allowed them to rather easily transfer the pollution abatement costs to their customers by charging higher fees.

Suppliers of abatement equipment

The suppliers of abatement equipment were involved in the formulation of the 17. BImSchV in so far as the BMU consulted them to get information about the technically feasible emission limits. The suppliers had an economic incentive to offer equipment that was able to reach emission limits as low as possible, because the lower the emission limits the more complex and the more expensive the equipment. But on the other hand the suppliers had to bear in mind that they would have to guarantee MWI operators to meet the low limits.

To be on the safe side, suppliers of abatement equipment usually adopted a strategy of incorporating a safety margin in the emission limits they gave policy-makers and guaranteed MWI operators, i.e. the limits they said to be achievable were slightly higher than those they in fact thought to be able to reach.

Federal Ministry of Economics

The ordinance could not be enacted by the BMU alone, but had to be approved by the entire Federal Government. Apart from the Ministry of Economics (Bundesministerium für Wirtschaft – BMWi), the other Federal departments were rather indifferent towards the 17. BImSchV. Therefore discussions only took place between the BMU and the BMWi. As industry's 'spokesman' in intra-governmental debates the BMWi mainly adopted the position of the operators of waste incineration plants. Since the operators accepted that the only way to get new

waste incinerators authorised reasonably quickly was to accept higher emission limits, the Ministry of the Environment and the Ministry of Economics soon reached agreement on the ordinance.

The German states

Because the German states are responsible for monitoring and enforcement, they actively participated in the discussions about the ordinance. At first, it was the German states, especially the Conference of the Environmental Ministers of the German States (Umweltministerkonferenz), that pressed the Federal Government to enact the ordinance on waste incineration plants. The states wanted the ordinance for two reasons. Firstly, they wanted stricter emission limits for waste incinerators in order to react to the public's concerns and to improve the permitting authorities' position in discussions with citizens' action groups and environmental organisations. Secondly, they preferred an ordinance to a technical instruction, because an ordinance is directly binding on third parties such as courts and plants. As described above, this helps to accelerate the authorisation of new waste incinerators and saves authorities from amending the authorisation documents of each individual plant.

Because the 17. BImSchV required the approval of the Bundesrat, the upper house of the German Parliament which consists of selected members of the state governments, the states had an institutionalised influence on the formulation and enactment of the ordinance.[8] Before the Bundesrat approved the ordinance, it demanded some minor modifications, all of which served to make the ordinance stricter.

3.1.2 Description of the process

Against the background of the public's high concern about emissions from waste incineration plants and the citizens' action groups' and environmental organisations' fight against new plants, the BMU considered stricter requirements for waste incinerators. It started discussing with political actors and experts already in the mid 1980ies. However, the debate was not only about the requirements to be imposed on waste incinerators, but also about the legal form of these requirements, i.e. whether they were to remain in the form of a technical instruction or were to be put in the form of an ordinance. The German states in particular pressed for an ordinance. In

May 1988, the BMU decided to formulate an ordinance on waste incineration plants and preliminary drafts were prepared during 1988.

The discussion about the provisions of the ordinance produced the 'typical' picture: federal and state ministries of the environment, environmental organisations and citizens' action groups were in favour of strict emission limits, while operators of waste incineration plants, their professional associations, and the BMWi all opposed tight limits. The German states, especially the environmental ministers, played a very active role. They called for emission limits that were much stricter than those laid down in the TA Luft of 1986, because they wanted to respond to the citizens' concerns and remove their permitting and enforcement authorities from the firing line. The BMU, the ministry responsible for the formulation of the ordinance, was easily convinced.

In order to obtain information about technically possible reductions, the BMU spoke to operators of waste incineration plants, suppliers of incineration and emission abatement technologies, and scientists.[9] After the Ministry had collected enough information, it began to formulate the ordinance together with experts from the Federal Environmental Agency (Umweltbundesamt – UBA) and the German states. The determination of emission limits for pollutants such as dust, CO, SO_2 and NO_X went off rather smoothly, because appropriate abatement equipment had already existed and been successfully operated for a number of years, for example in large combustion plants. Therefore policy-makers were well informed about the possible minimum emissions and related costs. In simple terms, the BMU had to choose between strict emission limits and low costs. In view of the high public pressure and the rather cooperative strategy of the operators of waste incinerators, in most cases the BMU decided in favour of strict limits. For example, it cut the limit for SO_2 by half from 100 mg/m³ in the 1986 TA Luft to 50 mg/m³. The most problematic emission limit was that for dioxins and furans. The BMU strove for an emission limit of 0.1 ng TE/m³, quoting the promising results achieved in test operations. Operators of waste incineration plants argued that the tests did not prove that the same results could be achieved in everyday operation in large-scale plants. Although even the BMU had to

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[8] Whether Bundesrat approval is necessary depends on the relevance the Act or ordinance has for the German states. In the past roughly 50% of federal laws required „Bundesrat" approval (Müller-Brandeck-Bouquet 1996, p.127).

[9] Here the typical German BAT-approach becomes obvious. It aims at identifying the emission limits achievable with the best available technology, fixing them in legal texts and imposing them on each individual plant. If a new technology is invented, which is able to reach lower limits, plants only have to apply them, after the legal texts have been amended.

admit that it was merely very likely but not actually certain that the limit of 0.1 ng TE/m³ could be met, it still decided to impose this value.

Citizens' action groups and environmental organisations were not invited to talks. They were only involved much later, mainly during the official hearing. At this stage they were only able to put forward their position via the media or letters to the Environmental Minister. Citizens' action groups and environmental organisations were of the opinion that the emission limits provided for in the draft ordinance were not strict enough and that lower limits were technically feasible. However, they would have preferred a complete ban on waste incinerators. The official hearing took place in late 1988 / early 1989. Following the hearing, some minor points of the draft ordinance were changed. Subsequently the ordinance was discussed by the Federal Government. Because the Federal Ministry of Economics was the only department that showed any interest in the discussions and industry itself had adopted a cooperative strategy, agreement was quickly reached.

Although in the subsequent Bundesrat approval process some emission limits, particularly those for heavy metals, were considerably tightened, the general concept of the ordinance remained unchanged. The enactment of European directives 89/429/EEC and 89/369/EEC made some minor adjustments necessary. For example, the time limit for which incinerators could continue to operate in the event that abatement equipment broke down (Art. 7(2) of 89/429/EEC and Art. 8(2) of 89/369/EEC) and the obligation to inform the public about the measuring reports (Art. 8 of 89/429/EEC and Art. 9 of 89/369/EEC) had to be integrated into the German ordinance. In terms of emission limits, scope, and most measuring procedures, the German ordinance was and still is much stricter than the European directives.

On 23 November 1990 the Ordinance on Incineration Plants for Waste and Similar Combustible Substances was enacted. It was incorporated in German Law as the 17th ordinance serving the implementation of the German Pollution Control Act (BImSchG) and is therefore known as 17. BImSchV.

3.1.3 The outcome

All in all, the formulation of the 17. BImSchV went off smoothly. The public debate about the negative effects of emissions from waste incineration plants and the environmental organisations' and citizens' action groups' strategy of blocking the authorisation of new plants, made MWI operators to accept strict requirements. Therefore, the 17. BImSchV often goes far beyond European directives 89/429/EEC and 89/360/EEC. The main features are summarised below.

Main features of the German Ordinance on Waste Incineration Plants (17. BImSchV)

Scope of application

The 17. BImSchV is not restricted to the incineration of municipal waste and also covers combustion plants which were not built solely to burn waste but merely use waste as one of a number of fuels (§1).

Emission limits and combustion conditions

Unlike the European directives, the German ordinance does not set different emission limits for existing and new plants, and does neiter distinguish between plants of different capacities. It regulates more pollutants than the EU directives (the additional pollutants are shown in Table 2 in bold type).

Pollutants	Daily average emission limits	Half-hourly emission limits
Total dust	10	30
CO	50	100 (hourly limit)
Organic compounds (expressed as total carbon)	10	20
Hydrochloric acid (HCl)	10	60
Hydrofluoric acid (HF)	1	4
$SO_2 + SO_3$ (expressed as sulphur dioxide (SO_2))	50	200
$NO_1 + NO_2$ (expressed as nitrogen dioxide (NO_2))	200	400
	average of series of measurement	
Mercury (Hg)*	0.05**	
Cadmium (Cd)* + **thallium (Tl)***	0.05	
Antimony (Sb)* + arsenic (As)* + lead (Pb)* + chromium (Cr)* + **cobalt (Co)*** + copper (Cu)* + manganese (Mn)* + nickel (Ni)* + **vanadium (V)*** + **tin (Sn)***	0.5	
Dioxins + furans	0.1 ng/nm^3	

Table 2: Emission limits in mg/nm³ for waste incineration plants set in the 17. BImSchV (§5)
* and compounds thereof, ** tightened to 0.03 as the daily and 0.05 as the half hourly limit in February 1999

The gas resulting from the combustion of the waste is raised to a temperature of at least 850 °C for at least two seconds in the presence of at least 6% oxygen (§4(2)).

Measuring procedures and monitoring of emissions

With the exception of heavy metals, dioxins and furans, all emissions and operating parameters have to be monitored continuously (§11(1)). The measuring equipment has to match the best available technology (§10(1)).
The results of all measurements have to be recorded and analysed. A report on the findings must be sent to the competent authority within three months after the end of a year, unless the competent authority has prescribed the telemetric transfer of data (§12(1-2)). Moreover, the data must be made publicly available (§18).
The measuring equipment has to be inspected and calibrated directly after its installation (§10(2)). Afterwards its functionality is checked once a year and calibration is repeated every three years (§10(3)).

Exemptions from the provisions of the ordinance

On the one hand competent authorities may allow for exemptions from individual provisions of the 17. BImSchV if their fulfilment would entail excessive costs (§19). On the other hand competent authorities are entitled to lay down requirements which go beyond the provisions of the ordinance (§20).

Time allowed for compliance / deadline

Existing municipal waste incineration plants have to comply with the provisions of the 17. BImSchV no later than 1 December 1996 (§17(2)).

3.2 Phase 2: Norm specification – Emission Reduction Plan for Dioxins in NRW

In February 1990 the government of NRW negotiated a voluntary agreement with the North Rhine-Westphalian waste incineration sector called Emission Reduction Plan for Dioxins from Waste Incineration Plants (Emissionsminderungsplan für Dioxine aus Abfallverbrennungsanlagen – EMDA). The agreement covered not only the incineration of municipal waste, but also included incinerators for hazardous and industrial waste. An emission limit for dioxins and furans of 0.1 ng TE/m³ was fixed and 1st December 1995 was set as the deadline for retrofitting incinerators. This means that the EMDA did not set emission limits different from those of the (yet to be adopted) 17. BImSchV, but imposed a stricter compliance deadline. The EMDA was agreed in February 1990, i.e. almost a year before the 17. BImSchV came into force. Therefore the EMDA was legally based on the requirement of the TA Luft of 1986 to reduce dioxin emissions as far as possible.[10]

Although the EMDA originally covered only dioxin emissions, it soon turned out that the abatement equipment for dioxin emissions could not be separated from that for the other pollutants regulated in the 17. BImSchV since enacted. Therefore the EMDA's retrofitting deadline (indirectly) applied to the entire abatement technology necessary to comply with the 17. BImSchV.

3.2.1 The actors, their motives and strategies

Environmental organisations and citizens' action groups

The enactment of the 17. BImSchV did not change the environmental organisations' and citizens' action groups' critical attitude towards municipal waste incineration. They wanted incineration plants to reduce emissions further and earlier.

NRW government

The TA Luft of 1986 only required waste incinerators to reduce dioxin emission as far as possible. The NRW government initiated the EMDA to put this requirement in concrete form. The aim was to set an emission limit of 0.1 ng TE/m³ and to reach this limit as soon as possible. Moreover, the NRW government wanted to demonstrate that technologies for the abatement of

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[10] The emission limit for dioxins and furans of 0.1 TE ng/m³ set in the EMDA decisively influenced the decision about the emission limit for dioxins and furans to be imposed by the 17. BImSchV (cf. MURL NRW 1996, p. 2).

dioxin emissions were available and could be installed without entailing excessive costs. After the 17. BImSchV was enacted in December 1990, the NRW government pushed for the integration of all pollutants regulated in the ordinance into the ambitious timetable agreed in the EMDA. By its commitment to the reduction of dioxin emissions, the NRW government wanted to respond to the public's high concern about dioxin emissions from waste incinerators. Because NRW is the German state with the highest waste incineration capacity, the need for action was especially high here.

The positive experience of the Emission Reduction Plan for large combustion plants encouraged the NRW government to apply the instrument of a voluntary agreement again. The NRW government knew that it depended on the waste incinerators' support to achieve its ambitious aims and thus adopted a rather co-operative strategy. [11] But at the same time the EMDA enabled the government to control and coordinate the companies' retrofitting measures. The NRW government regarded the coordination of retrofitting activities as particularly necessary in the case of waste incinerators, because it had to be ensured that there was always sufficient waste incineration capacity available while the abatement equipment was installed.

Operators of municipal waste incinerators

At first, the operators of waste incineration plants were reluctant to agree to the EMDA. The dioxin emission limit was regarded as too ambitious. The operators doubted that the techniques for the abatement of dioxin emissions were actually able to meet the limit of 0.1 ng TE/m³ because they were not yet applied in everyday operation at a large-scale waste incineration plant. The costs incurred in retrofitting were not a crucial factor because their regional monopolies enabled municipal waste incinerators to transfer the costs to their customers relatively easily.

What prompted the waste incineration plants to finally participate in the EMDA was largely public pressure. The operators wanted to show their willingness to actively contribute to solving environmental problems, especially the dioxin problem. They hoped to improve their public image and to make citizens' action groups and environmental organisations refrain from their strategy of blocking the authorisation of new waste incinerators. And of course they knew that the 17. BImSchV was about to be adopted. The tight timetable agreed in the EMDA might even have been an advantage for operators, because it required permitting authorities to carry out the

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[11] It would not have been possible to force the companies to reduce emissions earlier than provided for in the 17. BImSchV.

authorisation of the abatement equipment as quickly as possible and thus gave operators more certainty for their time planning (cf. MURL NRW 1990, p. 15).

As mentioned above, the EMDA covered not only plants for the incineration of municipal waste, but also hazardous and industrial waste. While the incinerators for municipal waste are often run by public authorities (or are at least subject to their influence), incinerators for hazardous and industrial waste are operated by private companies. In view of the scope of this report, we will only look at municipal waste incinerators. However, we would like to mention that public authorities involved in the EMDA did not report any differences between operators of plants for municipal waste and those of plants for hazardous or industrial waste regarding their commitment to the installation of abatement equipment.

Suppliers of abatement equipment

The suppliers of abatement equipment were integrated in the formulation of the EMDA in so far as they were asked whether they could guarantee that their equipment was able to meet the limit of 0.1 ng TE/m³ and whether it was feasible to retrofit all municipal waste incineration plants participating in the EMDA before 1 December 1995. Obviously, suppliers gave a positive answer in both cases.

3.2.2 Description of the process

The 1986 TA Luft only required municipal waste incinerators to reduce dioxin emissions as far as possible. The NRW government wanted to put this requirement in concrete terms. In August 1989 the NRW Ministry of the Environment (Ministerium für Umwelt, Raumordnung und Landwirtschaft – MURL) commissioned a study which analysed the effectiveness of activated carbon filters in reducing dioxin emissions from waste incinerators. The study also addressed the availability of these techniques and the costs incurred in their installation. It led to the result that there were four suppliers of activated carbon filters which had already tested their techniques in test plants and which could guarantee a limit of 0.1 ng TE/m³. These techniques were ready to be applied at large-scale incinerators and could be installed without entailing excessive costs (DM 10 – 15, € 5.11 – 7.67) per ton of waste, cf. MURL 1996, pp. 1/2).

The NRW government decided to apply the instrument of a voluntary agreement to get waste incineration plants to realise this emission limit. To this end it initiated talks with plant operators. Initially the operators were sceptical about the effectiveness of the abatement techniques

because there was insufficient experience of the recently developed techniques. Only after they had received guarantees from the suppliers did the operators agree to a limit of 0.1 ng TE/m³ for emissions of dioxins and furans. The NRW government wanted MWI operators not only to agree to the emission limit, but also to install the necessary abatement equipment as soon as possible, and therefore planned to make 1st December 1995 the deadline. A number of operators rejected the deadline. They claimed that it was only possible to install the abatement equipment within this time, if the installation went absolutely smoothly and that this could not be expected in real life. Therefore a passage was integrated in the EMDA, according to which operators may exceed the deadline, if it is for reasons they are not responsible for. Moreover, all operators were given an additional six months to optimise the abatement equipment they had installed in their incinerators (cf. MURL 1990, p. 13). The tight deadline not only required operators to install the abatement equipment as quickly as possible, but also meant permitting authorities had to carry out the authorisation of the abatement equipment extraordinarily swiftly. In order to put the time necessary for carrying out the authorisation procedures in concrete terms, the NRW government included non-binding time limits for the procedures in the EMDA.

The EMDA was agreed in February 1990, ten months before the 17. BImSchV was adopted. When the 17. BImSchV was enacted in December 1990, the installation of the abatement equipment necessary to meet the emission limits for all pollutants regulated in the ordinance was integrated in the timetable of the EMDA. After the consensus about the EMDA had been reached, the NRW government established a Coordination Committee (Koordierungsstelle) to draft the official agreement, to observe the EMDA's implementation and to coordinate the retrofitting activities such that there was always enough waste incineration capacity available. The Coordination Committee was located at the MURL. It presented the final agreement in early 1991 (cf. MURL 1996, pp. 2/3).

The EMDA did not have the status of a contract under public law and therefore could not be enforced. It is a special form of a voluntary agreement which encompasses serious declarations of intent on the part of the operators of municipal waste incineration plants.

3.2.3 The outcome

The EMDA included 14 municipal waste incineration plants, i.e. all MWIs in NRW except a few smaller plants. The total nominal capacity of these plants amounts to 4,737,638 t/a (540 t/h). In 1995 they burnt 3,492,748 tons of waste (cf. MURL NRW 1996, p. 6). The EMDA fixed an emission limit for dioxins and furans of 0.1 ng TE/m³, which had to be met by 1 De-

cember 1995. This means that the EMDA did not set emission limits different from those of the 17. BImSchV, but obliged incinerators to meet the emission limits one year before the deadline set in the ordinance. After the 17. BImSchV was enacted, all pollutants covered by the ordinance were integrated in the EMDA's timetable.

Only very few incinerators received exemptions from the deadline because they had special site-related problems. All incineration plants were given another 6 months to optimise the abatement equipment after it had been installed. Additionally, the written agreement explicitly mentions that the operators could only meet the retrofitting deadline if the authorisation of the abatement equipment was carried out swiftly, the suppliers of abatement equipment were able to cope with the workload, and waste disposal was ensured (cf. MURL NRW 1990, p. 13).

The written agreement was supplemented by a large annex giving details of available abatement techniques and the authorisation procedure to which the abatement equipment was subject. The part of the annex which deals with abatement techniques served to support MWI operators in choosing the technique they regarded as most suitable for their plant. The EMDA did not prescribe or promote special techniques. The part dealing with authorisation procedure described the procedure in detail and indicated ways of accelerating the process. For example, permitting authorities were encouraged to involve the other authorities that have to approve the authorisation at an early stage.[12]

3.3 Phase 3: norm realisation 1 – retrofitting and authorisation procedures

Only a minority of the municipal waste incineration plants ceased operation subsequent to the enactment of the 17. BImSchV. The vast majority of MWIs were equipped with flue gas purification equipment in order to meet the emission limits set in the ordinance. In NRW 13 of the 14 municipal waste incinerators that participated in the EMDA were retrofitted. Only one very small plant was shut down – and this was not directly due to the 17. BImSchV. In Germany, substantial modifications to plants requiring authorisation have to be authorised. This rule also applied to the installation of abatement equipment.

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[12] A representative of the Bavarian Ministry of the Environment reported that many Bavarian MWIs complied with the emission limits imposed by the 17. BImSchV well before the deadline set in the ordinance as well. He claimed that it was not necessary to negotiate an emission reduction plan in Bavaria, because the self interest of authorities and plant operators in emission reductions was sufficient to complete retrofitting of MWIs as soon as possible. Like NRW Bavaria did not prescribe or promote specific abatement techniques, but provided financial support for plants applying innovative technologies (in fact only about 1 or 2 plants got financial support).

3.3.1 The actors, their motives and strategies

Operators of municipal waste incineration plants

The operators independently retrofitted their waste incineration plants. They chose and installed flue gas purification techniques which they regarded appropriate for their individual plants. The choice of technique was based on a whole range of criteria such as effectiveness in reducing emissions, the possibility of integration into existing MWI plants and pollution abatement equipment, expected stoppage times, and price.

To avoid being sanctioned or having to apply for special exemptions they were keen to meet the deadlines set in the 17. BImSchV. For the North Rhine-Westphalian operators of waste incineration plants, the EMDA meant another impetus to try to complete retrofitting as soon as possible. In return, the companies demanded that the permitting authorities equally tried to carry out the authorisation procedures swiftly - for without authorisation the companies could not begin with the installation of pollution abatement equipment.

Suppliers of abatement equipment

The simultaneous retrofitting of all MWIs participating in the EMDA (not to mention all other German waste incinerators that had to be retrofitted only a year later), meant an extraordinary high demand for abatement equipment. Because the number of suppliers is limited, they were only able to serve the demand by working overtime, temporarily hiring extra staff and engaging sub-contractors.

Permitting authorities[13]

The permitting authorities' discretionary power was limited by a number of regulations. They had to follow the authorisation procedure described in the BImschG and base their decisions on the provisions of the 17. BImSchV.[14] However, the organisation of the procedures, the cooperation with plant operators and the decision on the authorisation in the end were left with the authorities. In NRW the EMDA called upon the permitting authorities to carry out authorisation procedures as quickly as possible in order to enable operators to meet the tight retrofitting

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[13] In NRW and in Bavaria the district governments (Bezirksregierungen) are responsible for the authorisation of MWI plants respectively the abatement equiptment.

[14] The BImSchG as well as the 17. BImSchV were enacted on the federal level and thus are binding for all German authorities.

deadline. The NRW government told the North Rhine-Westphalian permitting authorities to give priority to the authorisation of waste incinerators' abatement equipment and to use all the options available to accelerate matters. The NRW authorities were highly motivated to carry out the authorisation procedures swiftly. They wanted the EMDA to be a success and did not want to run the risk of being blamed for preventing the timely realisation of the agreement.

Coordination Committee at the MURL

The Coordination Committee which was installed at the NRW environmental ministry monitored the implementation of the EMDA, i.e. it observed compliance with the agreement by waste incinerators and permitting authorities. It intervened whenever problems arose which could not be solved by the parties involved themselves. The committee was obliged to act in accordance with the aims of the EMDA, i.e. to implement the 17. BImSchV, especially the emission limit for dioxins, before the agreed deadline (1 December 1995).[15]

3.3.2 Description of the process

In Germany the 1986 TA Luft had already imposed quite strict emission limits which could only be met by installing flue gas purification equipment. When the 17. BImSchV was enacted German waste incinerators either already had or were just about to put into operation a dedusting system (cyclones or electric filters) and some kind of scrubber to 'wash' acid substances out of the flue gas (dry, semi-dry, semi-wet or wet systems). Therefore the 17. BImSchV mainly required waste incinerators to additionally install denox-systems and devices for the abatement of dioxin and furan emissions. The decision concerning the specific abatement equipment purchased was left up to the individual MWI operators. With respect to both pollution abatement components they were able to choose from a handful of different techniques. However, the information basis on which the operators had to make their choice was much better as regards denox systems than with respect to the abatement of dioxins and furans.

Denox systems had already been applied, for example in LCPs, for several years. Hence there was comprehensive experience and knowledge upon which MWI operators could draw in order to choose the denox-technique most suitable for their plant. The equipment for the abatement of dioxin and furan emissions had only been developed lately and had not yet been applied in everyday operation of large-scale plants. Therefore the decision on the abatement equipment for

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[15] When retrofitting was completed, the Coordination Committee was disbanded.

dioxin and furan emissions was much more difficult to take and involved much more uncertainty. Some MWI operators even decided to build their own small test plants to obtain reliable data. With respect to denox systems, about two thirds of German MWI operators opted for the selective catalytic reduction (SCR) technique. About one quarter chose the technique of non-catalytic reduction (SNCR), and only a very few installed oxi-cat systems. In order to abate emissions of dioxins and furans, only about one quarter of German MWIs was equipped with activated carbon or coke filters. Most operators decided in favour of suspension flow adsorbers, which add a suspension of lime and carbon to the flue gas stream.

Operators reported that of the plethora of criteria influencing the decision on the specific abatement techniques, the decisive one was the question of how they could be integrated into the existing combustion units and abatement equipment. Retrofitting mainly took place between 1993 and 1996 and was often accompanied by the modernisation of the combustion units. However, before operators could start optimising their combustion units or the construction of the abatement equipment, their plans needed official authorisation.

The authorisation procedure is laid down in the BImSchG. The procedure described in §10 requires operators to send their application to the permitting authority, along with relevant drawings, explanations and other documents. The authority inspects the application and enclosed documents and may request further information. When the documents are complete, the permitting authority publicly announces the project and gives the public the opportunity to raise objections. If the modification of the plant will have no negative environmental impact, the authority can refrain from integrating the public (§16 (2)). Before authorisation is granted, other authorities whose areas of responsibility are affected, e.g. the authority responsible for health and safety at work, are asked to submit a statement.

The tight retrofitting deadline set in the EMDA required NRW authorities to carry out the authorisation procedures as swiftly as possible. To this end the NRW district governments (the permitting authorities) gave top priority to the authorisation of the MWIs' abatement equipment and modernisation measures, and transferred personnel to the department responsible for carrying out the authorisation procedures. The tight timetable did not alter the procedures, but led the authority to optimise their organisation and use all the options available to accelerate the process. In order to optimise organisational aspects, the district governments closely cooperated with MWI operators in order to enable them to present complete and correct application forms and documents. Moreover, the authorities which had to approve the authorisation were simultaneously integrated early on. The BImSchG mainly provides two options for accelerating

authorisation procedures. Firstly, it enables permitting authorities to refrain from involving the public if the modification to the plant will not harm the environment. Secondly, the BImSchG provided for an instrument enabling operators to start with the construction of the abatement equipment even if authorisation had not yet been granted (Zulassung des vorzeitigen Beginns). The NRW district government made use of both options whenever the necessary conditions were met.

Authorisation was based on the requirements of the 17. BImSchV. The authorisation document encompassed a detailed description of the modernisation and retrofitting measures, fixed emission limits, specified requirements regarding the measurement of emission values and their transmission to the supervisory authority etc. In some cases companies applied for exemptions from regulations of the 17. BImSchV already during the authorisation procedure. If these exemptions were granted, the special regulations were included in the licence as well. The exemptions granted for MWIs in Germany almost exclusively concerned the combustion conditions that require the gas resulting from combustion of the waste to be raised to a temperature of at least 850°C for at least two seconds (§4(2)). Many waste incineration plants, older ones in particular, have problems in meeting the conditions. However, exemptions from the emission limits were only granted in a few isolated cases.

The 17. BImSchV not only enabled permitting authorities to make exemptions, but also entitled them to lay down further requirements (§20). Because MWI operators have a legal right to the emission limits laid down in the 17. BImSchV, setting stricter limits in the authorisations was hardly possible. But several permitting authorities included ancillary requirements (Nebenbestimmungen) in the authorisation that went beyond the provisions of the 17. BImSchV. These requirements, for example, demanded the sewage-free operation of the abatement equipment and imposed quality criteria for the incinerated waste. After the permitting authority had granted authorisation, responsibility was passed on to the supervisory authorities. They monitored modernisation of the plant and the installation of the abatement equipment to make sure it complied with the provisions laid down in the authorisation documents and that the emission limits were met.

The implementation of the EMDA was observed by the Coordination Committee established in the NRW Ministry of the Environment. The committee monitored compliance with the agreement by both MWI operators and permitting authorities. The authorities provided the committee with a progress report once a year. The committee intervened in neither authorisation procedures nor retrofitting activities.

3.3.3 The outcome

In general, the 17. BImSchV only required German waste incinerators to supplement the pollution abatement equipment they already had in place by additionally installing denox systems and equipment for the abatement of dioxin and furan emissions. As already mentioned, the majority of German MWIs decided to install SCR systems to abate NO_X and suspension flow adsorbers to abate dioxin and furan emissions. Most plants modernised their combustion units simultaneously with the installation of the abatement equipment. They did so either in the context of the TA Luft at the end of the 1980ies or in the context of the 17. BImSchV.

In the following we will look in detail at the NRW municipal waste incineration plants which participated in the EMDA. Table 3 shows that the abatement techniques the MWIs installed vary considerably in terms of type, number and combination.

Incinerator	Modernisation of combustion unit * (primary measures)	Abatement equipment ** (secondary measures)
Aachen	shut down in 1991	
Bielefeld	1995/96	Electric filter, spray-drying, (semi-)wet system, denox-SCR, oxi-cat, suspension flow adsorber with filter
Bonn	1991 (start of operation)	Denox-SNCR, spray-drying, electric filter, semi-dry system, suspension flow adsorber with canvas filter
Düsseldorf	1996	Semi-dry system, electric filter, coke filter, denox-SCR
Essen	1987, 1993	Electric filter, wet system, activated carbon filter, de-nox-SCR
Hagen	1988/89	Spray-drying, semi-dry system, electric filter, denox-SCR, suspension flow adsorber with canvas filter
Hamm	1994	Denox-SNCR, cyclone dedusting system, semi-dry system, suspension flow adsorber with canvas filter
Herten	1990	Cyclone dedusting system, spray-drying, electric filter, (semi-)wet system, coke filter, denox-SCR
Iserlohn	1996	Electric filter, wet system, denox-SCR, canvas filter, rotary kiln furnaces with zeolite
Krefeld	1994	Canvas filter, wet system, denox-SCR, suspension flow adsorber
Leverkusen	1996 (enlarged in 1986)	Electric filter, semi-dry system, suspension flow adsor-ber, denox-SCR,
Oberhausen	1997	Electric filter, wet system, denox-SCR, suspension flow adsorber with canvas filter
Solingen	1993	Semi-dry system, electric filter, suspension flow adsor-ber with filter, denox-SCR
Wuppertal	enlarged in 1995	Electric filter, (semi-)dry system, electric filter, coke filter, denox-SCR

Table 3: Modernisation of combustion units and installation of abatement equipment

Source: * UBA 1999, pp. 19-29
** UBA 1999, pp. 31-40; MURL NRW 1996, pp. 30-32

Apart from a very few cases in which the plants needed a few extra months, German municipal waste incineration plants were retrofitted by 1 December 1996, the deadline set in the 17. BImSchV. In NRW all MWIs were able to meet the deadline. Due to the EMDA, many incinerators had the flue gas purification equipment in place long beforehand. Of the 13 MWIs that were retrofitted under the EMDA, 11 managed to meet the EMDA deadline of 1 December

1995 for the installation of devices to abate emissions of dioxins and furans and 7 plants already had their entire pollution abatement equipment in place. The early retrofitting of the MWIs in NRW required authorisation procedures to be carried out swiftly. The authorisation procedures took between 4 and 19 months, on average they were completed within 11 months. All procedures were executed in the stipulated time and never caused a municipal waste incinerator to exceed the EMDA deadline (cf. MURL NRW 1996, p. 27).

3.4 Phase 4: norm realisation 2 – monitoring and enforcement

After the waste incineration plants' operators had retrofitted their plants with abatement equipment and demonstrated they were able to meet the emission limits set in the 17. BImSchV, compliance had to be verified. To this end certain measuring techniques and equipment as well as procedures for transmitting the emission values to the supervisory authority were prescribed in the 17. BImSchV and specified by the permitting and supervisory authorities.

3.4.1 The actors, their motives and strategies

Operators of municipal waste incineration plants

Pollution abatement equipment is not cheap to run. The equipment consumes absorber materials and energy and needs to be maintained and repaired. Thus the operators of waste incineration plants would have an economic incentive not to operate the equipment and to violate the requirements laid down in the 17. BImSchV and their authorisation documents. Until the beginning of the 1990ies, the German municipal waste incineration sector did not have to worry about the financial aspect because the incinerators held regional monopolies and could thus transfer the costs to their clients. Due to recent changes in the ownership and market structure, they are beginning to lose this comfortable position and face increasing competitive pressure.[16] Therefore the importance of the cost argument can be expected to increase.

On the other hand, the comprehensive control mechanisms and the high probability of non-compliance being discovered and punished is an at least as important incentive to run the abatement equipment correctly and to act in compliance with the provisions laid down in the

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[16] In the beginning of the 1990s many MWIs were privatised, i.e. transformed in limited liability companies. Although local authorities in many cases still hold a majority interest in the companies, MWI operators and authorities act more as "normal" market contractors. This makes it more difficult for operators to put through an increase in fees, especially against the background that the TA-Siedlungsabfall of 1993 led operators of disposal sites to massive price reductions.

17. BImSchV and authorisation documents. The same holds true for the public interest in emissions of MWI.[17]

Supervisory authorities

The scope of action of a supervisory authority[18] is rather restricted. The 17. BImSchV does not only prescribe what emission values are to be measured, but also includes requirements regarding measuring methods and instruments and the transmission of emission values to the supervisory authority. Additionally, the German administrative law and criminal law contain regulations regarding possible sanctions for non-compliance with the 17. BImSchV. However, in the end it depends on the authority how thoroughly the plants are monitored and how non-compliance is actually sanctioned.

As the authorities only have a limited number of personnel at their disposal, they are forced to set priorities in their supervision activities. Since emissions from waste incinerators were the object of high public attention in the 1980s and the beginning of the 1990s, the supervisory authorities had an incentive to give priority to the implementation of the 17. BImSchV. Although public attention has since decreased, waste incinerators are still among large plants with a relatively high ecological relevance and are hence still high on the supervisory authorities' list of priorities.

3.4.2 Description of the process

Besides retrofitting with pollution abatement equipment the 17. BImSchV requires MWI operators to install equipment to continuously measure, record, and process emission values (§ 10 (1)). In Germany, the decision on the equipment is not taken by the operators alone. With respect to the equipment for measuring emission values, public bodies provide a list of approved instruments from which the operators can choose the one they think most appropriate. In NRW this list is provided by the MURL. In deciding which devices are to be approved the MURL is advised by expert institutes. The point where the measuring devices are installed, i.e. where the

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[17] Besides, we do not want to refute the notion that the MWI operators are interested in helping to protect the environment.

[18] In NRW, the monitoring and enforcement of MWI plants' compliance with the 17. BImSchV is organised decentrally with the 12 State Environmental Agencies (Staatliche Umweltämter) as supervisory authorities. By contrast, Bavaria has one central agency, the Bavarian Environmental Agency (Bayerisches Landesamt für Umweltschutz), which secures that the Bavarian MWI comply with the ordinance.

emission values are measured, is fixed by the relevant authority.[19] The decision on the equipment purchased to record and process the emission values is altogether left to MWI operators. Nowadays the plants are equipped with computers that automatically record and process the data, i.e. calculate half-hourly and daily mean values. However, once the devices have been installed, the whole system needs to be approved by the supervisory authority.

The 17. BImSchV requires MWI operators to have their measuring equipment checked (once a year) and calibrated (every 3 years). The companies are obliged to commission (and pay) authorised institutes to perform the tests and forward the results to the supervisory authority (§ 10(3)). Again, a list of authorised institutes is provided by public bodies, in NRW the MURL. To prevent manipulation the entire measuring system is sealed. The 17. BImSchV requires plant operators to submit a yearly emission report to the supervisory authority (unless the competent authority has prescribed the telemetric transfer of data). The report has to be provided within three months after the end of a year and covers all emission values of the preceding year (§ 12(2)). The emission values (half-hourly and daily means) are categorised in different classes, indicating whether the emission values fell below or exceeded the limits.[20]

Simultaneously to retrofitting with pollution abatement equipment, all MWIs in NRW were connected to a system for the telemetric transfer of emissions (Emissions-Fernüberwachung – EFÜ) by 1 December 1995.[21] The processed and classified emission values are automatically transmitted to the supervisory authority once a day. In addition to the emission data the authority has a message on its computer screen each morning saying whether emission limits have been exceeded during the last 24 hours. EFÜ makes it literally impossible to exceed emission limits without the supervisory authority finding out. EFÜ even enables supervisory authorities to log into the MWIs' electronic emissions control system at all times and without giving prior notice to the operators. Moreover, supervisory authorities are authorised to carry out on-site inspections as they see fit (§52(2) BImSchG).

If emission limits are exceeded, MWI operators are obliged to contact the supervisory authority to explain the reasons (§ 16(1) 17. BImSchV). Although operators could do this directly via EFÜ, most of them still prefer the telephone. Whenever emission limits are exceeded, waste

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[19] The measuring points are fixed pursuant to a standard developed by the German standardisation institute (DIN - Deutsches Institut für Normung).

[20] The classification of emission values was specified through an administrative guideline and therefore is applied in all German states in the same way.

[21] Bavaria did not install a system for the telemetric transfer of emission data. To improve the information basis of the supervisory authority, Bavarian MWI operators not only provide a yearly, but also a monthly report.

combustion units may continue operating for a maximum of 8 successive hours and a total of 96 hours a year (laid down in the 17. BImSchV respectively the European Regulations). To check whether the limit for the annual total has been met, the emission data recorded over the year have to be added up at the end of the year. Although MWI operators have so far done this in the annual report, some northrhine-westphalian operators have already announced that they do not want to provide the annual report in future, because the data they transmit via EFÜ enable supervisory authorities to perform the annual analysis themselves.

Currently each MWI (in NRW) exceeds emission limits a handful of times per month. In most cases the limits are only exceeded for a few minutes. Shortly after the installation of the abatement equipment, emission limits were exceeded more often and for longer periods of time. Nevertheless operators were nearly always able to meet the dual limits of 8 and 96 hours.[22] One supervisory authority reported the example of a MWI that had technical problems with its activated carbon filters. Because the operator was unable to solve the problems, emission limits were repeatedly exceeded, sometimes for more than 8 successive hours. Therefore the supervisory authority intervened and instructed the operator to reduce the waste throughput. The operator refused, arguing that there was no other way of disposing of the waste. When the authority checked this argument, it found that it was possible to temporarily landfill the waste. The operator was then forced to reduce the waste throughput and was not allowed to return to normal operation until the problems with the activated carbon filter had been solved.

If the requirements of the 17. BImSchV are violated, supervisory authorities have a whole range of sanctions available. When the authority finds out that a MWI is violating the ordinance, it generally tries to settle the issue informally. If informal contacts do not produce results, the authority passes an official order. This order not only specifies the measures the company is required to take, but also threatens means of coercion. Depending on the degree of non-compliance, the means of coercion can range from a fine to temporary or permanent closure of combustion units. Forcing companies to stop or reduce production, hits their economic basis and thus are sanctions they actually fear. The above example shows that supervisory authorities

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[22] All in all, emission limits are exceeded very rarely and only for a short period of time in Bavaria as well, but there are considerable differences between the plants. We were told that there is especially one plant, which exceeds the emission limits quite often. The reason is that the plant was already at the end of its lifetime, when the 17. BImSchV was enacted and therefore was only retrofitted with a rather undersized abatement equipment. But because the plant will be closed in short sight (a new plant is already under construction), the supervisory authority did not take any action against the plant. Mostly the plant is able to meet the dual limits of 8 and 96 hours for which emission limits may be exceeded.

do not hesitate to apply such sanctions, when they think this necessary to get a company in re-compliance.

3.4.3 The outcome

There appears to be no implementation gap in the monitoring of German municipal waste incinerators. MWIs are still high on the supervisory authorities' list of priorities. Moreover, the monitoring of MWIs needs relatively little time, because the controls are largely privatised and emission data are provided by the plant operators (in NRW they are even transferred electronically). As it seems to be almost impossible for waste incinerators to escape monitoring, the probability of non-compliance with the 17. BImSchV being discovered is very high.

Moreover, the companies are afraid of being severely punished. Although supervisory authorities at first try to solve problems rather informally, they also use tougher instruments like official orders or the temporary reduction of waste throughput. In fact, waste incineration plants have hardly ever exceeded emission limits. On the contrary, they were (and still are) normally well below the limits. Whenever the abatement equipment has broken down, the companies have been able to fix it in the stipulated period, apart from a few isolated cases.

4 Assessment of the implementation process

The purpose of this chapter is to assess the outcome of the implementation process in terms of goal attainment and efficiency. This will be done in accordance with the indicators the responsible IMPOL project partners developed for the MWI case-studies in the four countries.[23]

4.1 Attainment of the ecological goals

4.1.1 Aggregate level of domestic waste incinerators

Dioxin emissions played the main role in the German public discussion about emissions from municipal waste incineration plants. Therefore reductions in dioxin emissions from MWIs had top priority for policy-makers. The following tables show that they were successful.

Year	In ng I-TE**/m³ (average values)	In % of limits set in 17. BImSchV (to be met as of Dec. 1996)	Reduction in % compared to 1989/90	In g TE/a	Reduction in % compared to 1989/90
1989/1990*	8	8,000.0		400	
1994/1995	1	1,000.0	87.5%	30	92.5%
1997	< 0.1	< 100.0	< 98.7%	< 2	99.5%

Table 4: Emissions of dioxins and furans from municipal waste incineration in Germany
Source: Johnke (1997), * West Germany, ** International Toxic Equivalent

Year	In g TE/a	Reduction in %
Before retrofitting due to 17. BImSchV	66.2	
After retrofitting due to 17. BImSchV	0.3	99.5%

Table 5: Emissions of dioxins and furans from NRW municipal waste incinerators participating in EMDA
Source: MURL NRW 1996, pp. 33-36

Both dioxin emissions concentration (ng (I) TE/m³) and absolute emissions (g TE/a) have been reduced by almost 100%. This holds true for NRW (EMDA) and for Germany as a whole. Yet the reduction in emissions from MWIs was not restricted to dioxins and furans.

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[23] The general indicators were developed by Matthieu Glachant and Simone Schucht (CERNA, Ecole des Mines de Paris) and adapted to the MWI studies by Kris Lulofs (CSTM, University of Twente).

Table 6 shows the development of several pollutants emitted by NRW incinerators between 1994 and 1996.

	Dust	CO	HCl	SO_2	Cd	Hg	HF	Dioxins + furans
1994	145,000	601,000	149,000	673,000	196	1,024	4,380	0.040
1996	57,470	435,000	62,900	227,500	17	200	2,270	0.002
Reduction in %	60.4	27.6	57.8	66.2	91.3	80.5	48.2	95.0

Table 6: Emissions from NRW municipal waste incinerators in kg/a

Source: Data provided by the Landesumweltamt NRW (NRW Environmental Agency)

We cannot compare the actual emissions of the NRW MWIs with the limits imposed by the 17. BImSchV, because we do not have emissions in mg/m³ in an aggregated form, but only for individual incinerators.

4.1.2 Level of individual municipal waste incinerators

In this chapter we will present emission data of 10 of the 14 NRW municipal waste incineration plants which participated in the EMDA. To be able to assess the (relative) environmental performance of the incinerators, the emissions of the different pollutants are aggregated in two indices. Index 1 shows the average compliance with the EU directive. It is based on emissions in mg/m³ as a percentage of the limits set in the regulations and considers all pollutants as equally important. Index 2 is based on absolute emissions in tons and encompasses a weighting that takes the emission limits set in the EU directive as an indicator for the relative importance of the pollutants.

Incinerator A

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	0.03	0.05	0.1	0.2	0.3	0.5	+0.02	+66.7
CO	10.5	6.5	10.5	6.5	21.0	13.0	-4.0	-38.1
HCl	0.3	0.09	0.6	0.2	3.0	0.9	-0.2	-66.7
SO_2	1.8	0.4	0.6	0.1	3.6	1.0	-1.4	-77.8
Cd + Hg	0.02	0.009	10.0	4.5	41.8[c]	18.0[c]	-0.01	-50.0
HF	0.04	0.025	2.0	1.3	4.0	2.5	-0.015	-37.5
Dioxins + furans (ng TE)	2.5	0.4			2,500.0	400.0	-2.1	-84.0
Index 1			4.0	2.1	367.7	62.3		

Table 7: Emissions of incinerator A in mg/m³

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996
[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996
[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	763	864	+101	+13.2
CO	9,331	8,185	-1,146	-12.3
HCl	236	66	-170	-72.0
SO_2	1,629	537	-1,092	-67.0
Cd + Hg	19	7	-12	-63.2
HF	35	19	-16	-45.7
Dioxins + furans (in g TE)	2.260	0.477	-1.783	-78.9
Index 2 (in tons) without dioxins +furans	4.0	2.6		

Table 8: Emissions of incinerator A in kg

Incinerator B

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	2.02	1.2	6.7	4.0	20.2	12.0	-0.82	-40.6
CO	12.8	13.0	12.8	13.0	25.6	26.0	+0.2	+1.6
HCl	2.0	3.0	4.0	6.0	20.0	30.0	+1.0	+50.0
SO_2	1.1	1.7	0.4	0.6	2.2	3.4	+0.6	+35.3
Cd + Hg	0.01	0.002	5.0	1.0	20.0[c]	4.0[c]	-0.008	-80.0
HF	0.1	0.002 (1997)	5.0	0.1 (1997)	10.0	0.2 (1997)	-0.098	-98.0
Dioxins + furans (ng TE)	0.005	0.01			5.0	10.0	+0.005	+100.0
Index 1			5.7	4.1	14.7	12.2		

Table 9: Emissions of incinerator B in mg/m³

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	6,632	7,509	+877	+13.2
CO	35,222	30,085	-5,137	-14.6
HCl	5,503	6,942	+1,439	+26.1
SO_2	3,027	3,934	+907	+30.0
Cd + Hg	28	5	-23	-82,1
HF	275	—		
Dioxins + furans(in g TE)	0.014	0.023	+0.009	+64.3
Index 2 (in tons) * without dioxins + furans				

Table 10: Emissions of incinerator B in kg

* As we do not have data on HF emissions in kg for 1996 (and 1997), we refrained from calculating index 2.

Incinerator C

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	0.2	2.9	0.7	9.7	2.0	29.0	+2.7	+1,350.0
CO	40.9	29.9	40.9	29.9	81.8	59.8	-11.0	-26.9
HCl	2.4	2.6	4.8	5.2	24.0	26.0	+0.2	+8.3
SO_2	78.8	2.6	26.3	0.9	157.6	5.2	-76.2	-96.7
Cd + Hg	0.08	—	40.0		145.2[c]			
HF	0.04	—	2.0		4.0			
Dioxins + furans (ng TE)	7.8	0.004			7,800.0	4.0	-7.796	-99.9
Index 1*			18.2	11.4	1,613.1	24.8		

Table 11: Emissions of incinerator C in mg/m³

* As we do not have data on Cd, Hg and HF emissions for 1996, these pollutants were excluded in the calculation of index 1 for both years.

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	359	4,524	+4,165	+1,160.2
CO	82,192	46,421	-35,771	-43.5
HCl	4,758	4,026	-732	-15.4
SO_2	158,388	4,046	-154,342	-99.7
Cd + Hg	165	—		
HF	83	—		
Dioxins + furans (in g TE)	0.099	0.006	-0.093	-93.9
Index 2 (in tons) * without dioxins + furans				

Table 12: Emissions of incinerator C in kg

* As we do not have data on Cd, Hg and HF emissions for 1996, we refrained from calculating index 2.

Incinerator D

Pollutants	1994	1996	% of EU limits[a]		% of Ger. limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	5.6	1.5	18.7	5.0	56.0	15.0	-4.1	-73.2
CO	12.5	9.6	12.5	9.6	25.0	19.2	-2.9	-23.2
HCl	11.9	4.5	23.8	9.0	119.0	45.0	-7.4	-63.2
SO_2	49.4	41.6	16.5	13.9	98.8	83.2	-7.8	-15.8
Cd + Hg	0.07	0.02	35.0	10.0	120.0[C]	40.0[C]	-0.05	-71.4
HF	0.6	0.5	30.0	25.0	60.0	50.0	-0.1	-16.7
Dioxins + furans (ng TE)	0.9	0.06			900.0	60.0	-0.84	-93.3
Index 1			22.8	12.1	197.0	44.6		

Table 13: Emissions of incinerator D in mg/m³

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996
[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996
[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	4,026	1,172	-2,854	-70.9
CO	4,552	6,127	+1,575	+34.6
HCl	6,885	2,900	-3,985	-57.9
SO_2	28,487	26,452	-2,035	-7.1
Cd + Hg	63	28	-35	-55.7
HF	334	287	-47	-14.1
Dioxins + furans (in g TE)	0.517	0.035	-0.482	-92.3
Index 2 (in tons) without dioxins + furans	14.9	8.8		

Table 14: Emissions of incinerator D in kg

Incinerator E

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	41.7	—	139.0		417.0			
CO	36.3	14.6	36.3	14.6	72.6	29.2	-21.7	-59.8
HCl	5.5	3.8	11.0	7.6	55.0	38.0	-1.7	-30.9
SO_2	50.8	25.2	16.9	8.4	101.6	50.4	-25.6	-50.4
Cd + Hg	0.014	0.017	7.0	8.5	23.2[C]	33.6[C]	+0.003	+21.4
HF	0.1	0.4	5.0	10.0	10.0	40.0	+0.3	+300.0
Dioxins + furans (ng TE)	0.023	0.025			23.0	25.0	+0.002	+8.7
Index 1*								

Table 15: Emissions of incinerator E in mg/m³

* Due to data problems with respect to the 1996 dust emissions we refrained from calculating index 1.

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	199	—		
CO	22,081	8,990	-13,091	-59.3-
HCl	3,334	2,360	-974	-29.2
SO_2	30,885	15,468	-15,417	-49.9
Cd + Hg	8	10	+2	+25.0
HF	59	262	+203	+344.1
Dioxins + furans (in g TE)	0.014	0.015	+0.001	+7.1
Index 2 (in tons)* without dioxins + furans				

Table 16: Emissions of incinerator E in kg

* Due to data problems with respect to the 1996 dust emissions we refrained from calculating index 2.

Incinerator F

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	1.2	0.6	4.0	2.0	12.0	6.0	-0.6	-50.0
CO	34.4	21.1	34.4	21.1	68.8	42.2	-13.3	-38.7
HCl	0.8	0.3	1.6	0.6	8.0	3.0	-0.5	-62.5
SO_2	1.31	1.06	0.44	0.35	2.6	2.1	-0.25	-19.1
Cd + Hg	—	—						
HF	0.07	0.01	3.5	0.5	7.0	1.0	-0.06	-85.7
Dioxins + furans (ng TE)	0.007	0.006			7.0	6.0	-0.001	-14.3
Index 1*			8.8	4.9	17.6	10.1		

Table 17: Emissions of incinerator F in mg/m³

* As we do not have data on Cd and Hg emissions, these pollutants were excluded in the calculation of index 1.

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

Pollutants	1994	1996	Change	
			Kg	in %
Dust	1,876	887	-989	-52.7
CO	55,618	29,129	-26,489	-47.6
HCl	1,343	462	-881	-65.6
SO_2	2,115	1,461	-474	-22.4
Cd + Hg	—	—		
HF	115	14	-101	-87.8
Dioxins + furans (in g TE)	0.012	0.009	-0.003	-25.0
Index 2 (in tons) * without dioxins + furans				

Table 18: Emissions of incinerator F in kg

* As we do not have data on Cd and Hg emissions, we refrained from calculating index 2.

Incinerator G

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	11.1	1.0	37.0	3.3	111.0	10.0	-10.1	-90.9
CO	74.9	17.6	74.9	17.6	149.8	35.2	-57.3	-76.5
HCl	13.7	0.96	27.4	1.9	137.0	9.6	-12.74	-92.9
SO_2	38.6	17.9	12.9	5.9	77.2	35.8	-20.7	-53.6
Cd + Hg	—	0.014		7.0		28.0[C]		
HF	0.26	—	13.0		26.0			
Dioxins + furans (ng TE)	5.8	0.009			5,800.0	9.0	-5.791	-99.8
Index 1*								

Table 19: Emissions of incinerator G in mg/m³

* Due to data problems with respect to the 1994 Cd and Hg emissions we refrained from calculating index 1.

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	5,597	1,108	-4,489	-80.2
CO	24,498	9,962	-14,536	-59.3
HCl	4,501	444	-4,057	-90.1
SO_2	12,667	8,217	-4,450	-35.1
Cd + Hg	—	7		
HF	85	—		
Dioxins + furans (in g TE)	1.917	0.005	-1,917.995	-99.9
Index 2 (in tons) without dioxins + furans				

Table 20: Emissions of incinerator G in kg

* As we do not have data on HF emissions for 1996 and faced data problems with respect to the 1994 Cd and Hg emissions, we refrained from calculating index 2.

Incinerator H

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	2.2	3.8	7.3	12.7	22.0	38.0	+1.6	+72.3
CO	19.9	23.3	19.9	23.3	39.8	46.6	+3.4	+17.1
HCl	18.2	18.8	36.4	37.6	182.0	188.0	+0.6	+3.3
SO_2	52.3	49.6	17.4	16.5	104.6	99.2	-2.7	-5.2
Cd + Hg	0.16	0.03	80.0	15.0	320.6[c]	60.0[c]	-0.13	-81.3
HF	—	—						
Dioxins + furans (ng TE)	1.336	0.079			1,336.0	79.0	-1.257	-94.1
Index 1*			32.2	21.0	334.2	85.1		

Table 21: Emissions of incinerator H in mg/m³

* As we do not have data on HF emissions, this pollutant was excluded in the calculation of index 1.

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	3,956	6,608	+2,652	+67.0
CO	20,819	25,187	+4,368	+21.0
HCl	18,978	20,309	+1,331	+7.0
SO_2	54,586	53,637	-949	-1.7
Cd + Hg	292	51	-241	-82.5
HF	—	—		
Dioxins + furans (in g TE)	1.392	0.853	-0.539	-38.7
Index 2 (in tons) without dioxins + furans				

Table 22: Emissions of incinerator H in kg

* As we do not have data on HF emissions, we refrained from calculating index 2.

Incinerator I

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	7.9	1.2	26.3	4.0	79.0	12.0	-6.7	-84.8
CO	30.2	16.3	30.2	16.3	60.4	32.6	-13.9	-46.0
HCl	6.7	0.3	13.4	0.6	67.0	3.0	-6.4	-95.5
SO_2	22.4	3.8	7.5	1.3	44.8	7.6	-18.6	-83.0
Cd + Hg	—	—						
HF	0.24	0.14	12.0	7.0	24.0	14.0	-0.1	-41.7
Dioxins + furans (ng TE)	—	0.009				9.0		
Index 1*			17.9	5.8	55.0	13.8		

Table 23: Emissions of incinerator I in mg/m³

* As we do not have data on the emissions of Cd, HG, dioxins and furans, these pollutants were excluded in the calculation of index 1 for both years.

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

Pollutants	1994	1996	Change	
			Kg	in %
Dust	20,589	2,722	-17,867	-86.8
CO	77,887	35,845	-42,042	-54.0
HCl	17,321	645	-16,676	-96.3
SO_2	57,821	8,307	-49,514	-85.6
Cd + Hg	—	—		
HF	629	299	-330	-52.5
Dioxins + furans (in g TE)		0.019		
Index 2 (in tons) * without dioxins + furans				

Table 24: Emissions of incinerator I in kg

* As we do not have data on the emissions of Cd, Hg, dioxins and furans, we refrained from calculating index 2.

Incinerator J

Pollutants	1994	1996	% of EU limits[a]		% of German limits[b]		Change	
			1994	1996	1994	1996	mg/m³	in %
Dust	4.0	1.6	13.3	5.3	40.0	16.0	-2.4	-60.0
CO	32.1	22.4	32.1	22.4	64.2	44.8	-9.7	-30.2
HCl	23.3	1.0	46.6	2.0	233.0	10.0	-22.3	-95.7
SO_2	21.7	65.7	7.2	21.9	43.4	131.4	+44.0	+202.7
Cd + Hg	0.061	0.007	30.5	3.5	121.0[c]	13.8[c]	-0.054	-88.5
HF	0.015	—	0.75		1.5			
Dioxins + furans (ng TE)	11.1	0.07			11,100	70.0	-11.03	-99.4
Index 1*			25.9	11.0	1,933.6	47.7		

Table 25: Emissions of incinerator J in mg/m³

* As we do not have data on the emissions of HF for 1996, this pollutant was excluded in the calculation of index 1 for both years.

[a] Emission limits of 89/369/EEC (all 10 plants have a nominal capacity of more than 6t/h) to be met as of 1 December 1996

[b] Emission limits of 17. BImSchV (daily average) to be met as of 1 December 1996

[c] Hg emissions compared to the Hg emission limit

Pollutants	1994	1996	Change	
			Kg	in %
Dust	10,927	3,875	-7,052	-64.5
CO	31,501	12,499	-19,002	-60.3
HCl	22,573	561	-22,012	-97.5
SO_2	21,252	36,677	+15,425	-72.6
Cd + Hg	118	12	-106	-89.8
HF	10	—		
Dioxins + furans (in g TE)	10.740	0.039	-10.701	-99.6
Index 2 (in tons) without dioxins + furans				

Table 26: Emissions of incinerator J in kg

* As we do not have data on the HF emissions for 1996, we refrained from calculating index 2.

Abatement patterns summarised in two indices

After we calculated the environmental performance indices of the individual incinerators they are juxtaposed in one table and put in a rank order (Table 27). The column which says who owns and operates the incineration plants was added in order to be able to analyse whether the ownership structure influences the environmental goal attainment.

	1994	Rank order	1996	Rank order	Change (in %)	Owner / Operator*
Incinerator A						1
Index 1^{EU}	4.0	1	2.1	1	-1.9 (47.5)	
Index 2	4.0		2.6		-1.4 (35.0)	
Incinerator B						2
Index 1^{EU}	5.7	2	4.1	2	-1.6 (28.0)	
Index 2	16.1		—			
Incinerator C						3
Index 1^{EU}	18.2	5	11.4	6	-6.8 (37.4)	
Index 2	—		—			
Incinerator D						1
Index 1^{EU}	22.8	6	12.1	7	-10.7 (46.9)	
Index 2	14.9		8.8		-6.1 (40.9)	
Incinerator E	—		—			
Incinerator F						3
Index 1^{EU}	8.8	3	4.9	3	-3.9 (44.3)	
Index 2	—		—			
Incinerator G	—		—			
Incinerator H						2
Index 1^{EU}	32.2	8	21.0	8	-11.2 (34.8)	
Index 2	—		—			
Incinerator I						2
Index 1^{EU}	17.9	4	5.8	4	-12.1 (67.6)	
Index 2	—		—			
Incinerator J						1
Index 1^{EU}	25.9	7	11.0	5	-14.9 (57.5)	
Index 2	—		—			

Table 27: Indices of environmental effectiveness

* The numbers stand for the following owners/operators:

1 Local authorities
2 Limited liability company in which local authorities hold a majority interest
3 Company in which local authorities do hold no or only a minority interest

Table 27 demonstrates that those incinerators that had the lowest emissions in 1994 (incinerators A, B and F) realised the least emission reductions and still were at the top of the rank-order in 1996. This shows that the plants with higher emissions did not realise over proportionally high emission reductions. However, we shall be careful in comparing the absolute amount of emission reductions, because the emission data of 1994 and 1996 do not really present the emissions before and after the implementation of the 17. BImSchV. On the one hand, many incinerators already started to install the abatement equipment in 1994. On the other hand, they finished the retrofitting respectively the optimisation of the abatement equipment over the year 1996, so that the abatement equipment took effect not before 1997.

An analysis of the ownership situation and the emission data of the incinerators, does not reveal any correlations between the ownership structure and the environmental performance of the plants. A comparison of incinerators that are still run by local authorities and those that are operated by limited liability companies indicates that the privatisation of MWIs does not effect their level of emissions.

4.2 Efficiency of pollution abatement

4.2.1 Allocative Efficiency

The considerable emission reductions achieved by the 17. BImSchV incurred enormous costs. The MWIs that participated in the EMDA reported that the costs of the retrofitting and modernisation measures they took in the context of the ordinance varied between DM 9.8 million and DM 395 million (= € 5 - 202 million). The total investments taken by the MWI sector in NRW amounted to DM 2 billion (= € 1.02 billion) (cf. MURL NRW 1996, p. 27). In this chapter we analyse whether the emission reductions caused by the 17. BImSchV could have been realised at lower costs, if abatement activities were allocated among incinerators in a different, i.e. more efficient, way.

Allocative efficiency is attained when an environmental policy ensures that the least-cost implementation of abatement activities being achieved to reach a given goal (such as a certain level of emissions). This implies that the allocation of abatement activities among polluters is such that a reallocation would not produce any cost savings. Against this background, legal regulations can lead to allocative inefficiency if they either impose different requirements on companies with equal abatement costs or impose the same requirements on companies with different abatement costs.

The 17. BImSchV imposes uniform emission limits on all MWIs. In order to assess whether this results in allocative inefficiency, it is necessary to examine to what extent abatement costs vary between the incinerators. Table 28 shows the investments in abatement equipment and modernisation per unit of pollution abated taken by the ten NRW municipal waste incinerators to which we already referred in chapter 4.1.2.

Incinerator	Investment* / pollution abated** (in €)
A	102.17
B	45.99
C	17.46
D	37.40
E	—
F	39.87
G	—
H	66.64
I	38.62
J	16.37

Table 28: Investments in abatement equipment and modernisation

* The investments were mainly taken between 1993 and 1996. We did not discount the investments, but normalised them with respect to the MWI's different capacities.

** Pollution abated = decrease in index 1^{EU}

Table 28 illustrates that the investments per unit of pollution abated vary significantly between the incinerators. This result suggests that the emission reductions could have been achieved at lower costs, if the abatement activities were not allocated by applying a uniform emission limit, but in a way that accounted for the cost structure of the incinerators. However, we shall be careful in interpreting the cost figures presented in Table 28, because operators mentioned that they had difficulty in distinguishing between the investments they made due to the 1986 TA Luft and the 17. BImSchV. In many cases they had not yet finished construction of the TA Luft abatement equipment when the 17. BImSchV was enacted or the first drafts of the ordinance were circulated. However, operators additionally reported the following site-specific criteria to have influenced abatement costs:

- The size of the incineration plants: even for plants with a nominal capacity of more than 6 t/h specific abatement costs (DM/capacity) decrease with plant size.

- The spatial situation on-site: on some sites there was just not enough space to integrate the abatement equipment, so that other buildings had to be pulled down or the equpiment had to be located rather far away from the combustion units - thus significantly increasing retrofitting costs.
- The already existing combustion units and abatement equipment restricted operators in their choice of the abatement devices necessary to comply with the emission limits of the 17. BImSchV. In a number of cases this restriction meant that they could not realise the least-cost solution.

To sum up, the empirical data on the differences in abatement costs indicate a certain level of allocative inefficiency. But before we can draw the conclusion that the enactment and implementation of the 17. BImSchV led to allocative inefficiency, we have to analyse whether it would have been technically feasible to reallocate abatement efforts (and costs), without reducing ecological effectiveness. In Germany, policy-makers strived to reduce (dioxin) emissions from MWIs as much as possible. Therefore they identified the emission limits that could be reached with the best available abatement technology and imposed these limits on all incinerators. This restricts the potential for reallocating abatement activities, because reallocation means that some plants abate less, while others abate more. But if all plants are obliged to install the best available equipment, there is hardly any room to abate more. Another constraint for reallocation is the fact that dioxin emissions (which were in the centre of public discussion in Germany) have local effects. Reallocating abatement efforts would result in highly polluted areas on the one side and hardly polluted areas on the other. Since environmental impacts (and negative health effects) can be assumed to rise over proportionally, such a situation would lead to a lower ecological effectiveness. All in all, we conclude that there might be a certain level of allocative inefficiency in Germany, but that it is lower than the uniform emission standards and the cost data might suggest.

4.2.2 Productive efficiency

In the context of pollution control policy productive efficiency means that companies choose the cost-efficient way of pollution abatement, i.e. they are able to choose the abatement cost curve that represents minimum costs. The enactment and implementation of regulations can either increase productive efficiency by providing plant operators with information that help them to find the cost-efficient way of pollution abatement or decrease productive efficiency by

constraining the operators' flexibility in choosing the cost-efficient way and timing of abatement.

In order to evaluate the implementation of the European and German legislation on emissions from MWIs in terms of productive efficiency, we apply the 'Template for Assessment of Productive Efficiency' developed by one of our partners in the IMPOL project.[24]

1. *Were any new constraints on existing incinerators introduced as a result of the implementation of the European directives 89/429/EEC and 89/369/EEC?*

The 17. BImSchV significantly tightened the environmental demands imposed on MWIs, but government representatives denied that the 17. BImSchV was introduced as a result of the European directives. During the implementation of the German ordinance the following two constraints were introduced:

- As explained in detail in chapter 3.2, a voluntary Emission Reduction Plan was agreed between state government and MWI operators in NRW. The plan did not specify emission limits different from those of the 17. BImSchV, but imposed a tighter timetable for compliance with the limits.
- Parallel to the retrofitting activities NRW connected the waste incinerators to a system for telemetric transfer of emissions (see chapter 3.4).

2. *Was the abatement technology to be adopted specified for existing incinerators?*

No. It was left to MWI operators to choose the technique that was suitable for their incinerator.

3./4. *Were there external constraints upon operators' commercial freedom with respect to closure of plants, primary measures or end-of-pipe-technology?*

No, but MWIs were in the position of regional monopolists and thus could transfer the costs to their clients. This might have lessened the incentive to look for the least-cost pollution abatement measures.

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[24] The template was developed by Kris Lulofs (CSTM, University of Twente).

5. *Has a timetable been specified for upgrading existing incineration plants to the new standards?*

Yes. The 17. BImSchV layed down that existing MWIs had to be retrofitted not after 1 December 1996. The EMDA, the voluntary emission reduction plan agreed between the state government and the waste incineration sector in NRW, fixed 1 December 1995 as retrofitting deadline.

6. *Were multi-site operators provided with any flexibility regarding the location of the emission reductions to be achieved?*

The emission limit values set in the 17. BImSchV applied to each individual source of emissions (stack). This means that there was no flexibility regarding the location of emission reductions between sites. Only within sites encompassing several combustion units, operators had the flexibility to decide whether to discharge the emissions from the combustion units through individual stacks or through only one stack.

7. *Describe any informational 'events' that took place in the course of the implementation process which were initiated by the regulator.*

An exchange of information between public authorities and operators mainly took place as a side-effect of the discussions about the formulation of the 17. BImSchV on the federal level and the EMDA in NRW. The exchange of information mainly covered technical options for reducing emissions. The discussions about the EMDA also included authorisation procedures. Moreover, permitting authorities are generally demanded to support operators in preparing the forms and documents necessary to apply for authorisation.

To sum up, the implementation of the European directives respectively the 17. BImSchV did hardly help to increase productive efficiency. On the other hand, mainly the tight timetable set in the ordinance and in the EMDA made productive efficiency decrease, because it interferred with MWI operators' decision on the optimal timing of the retrofitting activities. [25]

4.3 Administrative efficiency

In order to assess the administrative efficiency of the implementation of the European and German legislation on emissions from MWIs, we will calculate the amount of administrative

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[25] Here exists a trade-off between a cost-efficient installation of FGD systems and a quick reduction of emissions.

costs that arose in connection with the 17. BImSchV. As an indicator of the administrative costs we use the number of persons currently dealing with the implementation of the ordinance. This means that neither the costs that occured for formulating the ordinance, nor the costs for buildings, equipment etc. are captured. In the following we present the data for each of the actors involved separately.[26]

Authorities - Strategic planning

In the Department of Prevention of Air Pollution from Plants (Referat für anlagenbezogene Luftreinhaltung) of the Federal Environmental Ministry 6 persons worked in August 1999. The number of personnel did not change over the previous ten years. At the time when the 17. BImSchV was formulated (three years from 1988 to 1990), 2 of the 6 persons spent the majority of their working time on the ordinance. Currently (August 1999) there is only 1 employee who is responsible for waste incineration plants. His area of responsibility does not only cover the 17. BImSchV, but all other environmental legislation that applies to waste incineration plants.

The environmental ministries of the German states also have some personnel which deal with municipal waste incineration plants. Similar to the BMU, the persons that are responsible for MWIs do not only deal with the 17. BImSchV, but also with other legislation applicable to waste incineration plants.

Authorities - Monitoring and enforcement

In Germany the states are responsible for implementing federal (and state) environmental legislation, i.e. they are in charge of authorisation, supervision, and enforcement. Although the general administrative structure is similar in the different states, the concrete allocation of responsibilities can vary significantly. Therefore we restricted our analysis to one state, i.e. NRW. In 1998 a total number of about 700 persons were employed in the area of pollution control (air and noise pollution) in NRW. By far most of them were engaged in supervisory activities. The number slightly decreased compared to the beginning of the 90s (750 persons in NRW in 1994). However, as no detailed statistics on the number of employees exist, we were not able to identify the number of persons occupied with the implementation of the 17. BImSchV.

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[26] The data were collected in interviews with representatives of federal and state governments, enforcement authorities and plant operators.

The empirical data we collected suggest that at the time when the abatement equipment of the existing municipal waste incineration plant was authorised, 0.5 person was full time occupied for 4 to 19 months with carrying out the authorisation procedure of one plant. There was no additional personnel employed to carry out the authorisation procedures, but the available persons concentrated on MWIs. After the authorisation of existing incinerators was completed, the time the authorisation bodies' personnel spent on MWIs reduced considerably. With respect to supervision and enforcement, interviewees in NRW reported that in 1999 about 0.3 person was required to supervise and enforce one municipal waste incineration plant's compliance with air pollution legislation, i.e. the 17. BImSchV.[27]

Plants

In the interviews we learned that running and maintaining the abatement equipment of a rather large municipal waste incineration plant (between 400 and 500 kt waste throughput per year) in 1999 required 2 persons per shift (1 person for the equipment added due to the 17. BImSchV). Multiplied by four shifts, this leads to 8 (respectively 4) persons a day. Additionally there were 2 persons per day who dealt with the inputs and residues of the pollution abatement processes. To control the emission values, another person per shift (0.5 person for the equipment installed due to the 17. BImSchV) and thus another 4 (respectively 2) persons a day were needed. 'Real' administrative costs only amount to a few working-days per year. They occur for fulfilling reporting and control duties, i.e. for providing the yearly emission report, communicating with authorities if emission limits are exceeded, and commissioning expert institutes with checking and calibrating the measuring equipment. However, there was no additional personnel employed due to the 17. BImSchV.

Although interviewees reported that as well in public authorities as in plants hardly any additional personnel was employed due to the 17. BImSchV, we shall bear in mind that the number of employees might have decreased, if the ordinance had not been enacted.

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[27] For Bavaria we were given the information that in 1999 altogether 2 persons dealt with supervising and enforcing all 17 Bavarian MWI plants' compliance with the 17. BImSchV. In contrast to NRW, Bavaria has centralised the supervision and enforcement activities.

5 Links between implementation process and outcomes

The last chapter is devoted to finding causal links between the implementation process and the observed level of performance of the four outcome indicators.

5.1 Attainment of the ecological goals

All data presented in chapter 4.1 indicate high over-compliance with both European and German regulations. This definitely results from a multitude of factors. In the following we give the reasons we regard as most important:

- MWI operators want to convince environmental organisations and the general public that the incineration of waste no longer means severe impacts on eco-systems and human beings.
- EFÜ makes it literally impossible to exceed emission limits without being noticed by the supervisory authority. Furthermore, authorities have shown that they are willing to apply severe sanctions in case of non-compliance.
- Because waste is not a homogenous fuel, the emission values of MWIs fluctuate. In order to make sure that emission limits are always met, operators need a safety margin and on average are below the limits.
- Suppliers of abatement equipment add another safety margin, because they have to guarantee that their equipment will meet certain emission limit values.
- While the emission limits are set on a daily or hourly basis, our emission data represent annual averages of emissions (it is easier to meet an emission limit on the yearly than on the hourly average).
- The abatement equipment German MWIs had to install in order to meet the limit for dioxon emissions set in the German ordinance, automatically reduced emissions of other pollutants as well and thus entail over-compliance of these pollutants.
- Their regional monopolies enable MWI operators to rather easily transfer pollution abatement costs to their clients (once the expensive abatement equipment is installed there are only low marginal abatement costs anyway).

All in all, the strict monitoring and enforcement system was the pre-condition for compliance with the European and German regulations, whereas technical reasons, a monopolistic market structure and a high environmental awareness of the German public led to over-compliance.

5.2 Allocative efficiency

There is some evidence that by allocating abatement activities in a way that accounted for the differences in abatement costs that existed between the plants the same amount of emission reductions could have been achieved at lower costs. However, the allocation of abatement activities was not determined during the formulation and implementation of the German 17. BImSchV, but was already imposed by the European directives. That the German ordinance unlike the European Directive 89/429/EEC does not set different emission limits for small and large incinerators, did hardly effect allocative (in-)efficiency, because almost all German MWIs have a nominal capacity of more than 6 t/h anyway.

5.3 Productive efficiency

The implementation of the European Directives and the 17. BImSchV did hardly help to increase productive efficiency for the following reasons:

- Public authorities did not take any measures in order to inform MWI operators about the technical options for the abatement of emissions. A certain distribution of information about abatement techniques was only achieved as a side-effect of the discussions about the formulation of the 17. BImSchV and the EMDA.
- The 17. BImSchV and especially the EMDA in NRW imposed strict deadlines for MWIs' compliance with the emission limits provided for in the ordinance.

5.4 Administrative costs

By looking at the German administrative costs alone, we cannot decide whether they are high or low. However, our analysis enables us to identify certain aspects of the implementation process which influenced administrative costs. These are:

- The tight timetable set in the 17. BImSchV and the EMDA in NRW required permitting authorities to carry out the authorisation of the FGD systems as swiftly as possible. As this implied an optimal organisation of the authorisation procedures, administrative costs were very likely reduced.
- The automatic measurement, processing and transfer of emission data considerably decreased the working time incurred in monitoring (but produced some costs for the technical equipment).

To sum up, the case study on the implementation of the European and German regulations on emissions from municipal waste incinerators revealed that the implementation activities of public authorities (monitoring and enforcement, distribution of information etc.) influenced the success or failure of the pieces of legislation, but also stressed the importance of technical factors and the public's environmental awareness.

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Annex: Current emissions of Bavarian municipal waste incinerators

MHKW Coburg

Pollutants	Combustion unit 1			Combustion unit 2		
	mg/m³	% of EU limits[a]	% of German limits[b]	mg/m³	% of EU limits[a]	% of German limits[b]
Dust	0.2	0.7	2.0	0.5	1.7	5.0
CO	5.1	5.1	10.2	6.8	6.8	13.6
HCl	0.4	0.8	4.0	0.2	0.4	2.0
SO_2	15.3	5.1	30.6	2.8	0.9	5.6
Cd + Hg (+TI)	< 0.004	< 2.0		< 0.012	< 6.0	
Hg	0.003		6.0	0.011		22.0
HF	< 0.9	< 45.0	< 90.0	< 0.8	< 40.0	< 80.0
Dioxins + furans (ng TE)	0.038		38.0	0.023		23.0
Index 1		9.8	25.8		9.3	21.6

Table 29: 1998 emissions of MHKW Coburg in mg/m³
Source: Web site of the Bavarian Ministry of the Environment
(www.bayern.de/STMLU/abfall/einwirk/techdat/pub/cobol1.htm and ~cobol2.htm, 02/10/00, 2:52 pm)

MKW Landshut

Pollutants	mg/m³	% of EU limits[a]	% of German limits[b]
Dust	0.94	3.1	9.4
CO	25.61	25.61	51.2
HCl	0.71	1.42	7.1
SO_2	6.72	2.2	13.4
Cd + Hg (+TI)	< 0.013	< 6.5	
Hg	0.011		22.0
HF	< 0.2	< 10.0	< 20.0
Dioxins + furans (ng TE)	0.014		14.0
Index 1		8.1	19.6

Table 30: 1998 emissions of MKW Landshut in mg/m³
Source: Web site of the Bavarian Ministry of the Environment (~lanol1.htm, 02/10/00, 2:34 pm)

[a] Emission limits of 89/369/EEC (all plants have a nominal capacity of more than 6t/h)
[b] Emission limits of 17. BImSchV (daily average)

MHKW Rosenheim

Pollutants	mg/m³	% of EU limits[a]	% of German limits[b]
Dust	2.8	9.3	28.0
CO	23.1	23.1	46.2
HCl	4.0	8.0	40.0
SO_2	12.9	4.3	25.8
Cd + Hg (+TI)	< 0.005	< 2.5	6.0
Hg	0.003		
HF	< 0.2	< 10.0	20.0
Dioxins + furans (ng TE)	0.0058		5.8
Index 1		9.5	23.1

Table 31: 1998 emissions of MHKW Rosenheim in mg/m³
Source: Web site of the Bavarian Ministry of the Environment (~rosol1.htm, 02/10/00, 2:27 pm)

[a] Emission limits of 89/369/EEC (all plants have a nominal capacity of more than 6t/h)
[b] Emission limits of 17. BImSchV (daily average)

CASE STUDY III

The implementation of national and European legislation concerning air emissions from large combustion plants in Germany

Table of contents

List of abbreviations

BDI	Bundesverband der deutschen Industrie (Federation of German Industries)
BImschG	Bundesimmissionsschutzgesetz (German Pollution Control Act)
BMI	Bundesministerium des Inneren (Federal Ministry of the Interior)
BMWi	Bundeswirtschaftsministerium (Federal Ministry of Economics)
EFÜ	Emissions-Fernüberwachung (telemetric transfer of emissions)
EMP	Emissionsminderungsplan für Großfeuerungsanlagen der öffentlichen Energieversorgung in NRW (Emission Reduction Plan for Large Combustion Plants of the Electricity Supply Industry in NRW)
FGD	Flue gas desulphurisation
GFA-VO	Großfeuerungsanlagen-Verordnung (Ordinance on Large Combustion Plants)
LCP	Large combustion plant
LCPD	Council Directive on the limitation of emissions of certain pollutants into the air from large combustion plants (88/609/EEC)
MURL	Ministerium für Umwelt, Raumordnung und Planung des Landes Nordrhein-Westfalena (Ministry of the Environment, Regional Policy and Planning of North Rhine-Westphalia)
NRW	North Rhine-Westphalia
TA Luft	Technische Anleitung zur Reinhaltung der Luft (Technical Instructions on Air Quality Control)
TAV	Trocken-Additiv-Verfahren (dry additive technique)
UBA	Umweltbundesamt (Federal Environmental Agency)
VDEW	Vereinigung Deutscher Elektrizitätswerke (Association of German Electricity Suppliers)

1 Introduction

The "Council Directive on the limitation of emissions of certain pollutants into the air from large combustion plants (88/609/EEC)" (LCPD) is not directly binding on the EU Member states. According to the directive, national authorities are obliged to "bring into force the laws, regulations and administrative provisions necessary to comply with this Directive no later than 30 June 1990" (Art. 17). In December 1994 the above directive was amended by Council Directive 94/66/EC, which had to be translated into national law within six months of coming into force (Art. 2).[1]

In Germany, emissions from large combustion plants (LCP) had been regulated years before the EEC directive was adopted. The German "Großfeuerungsanlagen-Verordnung" (GFA-VO, Ordinance on Large Combustion Plants) had already come into force on 1 July 1983. It was not only developed independently from the European regulations, but in fact was one of the driving forces behind the EEC directive. Because air emissions are a cross-border problem and to prevent competitive disadvantages resulting from domestic legislation, Germany had pushed for similar provisions to be established at the European level (cf. Ikwue/Skea 1996, p.87).

Although the German ordinance served as an example for the EEC directive, the two legal texts differ in some respects. Generally speaking, the German text is stricter than the European one, especially as far as the requirements set for (individual) existing LCP are concerned. The EEC directive (annex 1) provides for national emission ceilings and reduction targets that are perceived as rather undemanding by German government officials.

As the European Commission judged the German ordinance to be in compliance with the EEC directive, the enactment of the EEC directive did not constitute a need for implementation activities in Germany, neither with respect to the translation into German law nor regarding the enforcement. The demands on existing plants included in the German ordinance are also referred to in the context of the Member states' obligation to "draw up appropriate programmes for the progressive reduction of total annual emissions from existing plants" (88/609/EEC, Art 3).

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[1] The Regulation 94/66/EG served to fix SO_2 emission limits for plants with a rated thermal input of 50-100 MW_{th} which was left open in the Regulation 88/609/EEC.

Because the LCPD had no influence in Germany, our report will concentrate on the implementation of the GFA-VO.[2] We will describe the implementation process and then analyse it in terms of attainment of the ecological goals and efficiency. To gain the necessary data and information we reviewed the relevant literature and conducted expert interviews with representatives of government, enforcement authorities, and plant operators. The regulations on SO_2-emissions from existing large combustion plants have been in the centre of our investigations. Complexity was further reduced by concentrating on the electricity supply industry, which accounts for the majority of LCP.

The central outcome of the implementation process is the high ecological effectiveness, i.e. the SO_2 emission limits of the ordinance were met by the overwhelming majority of the combustion plants. In fact, in many cases emission limits were actually well below those allowed by the GFA-VO - despite ambitious aims, a tight time schedule and high compliance costs. Therefore, one key task of the case study is to explain why this happened and what costs had to be paid for the high degree of ecological effectiveness (or rather 'over-compliance').

The report is arranged as follows. The next chapter describes the structure of the German electricity supply industry (chapter 2). Chapter 3 describes the implementation of the GFA-VO and chapter 4 analyses the outcomes of the implementation process (i.e. the attainment of the ecological goals, efficiency of pollution abatement and administrative efficiency). Finally, chapter 5 develops some hypotheses on how goal attainment and efficiency have been influenced by specific features of the implementation process.

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[2] We exclude from our analyses the implementation of West German law in Eastern Germany following German reunification in 1990. As this has much to do with the transformation of a former communist country into a market economy, this warrants separate treatment.

2 The German electricity supply industry

In 1980 the electricity supply industry was the main producer of SO_2 emissions in West Germany. Table 1 subdivides SO_2 emissions in Western Germany in 1980 and 1994 into different emission sources. The electricity supply industry's contribution (including district heating) was 59.4% in 1980, but by 1994 had declined to 36.9%.

	1980		1994	
	kt	**Share in %**	**kt**	**Share in %**
Industrial processes	110	3.5	78	8.9
Road traffic	67	2.1	45	5.1
Other transport	20	0.6	9	1.0
Households	196	6.2	91	10.4
Small consumers	142	4.5	53	6.1
Industrial combustion	750	23.7	275	31.5
Electricity supply (incl. district heating)	1,879	59.4	323	36.9
Total	**3,164**	**100.0**	**874**	**100.0**

Table 1: Sources of SO_2 emissions in West Germany
(Source: UBA 1997, pp. 135-139)

Germany is one of the largest electricity producers (and consumers) in the European Union. In 1997 Germany generated 549.7 billion kWh electricity (and consumed 545 billion kWh) (cf. Statistisches Bundesamt 1999, S. 225 and VDEW, www.strom.de/zf_sz_15.htm, 03/23/99, 14:05). The German electricity supply industry is fragmented and has a rather complex structure. On the one hand there are eight large companies which own and operate the national high voltage grid and the majority of generation capacity. On the other hand there is a multitude of regional and local companies (nearly 1,000) which mainly distribute (but hardly generate) electricity. While the public sector owns or holds majority shares in many of the regional and local companies, the eight large companies are dominated by private share holders. Prior to the recent liberalisation of the European electricity markets, the German electricity suppliers enjoyed regional monopolies. The electricity supply industry was exempt from competition

and antitrust laws.[3] The electricity suppliers began to lose this comfortable position with the 1997 European regulation on a single electricity market.

The power stations of the electricity supply industry produced 486,768 GWh in 1997, which was 88.6% of the total electricity generated in Germany. Table 2 shows absolute and relative generation by electricity suppliers, industry and the German railways (Deutsche Bahn AG) in 1987 and 1997.

	1987		1997	
	GWh	**Share in %**	**GWh**	**Share in %**
Electricity suppliers	355,048	84.9	486,768	88.6
Industry	56,950	13.6	55,452	10.1
Deutsche Bahn AG	6,264	1.5	7,526	1.4
Total	**418,262**	**100.0**	**549,746**	**100.0**

Table 2: Electricity generation in Germany in 1987 and 1997
(Source: Statistisches Bundesamt 1991, p. 233; Statistisches Bundesamt 1999, p. 225)

In 1995, 79% of the electricity generated by the roughly 1,000 suppliers was produced by the nine largest companies.[4] The approximately 80 regional suppliers provided about 10% and the remaining 11% came from the small local utilities. With respect to electricity distribution there is a different picture: the regional and local companies have shares of 36% and 31% respectively. Only 33% of the electricity sold to households, companies and public institutions came from the nine large suppliers, because they often provide other suppliers with electricity instead of selling it directly to consumers (cf. VDEW, www.strom.de/arc_0003. htm, 02/22/99, 14:00). In 1996 RWE Energie AG (Essen) was the largest electricity supplier in Germany. The company sold 127.4 billion kWh and thus accounted for roughly 30% of the electricity generated by the electricity supply industry (and about a quarter of Germany's total electricity generation) (cf. VDEW, www.strom.de/arc_0052.htm, 03/23/99, 14:06).

Coal and uranium are the main energy sources in Germany. In 1997 the electricity supply industry produced 28% of its electricity from lignite, 25% from hard coal and 35% from nuclear

[3] Electricity prices were fixed by electricity suppliers, but had to be approved by public authorities. In order to increase prices suppliers had to prove a corresponding rise in production costs.

[4] Two of them merged in 1997 (Badenwerk Holding AG and Energie-Versorgung Schwaben Holding AG merged to Energie Baden-Württemberg AG), so that their number reduced to eight.

energy. Approximately 7% was produced from gas and 1% from oil. Hydroelectric power stations accounted for 4%. Other sources (incl. renewable energy sources such as waste, wind and solar energy) contributed 1% to electricity generation. Compared to 1987 the contributions of the different energy sources remained almost constant (see Fig. 1).

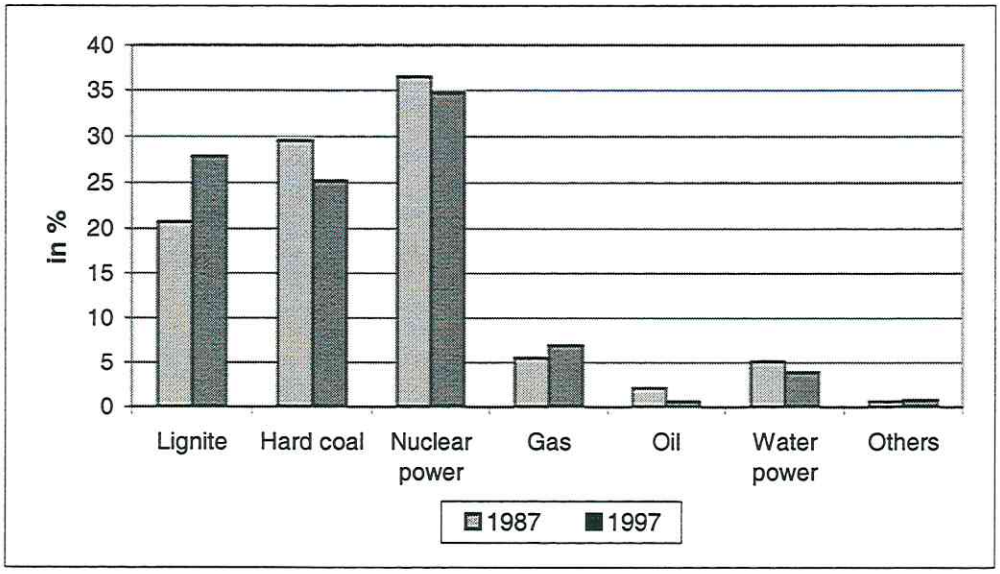

Figure 1: Energy sources used in electricity generation in Germany in 1987 and 1997
(Source: Statistisches Bundesamt 1991, S. 233 and Statistisches Bundesamt 1999, S. 225)

Germany has rather large coal reserves. As German hard coal is very much more expensive than coal available on the world market, the German government has traditionally intervened to ensure that indigenous hard coal is used for electricity generation (cf. Ikwue/Skea 1996, p. 81). Between 1964 and the early 1970s electricity suppliers were encouraged to build hard coal-fuelled power stations by being granted tax benefits and subsidies. As of 1974 the use of hard coal was supported by a long-term contract between electricity suppliers and the coal industry. The contract was legally based on the 'Drittes Verstromungsgesetz' (Third Act on the conversion of hard coal into electricity) of 1974. It stipulated that the electricity supply industry buys a certain amount of German hard coal each year (between 33 and 47.5 million tons) and pays a price sufficient to cover the costs of the mining companies. Electricity suppliers that ran hard coal-fuelled power stations got subsidies that were financed by a levy on electricity prices (Kohlepfennig). The contract applied until 1995. (cf. www.nrw-online.de/bergbau/lex_v.htm, 05/08/00)

Since 1996 the amount of hard coal the electricity supply industry buys and the price it pays is not regulated any more. Now the mining companies sell the hard coal at world market prices, but are compensated for the difference between the price they get and their production costs. The subsidies are taken from the federal budget and are only paid for a limited amount of coal.

3 Characterisation of the implementation process

The LCPD was preceded by German legislation which came into force in 1983. When the LCPD was adopted, it had no influence on the German pollution control policies. The Commission agreed that with the GFA-VO Germany had met all the requirements of the LCPD. Therefore, we shall concentrate our analysis on the implementation process of the German ordinance.[5]

The implementation process can be divided into four phases: political evolution of the GFA-VO, norm specification, retrofitting and authorisation procedures, and monitoring and enforcement. Although the political evolution of the GFA-VO is not part of the actual implementation, we consider it a sub-phase of the implementation process (similar to the translation of EU legislation into national law). The reason is that the decisions made in this phase (e.g. concerning the technological options to comply with the regulation, the retrofitting schedule, and measurement requirements) have strongly influenced the performance of the implementation process itself. The second phase deals with norm specification activities, especially an Emission Reduction Plan agreed between the state government and the electricity supply industry of North Rhine-Westphalia. The third phase describes the installation of desulphurisation equipment and the authorisation procedures they had to go through. The fourth and last phase analyses how compliance with the emission limits is monitored once retrofitting has been completed and how enforcement activities are carried out.

The characterisation of the last three phases concentrates on the state of North Rhine-Westphalia (NRW). Geographical concentration was necessary given the decentralised administrative structure of Germany and the large number of LCP run by electricity suppliers. However, the basic implementation features were relatively similar in all German states. We chose NRW as an example, because it accounted for roundabout 60% of the German electricity generation capacity on the basis of fossil fuels (approx. 28,000 of 49,000 MW_{el}, cf. EMP, p.7 and Hildebrand 1986, p. 7). Moreover, NRW was interesting for the reason that it implemented the GFA-VO in the form of an institutionalised cooperation with the electricity supply industry.

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[5] The information on the implementation process is mainly based on expert interviews we conducted with representatives of government, enforcement authorities and plant operators. The interviews were carried out over the year 1999.

Our characterisation of the implementation process is centred upon the actors involved. We analyse their relationships as well as their motives, interests and strategies. Figure 2 gives a schematic picture of the basic actors and the transactions taking place between them.

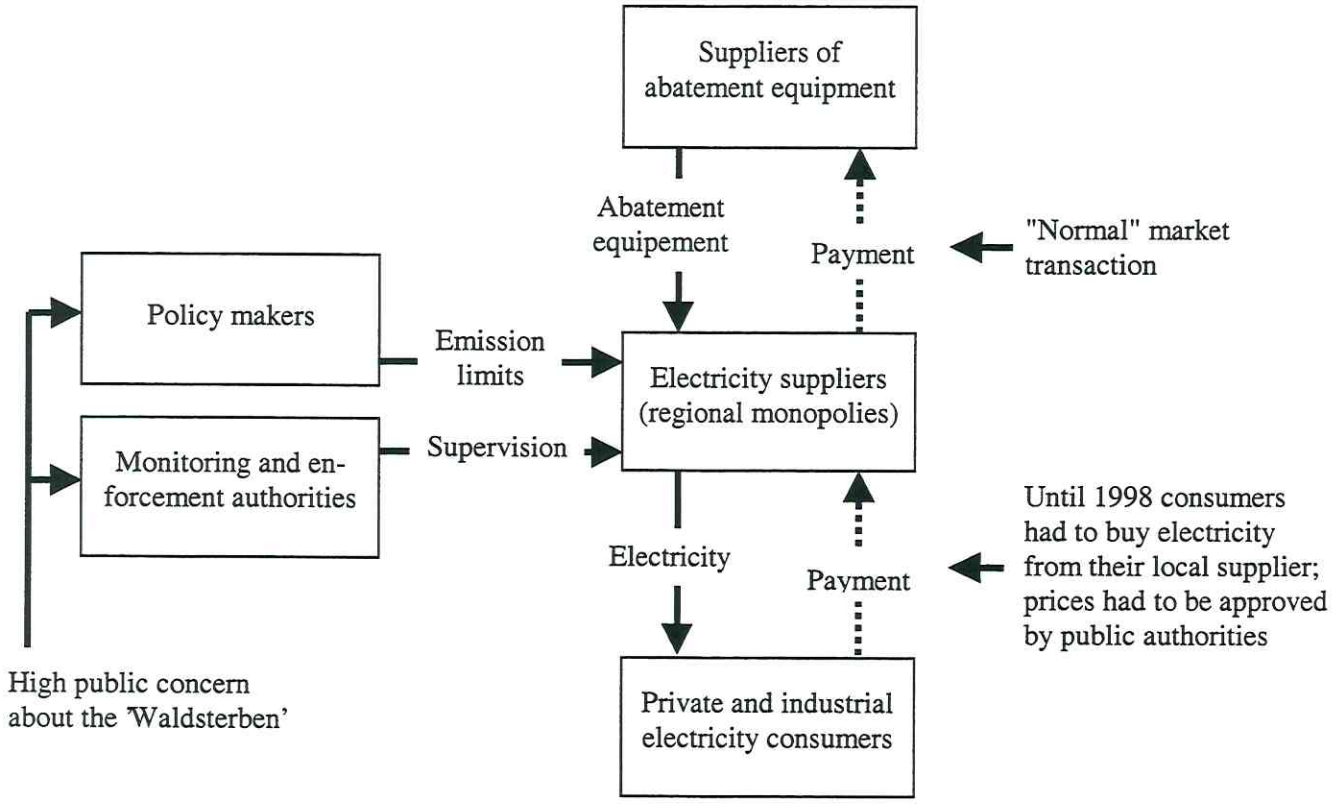

Figure 2: Structure of basic actors and their relationships

The structure of actors and transactions shown in Figure 2 forms the basis respectively the background of the entire implementation process. In the following a more detailed analysis of the relevant actors, their relationships and activities as well as the outcome of their activities is provided for each of the single implementation phases.

3.1 Phase 1: The political evolution of the GFA-VO[6]

Before the 1970s the general concern over SO_2 emissions was that they affect the environment close to an emission location. The obvious response to this problem was to construct tall chimney stacks which distributed the emissions over a larger area. In the 1970s it became evident that such a policy leads to the deterioration of air quality in formerly pollution-free zones

[6] Large parts of this chapter are based on Dose 1997, pp. 153-160.

and negatively affects vegetation in these areas. The first signs of what became known as 'Waldsterben' (forests dying) became visible. At the end of the 1970s and early 1980s the 'Waldsterben' spread rapidly. By 1984 already 50% of the German forests were affected, with 33% being considered slightly damaged and 17% severely damaged (cf. UBA 1994, p. 166).

3.1.1 The actors, their motives and strategies

Ministry of the Interior

The 'Bundesministerium des Inneren' (BMI, Ministry of the Interior) was the ministry in charge of pollution control at the end of the 1970s. It reacted to the problem of the 'Waldsterben' and the public discussion about it by resolving to significantly reduce SO_2 (and NO_x) emissions. In pressing for tighter emission limits the BMI obviously accepted that through higher electricity prices, private and industrial electricity consumers would have to pay the pollution abatement equipment in the end.

Despite choosing a confrontational strategy, the BMI remained in contact with industry. Communication with industry facilitated an exchange of views on feasible technological options to reduce SO_2 emissions. Unlike electricity suppliers, the BMI was convinced that reliable desulphurisation techniques existed that could enable an emission limit of 400 mg SO_2/m^3.

Industry

The industrial groups involved in the discussion about the GFA-VO were the electricity supply industry, the coal industry and industrial associations such as the 'Bundesverband der deutschen Industrie' (BDI). The electricity supply industry generally welcomed definite regulations on SO_2 (and NO_x) emissions at the national level. The legislation on which air pollution control policy was based at that time (TA Luft, Technical Instructions on Air Quality Control) only demanded that SO_2-emissions should be reduced "as much as possible". This led to varying regulations in the German states. Nevertheless, the electricity suppliers were opposed to the GFA-VO, as they believed the emission limits and deadlines to be too strict. They stressed that hardly any experiences with denitrification and desulphurisation existed in Germany so that they would have to rely on Japanese experience not yet adapted to conditions in Germany. They argued that this experience was insufficient to ensure compliance with the strict emission limit (400 mg/m³). Additionally, electricity suppliers feared that the period of

time they were given to comply with the limits was too short to test desulphurisation techniques in pilot plants first. Consequently, many shortcomings and optimisation methods could not be discovered before the techniques were applied to the entire fleet of power stations (cf. Bertram/Karger 1988, p. 99). The high costs incurred in installing desulphurisation techniques were less important for the electricity supply industry because they held regional monopolies and thus could rather easily transfer the costs to their customers via higher electricity prices. It was precisely this mechanism which led industry, especially energy-intensive branches, to resist the GFA-VO. Industry was afraid its international competitiveness would be jeopardised, if only German companies had to pay higher electricity prices. Moreover, the coal industry was concerned that strict emission limits for SO_2 would force electricity suppliers to stop using highly sulphurous German coal.

Industry generally adopted a confrontational strategy, but always stayed in touch with the BMI. Industry argued that high abatement costs would endanger the economic competitiveness of German industry, highlighted possible dangers for German coal production and argued there was no clear scientific evidence that SO_2 emissions were responsible for the 'Waldsterben'.

Ministry of Economics

The GFA-VO could not be enacted by the BMU alone, but had to be approved by the federal government. In the inner-governmental discussions that preceded the adoption of the ordinance, the 'Bundeswirtschaftsministerium' (BMWi, Ministry of Economics) was a strong supporter of business interests. The BMWi especially tried to prevent the strict SO_2 emission limit envisaged by the BMU.

Suppliers of abatement equipment

The suppliers of abatement equipment were involved in the formulation of the 17. BImSchV in so far as they were asked by policy-makers to provide information about the technically feasible emission limits. The suppliers had an economic incentive to offer equipment that was able to reach emission limits as low as possible, because the lower the emission limits the more complex and the more expensive the equipment. But on the other hand the suppliers had to bear in mind that they would have to guarantee LCP operators to meet the low limits.

To be on the safe side, suppliers of abatement equipment usually adopted a strategy of incorporating a safety margin in the emission limits they gave policy-makers and guaranteed LCP

operators, i.e. the limits they said to be achievable were slightly higher than those they in fact thought to be able to reach.

Political actors

The decision about the GFA-VO was influenced by leading politicians, especially at the level of the Federal Government. Until October 1982 the Federal Government was a coalition between the Social Democrats (SPD) and the Liberals (FDP). It was succeeded by a coalition between the Liberals (FDP) and the Conservatives (CDU/CSU), which also won the March 1983 general election. The growing concern of the population about the 'Waldsterben' put enormous pressure on the politicians to do something about it, not least because it was an issue in the 1983 election. Furthermore, the Green Party scored its first electoral successes at this time. It was especially important for the Social Democrats to stop the rise of the Greens as many of their voters sympathised with green ideas.

3.1.2 Description of the process

Growing concern about negative effects of SO_2 emissions led the BMI to start working out a concept for an ordinance dealing with the reduction of SO_2 emissions in power stations at the end of 1977. In May 1978 a preliminary draft was presented to and discussed with representatives of industry. The BMI suggested an emission limit of 400mg/m³ SO_2, which was strongly opposed by representatives of the electricity supply industry and the coal industry. Although this limit was technologically feasible, it was feared that it could not be met with highly sulphurous German coal (which had been used so far in 25% of the German coal combustion plants) and would require companies to switch to imported coal. Because the department in charge of the ordinance was involved in the highly controversial revision of other air pollution laws, work on the ordinance came to a standstill.

As the 'Waldsterben' became increasingly conspicuous there was mounting pressure to resume work on the ordinance. In December 1980 the Umweltbundesamt (UBA, Federal Environmental Agency) presented a second draft which included an emission limit of 650 mg/m³ SO_2 for all combustion plants with a capacity of more than 1 MW_{th}. This draft was discussed with representatives of industry and technical experts at a meeting on 28-30 September 1981. It was decided to commission a working group consisting of representatives of the BMI and the German states as well as technical experts such as suppliers of abatement equipment to elaborate the draft.

In May 1982 the working group presented a proposal for an ordinance which was discussed by the Cabinet on 1st September 1982. The proposal included an emission value of 400mg/m³ SO_2. The limit had been reduced due to the personal intervention of the Minister of the Interior, Gerhard Baum (FDP). This reduction was opposed by the Minister of Economics, Otto Graf Lambsdorff (FDP), because it implied higher costs for industry. However, growing public concern about the 'Waldsterben' led the leader of the Liberals and Foreign Minister, Hans-Dietrich Genscher, to push this limit through within the FDP. The German Chancellor, Helmut Schmidt (SPD), also supported a lower emission standard for the same reason.

The proposal was then sent to the German states and relevant organisations for feedback. The official hearing was on 29 November 1982 and a revised proposal was presented in January 1983. However, this proposal was not so much influenced by the hearing than by a conference of the Federal Ministers of the Environment (11–12 November 1982), who were in favour of a stricter ordinance. In a third revised proposal some ideas of industry were finally taken into account, for example, special regulations for plants with heat recovery technology. However, industry was not able to reach substantial modifications. This third version of the proposal was accepted by the Cabinet on 23 February 1983 and sent to the 'Bundesrat' (Upper House of Parliament) for approval. The 'Bundesrat' agreed to the proposal with a number of minor amendments, most of which provided for even stricter regulations. After the Federal Government had completely accepted the modifications proposed by the 'Bundesrat', the GFA-VO came into force on 1 July 1983.

3.1.3 The outcome

The striking characteristic of the political evolution of the GFA-VO is that it constituted a continuous development towards a stricter ordinance. Industry was under strong pressure and lost nearly all the battles. The reason was that the 'Waldsterben' became manifest in many forests and put enormous pressure on politicians to act. The fears of the electricity supply industry that desulphurisation technologies were not advanced enough to ensure an SO_2 emission limit of 400 mg/m³ and that the schedule was too tight to enable the techniques to be first tested in pilot plants, were only partly considered. Therefore, the outcome of this phase, the GFA-VO, can be regarded as a fairly strict piece of legislation. The main features are summarised below. Special emphasis is placed on regulations relevant for SO_2 emissions, existing combustion plants and the implementation process.

Main features of the GFA-VO
(Verordnung über Großfeuerungsanlagen – 13. BImSchV)

Scope of application (§1)

The GFA-VO only covers combustion plants with a rated thermal input of more than 50 MW (100 MW if gaseous fuel is used).

SO_2 emission limits for existing plants (§20)

While the European directive (annex 1) provides for national emission ceilings and reduction targets, the German ordinance sets emission limits for individual plants. They are differentiated by fuel, capacity and remaining operating time.

Solid or liquid fuel	Rated thermal input of >300 MW_{th} and a remaining operating time of	≤ 10,000 hours	As agreed in the permits
		> 10,000 and ≤ 30,000 hours	2,500 mg/m³
		> 30,000 hours	As for new plants (400 mg/m³)
	Rated thermal input of ≤ 300 MW_{th} and a remaining operating time of	≤ 10,000 hours	As agreed in the permits
		> 10,000 hours	2,500 mg/m³
Gaseous fuel	No limits set		

Table 3: SO_2 emission limits in mg/m³ for existing plants

The above limits for SO_2 emissions apply until 1 April 1993. Thereafter existing plants also have to meet the requirements imposed on new plants. These are generally 400 mg/m³ and 650 mg/m³ SO_2 for plants using coal with a high or fluctuating percentage of sulphur. The limits are regarded as complied with, when within one year all daily averages and a certain percentage of the half-hourly averages meet the limits. In addition to the emission limits, a desulphurisation rate of 85% is stipulated.

Measuring procedures and monitoring of emissions

Combustion plants using solid or liquid fuels have to install measuring devices which continuously monitor the SO_2-concentration in the waste gases (§25 (4)).

It must be ensured by the continuous recording of either the desulphurisation rate of the cleaning technology or other relevant parameters that the imposed desulpurisation rate is reached (§ 25 (5)).

The results of all measurements have to be recorded and analysed. A report on the findings must be sent to the competent authority within three months after the end of a year (§27 (1)).

The measuring equipment has to be inspected and calibrated directly after its installation. Afterwards its functionality is checked once a year and calibration is repeated every three years at plants with a rated thermal input of more than 300 MW and every five years at other plants (§ 28 (1-2)).

Exemptions from the provisions of the ordinance

On the on hand competent authorities may grant exemptions from requirements of the GFA-VO, if their fulfilment is impossible or entails excessive costs (§33). On the other hand competent authorities are entitled to lay down requirements which go beyond the provisions of the ordinance (§34).

Time allowed for compliance / deadlines

Generally plants are given five years to comply with the emission limits for SO_2. If the operators aim to achieve the emission limits by fuel switching they have to comply with the SO_2 emission limits within two years (§ 36 (2)).

3.2 Phase 2: Norm specification – the Emission Reduction Plan in NRW

Following the enactment of the GFA-VO there were two important norm specifications we would like to mention. The first was the resolution of the Conference of the Environmental Ministers of the German states (UMK-Beschluß) of 5 April 1984. The resolution specified the best available technology for denitrification and significantly reduced the emission limits for NO_x. By doing so it complied with the paragraphs of the GFA-VO which demanded a continous adaptation of NO_x emissions to the best available technology (Dynamisierungsklausel). Since the resolution was focused on NO_x, we will not examine it in this report.

The second norm specification was a voluntary agreement which the government of NRW negotiated with the North Rhine-Westphalian electricity supply industry in 1984. It was called 'Emissionsminderungsplan für Großfeuerungsanlagen der öffentlichen Energieversorgung in NRW' (EMP, Emission Reduction Plan for Large Combustion Plants of the Electricity Supply Industry in NRW) and served to reduce SO_2 and NO_x emissions as quickly and as effectively as possible (cf. EMP, p.7). The plan did not change the emission limits set in the GFA-VO and the Environmental Ministers' resolution, but instead fixed annual emission ceilings which were said to go beyond the ordinance. Since the EMP formed the basis of the North Rhine-Westphalian implementation process, it will be described in more detail.

3.2.1 The actors, their motives and strategies

NRW government

There were a number of reasons for the NRW government's endeavours to implement the GFA-VO as quickly and effectively as possible, i.e. to reduce the emissions even faster and more effectively than provided for in the GFA-VO. First of all, it wanted to respond to the high public concern about the 'Waldsterben' and the resulting pressure on public authorities to improve the situation. As the German state with the highest number of large combustion plants, NRW was determined to set a good example and to demonstrate that the emission limits and deadlines set in the ordinance and the Environmental Ministers' resolution were realistic and attainable.

The NRW government concentrated on the electricity supply industry, because it accounted for about 80% of the total capacity of the North Rhine-Westfalian LCPs (82,540 MW_{th} of 110,000 MW_{th}). The power stations of the electricity suppliers were responsible for 85% of

the SO_2 and 80% of the NO_x emissions discharged by LCPs in NRW. Therefore, they bear the highest potential for emission reductions – especially against the background that most of them had a rated thermal input of more than 300 MW and thus were subject to the tightest emission limits of the GFA-VO (cf. EMP, pp. 7/8).

As the NRW government realised it depended on the electricity suppliers' support to achieve its ambitious aims,[7] it adopted a rather co-operative strategy. However, at the same time the EMP enabled the government to control the companies' activities aimed at the development and installation of flue gas cleaning systems.

Electricity supply industry

The electricity suppliers participated in the EMP in order to show their willingness to actively contribute to solving environmental problems, chiefly the 'Waldsterben'. But they did not only have their reputation in mind. They benefitted from the EMP insofar as the plan's tight timetable required permitting authorities to carry out the authorisation procedures as swiftly as possible and thus gave electricity suppliers more certainty for their time planning. Once again, it was relatively easy for the electricity suppliers to promise ambitious emission reductions, because their regional monopolies enabled them to transfer the costs to their customers.

3.2.2 Description of the process

By mid 1984 the electricity suppliers had to declare which of their plants they planned to shut down or reduce in their capacity (rated thermal input). These plants had to be closed once their remaining operating time had expired, by January 1993 at the latest. From the declarations it followed that in West Germany power stations which accounted for about 88% of the total capacity on a fossil fuel basis would continue to operate (cf. Bertram/Karger 1988, p. 98/99). In NRW 80% of the fossil fuelled power stations would remain in operation (cf. EMP, p. 9). At this point the NRW government initiated talks with the large North Rhine-Westphalian electricity suppliers and the 'Vereinigung Deutscher Elektrizitätswerke' (VDEW, Association of German Electricity Suppliers).

The initial talks were held between the NRW president and members of the management boards of the five large North Rhine-Westphalian electricity suppliers (Elektromark, RWE,

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[7] It would not have been possible to force the companies to reduce emissions further and earlier than prescribed in the GFA-VO.

STEAG, VEW, VKR). Although a basic consensus to formulate an Emission Reduction Plan was achieved relatively quickly, some more meetings were necessary to reach an agreement on its content. It was agreed to set up an emission reduction schedule which consisted of annual emission ceilings for individual combustion units. While these key features were developed during the 'high level' meetings between the NRW president and the management board members, the concrete emission ceiling values were negotiated at 'working level' meetings, which were also attended by the local electricity suppliers.

After the basic consensus about the EMP had been reached, the NRW government established the 'Koordinierungsstelle GFA-VO' (Coordination Committee GFA-VO) to prepare and conduct the negotiations and to observe the EMP's implementation. The committee was located at the 'Ministerium für Umwelt, Raumordnung und Planung' (MURL, Ministry of the Environment, Regional Policy and Planning)[8] and consisted of government representatives as well as officials from the permitting and supervisory authorities.

The government of NRW did not require special emission ceilings, but demanded that the EMP laid down requirements that went beyond the GFA-VO. The concrete annual emission ceilings were worked out in close co-operation with the electricity suppliers. The government asked the LCP operators to reveal their actual 1983 emissions and to indicate to what extent and in what time they could reduce their emissions. The operators gave emission reductions that were based on the plant closures they planned and the abatement measures they envisaged in order to meet the emission limits set in the GFA-VO. As they took into account the need for safety margins[9], in some cases promised additional measures and agreed to reduce emissions as soon as possible, they went beyond the ordinance. The emission targets and timetables 'offered' by the companies were here and there tightened on demand of the NRW government and then integrated in the EMP. The negotiations were concluded in November 1984.

Despite some reservations, for example regarding the future fuel quality or the timely execution of authorisation procedures, in the end both parties regarded the EMP as a realistic action plan (cf. EMP, p. 10). To resolve the companies' doubts about the authorisation procedures

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[8] Until the MURL was founded in 1985, the Coordination Committee belonged to the 'Ministerium für Arbeit, Gesundheit und Soziales' (MAGS, Ministry of Employment, Health and Social Welfare).

[9] In order to ensure that not even peak emissions exceed the limits imposed by the GFA-VO, companies needed to include a safety margin in the construction of the abatement equipment and therefore on average achieve emission values that are well below the legal limits.

the government officials promised that the procedures would be carried out as swiftly as possible.

The EMP did not have the status of a contract under public law and therefore could not be enforced. It was a special form of a voluntary agreement which encompassed serious declarations of intent on the part of the LCP operators.

3.2.3 The outcome

The EMP in NRW applied to all LCPs run by electricity suppliers; in total they accounted for a capacity of 82,540 MW_{th}. The plan did not set new emission limits, but was based on the limits set in the GFA-VO (SO_2) and the Environmental Ministers' resolution (NO_x). By setting annual emission ceilings it provided a timetable for the gradual realisation of SO_2 and NOx emission reductions that were said to go beyond the ordinance. Emission ceilings were set for each individual power station. In total, the electricity supply industry faced the following SO_2 emission targets.

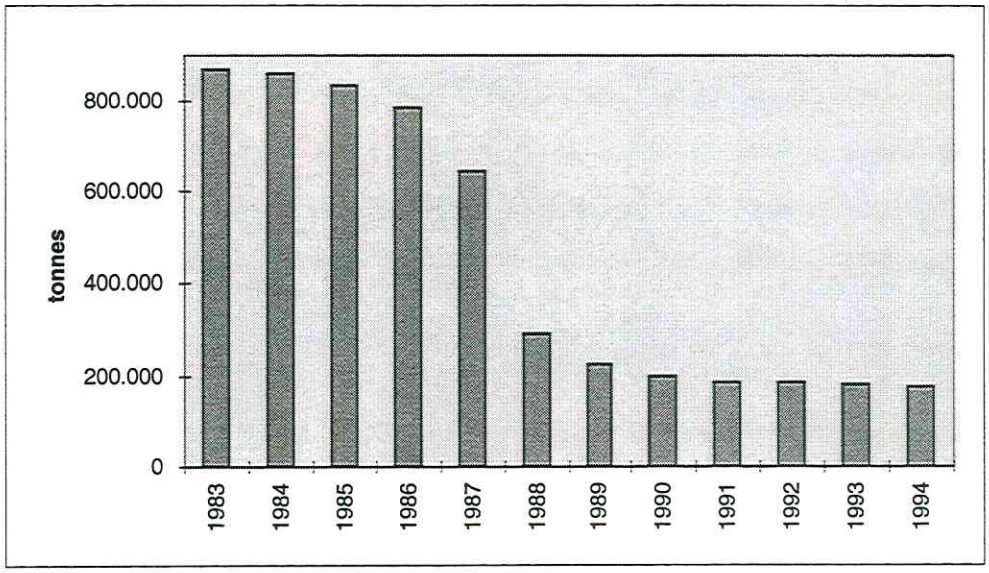

Figure 3: Annual ceilings for SO_2 emission from the electricity supply industry in NRW
(Source: EMP, p. 12)

According to the GFA-VO, the emission limits had to be met as of June 1988 at the latest. Consequently, the EMP in NRW provided for outstanding reductions in this year. However, a remarkable decline in emissions was to be reached even beforehand. This can mainly be explained by a special agreement between the NRW government and one electricity supplier, RWE, which stipulated that RWE decreased its SO_2 emissions by round about 110,000 tons

between 1984 and 1987 by applying a technique called 'Trocken-Additiv-Verfahren' (TAV, dry additive technique) (cf. EMP, p. 14). The TAV involves the addition of lime before or during the combustion process. This simple technique allows SO_2 emissions to be quickly reduced, but only to a limited extent. Although the demands of the GFA-VO could not be met by means of the TAV, the technique was useful for bridging the period of time necessary to install desulphurisation plants. The company then stopped using TAV and switched to flue gas desulphurisation (FGD). The EMP itself did not prescribe or promote the application of any particular desulphurisation techniques.

3.3 Phase 3: Norm realisation 1 – retrofitting and authorisation procedures

Only a minority of the LCPs run by the electricity supply industry were shut down as a consequence of the GFA-VO, and hardly any were reduced in their capacity. Many of the plants that were closed in the years following the enactment of the ordinance would have been shut down anyway due to their age.[10] Fuel switching was an option that was hardly pursued by German electricity suppliers.

The LCPs of the electricity supply industry are almost exclusively fired by coal (about 90% in NRW) and have a rated thermal input of more than 300 MW_{th}. Therefore they were subject to the 'normal' strict emission limits of the GFA-VO which could only be met by installing desulphurisation facilities. As substantial modifications to plants requiring authorisation, the FGD systems themselves needed to be authorised.

3.3.1 The actors, their motives and strategies

Electricity supply industry

The companies retrofitted their LCPs independently. They chose and installed desulphurisation techniques they regarded appropriate for their individual power stations. The choice of

[10] According to interviewees the ordinance sometimes had the effect of prolonging the operating time of combustion plants. When the GFA-VO came into force, a number of existing LCPs were rather old, but not old enough to be closed down, and were therefore retrofitted. However, the installation of cost-intensive FGD facilities is only economically viable if they are used for at least 10 years (sunk costs) (cf. Bertram/Karger 1988, p. 99). Consequently, some combustion plants were rehabilitated to stay in operation for this period of time. The construction of new plants and thus the development of more efficient and environmentally friendly combustion techniques was postponed.

technique was based on a whole range of criteria such as effectiveness in reducing SO_2 emissions, usability of the resulting reaction product, possibility of integration into existing power stations, availability of absorbers, experience, expected stoppage times, and price.

To avoid being sanctioned or having to apply for special exemptions, they were keen to meet the deadlines set in the GFA-VO. For the North Rhine-Westphalian electricity suppliers, the EMP meant another impetus to try to complete retrofitting as soon as possible. In return, the companies demanded that the permitting authorities equally tried to carry out the authorisation procedures as swiftly as possible - for without authorisation the companies could not begin installing of desulphurisation equipment.

Suppliers of abatement equipment

The simultaneous retrofitting of all LCPs participating in the EMP (not to mention all other German LCPs), meant an extraordinary high demand for desulphurisation equipment. Because the number of suppliers is limited, they were only able to serve the demand by working overtime, temporarily hiring extra staff[11] and engaging sub-contractors. Nevertheless the suppliers of abatement equipment were in the comfortable position of a surplus demand, which enabled them to realise (moderate) mark-ups.

Permitting authorities

The permitting authorities' discretionary power was limited by a number of regulations. They had to follow the authorisation procedure described in the BImschG and base their decisions on the requirements of the GFA-VO.[12] However, the organisation of the procedures, the cooperation with plant operators and the decision on the authorisation in the end were left with the authorities. In NRW the EMP called upon the permitting authorities to carry out authorisation procedures as quickly as possible in order not to jeopardise the timely realisation of the plan. The NRW government told the North Rhine-Westphalian permitting authorities to give priority to the authorisation of desulphurisation facilities and to use all the options available to accelerate matters. The NRW authorities were highly motivated to carry out the authorisation procedures swiftly, because they wanted the EMP to be a success.

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[11] The positive employment effects were not sustainable. After the retrofitting of LCP was completed in 1988, the majority of the newly hired employees were laid off.

[12] The BImSchG as well as the GFA-VO were enacted on the federal level and thus are binding for all German authorities.

Coordination Committee GFA-VO

The Coordination Committee GFA-VO monitored the realisation of the EMP, i.e. it observed whether electricity suppliers and permitting authorities complied with the EMP and intervened in case problems arose which could not be solved by the parties involved themselves. The committee was expected to act in accordance with the aims of the EMP, i.e. to implement the GFA-VO as soon and as (ecologically) effectively as possible.[13]

3.3.2 Description of the process

The decision on the desulphurisation equipment was left to the individual companies. They could choose from 10-20 different techniques.[14] When the GFA-VO was enacted in 1983, experience with desulphurisation mainly covered additive techniques and wet flue gas scrubbing (Japan). The companies analysed the different techniques, sometimes carried out tests in test plants and then chose the one that they regarded most appropriate. The majority of companies decided in favour of wet flue gas scrubbers on a lime basis.

To meet the deadlines set in the GFA-VO and the EMP in NRW, the companies had to plan, construct and start the FGD facilities much quicker than they would normally have done. RWE engineers, for example, explained that the retrofitting project had to be completed in 80% of the time that they normally calculated for a project of this scale (58 instead of 70 months) (Kallmeyer/Lenkewitz 1988, p. 20). Many electricity suppliers reported that the tight retrofitting schedule brought about some (extra) difficulties. The main one was that shortcomings[15] and ways of optimising the FGD systems which should have come to light before the systems were introduced in the entire fleet of power stations remained undiscovered. As a result, these shortcomings existed in all power stations. Moreover, FGD suppliers were overburdened because all German LCPs had to be retrofitted more or less at the same time. Therefore they were forced to work overtime, hire extra staff and rely on sub-contractors who sometimes lacked the necessary know-how. This often meant quality declined and caused additional repair work.

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[13] When retrofitting was completed, the Coordination Committee was disbanded.

[14] Besides additive techniques which added lime before or during the combustion process, there were also dry and wet flue gas scrubbers which discharged certain chemicals (absorbers) into the flue gas stream. The absorber chemicals formed a compound with SO_2 and thus made it 'disappear'. Especially wet flue gas scrubbing could be based on various absorbers, e.g. lime, ammonia (Walther) or sodium-sulphite (Wellmann-Lord).

[15] These were shortcomings such as blocked valves and flaked-off coatings.

As substantial modifications to plants requiring authorisation, FGD systems themselves needed to be authorised under the BImSchG. The authorisation procedure (§10 BImSchG) requires the company to send its application to the permitting authority, along with relevant drawings, explanations and other documents. The authority inspects the application and enclosed documents, and may request further information. When the documents are complete, the authority publicly announces the project and displays the application and documents for four weeks, whereupon the public has six weeks to raise objections. The permitting authority then holds a hearing to discuss any objection with the applicant and those who raised the objection. Additionally, other authorities whose areas of responsibility are affected, e.g. the authority responsible for health and safety at work, are asked to submit their statements. The decision whether or not authorisation is granted is supposed to be taken within 7 months after the application (6 months for LCPs in NRW, cf. Kallmeyer/Lenkewith, p. 20). If necessary, the permitting authority can extend this period.

Authorisation is granted for individual FGD plants[16] and is based on the requirements of the GFA-VO. The authorisation documents fix the emission limits valid for the individual units (limits can vary according to size, fuel and remaining operation time), and specify requirements regarding the measurement of emission values and their transmission to the supervisory authority etc. In some cases companies applied for exemptions from regulations of the GFA-VO during the authorisation procedure. Whenever these exemptions were granted, the special regulations were included in the licence as well.

In NRW there was one important case in which an electricity supplier, RWE, asked for an exemption. In many of its combustion units RWE discharged waste gases from cooling towers. For technical and economic reasons the electricity supplier wanted to retain this practice and thus applied for an exemption from §29 GFA-VO, which demands that waste gases have a temperature of at least 345 K and are discharged through a stack. The permitting authority required RWE to provide evidence that discharging waste gases from cooling towers does not damage the environment. RWE tested the discharge from cooling towers in a test plant and commissioned comprehensive scientific studies to analyse the effect on immissions. It was shown that discharging waste gases from cooling towers is not harmful for the environment.[17]

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[16] Generally each combustion unit is equipped with an FGD plant. Therefore at large power stations, which consist of more than one combustion unit, several FGD plants were to be installed.

[17] Please refer to Gebhard et al. 1985, Eckel/Ortner 1985, and Schatzmann et al. 1987 for more information.

After observing the tests and research activities and analysing the results, the permitting authority decided to grant the exemption.

In the context of the EMP, the North Rhine-Westphalian electricity suppliers stressed that they did not want the short time they had to retrofit their LCP to be further reduced by lengthy authorisation procedures. Accordingly, permitting authorities in NRW were required to give priority to the authorisation of FGD systems belonging to electricity suppliers and were told by the NRW government (MURL) to put everything else on the back burner. In fact, the retrofitting of LCP required great efforts by not only the electricity suppliers but also the permitting authorities. At peak times a considerable number of permitting authorities' personnel did nothing but deal with LCP.

The implementation of the EMP was observed by the Coordination Committee GFA-VO. It controlled whether both electricity suppliers and permitting authorities complied with the agreement. The authorities provided the Committee with a progress report every six months. Electricity suppliers did not regularly report to the committee, but were asked for information if necessary. Whenever any problems arose, the Coordination Committee GFA-VO usually was informed via informal channels anyway. The Committee itself provided the NRW government with a progress report every six months and reported on problems.

Whenever difficulties arose during the authorisation process or the emission ceilings were not met, the Coordination Committee GFA-VO made enquiries. If the problems could not be solved by the relevant authorities and electricity suppliers themselves, the Committee intervened by bringing authority officials and company representatives together and acting as a kind of arbitrator. The Committee, for example, dealt with the case in which RWE applied for an exemption to discharge waste gases from cooling towers.

If not even the intervention of the Coordination Committee GFA-VO was enough to produce a solution, the Committee informed the NRW government. Whereas the activities of authorities were easily controlled by means of administrative instructions, the electricity suppliers could not be forced to act in accordance with the EMP. The only way to make them comply was to threaten to make the issue public and thus damage their image.

Kallmeyer/Lenkewitz pointed out that some authorisation procedures were not carried out on time. The construction of the FGD systems had to be postponed accordingly (cf. Kallmeyer/Lenkewitz 1988, p.20). However, in the majority of cases the authorisation and retrofitting procedures went off smoothly and as swiftly as possible. The fact that the EMP was

agreed with high-level involvement (NRW president, management board members) turned out to be very helpful for motivation reasons.

3.3.3 The outcome

In the North Rhine-Westphalian electricity supply industry, 30 power stations with a total capacity of approximately 62,000 MW_{th} were retrofitted with desulphurisation systems (cf. MURL 1992, p. 3). For the whole of West Germany more than 70 fossil-fuelled power stations of the electricity supply industry with a total capacity of 37,600 MW_{el} were retrofitted with FGD (cf. Bertram/Karger 1988, p. 98). The dominating desulphurisation technique was wet scrubbing on a lime basis. This technique, which literally 'washes' the waste gases by means of a water-lime-suspension, reached a market share of 90% in Germany (cf. UBA 1997, p. 188 and Hildebrand 1986). The resulting compound is plaster which is mostly used in the building materials industry.

Apart from a few exceptions, retrofitting was completed between mid-1987 and mid-1988. The actual construction of the FGD systems took 2 to 3 years. Against the background of the EMP many North Rhine-Westphalian electricity suppliers had installed FGD facilities well before the deadline set in the GFA-VO (June 1988). Between 1983 and 1990 the electricity suppliers in NRW reduced their annual SO_2-emissions by 886,000 tonnes (cf. MURL 1992, p. 3), while for the whole of West Germany a reduction of 1,310,000 tonnes was achieved (cf. Hildebrand 1995, p. 37). All in all, the tight schedule laid down in the GFA-VO and the EMP in NRW led to early emission reductions, albeit sometimes at the expense of optimum planning and construction processes and high retrofitting costs.[18]

3.4 Phase 4: Norm realisation 2 – monitoring and enforcement

After the electricity suppliers had retrofitted their LCPs with FGD systems and demonstrated that the systems were able to meet the emission limits set in the GFA-VO, it had to be ensured that these limits actually were met. To this end certain measuring techniques and equipment as well as procedures for transmitting the emission values to the supervisory authority were prescribed in the GFA-VO and specified by the permitting and supervisory authorities. SO_2 emissions are subject to continuous measurements.

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[18] One of our interviewees estimated that nowadays the installation of an FGD system would be one third cheaper.

3.4.1 The actors, their motives and strategies

Electricity suppliers

Operating FGD systems is not cheap. The systems consume absorber materials and energy, and need to be maintained and repaired. Thus the companies would have an economic incentive not to operate them and to violate the requirements laid down in the GFA-VO and their authorisation documents. Previously, German electricity suppliers did not have to worry much about the cost aspect because they held regional monopolies and could thus rather easily increase electricity prices and transfer the costs to their customers. The recent liberalisation of European electricity markets means they are now starting to lose this comfortable position and are facing increasing competitive pressure. Therefore the costs argument can be expected to become more and more important.

On the other hand, the comprehensive control mechanisms and the high probability of non-compliance being discovered and punished is an at least as important incentive to run the FGD systems correctly and to act in compliance with the GFA-VO and the authorisation documents.[19]

Supervisory authorities

The scope of action of the supervisory authority[20] is rather limited. The GFA-VO does not only prescribe which emission values are to be measured, but also encompasses requirements regarding measuring techniques and instruments and the transmission of emission values to the supervisory authority. Additionally, the German administrative law and criminal law contain regulations regarding possible sanctions for non-compliance with the GFA-VO. However, in the end it depends on the authority how thoroughly the plants are monitored and how non-compliance is actually sanctioned.

As the authorities only have a limited number of personnel, they are forced to establish priorities in their supervisory activities. Since SO_2 and NO_x emission, the 'Waldsterben' and thus the GFA-VO received high public attention in the 1980s, the supervisory authorities had an incentive to give priority to the implementation of the GFA-VO. Although public attention has

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[19] Besides, we do not want to refute the notion that the MWI operators are interested in helping to protect the environment.

[20] In NRW until 1996 one and the same authority constituted both permitting and supervisory authority.

since declined, LCPs are still among large plants with a relatively high ecological relevance and thus are still high on the supervisory authorities' list of priorities. Thanks to the introduction of the automatic measurement and transmission of emission values, the supervision of LCP has become much less time-consuming.

3.4.2 Description of the process

Besides retrofitting with FGD, the GFA-VO requires LCP operators to install equipment to continuously measure, record, and process SO_2 emissions (§ 25(4-5)). In Germany, the decision on the equipment is not taken by the companies alone. With respect to the equipment for measuring emission values, public bodies provide a list of approved instruments from which the companies can choose the one they think most appropriate. In NRW this list is provided by the MURL. In deciding which devices are to be approved, the MURL is advised by expert institutes. The point where the measuring devices are installed, i.e. where the emission values are measured, is fixed by the relevant authority.[21] The decision on the equipment purchased to record and process the emission values is left to the companies. However, once the instruments have been installed, the whole system needs to be approved by the supervisory authority.

The GFA-VO requires the LCP operators to have their measuring equipment checked (once a year) and calibrated (every 3 or 5 years). The companies are obliged to commission (and pay) authorised institutes to perform the tests and forward the results to the supervisory authority (§ 28(1-3)). Again, a list of authorised institutes is provided by public bodies, such as the MURL in NRW. To prevent manipulation, the entire measuring system is sealed. At the end of each year a report on all the year's emission values is submitted to the supervisory authority (§ 27(1)). Additionally supervisory authorities are authorised to do on-site controls whenever they think this necessary (§52(2) BImSchG).

The devices that record and process emission values have undergone a remarkable evolution. In the beginning the data were simply written on punched paper tape. Since the end of the 1980s and early 1990s electricity suppliers have used computers that not only recorded but also processed the data, i.e. automatically calculated half-hourly and daily mean values. In

[21] The measurement points are fixed pursuant to a standard drawn up by the 'Deutsches Institut für Normung' (DIN, German Standardisation Institute).

1998 NRW started connect the companies to the so-called 'Emissions-Fernüberwachung' (EFÜ), a system for the telemetric transfer of emissions.

The introduction of EFÜ was controversial. The electricity suppliers doubted that the supervisory authorities were authorised to force the companies to participate in the telemetric transfer of emissions. They regarded EFÜ as an instrument to tighten controls. As they usually fell below the emission limit values set in the GFA-VO instead of exceeding them, they could not see why it was necessary. The electricity supply industry took legal action over being compelled to use EFÜ. But they lost when the court ruled in favour of the supervisory authorities.

The technical progress of the recording and processing devices made monitoring much easier. At first supervisory authorities had to analyse hundreds of metres of punched paper tapes. When computers were introduced the annual emissions report was just a single piece of paper on which the emission values (half-hourly and daily means) were categorised in different classes indicating whether the emission values fell below or exceeded the limits. This enabled non-compliance to be detected at a glance. With EFÜ the emission values are automatically transmitted to the permitting authority once a day. The authority automatically has a message on its computer screen which says whether emission limits have been exceeded during the last 24 hours. In addition, permitting authorities still receive the annual emissions report.

The improvement of the monitoring processes significantly increased the probability of discoveringt non-compliance. In the times of the punched paper tapes there was a chance that non-compliance would slip through. The introduction of computers already made it much more difficult to escape the controls. And nowadays EFÜ makes it literally impossible to exceed emission limits without being noticed by the supervisory authority.

If emission limits are exceeded, the companies are obliged to inform the supervisory authority and explain the reasons. By comparing the data given in the annual emission report with the cases of non-compliance the companies have reported over the year, permitting authorities can check whether they were always informed when emission limits were exceeded. According to the GFA-VO, combustion units may be run without FGD for 72 successive hours and a total of 240 hours a year.

In NRW there have only been two cases in which electricity suppliers failed to fix their FGD systems within the stipulated time (as far as the interviewees remembered). In the first case the FGD system did not work at all and had to be replaced by a new one. In the second case the coating of the absorber building caught fire, necessitating a new coating. In both cases the

electricity suppliers applied for an exemption under §33 GFA-VO, i.e. they asked for special regulations which permitted them to run the combustion units without FGD until the FGD systems had been repaired. In both cases the supervisory authorities refused an exemption and closed the combustion units for one year or 3-4 months respectively.

As problems with FGD systems initially occurred relatively often, the companies actually needed the chance to exceed emission limit values for 72 or 240 hours. In recent years the companies have only rarely made use of the 72/240-hour rule. On average emission limits are not exceeded for more than 100-150 hours a year. Usually the FGD systems were fixed in 10-15 hours. In fault-free operation, the emission values of the electricity suppliers are well below the limits set in the GFA-VO. The power stations often emit no more than 200 mg SO_2/m^3.

If the requirements of the GFA-VO are violated, supervisory authorities have a whole range of sanctions available. When the authority finds out that a company has violated the GFA-VO, it generally tries to settle the issue informally. If informal contacts do not produce results, the authority passes an official order. This order does not only specify the measures the company is required to take, but also threatens means of coercion. Depending on the degree of non-compliance, the means of coercion can range from a fine to temporary or permanent closure of combustion units.

Apart from the two cases described above, North Rhine-Westphalian supervisory authorities have never had to actually use any means of coercion. In most cases it was enough to threaten the companies with coercion, assuming that the issue had not already been settled informally. However, authorities have demonstrated that they do not hesitate to apply tougher sanctions, when they think this necessary to get a plant in recompliance.

3.4.3 The outcome

The monitoring of LCPs in Germany appears to be exhaustive. The plants are still high on the supervisory authorities' list of priorities. Moreover, the monitoring of LCPs needs relatively little time, because the controls are largely privatised and emission data are provided by the plant operators (in NRW they are even transferred electronically). It seems almost impossible for electricity suppliers to escape monitoring, and so the likelihood of non-compliance with the GFA-VO being discovered is very high. The companies also have to fear severe punishment. Although supervisory authorities at first tried to solve problems rather informally, they

also used tougher instruments such as official orders or even the temporary closure of combustion units.

In fact, electricity suppliers have literally never exceeded emission limits. On the contrary, they were normally well below the limits. Whenever FGD systems broke down, the companies were nearly always able to fix them within the stipulated period.

4 Assessment of the implementation process

The purpose of this chapter is to assess the outcome of the GFA-VO implementation process in terms of goal attainment and efficiency. This will be done in accordance with the indicators the responsible IMPOL project partners developed for the LCP case-studies in the four countries.[22]

4.1 Attainment of the ecological goals

4.1.1 Comparison of actual emissions with legal provisions

The LCPD

At first we present the development of the overall SO_2 emissions from German combustion plants and compare it with the national emission targets formulated in the LCPD. We present different tables for West Germany und (re-)united Germany.[23]

	1980[24]	1985	1990	1993	1996	1998	2003
LCPD emission target (Y*)	-	-	-	1,335	-	890	668
Existing emissions (Yf)	1,879	1,506	295	236	-	-	-
$\Delta Y1 = Yf / Y^* \bullet 100$ (in % of the LCPD limit)	-	-	-	23.8	-	-	-
$\Delta Y2 = (Y^o - Yf)/Y^o \bullet 100$ (reduction in % comp. to 1980)	-	19.9	84.3	83.1	-	-	-

Table 4: Development of SO_2 emissions from combustion plants in West-Germany (in 1,000t/annum) and resulting indicators
(Source: UBA)

[22] The general indicators were developed by Matthieu Glachant and Simone Schucht (CERNA, Ecole des Mines de Paris) and adapted to the LCP studies by Malcolm Eames (SPRU, University of Sussex).

[23] The LCPD only formulates emission targets for West Germany. After the German reunification the Council Directive 90/656/EEC was enacted which *inter alia* sets SO_2 emission targets for reunited Germany (see Table 5). The emission target for 1993 was to be met not before 1 January 1996

[24] The year when the debate about the GFA-VO started was chosen as the initial emission level.

	1980	1985	1990	1993	1996	1998	2003
Revised LCPD emission target (incl. former East Germany)	-	-	-	3,000[25]	-	2,000	1,500
Existing emissions (Yf)	3,803	4,251	2,768	1,967	1,144	-	-
$\Delta Y1 = Yf / Y^* \bullet 100$ (in % of the LCPD limit)	-	-	-	-	38.1	-	-
$\Delta Y2 = (Y^o - Yf)/Y^o \bullet 100$ (reduction in % comp. to 1980)	-	-11.8	27.2	48.3	69.9	-	-

Table 5: Development of SO_2 emissions from combustion plants in (re-)united Germany (in 1,000t/annum) and resulting indicators
(Source: Statistisches Bundesamt 1997, p. 725 and UBA 1997, p. 135-139)

The indicators clearly show that since 1990 the SO_2 emissions in West Germany and in Germany as a whole were much lower than the emission ceilings given in the LCPD. With respect to the LCPD we can therefore observe massif 'over-compliance'.

The GFA-VO

We will now assess the environmental effectiveness with respect to the relevant legislation in Germany, the GFA-VO. The difference between the LCPD and the GFA-VO in terms of emission limits is that the LCPD focuses on nation-wide emission ceilings for large combustion plants, whereas the GFA-VO sets emission limit values in mg/m³ waste gases. These limits vary with fuel, size and remaining operating time of the plant, and are described in detail in chapter 3.1.3. As a general rule we can say that nearly all large combustion plants had to comply with an emission limit of 400mg/m^3 SO_2 as of 1 April 1993. Table 6 shows the development of the average SO_2 emissions of West German combustion plants in the electricity supply industry for selected years between 1980 and 1995.

	1980	1982	1985	1988	1989	1990	1992	1995
Emissions of SO_2 in mg/m^3	2,154	2,160	1,847	582	270	290	250	154
$\Delta Y1 = Yf / Y^* \bullet 100$ (in % of GFA-VO limit)	538.5	540.0	461.8	145.5	67.5	72.5	62.5	38.5
$\Delta Y2 = (Y^o - Yf)/Y^o \bullet 100$ (reduction in % comp. to 1980)	-	-0.3	14.3	73.0	87.5	86.5	88.4	92.9

Table 6: Development of the average SO_2 emissions of combustion plants in the electricity supply industry in West Germany and resulting indicators
(Source: VDEW)

[25] Germany had to comply with this figure as of 1 January 1996.

Because the GFA-VO sets emission limits for individual plants on a daily and half-hourly basis, the yearly average emissions can only indicate, but not prove (over-)compliance with the GFA-VO. However, we know from our interviews that the individual combustion plants actually reached emissions that were well below the legal limits.

Interviewees indicated that only very recently[26] some LCP operators have increased their emissions approaching the emission limit of 400mg/m^3 SO_2 laid down in the GFA-VO. This is done by reducing the lime input in the FGD systems and thus enables the operators to save costs (albeit only to a very limited extent). This can be explained as a reaction to the recent liberalisation of the European electricity market (see chapter 2) and the loss of the energy suppliers' comfortable position as regional monopolists.

The EMP in NRW

Our analysis of the implementation process is focused on NRW. As mentioned earlier, the government and electricity supply industry in NRW agreed on an Emission Reduction Plan (EMP) with respect to SO_2. The emission targets of this plan and the emission levels finally achieved are given in Table 7.

	1983	1984	1985	1986	1987	1988	1989	1990
Actual SO_2 emissions in 1,000 t/a	870	845	750	745	640	205	90	95
Emission targets according to the EMP in 1,000 t/a	870	860	833	786	645	289	224	197
$\Delta Y1 = Yf / Y^* \bullet 100$ (in % of EMP limit)	100.0	98.3	90.0	94.8	99.2	70.9	40.1	48.2
$\Delta Y2 = (Y^o - Yf)/Y^o \bullet 100$ (reduction in % comp. to 1983)	-	2.9	13.8	14.4	26.4	76.4	89.6	89.1

Table 7: Actual SO_2 emissions from large combustion plants of the electricity supply industry and emission targets according to the EMP (North Rhine-Westphalia)
(Source: MURL 1992, p. 12)

Table 7 shows that the emission targets of the Emission Reduction Plan were met. Only in 1987 were they nearly exceeded, but in 1990 overall emissions were roughly 50% lower than agreed between the NRW government and electricity supply industry.

[26] This behaviour is not yet reflected in the existing data.

4.1.2 Extraction of the legal provisions' effect on the development of emissions

We identified the following driving forces that cause or would have caused a decrease (or increase) in SO_2 emissions independentend from the legal provisions.

Increase in the efficiency of power stations

The efficiency of coal-fuelled power stations, i.e. the ratio between the primary energy contained in the coal and the electrical energy produced, has increased from roughly 30% in the 1950s to 45% today. This came along with a reduction of specific coal consumption (kg/kWh) and thus reduced SO_2 emissions. The specific consumption of hard coal in power stations of the electricity supply industry, for example, decreased from 0.682 k/kWh in 1950 to 0.344 k/kWh in 1995. However, improving the efficiency of existing power stations is virtually impossible. A significant increase in efficiency can only be achieved by replacing old plants with modern ones. In NRW, no new power stations have been put into operation since the beginning of the 1980s, i.e. the period in which the GFA-VO has been in force. Therefore an increase in the efficiency of power stations has hardly influenced the emission reductions described above.

Decrease in the sulphur content of fuels

The sulphur content of German lignite has decreased over the last 15 years. NRW lignite nowadays contains only half as much sulphur as at the beginning of the 1980s. This decrease stems from the exploitation of new coalfields containing low-sulphur coal. Ceteris paribus this would have noticeably reduced the SO_2 emissions of lignite-fuelled NRW power stations. Moreover, in the second half of the 1980s legal regulations were enacted that demanded the sulphur content of fuels be reduced.

Electricity generation/mix of energy sources

Although the development of the mix of energy sources and the amount of electricity generated cannot influence emission values on a mg/m^3 basis, they affect absolute emissions (t/a). In western Germany, the electricity generated by the electricity supply industry slightly increased between 1980 and 1995, from 175.581 GWh to 183.333 GWh (source: VDEW). The share of non-fossil energy sources in the West German energy mix has remained almost constant since the mid 1980ies. Therefore the annual emissions of the electricity supply industry presented above were only to a limited extent affected by a change in electricity generation or the mix of energy sources.

All in all, although there might have been a modest decrease in SO_2 emissions even without the GFA-VO, reductions would not have been nearly as high or achieved as quickly as with the ordinance.

4.2 Efficiency of pollution abatement

4.2.1 Abatement Costs

The considerable emission reductions achieved by the GFA-VO were not for free. The VDEW carried out a survey in which West German electricity suppliers were asked to indicate the investments in FGD they had taken due to the enactment of the GFA-VO. The survey covered 70% of the FGD systems installed at power stations of the electricity supply industry and came to the result that for the whole of West-Germany DM 14.3 billion (= € 7.3 billion) have been invested (cf. Jung 1988a, p.268). This corresponds to specific investment costs (arithmetic mean) of DM 150/KW_{th} (= € 77/KW_{th}) (cf. Jung 1988b, p. 155).[27] In the survey electricity suppliers were also asked to provide data on the costs necessary for running the FGD systems. On the basis of their answers Jung estimated that the specific operating costs amount to DM 0,019/kWh (= € 0,01/kWh). The figure includes costs for resource and energy use, personnel, maintenance, capital servicing, and other (Jung 1988a, p. 268/269). The investments in desulphurisation plants in the North Rhine-Westphalian electricity supply industry amounted to over DM 8 billion (= € 4.1 billion) (cf. MURL 1992, p. 4).

In addition to the aggregated costs, we present some data on costs that were born by individual companies. RWE, the largest electricity supplier in Germany, installed 37 FGD systems (wet scrubbers on a lime basis) at four lignite-fuelled power stations with a total capacity of 9,300 MW_{el}. All four power stations have a capacity of more than 2,000 MW_{el} and were built between 1955 and 1976. Total investment costs amounted to roundabout DM 5 billion (= € 2.6 billion) (cf. Kallmeyer/Lenkewitz 1988, p. 20). VEW provided cost data for one existing power station, the hard coal- (and oil-) fuelled 'Kraftwerk Westfalen'. The power station has a capacity of 640 MW_{el} and was built in the mid 1960ies. The costs for equipping the power station with an FGD system (wet scrubber on a lime basis) were put at DM 160 million (= € 81.8 million) (cf. Bertram/Karger 1988, p. 103). VEW claims that the retrofitting of this power station is typical for desulpharisation measures taken due to the GFA-VO.

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[27] On the grounds of the survey Jung claims that cost estimates that are based on the prices provided by FGD suppliers generally underestimate retrofitting investments by approximately 25% because they do not consider the contribution of the plant operators to the installation of the abatement equipment and the fact that it is more expensive to install the equipment at existing plants than at new ones (Jung 1988a, p. 268).

4.2.2 Allocative efficiency

The cost figures presented in the previous chapter clearly show that the GFA-VO did not only produce considerable emission reductions, but also enormous costs. In this chapter we analyse whether the same amount of emission reductions could have been achieved at lower costs, if the abatement activities were allocated in a different, i.e. more efficient, way. Allocative efficiency is attained when an environmental policy ensures that the least-cost implementation of abatement activities being achieved to reach a given goal (such as a certain level of emissions). This implies that the allocation of abatement activities among polluters is such that a reallocation would not produce any cost savings.

In this framework, legal regulations can lead to allocative inefficiency if they either impose different requirements on companies with equal abatement costs or impose the same requirements on companies with different abatement costs. The SO_2 emission limits set by the GFA-VO for existing LCPs are differentiated by remaining operation time, capacity and fuel. However, as most German LCPs remains in operation for more than 30,000 hours, use solid fuels (hard coal and lignite) and have a rated thermal input of more than 300 MW_{th} they are subject to the same emission limit value, namely 400 mg SO_2/m^3. Against the background of the comparably low degree of heterogeneity among these plants, this is generally justified. Nevertheless abatement costs can very notably even between these plants due to the following factors:

- The size of the combustion plants: even for plants with a rated thermal input of more than 300 MW_{th} specific abatement costs (DM/kW_{th}) significantly decrease with plant size (cf. Jung 1988b, p. 155).
- The spatial situation on-site: at some existing power stations there was simply insufficient space to integrate large FGD systems, and so other buildings had to be demolished or the FGD systems had to be located some way away from the combustion units - thus significantly increasing retrofitting costs.
- Plant age: even among the plants with a remaining operation time of more than 30,000 hours there are differences in age of about 20 years. In tendency, abatement costs are higher for older plants, not only because older plants are often smaller and have a more difficult spatial situation, but also because the older combustion techniques are less compatible with the modern FGD systems.

This evidence on different abatement costs is an indicator of allocative inefficiency. However, in order to definitely diagnose allocative inefficiency, it is necessary to ask whether it would have been technically feasible to reallocate abatement acitivites, without changing the overall level of emissions. This implies that some LCPs (for which emission reduction is more costly) could have reduced their SO_2 emissions less at the expense of other LCPs (for which emission reduction is less costly) that would have reduced their emissions even further.

Interviewees indicated that the choice of a so-called 'bubble solution' would have been less expensive than the allocation of abatement activities actually applied. But the cost savings would have been rather small, because the potential for reallocating abatement activities would have been limited. Once FGD systems are installed, the 'fine-tuning' of emissions is possible by increasing or decreasing lime input. Since the lime input develops proportionally with the emissions, no cost savings can be achieved by reducing the lime input at one plant and adding a comparable amount at another. Therefore options for cost savings only exist regarding the installation of FGD systems. Cost savings could have been realised by installing smaller or no FGD systems at all in some plants and compensating for the resulting increase in emissions by raising abatement at other plants.[28] But the increase in emissions (unpurified flue gas contains about 2,300-2,400 mg SO_2/m^3) would be rather high while the options for further reductions are limited, given the ambitious political aim of drastic reductions of SO_2 emissions. This means it would have been impossible to run large power stations without FGD, because the increase in emissions could not have been compensated. Realistically, cost savings could only have been realised by higher abatement at large power stations and saving comprehensive FGD systems in a few small ones (or at plants that would soon have been decommissioned anyway).

4.2.3 Productive efficiency

In the context of pollution control policy productive efficiency means that companies choose the cost-efficient way of pollution abatement, i.e. they are able to choose the abatement cost curve that represents minimum costs. The enactment and implementation of regulations can either increase productive efficiency by providing plant operators with information that help them to find the cost-efficient way of pollution abatement or decrease productive efficiency by

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[28] The installation of smaller FGD systems implies that only parts of the flue gas are dusulphurised. Those parts that are not purified are not cooled down in the desulphurisation process. Therefore, by mixing the two flue gas streams again before they are emitted, the required temperature of 72°C can be met without costly reheating. This means that cost savings rather result from saving reheating than from smaller FGD systems.

constraining the operators' flexibility in choosing the cost-efficient way and timing of abatement.

In order to evaluate the implementataion of the GFA-VO in terms of productive efficiency, we apply the 'Template for Assessment of Productive Efficiency' developed by one of our partners in the IMPOL project.[29]

1. *Were any new constraints on existing LCP introduced as a result of the implementation of the GFA-VO?*

In Germany, the following two constraints were introduced:

- As explained in detail in chapter 3.2, an Emission Reduction Plan (a voluntary agreement between state government and electricity supply industry) was implemented in North Rhine-Westphalia. The plan did not specify new emission limits, but was based on the limits set in the GFA-VO. By setting annual emission ceilings for individual power stations, it provided a schedule for decreasing SO_2 emissions earlier than provided for in the ordinance.
- In 1998 NRW started to connect the LCPs to a system for telemetric transfer of emissions (see chapter 3.4)

2. *Was the abatement technology to be adopted for SO_2 specified for existing LCPs?*

No, operators were free to choose the technology they regarded most suitable.

3.a Were there any external constraints upon operators' commercial freedom with respect to the closure of plants?

No, operators were free to choose whether to comply with the GFA-VO by installing abatement technologies or by closing plants. Plants that did not meet the emission limits had to be shut down by 1993.

3.b Were there any external constraints upon operators' commercial freedom with respect to fuel switching?

There were no constraints imposed by the GFA-VO, but until 1995 a contract between electricity suppliers and the coal industry existed which obliged electricity suppliers to fire a certain amount of German coal.

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[29] The template was developed by Malcolm Eames (SPRU, University of Sussex).

3.c Were there any external constraints upon operators' commercial freedom with respect to the use of low sulphur fuel?

No, but the strict SO_2 emission limits and the desulphurisation rate could not be met by the use of low-sulphur coal alone. The installation of FGD was necessary to meet them.

4. *Has a timetable been specified for upgrading existing plants to the GFA-VO standards for new plants?*

Yes, a relatively strict timetable has been laid down in the GFA-VO (for dates refer to chapter 3.1.3). Even stricter deadlines were set in an NRW-specific Emission Reduction Plan for North Rhine-Westphalian electricity suppliers (for more details refer to chapters 3.2).

5. *Were multi-site operators provided with any flexibility regarding the location of the emission reductions to be achieved?*

No, it was not possible to offset high reductions in one plant with less reductions in another. The emission limit value for SO_2 had to be reached at all plants.

6. *Describe any informational 'events' that took place in the course of the implementation process which were promoted by the regulator as measures accompanying the implementation processes.*

During the political evolution of the GFA-VO a working group was established (September 1981 until May 1982) to develop a draft version of the GFA-VO (see chapter 3.1.2). One controversial topic of this working group was whether the technology was available to meet several proposed emission limits. In the context of the working group many experts were heard and LCPs with SO_2 emission reduction technologies were visited (Dose 1996, p.154). Technological options for desulphurisation were also discussed between the NRW government and electricity suppliers in the context of the NRW Emission Reduction Plan. However, these discussions about desulphurisation technologies served to set feasible emission limits (GFA-FO) and timetables rather than to inform electricity suppliers.

To sum up, the implementation of the GFA-VO did hardly help to increase productive efficiency. On the other hand, mainly the tight timetable set in the ordinance and in the EMP in North Rhine-Westphalia made productive efficiency decrease, because it interfered with LCP operators' decisions on the optimal timing of the retrofitting activities. This result corresponds

to the complaints of LCP operators that they had to plan, construct and start the FGD plants much quicker than they would normally have done (see chapter 3.3.2).[30]

4.3 Administrative efficiency

In order to assess the administrative efficiency of the implementation of the GFA-VO, we will calculate the amount of administrative costs connected with the implementation of the ordinance. As an indicator of the administrative costs we use the number of persons currently dealing with the implementation of the GFA-VO. This means that neither the costs that occured for formulating the ordinance, nor the costs for buildings, equipment etc. are captured. In the following we present the data for each of the actors involved separately.[31]

Authorities – strategic planning

In the Department of Prevention of Air Pollution from Plants (Referat für anlagenbezogene Luftreinhaltung) of the Federal Environmental Ministry 6 persons worked in August 1999. The number of personnel did not change over the previous years. As the employees deal with all kinds of plants that are sources of air pollution (including heating systems in residential buildings and filling stations) they spend only a small percentage of their working time on LCPs. Similarly, the environmental ministries of the German states have some personnel which *inter alia* deals with LCPs.

Authorities – monitoring and enforcement

In Germany, the states are in charge of implementing environmental legislation. Although the general administrative structure is similar in the different states, the concrete allocation of responsibilities can vary significantly. Therefore we restricted our analysis to one state, i.e. NRW. In 1998 a total number of about 700 persons were employed in the area of pollution control (air and noise pollution) in NRW. By far the most of them worked in the supervisory authorites. The number slightly decreased compared to the beginning of the 90s (750 persons in NRW in 1994). However, as no detailed statistics on the number of employees exist, we were not able to identify the number of persons occupied with the implementation of the GFA-VO.

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[30] Here exists a trade-off between a cost-efficient installation of FGD systems and a quick reduction of emissions.

[31] The data were collected in interviews with representatives of federal and state governments, enforcement authorities and plant operators.

Our interviewees reported that at the time the abatement equipment at the existing LCPs was installed and authorised, some permitting authorities' employees did nothing, but deal with these permitting procedures. The authorisation of the FGD system of one power station tied up to 0.5 person for 6 to 12 months. After the authorisation of existing incinerators was completed, the time the permitting authorities' personnel spent on LCPs reduced considerably.

Plants

An extrapolation of the data collected in the survey conducted by the VDEW, leads to the result that approximately 1,500 persons will be needed to run the FGD systems of the West German electrictiy supply industry (cf. Jung 1988a, p. 269).

In our interviews we learned that between 3 and 5 persons per shift are required to run and maintain a large FGD plant. This includes the monitoring of the emission values as well as the supervision of the delivery of the lime and the transport of the plaster. Apparently the number of personnel dealing with pollution abatement was slightly higher for the first few months following the installation of the abatement equipment. 'Real' administrative costs only amount to a few working-days per year. They occur for fulfilling reporting and control duties, i.e. for providing the yearly emission report, communicating with authorities if emission limits are exceeded, and commissioning expert institutes with checking and calibrating the measuring equipment.

Both electricity suppliers and public authority officials stated that no extra personnel was employed for the implementation of the GFA-VO. The persons were withdrawn from other positions. However, we shall bear in mind that the number of employees might have decreased, if the ordinance had not been enacted.

5 Links between implementation process and outcomes

The last chapter is devoted to finding causal links between the implementation process and the observed level of performance of the four outcome indicators.

5.1 Attainment of the ecological goals

The striking outcome of the implementation of GFA-VO is the high degree of over-compliance with the legal provisions. This can be observed not only with respect to the GFA-VO, but also the EMP (and the LCPD). We see the following explanations:

- There was enormous public pressure on politicians, public authorities and LCP operators to reduce SO_2 emissions as far as possible in order to stop the increasingly visible 'Waldsterben'. The perceived urgency of the environmental problem influenced not only the political evolution of the GFA-VO, but also its implementation.
- EFÜ makes it literally impossible to exceed emission limits without being noticed by the supervisory authority. Furthermore, authorities have shown that they are willing to apply severe sanctions in case of non-compliance.
- The emission values of LCPs fluctuate, e.g. because of a varying sulhpur content in the coal. In order to make sure that emission limits are always met, operators need a safety margin and on average are below the limits.
- Suppliers of abatement equipment add another safety margin, because they have to guarantee that their equipment will meet certain emission limit values.
- As there was only little experience with FGD systems the effectiveness of the system was underestimated. Additionally, learning effects in the operation of the FGD systems also enabled LCP operators to reach even lower emission values.
- While the emission limits are set on a daily or hourly basis, our emission data represent annual averages of emissions (it is easier to meet an emission limit on the yearly than on the hourly average).
- Once the FGD systems are installed, the emission values are fine-tuned by the amount of lime that is added. Adding more lime is a rather inexpensive way of reaching low emission values. Moreover, their regional monopolies enable electricity suppliers to shift the costs to their customers.

To sum up, the strict monitoring and enforcement system were the pre-condition for compliance with the GFA-VO, whereas technical reasons, a monopolistic market structure and a high environmental awareness of the German public led to over-compliance.

5.2 Allocative efficiency

There is some evidence that by allocating abatement activities in a different way (bubble solution) the same amount of emission reductions could have been achieved at (slightly) lower costs. However, the allocation of abatement activities was not determined during the implementation process, but was imposed in the GFA-VO itself.

5.3 Productive efficiency

The implementation of the GFA-VO did hardly help to increase productive efficiency for the following reasons:

- Public authorities did not take any measures in order to inform LCP operators about the technical options for the abatement of SO_2 emissions. A certain distribution of information about abatement techniques was only achieved as a side-effect of the bargaining about the formulation of the GFA-VO and the EMP.
- The GFA-VO and especially the EMP in NRW set a strict timetable for LCPs to comply with the emission limits of GFA-VO.

5.4 Administrative costs

By looking at the German administrative costs alone, we cannot decide whether they are high or low. However, our analysis enables us to identify certain aspects of the implementation process which influenced administrative costs. These are:

- The tight timetable set in the GFA-VO and the EMP in NRW required permitting authorities to carry out the authorisation of the FGD systems as swiftly as possible. As this implied an optimal organisation of the authorisation procedures, administrative costs were very likely reduced.
- The automatic measurement, processing and transfer of emission data considerably decreased the working time incurred in monitoring (but produced some costs for the technical equipment).

To sum up, the case study on the implementation of the GFA-VO revealed that the implementation process had some influence on the success or failure of the ordinance, but also stressed the importance of technical factors and the public's environmental awareness.

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