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Mikael Hildén, Jukka Lepola, Per Mickwitz, Aard Mulders,
Marika Palosaari, Jukka Similä, Stefan Sjöblom and Evert Vedung

Evaluation of environmental policy instruments
– a case study of the Finnish pulp & paper and chemical industries

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Foreword

This study was a joint project of the Finnish Environment Institute (Mikael Hildén, Jukka Lepola, Per Mickwitz, Marika Palosaari and Jukka Similä), the Swedish School of Social Sciences at the University of Helsinki (Aard Mulders and Stefan Sjöblom) and Uppsala University (Evert Vedung). We started planning the project during the summer of 1998. In March 1999 we obtained resources for a pilot study, which was completed in May 1999. The main study started thereafter and this report was finalised in March 2001.

Although the whole research team has influenced all parts of the project through in-depth discussions during its execution, different persons have been responsible for writing this report. Per Mickwitz, Mikael Hildén, Jukka Similä and Stefan Sjöblom wrote most of the text, and Mikael Hildén and Per Mickwitz were responsible for the overall editorial work. Aard Mulders, Jukka Lepola and Marika Palosaari contributed specifically to the sections on networks, contents of permits and environmental managements systems, respectively that have been incorporated into the text. Evert Vedung has throughout the process been our methodological guide and helped us with the evaluation design.

Evaluation of environmental policy instruments

– a case study of the Finnish pulp & paper and chemical industries

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This research-based evaluation of environmental policy Instruments in Finland is focussed on regulatory instruments based on the Water Act, the Air Pollution Control Act and the Chemicals Act, on electricity taxation and on voluntary environmental management systems. The examined policy instruments have had several positive effects. They have directed major industrial point source polluters towards solving environmental problems. The transparency has been an important factor ensuring the success of the policy instruments and in avoiding the regulatory capture that could have thrived in a system largely based on negotiations between operators and authorities. The transparency has made it easy for Finnish firms to adopt environmental management systems and an open attitude to environmental reporting.

The permit conditions have not directly resulted in innovations, but they have contributed to the diffusion of end-of-pipe technology and have contributed to innovations by expanding the market for environmentally better technical solutions. The permit systems have also indirectly contributed to innovations by creating a demand for environmental experts and environmental education.

Networks have clearly developed as a consequence of and in response to regulatory instruments. These networks appear to have had their greatest significance prior to the permit procedures. The trend has been towards a greater emphasis of the communication in the networks prior to the presentation of an application in order to ensure a smoothly functioning permit process. In the networks contributing to innovations and the diffusion of innovations authorities have largely been outsiders, except when an innovation has become a de facto standard for permit conditions.

The different kind of effects, the complexity of consequences and the uncertainties with respect to causes and effects mean that studies aiming at evaluating the overall worth and merit of an environmental policy instrument should never be structured from a single point of view using only one method. Multiple criteria should be used. The drawback of the multiple approach principle in evaluation is that the evaluations will run into data problems and all the difficulties of multi- and transdisciplinary research, but the multidisciplinary is a necessary condition for developing an informed view of the functioning and effects of environmental policy instruments.

Keywords: environmental policy, evaluation, environmental management, regulatory systems, permits, environmental legislation, industrial pollution, pollution control

1 Introduction

Despite the importance of environmental policy instruments for the development of several sectors in society, few systematic evaluations have been carried out of environmental legislation in Finland. In a recent comparison of the state of evaluations in different countries (Furubo and Sandahl 2000), Finland was categorised as a country with strong external pressures for evaluations (mainly from the European Union) as well as strong internal pressures. The present state of evaluations was ranked twelfth of twenty-one countries.

Evaluations of policy instruments have emerged gradually; in 1998 the interest in evaluating the effects of acts appeared to be lowest in the Ministry of Justice and in the Ministry of the Environment (Harrinvirta et al. 1998). This suggests a lack of balance between the effort spent on developing policy instruments and the examination of what actually has been achieved. Since 1998 the situation has changed. The Ministry of the Environment has commissioned a review of issues related to environmental policy (Sairinen et al. 2000), studies of the historical development of environmental policy have been published (Laakkonen et al. 1999, Sairinen 2000) and a study on waste policy has been completed (Melanen et al. 2002).

Interest in the evaluation of policy instruments is broad (Scriven 1991, Vedung 1997, Bartlett 1994, Nagarajan and Vanheukelen 1997, Davies and Mazurek 1998, Ahonen 1998), but there is no standard method for carrying out evaluations. Instead there are many different definitions of evaluations and various possible approaches to

them. Our starting point is Scriven's (1991) broad definition that evaluation is about assessing the merit, worth or value of something. To this we add Vedung's (1997) requirement that it is a careful and systematic analysis of the implementation, actions and results of public policy.

We have focused our study on public policy instruments that have been used to direct and regulate the environmental impacts of the Finnish pulp and paper and chemical industries. The emphasis has been on regulations for pollution control, because this is the form of policy instruments that has been used the most, in Finland as well as in other industrialised countries (OECD 1997). In the evaluation we will nevertheless consider a broader range of policy instruments. Different instruments can have synergistic or antagonistic effects. Furthermore markets, which in their turn are influenced by other policy instruments, give signals to companies that either enhance or attenuate the signals of the environmental policy instruments. Neglect of other instruments and market signals would thus probably lead to incorrect conclusions.

The influence of environmental policy instruments on environmental know-how and environmental technology within companies and sectors is a particular aspect that has received increasing attention in recent years (Carraro and Siniscalco 1994; Porter and van der Linde 1995a; Palmer et al. 1995, Jaffe et al. 2000). Some of these effects are direct and intended, whereas others are unintended or even unanticipated (Wolf 1996, Fung and O'Rourke 2000). In some cases these other effects of instruments can be as important as the main effects and this will be taken into account in our approach to evaluation.

2 The purpose of the study

The aim of this study was to contribute to discussions on the use and development of environmental policy instruments. For this purpose we have examined examples of policy instruments and their application in the pulp and paper and the chemical industry sectors. The Water Act, the Act on Air Pollution Control and the Chemicals Act have regulated several of the companies in the studied sectors. The Electricity Tax is an economic instrument that affects all branches of industry, and voluntary environmental management systems are increasingly adopted within both sectors.

We have approached the aim by specifying four main objectives for the study:

- **To undertake a general evaluation of specific environmental policy instruments**

How do the selected environmental policy instruments meet a set of evaluation criteria in the case of the Finnish pulp and paper and chemical industries? What intended as well as unintended effects have occurred in and outside the target area?

- **To investigate the relationship between the environmental policy instruments and innovations**

Have the selected environmental policy instruments fostered or hindered environmental innovations and their diffusion?

- **To explore the role of interorganisational networks**

What interorganisational networks have the environmental policy instruments changed and created, and how have these networks affected the implementation procedures of the policy instruments?

- **To examine evaluation methods**

What are the special features that should be taken into account when evaluating environmental policy instruments?

The main findings of our inquiry will be summarised in this report, while the detailed results are presented in a series of papers and reports (Kiviluoto 1999, Luoma 1999, Hildén 2000, Mickwitz 2000a,b,c, Similä 2000, Similä 2002, Sjöblom 2001, Sahala 2001, Mulders 2001, Palosaari 2001). This report also examines relevant literature in the field and uses both primary and secondary material for the evaluation of the examined policy instruments.

The report is organised as follows. In Section 3 we present the theoretical background of the study. Section 4 contains an overview of the material and the methods that we have used. In Sections 5 and 6 we have compiled background information on the sectors, the administration, the instruments and the environment. The main results of the investigations are presented in Sections 7 to 9, and these findings are discussed in Sections 10 and 11. Section 12 summarises the methodological aspects and Section 13 presents the key conclusions with respect to the four main objectives specified above.

PART 1
THEORY AND APPROACHES

3 Theoretical framework

3.1 Evaluation of environmental policy

3.1.1 Evaluation approach

Environmental problems have features which make them particularly difficult to solve. Lafferly and Meadowcroft (1996b, p.4ff) list the following: the knowledge deficit, including complexity, technical difficulties and uncertainty; complex geographical patterns of impact and causation, links between regions that are geographically but also socially remote; redistribution of losses and gains, actions resulting in significant redistributions of costs and benefits; and time-scale effects arising from long time lags between activities and the appearance of effects and between remedial action and positive results. These features have implications for the choice of evaluation model and evaluation design, evaluation criteria, the problem of linking impacts to activities, evaluability and the use of the evaluations (Mickwitz 2000c). They also partly explain why the evaluation of environmental policies and programmes has developed slowly and why many practices are not standardised (Knaap and Kim 1998).

In our study we will focus on policy instruments rather than specific programmes. This complicates the evaluation because the intervention is not unambiguous. It consists of the creation or revision of policy instruments, but the implementation of the instrument is equally important. What is then the rationale for choosing policy instruments as the evaluand, i.e. the object of the evaluation? In an evaluation focused on policy instruments, the specific characteristics of these instruments are expected to be of relevance not only for that particular situation, but also more generally. Thus, it should be possible to extrapolate the results of an evaluation that focuses on policy instruments to other contexts, at least to some degree, but it is important to note that it is not possible to extrapolate the results to an evaluation of the environmental policy as a whole.

An evaluation approach that is suitable for the evaluation of environmental policy instruments is Vedung's model for "*side-effects evaluation*" (Vedung 1997). It offers possibilities for dealing with both the complexity and uncertainty of many environmental policy problems and the instruments that are used to solve them. The name "side-

effects evaluation" is slightly misleading, because the definition of a side-effect only refers to the occurrence of an effect inside or outside the target area. We will also pay attention to unanticipated effects within the target area. These are not side-effects in the strict sense. In addition we have to note that a strict classification into main effects and side-effects is often problematic in the context of complex policy instruments, which include multiple objectives, some of which may be implicit. Thus although the target area specifies the focus of the policy instrument (Rossi et al. 1999) it is not always unambiguously defined. For example reducing water pollution was one of the key target areas of the Finnish Water Act, but objectives also include the regulation of issues related to the rights and limitations to use waters and the establishment of fair procedures for dealing with these. In this case the target area is very broad and one can argue that only effects on e.g. education are genuinely side-effects, whereas the accumulation of numerous court cases on water pollution is an effect within the target area although the delays in the procedures can be regarded as an unanticipated effect.

In the side-effects evaluation approach the effects of the studied instruments are conceptually divided, first, into anticipated and unanticipated effects (Fig. 1). The next level examines whether effects occur inside or outside the target area. The third level is a qualitative categorisation of the effects. The main value of this categorisation is that it helps in the identification of different kind of effects of the examined policy instruments. It provides a broader frame of reference than an evaluation which would focus only on some well defined objectives of the policy instruments.

To stress the nature of the approach as a conceptual frame of reference our qualitative categorisation differs from the original side-effects model (Fig. 1). It is often not meaningful to divide all effects into the categories "beneficial" and "detrimental", because this classification depends on an unambiguous specification of objectives and cannot therefore always be justified, especially for unanticipated effects outside the target area. For example an increasing number of specialised authorities for pollution control may be regarded as beneficial from an environmental quality point of view, but may represent an economic burden for society unless a strict polluter pays principle applies.

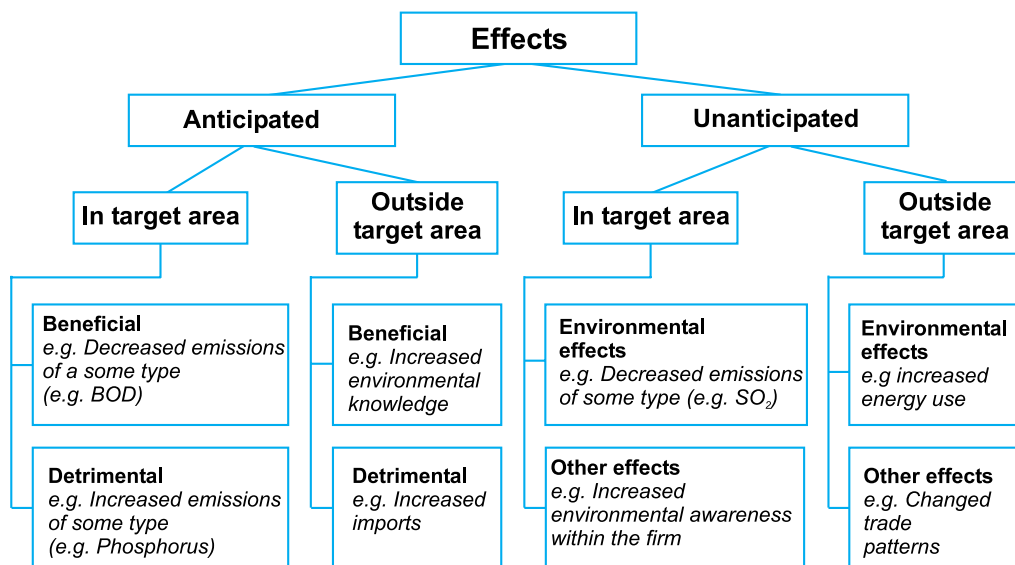


Fig.1. Different types of effects; summary of the classification used. Strictly speaking side-effects are those effects occurring outside the target area.

Unanticipated effects can only partially be known before an evaluation is actually undertaken. An important part of both interviews and document analyses will thus be to develop a more complete picture of the unanticipated effects of the environmental policy instruments that have been used.

3.1.2 Intervention theories

The starting point for the identification of the different types of effects is the definition of intervention theories for the instruments that will be evaluated. Vedung (1997, p. 301) defines intervention theory¹ as: The "empirical and normative suppositions that public interventions rest upon". The role of intervention theories is to describe how the policy is intended to be implemented and function. They are not intended to be descriptions of how a policy instrument actually

¹ Although most authors use the term "programme theory" (e.g. Rogers et. al. 2000), the term "intervention theory" will be used here, unless reference is made to a specific source that uses the term "programme theory". The justification is that "intervention theory" is seen as a more general term including theories of programmes, policies and policy instruments.

works. Thus we will use them as tools guiding the evaluation of how the intervention has been implemented and what effects it has had in practice (Vedung, 1997, 143f.). For public policy instruments we can retrospectively identify an intervention theory using official documents concerning the instrument. Because policy instruments frequently arise through compromises, such an intervention theory may contain conflicting elements and it may leave room for different interpretations on how the instruments is assumed to achieve its objectives. It should also be noted that different groups may have their own views and assumptions concerning the operation of an intervention and these they use as a basis for their support for or opposition against the intervention.

Intervention theories generally consist of the following elements and their causal links:

actors, decision-making entities, e.g. authorities, companies, non-governmental organisations and individuals. The actors include *agencies*, implementing the policy instrument and *addressees*, i.e. the targets of the instrument. In this study the term *operator* will be used for those responsible for the action at an industrial site, e.g. a specific paper mill.;

inputs, the means used by the administration to produce outputs. Inputs include such resources as personnel and finance, but also matters that come from the addressees that the agencies take into account or respond to, for example permit applications.;

outputs, matters that the addressees are faced with, e.g. a permit and its specific conditions; and

outcomes, the actions taken by the addressees because they are faced with the outputs, but also the consequences of these actions. Outcomes can be further divided into immediate, intermediate and ultimate outcomes.²

Patton (1997) distinguished three different approaches to the development of intervention theories: the deductive approach, which is based on literature; the inductive approach based on field work; and the user-focused approach based on the implicit theory of action of the intended users. In many cases elements from all these approaches can be used simultaneously.

In this study we have used a deductive approach in extracting basic intervention theories from the legislation and its justifications, official decisions and other formal documents related to the instruments. The intervention theories thus have two important functions in this evaluation: first they have been used to establish the anticipated effects and the target area of each instrument; second they have been used to determine on which outputs and outcomes data should be collected. Further, our empirical material provides user-focused material on how different actors perceive and form their own views of how the instruments work, which can be contrasted with the assumptions in the intervention theory deduced from the official documentation.

3.1.3 Criteria

The purpose of evaluation criteria is to specify the dimensions or aspects of the policy instruments

² Some additional terms that are often used are impact, result and effect. Impact is generally used as a synonym to outcome, while results refer to both outputs and outcomes. When outcomes are further divided into effects in the target area and side-effects, the term effect is used as a synonym to outcome.

which will be studied in order to assess their merits. The chosen criteria will be examined in the light of the intervention theories and empirical findings of the effects. The criteria ensure a systematic approach in the evaluation, although not all criteria are equally important for all instruments. It is also not always possible to obtain equally detailed information on all criteria.

Any choice of criteria reflects a value judgement. While value choices can never be avoided, they should be expressed as explicitly as possible (Shadish et. al. 1995, House and Howe 1999). Two general approaches are recognised: a descriptive and a prescriptive approach (Shadish et. al. 1995, p.47f). In the prescriptive approach the evaluators select the criteria, whereas in descriptive approaches the criteria are based on goals or needs stated by others, e.g. by legislators or stakeholders and they are generally not weighed together. Our criteria choice is more towards the descriptive approach, but not entirely, since we will also use some criteria even if they have not been explicitly stated as important for a studied policy instrument. When it comes to making a final synthesis for all the criteria, we support the views expressed by Shadish, Cook and Leviton (1995, p.47ff) and Vedung (1997, 248ff) that in democratic societies a pluralism of values should be appreciated and therefore the overall judgement on the worth of the instruments should be made in a communicative political process.

The criteria that will be used in this study are presented in Table 1. These criteria do not represent an exhaustive list of all the criteria that could be used. Mickwitz (2000c) discusses three groups of criteria: general criteria; economic criteria; and criteria linked to the functioning of democracy. Economic criteria are considered important but their use in evaluations in the environmental context involve particular problems. Here only two economic criteria are included, i.e. *efficiency* in the cost-effectiveness sense and some aspects of *equity*. Due to resource and data limitations these criteria will be used only at a general level. It has not been possible to collect comprehensive data on all costs related to the use of the studied policy instruments.

There are several criteria linked to the functioning of democracy: *acceptability*, *equity* and *transparency*. It has been argued that environmental policy imposes special challenges on democracy (e.g. Lafferty and Meadowcroft 1996a) and

Table 1. The criteria that will be used in this evaluation.

Relevance	Do the goals of the instruments cover key problems of environmental policy? On a general level this criterion is trivial, but specific norms or rules can be questioned using this criterion.
Impact	Is it possible to identify impacts that are clearly due to the policy instruments and its implementation? All impacts may be considered in the light of this criterion, irrespective of their occurrence within or outside the target area.
Effectiveness	To what degree do the achieved outcomes correspond to the intended goals of the policy instrument? Similarly, the effectiveness of reaching other public goals can also be assessed if the goals are first identified.
Efficiency (cost-effectiveness)	Do the results justify the resources used? This is a cost-results criterion, in which benefits are not valued in monetary terms. Another possibility of how to consider costs is to use the cost-effectiveness criterion: Could the results have been achieved with fewer resources?
Acceptability	To what degree do individuals and organisations accept the environmental policy instrument?
Transparency and participatory rights	To what degree are the outputs and outcomes of the environmental policy instrument, as well as the processes used in the implementation, observable for outsiders? Who can participate?
Equity	How are the outcomes and costs of the environmental policy instrument distributed?
Flexibility	Can the policy instrument cope with changing conditions?
Predictability	Is it possible to predict the administration, outputs and outcomes of the policy instrument? Is it thus possible for those regulated, as well as others, to be prepared and take into account the policy instrument and its implications?
Sustainability ^a	Are the effects sustainable in such a way that they have a lasting effect on the state of the environment? Through this criterion the effects outside the target area and the unintended effects that may create new problems can also be considered.

^a It should be emphasised that sustainability in this context does not refer to "sustainable development", which is a general goal of environmental policy. The relationship between a policy instrument and "sustainable development" would have to be considered in the light of several of the criteria to cover ecological, economic and socio-cultural sustainable development.

therefore democracy criteria are particularly interesting.

Not all effects (Fig. 1) are relevant for all the criteria in Table 1. Some criteria become more useful when applied only on a subset of the effects. For example the relevance criterion is relevant for comparing the anticipated effects in the target area with knowledge of key issues with hindsight, whereas the impact criterion is useful for all effects. Effectiveness is a criterion that can be limited to the anticipated effects in the target area in relation to the stated objectives.

Another characteristic of the criteria is that they involve different stages in the "input/output" model (Vedung 1997; Nagarajan and Vanheukelen 1997, p.20; Fig. 2). The *relevance* criterion will link the needs to the objectives of the environmental policy instruments, by asking whether the instruments, as they were established years or decades ago, actually addressed real needs in the light of our knowledge of the environmental issues today. *Impact* assesses to what degree an outcome is due to the output of the policy instrument. Often, impact will have to be assessed at

an earlier stage than the final outcome. The difference between impact and effectiveness is that *effectiveness* links the outcomes to the objectives and not the outputs as impact. While some view *efficiency* as a criterion that links inputs and outputs, e.g. how many permits does a Water Court with a certain amount of employees and financial resources produce, we see efficiency as a criterion that conceptually can also be used to link outcomes at any stage to the inputs. *Sustainability* and *flexibility* both concern the ability of the final outcomes to meet long-term needs. *Transparency* and *distributional equity* refer to all individual stages as well as the whole system, while *acceptability* refers primarily to the whole system, although problems with acceptability may arise at a specific stage.

3.1.4 Regulatory capture

Several of the criteria refer to the role of policy instruments in a democratic and open society. The policy instruments can also be approached by ex-

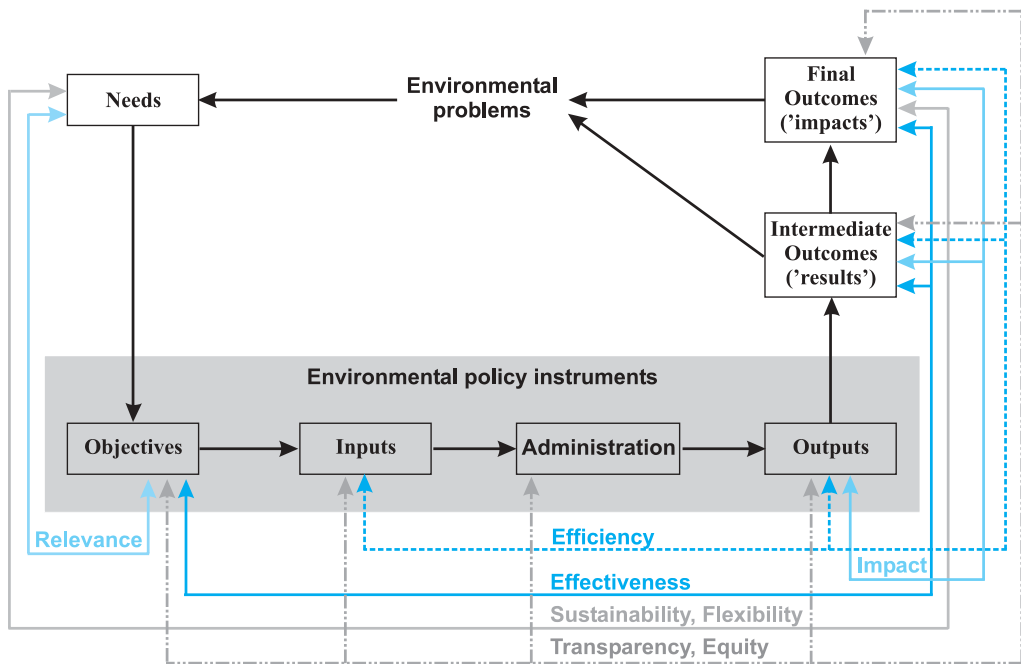


Fig. 2. The evaluation criteria and their links to the stages of the input-output model (inspired by Pollitt and Bouckaert 2000).

amining to what degree they lack the characteristics that would make them meet the positive criteria. This notion is included in the concept "regulatory capture", which means that powerful interests, for example a company, an industrial sector or a political party, can influence the regulators to prioritise their interest over the public one. Throughout history, parties with strong interests have used varied means to achieve unfair benefits, ranging from simple persuasion in negotiations to partly or wholly illegal practices (Laffont and Tirole 1993). The risk and severity of the regulatory capture differs between different types of instruments. In our study we will point out characteristics of instruments that increase or diminish the risks of regulatory capture.

3.2 Environmental policy instruments and their characteristics

Environmental policy instruments – and policy instruments in general – can be categorised in different ways for the purpose of an evaluation. One

way of categorising them is based on the degree of authoritative force involved. This results in three main types of environmental policy instruments: regulatory instruments, economic instruments and information (OECD 1994, Vedung 1998), all with substantially different intervention theories.

Regulatory instruments aim at alteration of the set of options open to agents. Instruments used include: standards, bans, permits, zoning, and use restrictions. Economic instruments aim at altering the benefits and/or the costs of the agents. Economic instruments that have been used include: grants and subsidies; taxes and charges; and market creation, through tradable emission or resource use quotas. Information as a policy instrument aims at altering the priorities and significance agents attached to environmental issues. These instruments include different forms of information campaigns, research and development, and education. (OECD 1994).

Environmental policy instruments can also be viewed in an input-process-output context, in which the input-output model refers to produc-

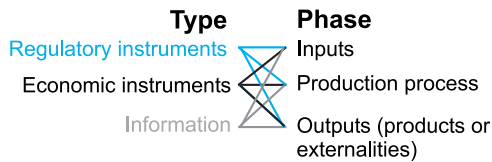


Fig. 3. Two dimensions defining nine kinds of policy instruments (Mickwitz 2000c).

tion, not policy implementation as in Section 3.1.3. The categorisation is in this case based on the phase that is the primary target of the instrument. Since these phases are linked, they are all affected irrespectively of which one is the primary target of the instrument. The primary target is still essential since the other effects differ depending on the target. It is, for example, often argued that process innovations are hampered more if emissions regulations target on inputs or processes, than if they directly regulate the output of emissions. Another example of how the target matters is that it is quite impossible to measure and therefore tax the emissions from all private cars, whereas taxing the input – fuel – is feasible. (Fig. 3).

In our study we have examined examples of all types of instruments. The Water Act, the Air Pollution Control Act and the Chemicals Act are regulatory instruments. The Electricity Tax is an economic instrument and voluntary environmental management systems are based on information. It is important to note that economic policy instruments and information are to some extent also based on laws. All policy instruments also require information, otherwise they could not function, but the distinction is between information *on* policy instruments and *as* policy instruments (Vedung 1998, p 48f.). Finally, all policy instruments have economic consequences, but only the economic instruments aim at directly changing the economic incentives of those regulated.

The terminology used in this study is based on the praxis in political science and economics. The term “*regulatory instrument*” will be used to describe the policy instruments that governments use to change the behaviour of different agents by acts, rules and directives. These are often, but not always, supported by the threat of sanction (e.g. Vedung 1998, p. 31) The term “*norm*” refers to a type of regulation, i.e. a regulatory instrument that directly contains conditions or requirements, not procedures. An example of a norm is the “Coun-

cil of State Decision on restricting emissions of sulphur compounds from kraft pulp mills” (160/1987). Individual conditions or requirements are also set by permits based on the regulatory instruments. A technology requirement determines which technology should be used and other permit conditions set limits for the emissions of particular pollutants. The conditions and requirements can be individual, i.e. designed for a particular unit in a permit, or be specified in detail by acts or norms, thus covering all or at least a group of operators.

3.3 Interorganisational networks and their evaluation

One important feature of policy instruments is that they invariably involve connections between different actors. These links may profoundly influence the outcomes of the policy instruments and are therefore of particular interest in an evaluation. A policy network approach focuses on the relations between authorities and other agents. Generally speaking, resource interdependency is a common feature of recent network definitions. Networks are defined as “...a cluster of complex organisations connected to each other by resource dependencies and distinguished from other clusters or complexes by breaks in the structure of resource dependencies.” (Daugbjerg 1998, 21). Networks are expected to develop in relation to policies when political actors exchange resources regularly and the patterns of dependencies are strongly affected by the type of policy in question and related regulation (ibid.).

In our study we will use the network approach to address two fundamental questions: what networks arise as a consequence of the introduction of a policy instrument and how can the networks influence the implementation procedures and thereby, possibly, the outcome of the instruments. The analysis undertaken in this study follows a structural approach which takes as its point of departure the legislation and the intervention theories. The general idea is that the legislation imposes more or less severe restrictions concerning the role of various actors, and thereby affects networks. On the other hand networks are not applied on isolated actors and thus networks will play a role in determining the results of an intervention.

From an evaluation point of view variations in the networks are of particular interest. In other words, to what extent the networks vary from one policy instrument to another and from one regional/local environment to another, taking into account contextual differences such as industrial structure and size of administration. This variation can illustrate the flexibility of the instruments, but is also significant when considering predictability, transparency, equity and legitimacy.

The formal roles of the actors constitute the basis of the study. In general, policy instruments presuppose at least three types of roles: decision-making, supervision and interest mediation. There is considerable variation from one policy instrument to another in the importance of the roles, which may occur in various combinations. The analysis focuses primarily on the networks related specifically to the instruments, although it may be problematic to separate such interactions from general information networks that exist regardless of the instruments.

The network characteristics will be studied within three main phases of the permitting process (Fig. 4). The first phase, the *pre-decision phase*, starts when a need for a new permit arises, either because a new plant is planned or an old permit will have to be revised. An operator who already has a permit starts to prepare a new permit application mainly for two reasons. First, conditions external to the regulatory instrument may have changed, e.g. demands for the product have increased or new production processes are being introduced. Second, the regulatory instrument could demand a new permit application irrespective of the conditions of the operator. The pre-decision phase ends when the permit application is formally handed to the appropriate authorities.

The *decision phase* starts when the authorities receive the permit application and it continues until the permit decision enters into force. Normally this marks the beginning of the *post-decision phase*. If the permit decision is a rejection of the application a new pre-decision phase may start. For the operator the post-decision phase includes implementing the permit conditions, while this phase for the authorities includes supervision and monitoring. As a result of the implementation of the permit some outcomes will occur: the state of the environment may improve, the operator may have some additional costs, etc.. These outcomes will together with many other external factors re-

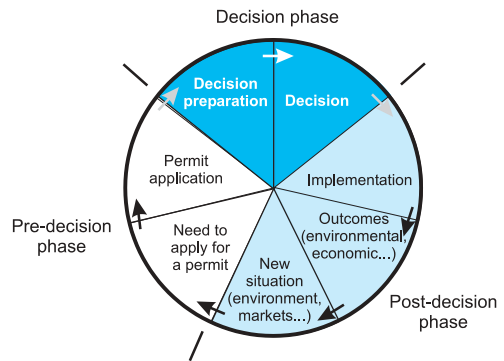


Fig. 4. Three phases with different networks.

sult in a new situation, in which the need for a new permit may arise gradually or on a specific date if the permit has been issued for a fixed time.

When the need for a new permit leads to concrete activities the post-decision phase has ended and a new pre-decision phase has started. The exact borderlines between the phases are theoretical and used here as a classification tool for systemising the empirical information. In reality the phases may overlap and affect one another.

Part of our network analysis will be descriptive, but we will also introduce situational and dynamic approaches concerning networks as demanded by March (1999). We will specifically examine in which ways the network structure affects the implementation procedures, and whether the structure can explain policy outcomes. For this purpose the *structural approach* has advantages compared to other approaches. The strength of the structural approach is that it distinguishes between several types of networks (i.e. professionalised networks, issue networks, producer networks). The type of network emerging in a given context depends on the interests of actors, the degree of vertical and horizontal interdependence and the pattern of resource distribution (Rhodes 1986, p. 22–23).

In this context we will draw on Matland (1995, also Offerdal 1999, Sjöblom 2001), who proposed that implementation procedures differ due to varying combinations of conflict and ambiguity caused by, for example, a high degree of complexity within the organisation or its environment. The idea is not that the types of implementation

occur in pure forms, rather the aim is to illustrate the possible tensions between various implementation procedures and their determinants.

The structural approach does not, however, indicate that the categories of networks should necessarily be fixed a priori. Such network models tend to become rather rigid. A more convenient strategy is to operate with a continuum of networks based on several analytical characteristics, thereby emphasising variation (Daugbjerg 1998, 30). Characteristics frequently used in the literature include membership, integration, resource distribution and stability of the organisational environment (Daugbjerg 1998, p. 31, Offerdal 1999).

Matland (1995, also Offerdal 1999, Sjöblom 2001), suggested that the network characteristics affect the implementation processes so that varying combinations of conflict and ambiguity in the decisionmaking situation produce specific implementation types. In this context the conflict level reflects the number of divergent interests and actors involved in the decision-making. Ambiguity is a measure of the lack of evident solutions to the perceived problems and of industrial or administrative complexity in the implementation environment.

When combining the two characteristics Matland (1995, p. 155 ff.) defined four types of implementation, two of which are of special interest for our study, namely administrative and political implementation (Table 2). The types of implementation cannot be expected to occur in pure forms, but they illustrate the possible tensions between various implementation processes and their determinants.

In a situation with low conflict and low ambiguity, the implementation process is expected to proceed as administrative routine. Regional or local variations in implementation are largely related to varying resources of the involved actors. Such implementation processes can be described as *administrative*. *Political implementation* is ex-

pected to occur in situations with high conflict levels and little ambiguity. Power relations become important in understanding the outcome in terms of implementation – changes can be pursued by force, despite strong resistance from some actors.

Coalition building is proposed to be a crucial mechanism within *symbolic implementation*, presumed to emerge in situations with a high degree of ambiguity and conflict. The final type – *experimental implementation* – seems a priori less important in the case of regulatory instruments. High ambiguity and little conflict would materialise in trial and error- processes, in which local conditions and perhaps pure coincidences would determine the implementation processes.

3.4 Inventions, innovations, adoption and diffusion

The influence of environmental policy instruments on environmental know-how and environmental technology within companies and sectors (Carraro and Siniscalco 1994; Porter and van der Linde 1995a; Palmer et al. 1995, Jaffe et al. 2000) is a specific issue in our evaluation. It is related to the characteristics and effects of the policy instruments and the networks (Sections 3.1 to 3.3).

3.4.1 Concepts

The term "invention" refers to "a novel idea, sketch or model for a new or improved product, process or system" while "innovation" means "the introduction of a new product, process, method or system into the economy" (Freeman 1987). Nowadays, however, it is often difficult to distinguish between the two in practice because research and development also occur within companies (Nelson and Winter 1982). For example, Kamien and Schwartz (1982) included basic research, in-

Table 2. Implementation under varying combinations of ambiguity and conflict.

Ambiguity	Conflict	Implementation	Determinant
Low	Low	Administrative	Resources
Low	High	Political	Power
High	Low	Experimental	Local conditions
High	High	Symbolic	Strength of coalitions

vention as well as development into the concept of innovation. Others, e.g. Freeman (1987), still emphasise the distinctions between the two concepts, for example by stating that only few inventions ever become innovations.

Not all companies will introduce an innovation simultaneously. The term "diffusion" is used to describe how innovations are adopted in different firms over time. Since companies are nowadays very heterogeneous, many innovations will have to be adapted to the firm's specific situation before they can be utilised. This may make it hard to draw a sharp line between the innovation and the diffusion processes. This is especially true in the case of process innovations.

In some cases it is useful to distinguish between different types of innovations³:

- Market innovations, i.e. new products, processes or technology, from which the firm obtains the main benefits directly through the market, due to increased income or reduced costs. These can have beneficial or detrimental effects on the environment;
- Environmental innovations, i.e. innovations of which the main objective is to improve the environmental performance of the company; and
- Policy innovations, i.e. new regulatory instruments or processes.

The difference between market and environmental innovations is far from clear. First, many environmental innovations can be used to promote the firm's green image. Thus, they create benefits that can be captured on the market. Second, many environmental innovations are not produced by the firm actually using them, but are supplied by other companies. It is therefore clear that these suppliers capture their benefits in the market.

In this study the focus will be on environmental innovations. Environmental innovations can emerge on the technological and on the management/organisational level. Market innovations

with beneficial environmental effects will also be dealt with to a certain degree. Policy innovations will be touched on because changes in the policy instruments and the introduction of e.g. environmental management systems can represent innovations.

Many important innovations are technological. Kemp (1997, p. 11) defined an environmental technology as "each technique, process or product which conserves or restores environmental qualities. Environmental qualities may be conserved directly, through the treatment of pollution, re-use of waste material, and they may be conserved in an indirect way by technologies and materials that are less environmentally harmful than comparable processes, products and substances." As indicated above innovations are not, however, limited to technological solutions. In some cases organisational innovations might have a greater impact than technological ones, but they have been far less intensively studied.

3.4.2 Theories on the relationship between policy instruments and technological change

The effects of environmental policy instruments on innovations and their diffusion are one of their most important features, especially in the long term (Hahn and Stavins 1992; Freeman and Soet 1997; Sikor and Nordgard 1999; Jaffe et al. 2000). However, there is still comparably little published research on this issue and especially empirical studies are rare.

Based on theoretical models many economists tend to agree that economic instruments are superior with respect to promoting innovations, since they impose a cost on the pollution irrespective of its level. Regulatory instruments have been criticized for not providing incentives for innovations or even for hindering diffusion. Information based instruments have hardly been considered at all.

The incentives for innovations and diffusion that individual firms face in different settings have been studied by for example by Milliman and Price (1989). Their main conclusion is that on a relative basis, emission taxes and auctioned permits provide the highest incentives for innovation, whereas direct regulations provide the lowest incentives. A similar study comparing the incentives at the industry level for heterogeneous industries

³ Our distinction of different types of innovations is inspired by Stewart (1981, p. 1279). He defined market innovations as "product or process innovations that create benefits that firms can capture through the sale of goods and services in the market". The other type of innovations used by Stewart is social innovations, which "refer to product or process innovations that create social benefits such as clean air, that firms cannot capture through market sales".

was undertaken by Jung, Krutilla and Boyd (1996). They concluded that the most innovation-promoting instrument is auctioned permits followed by taxes and subsidies, whereas performance standards are the least innovation-promoting instrument.

Kemp (1997, p. 57ff., 2000) criticised the models referred to above for not taking into account the policymaking process under technological uncertainty. When this is taken into account an environmental tax would in most cases have resulted in less incentives to innovate than direct regulations, since the tax rate would be set at a low level in order not to impose too high costs on the industry. In the case of auctioned tradable permits the incentives to innovate would also be reduced, since the total limit would be set "too high".

However, there is also another even more fundamental critique of the standard ranking of the effects of environmental policy instruments on innovations. This critique is based on another view on how companies in the real world behave and differs from the neoclassical one in which companies behave optimally. The alternative view, based on bounded rationality, is labelled an evolutionary theory (Nelson and Winter 1982). Since companies are not carrying out optimisation in this model but rather follow other decision rules, it is not certain that external constraints, e.g. those

imposed by environmental policy instruments, reduce profits (Jaffe et al. 2000).

Within the context of environmental policy Porter and Linde (1995a,b) advocated arguments based on the evolutionary framework. In its simplest form the "*the Porter-hypothesis*" has been expressed in the following way: "*properly designed environmental standards can trigger innovations and production efficiency gains that may lead to absolute advantages over non-regulated firms*" (Brännlund et al. 1996, p. 12). According to Porter and Linde (1995b, p. 99f.) this is due to five mechanisms: first, regulations signal inefficiencies; second, regulations foster information gathering; third, regulations reduce uncertainty about payoffs; fourth, regulations create pressure to innovate; and fifth regulations reduce the free riding effect caused by lowering future adoption costs due to learning.

However, environmental policy instruments are far from the only factors affecting innovations and their diffusion. Karshenas and Stoneman (1993) categorised the economic theories of diffusion into four groups: epidemic models, rank models, order models and stock models. By stressing the complementary rather than the competitive nature of these models Blackman (1999) summarised them by stressing that diffusion is affected by many factors and not a single one. These factors

Table 3. Determinants of the decision to adopt an environmentally beneficial technology (based on Kemp 1997, p. 96ff.).

Transfer of information	Characteristics of the technology	Characteristics of the adoption environment
Information channels	Purchase price	Environmental standards and enforcement of such standards
Content and frequency of information	Operating costs	Acceptance of environmental policies
The number of people reached	Performance characteristics	Environmental awareness and attitudes
The need for information by potential adopters	(in comparison to competing technologies)	Price and cost structure
The willingness of potential adopters to search for information	Economic life time	Availability and costs of complementary techniques and skills
Credibility of information		Age of capital stock
The concentration of information to one source		Competitive pressures, profit margins and possibility to shift costs to others
Networks		Resistance to change
		Availability of financial means, and credit conditions
		Societal pressures to reduce environmental burden

include: information and learning, characteristics of potential adopters, characteristics of technology, fixed resources and the effect of adoption on output prices.

Kemp (1997, p. 96ff.) grouped the characteristics that explain the decision to adopt or not to adopt a particular environmental technology at a certain point of time into three groups: factors related to the transfer of information; the characteristics of the technology; and the characteristics of the environment of adoption (Table 3).

The diffusion process is affected by the company characteristics such as size, information about the innovation and its effects on profits and

the willingness to take risks. The diffusion is further influenced by reduced adoption costs over time and the decrease in the benefits from adoption with the number of previous adopters. The benefits of an innovation to society as a whole will largely depend on its diffusion rate, which is influenced by public policy. The diffusion rate can be slowed down through, for example, licenses or patents or it can be enhanced through e.g. information campaigns. Although patents and licenses might slow down diffusion, they can be essential for the promotion of research and development and can thus increase the rate of innovations.

4 Materials and methods

4.1 The methodological approach

The research of the four main objectives of this study (Section 2) was based on statistical analyses, using a variety of methods, qualitative analyses of interview data and reconstruction of specific water court processes. In addition a large number of documents, such as environmental reports, general statistical data, acts, decrees, committee proposals etc. were analysed. Thus the general approach was based on the idea of triangulation: the conclusions were not based on findings from a single viewpoint or data source but on the combination of results using different methods and data. The general argument for combining quantitative and qualitative research designs is that this is one way of reducing or neutralising the risks caused by inherent bias in a particular data source or method.

The four objectives have required different combinations of methods. Thus the general evaluation is a synthesis in which the findings of qualitative and quantitative methods have been combined. The qualitative data and analysis have strengthened the hermeneutic aspects of the evaluation. The study of the relationship between environmental policy instruments and innovations has had its starting point in statistical analyses of the reductions in emissions and the associated improvements in the state of the environment. The qualitative data and analysis is then used to examine the likely role and operation of the different policy instruments. The study of interorganisational networks is almost entirely based on qualitative data, part of it referring to the legal basis of the network, part to the views of the actors as revealed by the interviews. Finally we have approached the methodological aspect of the study as an reflective qualitative exercise within the research group.

In practice we approached the evaluation of environmental instruments in the pulp and paper and chemical industries using two types of case studies (Yin 1994). Some questions were examined by collecting data for the entire sector, whereas most questions were investigated by studying not the entire industries, but selected cases, e.g. the water permit histories of six mills were examined in detail (Section 4.4)

Because the cases studied do not represent a sample, statistical generalizations, to for exam-

ple other industries or from the six mills studied in detail to all other mills, should not be made on the basis of the evidence. The cases should rather be seen as examples of results that can occur, and these examples can only be generalised analytically if combined to other information and theories. The result can be considered stronger if the evidence clearly support a theory while it also contradicts alternative theories (Yin 1994).

4.2 Background data on the sectors, the administration and environmental issues

The background information on the sectors, the administration and key environmental issues were compiled from published sources and available statistics. Statistics Finland publishes detailed information on the output and economics of different sectors of industry. The state budgets provide data on the development of the administration and general information on the state of the environment has been published by the Finnish Environment Institute (Wahlström et al. 1993, 1996; Hallanaro et al. 2000; Rosenström and Palosaari 2000), in addition to detailed studies of specific issues.

4.3 Quantitative data and statistical analyses

4.3.1 The material

The material used in this study for quantitative analyses was collected from many different sources. It includes sectoral as well as site specific data on water discharges, air emissions, production and energy use. Another important source of information are the permits. All quantitative permit limits of the water permits for pulp and paper mills operating in 1998 have been coded into a database. Furthermore, all quantitative limits in air permits since 1995 and also some earlier permits have been studied. Data on water quality and the responses to a survey of attitudes of the environmental administration were also used.

The most detailed quantitative data available is for water discharges and permits of pulp and paper mills. This data contains mill level information on waste water discharges, production and

permit conditions. The data on discharges was obtained from the official database of the environmental administration and is thus the official discharges that the mills have reported to the authorities. The data on the permit conditions consists of all the quantitative limits of all waste water permits for the pulp and paper mills operating in 1998. This data set was compiled by starting with the present permits and going backwards through the history of the permits. Only decisions in which at least one limit value was set are included and thus decisions that only deal with, for example, compensations have been excluded.

When the introduction of limits into the permits was studied the database was organised using the individual permit decisions. Since many of the decisions contain limit values for different time periods, the data of permit limits aggregated for all mills contains far more discharge limit values than the number of decisions.

Another type of data is on water quality. This data was compiled so that it would reflect the prevailing view of the state of the waters during previous time periods, not the present view of what their state has been. For each mill the data from the nearest observation point was used and the state was calculated for time periods of 5 years⁴. One source of error in the analysis is that most observation points are only a few kilometres from the point of the discharges, but in some cases they are more than 10 kilometres away.

The final source of information, here used quantitatively, was provided by the answers to a questionnaire sent out in 1997 to civil servants (n= 1250) working within environmental administration in Finland. The response rate of the questionnaire was 57 per cent (for details see Mulders 1999).

4.3.2 Methods

The quantitative data has been used in numerous ways. Descriptive statistics, such as means, variances etc. were calculated for all variables and graphical analyses were performed. In some cases statistical hypotheses were tested, for example

⁴ The huge task of compiling the water quality data, with all the steps from determining the points to the final calculations, was performed by Heidi Vuoristo of the Finnish Environment Institute.

reductions in phosphorus discharges of mills with a phosphorus limit compared to the reduction of those without a limit. Correlations were calculated in order to examine whether different parameters have common patterns. Finally, a wide range of statistical modelling was undertaken, including time-series analyses and probit and logit models (Cramer 1991) of permit contents.

In the cases in which time series analyses could be used, three types of models were estimated: single equation models for logarithmic transformations of BOD and phosphorus discharges; single equation models for the first differences of BOD and phosphorus discharges, i.e. models of the change in discharges; and equation systems modelling BOD and phosphorus discharges simultaneously.

Time series usually change over time. If they change so that the mean and the variance also change then the time series are said to be non-stationary. A non-stationary time series can often be made stationary if it is differenced once or several times. If a time series is non-stationary but its first difference is stationary it is said to have a unit root and to be integrated of order one (I(1)). A time series that must be differenced d times before it becomes stationary is integrated of order one (I(d)). The order of integration of the time series used were tested by an Augmented Dickey Fuller (ADF) test (e.g. Hendry and Doornik 1999).

In addition to the mill-specific models some sectoral models were also estimated. If the mills are acting not only on the basis of their own permit limits, but also take the development of permit conditions of other mills into account in their expectations of the limits that will affect them in the future, this could be revealed by sectoral models. The sectoral models have basically the same form as the mill-specific models but use aggregated data.

We analysed why some mills have obtained a permit limit for a particular substance which they discharge, whereas others have not. The inclusion of a particular permit limit in a permit is an example of a binary choice; either it is included or it is not. Models that aim at explaining these types of variables are called binary choice models. Modelling binary choices with ordinary linear regression models is not appropriate (Hendry and Doornik 1999). In this study we used logit and probit models. Since there are no clear theoretical arguments for choosing between the two model

types, both logit and probit models were estimated. Generally, when the two types of models are fitted to the same data set they are so close that the choice cannot even be made on empirical grounds. (Cramer 1991, p. 17) However, this is not very important in the context of this study since the objective here was to identify variables that are statistically connected to the permit decisions.

4.4 Thematic interviews and qualitative analyses

Qualitative analyses of thematic interviews were used as a complementary method in addition to statistical analyses, reconstruction of cases and analyses of official documents. Thematic interviews provide the opportunity to map the opinions of multiple actors on crucial aspects of the policy instruments. Apart from minor adjustments, the structure of the interviews was the same regardless of the actor in question.

Two types of thematic interviews were used. First, we made general thematic interviews that covered all the instruments of the study and the key issues related to the overall evaluation. Second, we made specific interviews on the use of environmental management systems and environmental reports. The reports on environmental management systems and environmental management within the chemical industry have been published elsewhere (Luoma 1999, Kiviluoto 1999). Here, findings of the interviews of environmental reports will also be presented as they provide further information on environmental management systems more generally.

4.4.1 The material

The general interviews were, apart from the national level, geographically concentrated to two regions; the jurisdiction of the Western Finland Regional Environment Centre and the Southeastern Finland Regional Environmental Centre. This provided some possibilities for examining regional differences in implementation of the policy instruments. The administrative levels were: *national administration* (Ministry of the Environment, Finnish Environment Institute, Supreme Administrative Court) *regional administration* (Regional Environment Centres, Water Courts), *municipal*

environmental administration, headquarters of industry groups and local factories (Table 4). The sample of municipalities takes into account the size and administrative structure of the municipalities, the industrial structure and the relative importance of the industry in question. Consequently, the sample includes municipalities with primarily pulp and paper industry, primarily chemical industry as well as municipalities including both types of industries. The persons interviewed were in central positions in developing and implementing the instruments (national level), responsible for the environmental policy (companies) or in charge of the environmental administration (regional and municipal level).

The interviews were structured around six major themes: a) *policy issues* concerning the possibilities of reaching the objectives of the instruments, b) *major environmental changes* during the past two decades, c) *technology and innovations* related to the policy instruments, d) *networking*, e) *feed back and monitoring*, and f) the expected consequences of *the new environmental protection act*. The interviews lasted for approximately one and a half hours. The relatively limited number of thematic interviews is a methodological disadvantage, although diminished by the fact that the interviews were regionally concentrated and that none of the objectives of the study – according to the principle of triangulation – rest solely on interview data.

The set of interviews aiming at describing environmental reporting as a communication tool between enterprises and their stakeholder groups focused on three EMAS-registered chemical industry enterprises and their stakeholder groups. The objective of this special topic was to explore stakeholder groups' interests and needs concern-

Table 4. The thematic interviews of the study.

Actor	National	Region	
		Western Finland	Southeastern Finland
National administration	5		
Headquarters of industry groups	3		
Regional administration		3	3
Municipalities		3	4
Factories		6	3

ing environmental reporting. The empirical material consisted of 20 thematic interviews, which lasted approximately 45 minutes. The interviewees were representatives of stakeholder groups with an important significance for enterprises. In addition three environmental managers of chemical industry enterprises were interviewed in order to be able to compare their points of view with those of the representatives of stakeholder groups. The interviews consisted of three major themes: a) experiences of using environmental reports, b) expectations on the environmental reports, c) reliability and credibility issues.

4.4.2 The analysis

The categorisation/coding of statements followed the general structure of the interviews, indicated above. The aim was to identify a hierarchy of statements so that the analysis could be carried out at several levels from the general to the specific. For example the theme concerning environmental change was categorised in statements on general development of emission, development of specific emissions (water, air, chemical emissions), reasons for developments in emissions, responsibility for environmental conditions and factors affecting specific permit conditions. The total number of statement categories used was about 70, distributed over the 6 main themes (Table 5). By examining both the general statements and the details it was possible to check the consistency between statements as well as between various actors and administrative levels, thereby deepening the picture delivered by other data sources.

The statements were coded using the QSR Nvivo program for qualitative analyses. Compared to older versions of such programs Nvivo has sev-

eral advantages; graphical applications, continuous modifications of categories of statements and a hierarchical ordering of statements are all possible, which also makes the program more useful for theoretical purposes. In this report we used specific quotations from the interviews to show general views shared by many interviewees but also specific claims by individual interviewees to illustrate the diversity of views concerning different aspects of the policy instruments.

It is important to take into account the fact that actors use story lines in order to control the picture of the issue at hand. This often occurs even when they seem to be simply describing facts. (e.g. Hajer 1995, Stone 1989) In this case all interviewees have an incentive to present the system in a good light. For example, industries might want to exaggerate the effects of voluntary measures, such as EMAS and ISO 14001. It is also important to note that the length of the history differs for the policy instruments. The regulatory instruments have the longest history and therefore different views have had time to develop. The management systems are the most recent instruments and still in an early phase of their development. This is likely to affect also the perception of the instruments in an interview.

It is rather difficult to assess how much the differences in the views expressed on the direct effects of permits are due to different personalities, tactical answers or different attitudes and policies in environmental matters. There are certainly differences between the factories, e.g. some have environmental management systems and others do not. Those which have environmental management systems tend to stress their role for the reduction of discharges far more than those which do not have such a system. It might be that they really have this experience, but there might also be a positive bias, either for strategic reasons or

Table 5. Main aspects of the themes and statement categories.

Interview theme	Main aspect of the detailed categories
Policy issues	Main considerations and objectives behind the permit systems
Technology and innovation	Technological options and the role of environmental considerations
Environmental change	Effects of policy instruments and sources of information
Networking	The decision-making process and the role of networks
Feedback and monitoring	Deviations in emissions, use of monitoring information
Change in environmental legislation	Expectations and fears concerning the new legislative system

simply because they are so involved in the environmental management system.

4.5 Analysis of decision-making material

4.5.1 The material

The material produced for legal decision-making is an important source of information. The document, which is an output of the decision-making, contains two parts: the permit itself, i.e. a decisive part of the document and a report. In the report the history of the procedure is described, starting from the application. Thereafter different phases of the procedure are reported chronologically. The documents include an overview of the plan of the environmental measures to be taken as well as opinions and arguments of different actors concerning the key conditions of a permit. The documents also contain information on the environmental consequences of the activity concerned, presented mainly by supervisory authorities and the operator. Especially in the 1970s and the 1980s the documents were rather long, even some hundreds of pages. In the 1990s the documents became much shorter, mainly due to the decreasing amount of complex monetary compensation issues. In addition, the different stages are no longer reported with the same level of detail.

Due to the vast amount of long documents, it was not possible to analyse all the documents related to all permits. Therefore, 6 pulp and paper mills were chosen for detailed examination of the whole permitting history. Four of the mills produce both pulp and paper as well as cardboard, one only cardboard and one only pulp. The total number of permits which include an emission limit value is 23, i.e. three or four for each mill. The number of decisions of Water Courts based on the same legal ground as the permits concerning the mills is significantly greater. The main reason for this is that the production capacities were limited in the permits. If a mill wanted to increase its capacity, an amendment of the permit was required. In practice, the production capacity has been increased several times between two permit cycles and the permit amended accordingly, without any change in other conditions of the permit (with one exception). Substantial changes, such as change of an emission limit value, have been made ac-

ording to the timetable set up in a review clause. In addition to the Water Courts, appeal bodies may have handled a permit. This adds to the number of decisions made, although not to the number of permits granted.

Despite lengthy presentation of the administrative procedure, the decision itself has been poorly justified. Typically the Courts have justified their decisions only by repeating, with minor modifications, the essential Section of the Water Act. They have not presented which of the facts the Courts considered to justify the exact contents of a permit. Thus, there are a significant number of different kinds of facts in the documents, but it is unclear which of them have been considered to be relevant by the decision-making body. During recent years the Courts have improved their justifications by presenting the decisive facts behind their decisions more clearly.

In addition to the detailed legal material we have examined a larger sample of permit decisions in order to study the interactions between the authorities at a documentary level. This sample is used especially in the network analysis (Section 8). It is based on a permit register (VAHTI) maintained by the Finnish environmental administration, containing permit decisions issued by the Regional Environment Centres and includes permits for chemical and pulp and paper industries. For this sample all contacts, such as negotiations, statements and decisions, between actors as revealed by the documents were registered and categorised.

4.5.2 The analysis

The documents were analysed qualitatively. The aim of the analysis was twofold: on the one hand to identify the typical features of the actual permits granted and on the other hand to gather information from the documents on the impacts of the permits granted. Certain issues, such as technology specified by the permits, can be analysed purely on the basis of the decision part of a permit. Although the documents contain a complete set of information of the contents of permits granted and useful information on the opinions and proposals presented by different actors during the process, they do not contain complete information of all impacts of the permits. However, the documents include e.g. information on environ-

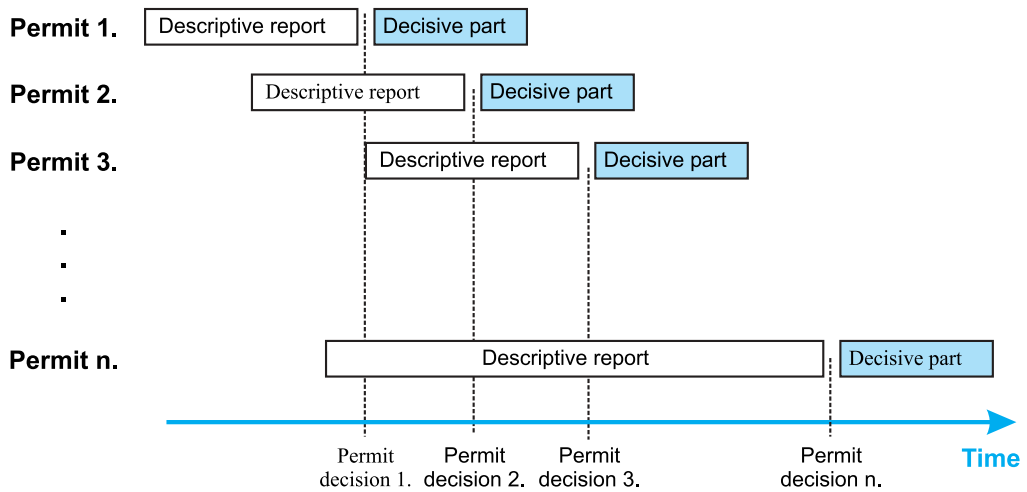


Fig. 5. Obtaining a picture of the history of an operator by linking its permits.

mental measures which the operator has taken during the process or shall take after the permit has been granted. In addition, the document concerning the next permit cycle may contain information concerning the impacts of preceding permits (Fig. 5). However, it must be pointed out that the documents do not always contain reliable information on the impacts of a permit. Therefore different sources of information were used in the analysis.

The effects of the deficiencies of information found in the document analysis on the impacts, can be overcome in certain cases by the interviews. The documents do not, for example, provide information on the influence of other factors than permitting on the behaviour of an operator. In this respect the interviews are a much better source

of information. Three of the interviewees were employees of the mills of which the permitting history had been examined. All interviewees from regional administration were employees either of the supervisory authorities or of the Water Courts, which issued the permits examined.

During the analysis a fact sheet of each mill was produced. The fact sheets include information with respect to each permit granted on production capacity, environmental measures, emission development, conflicts between the mill and the authorities, implementation problems and types of conditions set up in a permit. In addition, a judgement was made concerning whether an operator had or had not been forced to adopt new environmental measures due to the permit granted.

PART 2
BACKGROUND INFORMATION

5 The industrial sectors, the administration and the instruments

This section presents a general overview of the focus of the evaluation. A general description of the sectors places them in their societal context, which also includes the public administration responsible for the implementation of the instruments regulating the activities of the sectors. Finally, the instruments are briefly described by identifying key elements of their intervention theories.

5.1 The industrial sectors

Regulatory instruments have been important tools with respect to both pulp and paper production and the chemical industry. In addition, a range of other environmental policy instruments and external signals have significantly influenced these industrial sectors during the 1970s, 80s and 90s. In the 1970s and 1980s, environmental policy making was almost exclusively based on regulatory instruments. Economic instruments were introduced in the early 1990s and the environmental management systems were introduced in the latter half of the 1990s.

Both of the studied industrial sectors are important for the Finnish economy. Pulp and paper production and the chemical industry accounted for approximately 15 and 10 percent, respectively, of the total value added of Finnish industry in 1998 (Statistics Finland 1999). The two sectors differ somewhat with respect to the size distribution of the companies and establishments. These differences are important, as the size of the establishment and company affects means and possibilities to respond to international trends and environmental policy.

Forest industries have for a long time been a key industrial sector in Finland and the Finnish pulp and paper industry is among the most important developers of the industry worldwide. The sector is characterised by large companies and establishments. In 1999 there were a total of 226 establishments in the field of pulp and paper production, of which 35 per cent had a turnover of 10 million FIM (€ 1.68 million) or greater (Statistics Finland 2000a). In recent years the pulp and paper industry has undergone substantial structural change with respect to ownership and it is currently dominated by a few multinational companies.

The Finnish production of pulp has increased from under 4 million tons in 1960 to almost 12 million tons in 2000. The production of paper and paperboard has grown even more, from about 2 million tons in 1960 to 13.5 million tons in 2000. Also the composition of the production has changed, i.e. the value-added level has been rising. In recent years about 60 per cent of the production has been printing and writing paper. The recovery rate of paper was about 65 per cent in 1999, but since only 10 per cent of the production is used domestically, recycled paper covers only some 5 percent of the fibre demand. (Finnish Forest Industries Federation 2001)

A large share of the production by the Finnish forest industry is exported, during the last years, about 90 per cent. The only country exporting more paper and paperboard products than Finland is Canada. The largest part of the export goes to Europe. Almost 70 per cent of the value of the export in 2000 was from export to the European Union, with Germany (20 %), the UK (15 %), and France (7 %) being the most important individual countries. The composition of the Finnish export has gradually changed during the last decades; the share of pulp and other lower value added products has decreased, while the share of printing and writing paper has increased. In 2000 some 45 per cent of the export was printing and writing paper, which makes Finland the world's largest exporter of these products. (Finnish Forest Industries Federation 2001)

The chemical industry is important worldwide, but Finnish companies have only in a few cases been world leaders in the development work. Within the sectors there are large as well as small and medium-sized companies. In 1999 the number of establishments was 375, of which 27 per cent had a turnover greater than 10 million FIM (€ 1.68 million) (Statistics Finland 2000a).

The production of the chemical sector is very heterogeneous, including besides basic chemicals also petroleum products, plastic and rubber products, paints and inks, and pharmaceuticals. The total value of the production in 2000 was € 11.7 billion of which the largest amounts were from: petroleum products (35 %), basic chemicals (29 %) and plastic products (19 %). (Chemical Industry Federation of Finland 2002)

The Finnish chemical industry is besides a producer for the domestic market also an important export sector, in 2000 about 40 per cent of the

production was exported. The value of the export was, some € 5.2 billion. More than half of the export is to the EU area, the largest individual countries being, Sweden (€ 1.1 billion), USA (€ 0.5 billion), Russia (€ 0.4 billion) and Germany (€ 0.4 billion). The largest shares of the export are basic chemicals and oil product accounting for about one third each. (Chemical Industry Federation of Finland 2002)

Our sample covers an essential part of the pulp and paper sector, whereas coverage of the chemical industry sector is very heterogeneous. The sample includes examples of mainly small and medium-size companies. Therefore our findings are more illustrative than conclusive with respect to the chemical industry, but the small- and medium-sized companies raise certain specific issues in the study.

5.2 The administration

In Finland duties in what now is considered to be the field of environmental administration were for a long time fragmented and divided between several authorities. The first initiatives towards a more comprehensive environmental administration were taken in water management, which was initially under the jurisdiction of the Ministry of Agriculture and Forestry. The Water Courts had Court Status and belonged to the jurisdiction of the Ministry of Justice.

The first central environmental agency was founded in 1970 as the National Board of Waters under the Ministry of Agriculture and Forestry (Fig. 6). On a regional level, Finland was divided into Water Districts. The Provincial Administrative Boards were assigned tasks in environmental protection in 1973 (Decree 132/1973). The Provincial Administrative Boards were part of the regional administration of the Ministry of the Interior.

When the Ministry of the Environment was founded in 1983, water protection was placed under the jurisdiction of this Ministry, whereas other water policy still fell under the jurisdiction of the Ministry of Agriculture and Forestry. In 1986, the Water Administration was reorganized into a Water and Environment Administration, under the primary jurisdiction of the Ministry of the Environment. The National Board of Waters became the National Board of Waters and the

Environment, which supervised and coordinated the activities in the regional Water and Environment Districts.

After the founding of the Ministry of the Environment the environmental tasks of the Provincial Administrative Boards were supervised and coordinated by this ministry (Act on Provincial Administrative Boards 1233/1987). The Provincial Administrative Boards were given several functions: guidance and supervision of municipal environmental protection, nature conservation, development and regulation of recreational use, landscape protection, particularly as part of land use planning, land use planning and housing, protection of historical sites, air pollution control, noise pollution control, environmental health and waste management.

The Finnish Cabinet decision of June 17th 1993 led to an administrative reform, which aimed at concentrating the regional environmental administrations into one unit per region; the Regional Environment Centres (there are thirteen such centres). These Regional Environment Centres are supervised directly by the Ministry of the Environment, but the Ministry is not allowed to intervene in individual permit decisions made by the Centres. In the reorganisation, the National Board of Waters and the Environment lost most of its administrative tasks and became a research and development centre in environmental matters, the Finnish Environment Institute. (Government Bill 1994/241)

The Environmental Protection Act, which came into force March 1st 2000, has led to a further reorganization of the environmental administration in Finland. The Water Courts from 1962 were abolished and instead three Environmental Permit Authorities were founded. (Government Bill 1999/84). The Environmental Permit Councils are a regional permit administration in accordance with the Water Act and the Environmental Protection Act.

The development described above has also been reflected in the development of the state expenditure on environmental administration. In 1963 the environmental administrative costs were distributed mainly within the budget of the Ministry of Agriculture and Forestry and the Ministry of Justice, which had allocated e.g. FIM 4 million (deflated to 1999 prices, i.e. about € 0.7 million) for the Water Courts. In the 1970s the budget of the Water Administration was around

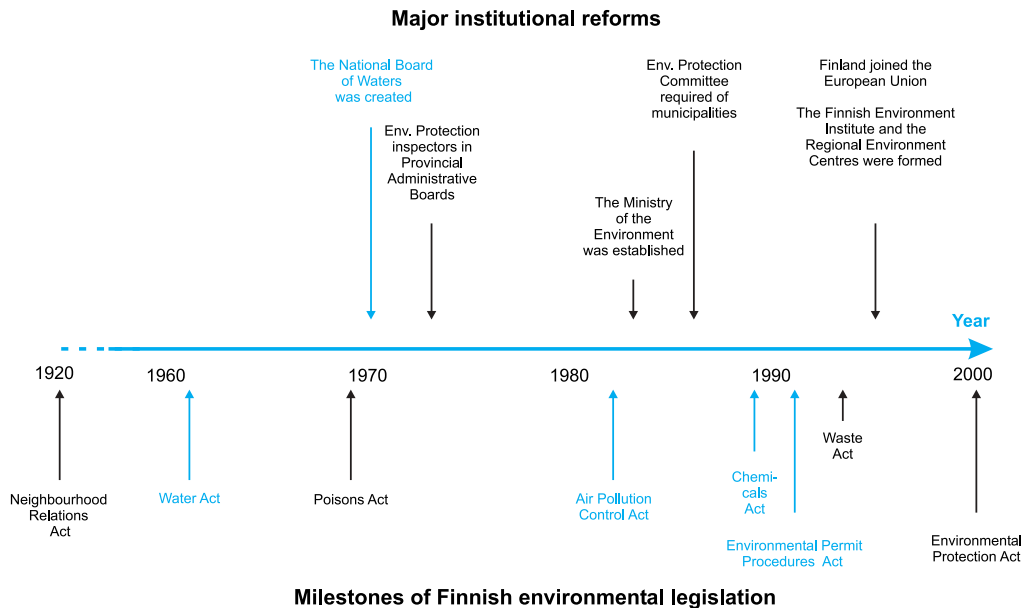


Fig. 6. The temporal development of Finnish environmental regulatory instruments.

FIM 150 million (1999 value, i.e. € 25 million) and in the late 1990s the budget of the Ministry of the Environment and the state environmental administration had increased to more than FIM 500 Million (1999 value, i.e. € 84 million).

In addition to the administrative costs the state has provided grants and subsidies for environmental measures. The interest subsidy for water protection investments in industry peaked in the mid 1970s and in the mid 1980s at FIM 7 million (1999 value, € 1.2 million), but has since declined. Interest support for air pollution control in industries was initiated in 1980 and reached approximately FIM 15 million (1999 value, i.e. € 2.5 million) by 1993. By 1999 the interest support for all environmental investments had declined to FIM 14 million (€ 2.4 million). In 1999 the environmental subsidies amounted to FIM 31 million (€ 5.2 million), but this sum also included support for the clean-up of polluted soils. Subsidies have also been granted for the development of waste management. A general condition has been that the subsidy should represent no more than 50 per cent of the total cost and no more than 30 per cent of investments (State Budget for 1999).

Until 1986, many municipalities did not have any personnel with specific environmental com-

petence. In October 1986, an Act on Municipal Environmental Administration (64/1986) came into force. This Act made environmental committees mandatory in municipalities with more than 3 000 inhabitants. Municipalities were further obliged to supervise and promote environmental control to secure a healthy, pleasant and stimulating living environment for their inhabitants (Kettunen, 1996, p. 24). In 1997, this act was amended, giving municipalities more freedom to organize their environmental administration in collaboration with other municipalities, or in corporation with other sectors within the municipality (Government Bill 1996/212).

5.3 The instruments and their use

5.3.1 The Water Act

5.3.1.1 The basic structure of the Act and the decision-making

Between 1962 and 2000 the Water Act was the most important piece of legislation with respect to water pollution. The Act also covers other aspects of water management and development, but

these aspects will not be dealt with in this study. The Water Act (19.5.1961/264) replaced the earlier Water Rights Act (Vesioikeuslaki, 1902) when it came into force April 1st 1962. The central decision-making body was the Water Court. Finland was divided into three regions, with one Water Court in each. The Courts had legal, technical and, since 1987, ecological expertise. With respect to water pollution, the main function of the Court was to issue wastewater permits. In addition the Water Court was empowered to take decisions in a great variety of issues related to the use of water.

The basis of the intervention theory of the Water Act has been three bans: on closing off, on altering and on polluting a body of water. The two first bans are still part of the Water Act and the third ban, which is crucial for pollution control, was transferred to the Environmental Protection Act (86/2000) in March 2000.

The ban on polluting a body of water was not intended to be absolute, but conditional on the decision made by the Water Court. Thus the intervention theory emphasises flexibility. The ban merely defined the kind of activities for which a permit was needed. All activities that emitted or discharged solid, liquid or gaseous substances or energy into a water body, thus immediately or ultimately causing pollution, were covered by the ban. Detrimental impact on nature, apparent damage to fish stock, danger to health, significant deterioration of the amenities of the environment, of cultural values or the environment's suitability for water supply or recreational purposes were also cited as examples of violations of public interests, which were to be taken into account according to Section 19 of Chapter 1 (as amended in 1987).

The Water Courts were decision-making, not supervisory, bodies. Between 1970 and 1995 Finland had a centralised supervisory system in the field of water pollution, which was led by the National Board of Waters and the Environment (until 1986 the National Board of Waters). Since 1995 the Regional Environment Centres have been responsible for supervision. Although the Centres are regional state organisations under the Ministry of the Environment, their position is rather independent. Municipal environmental authorities are autonomous with respect to the state environmental authorities. According to the Water Act they decided on smaller matters and had certain supervisory duties. With respect to pollution from

major industrial installations, they did not have a decision-making role, although they had an additional role in supervision. In practice, the Water Court gave municipalities an opportunity to participate in decision-making by requesting comments on the cases.

From a legal point of view only the operator was recognised in the *pre-decision phase*. The starting point of the law was that a permit matter should be brought to the Court by an application of the operator of the polluting activity. The Decree on Precautionary Measures for the Protection of Waters (283/1962) assisted operators by listing activities for which a notification was required to the supervising authority in order to judge the necessity of a permit application. Otherwise the operator was free to decide with whom it wanted to co-operate. According to the revision in 1970 of the Decree (283/1962), the supervising authority was empowered to demand supplementary information and to require the operator to make a permit application to the Water Court.

During the *decision phase* those likely to be affected by the polluting activity were informed about the process and they had a right to express their views. In addition, the authorities protecting a public interest likely to be affected were informed and they had an opportunity to give statements. The regional centres (or their administrative predecessors), were always involved as supervisory authorities and certain other authorities such as the regional fisheries authorities were in practice also always involved.

In order to get a more detailed assessment of the consequences of the activity concerned, the Water Court was empowered to set up a special Inspection Procedure. Minor issues were handled without the inspection procedure. The ad hoc Inspection Board consisted of an expert (typically an employee of the environmental administration) and two laymen. In addition other experts were frequently involved in carrying out the analysis of specific issues such as damage to fish resources or property. The Inspection Board scrutinised the matter in detail, organised hearings and produced an Inspection Document containing a draft permit.

During the *post-decision phase* the Water Court had no active role. The environmental authorities were responsible for supervision and partly for monitoring. While the duties of the operator were expressed in the permit, generally these included

action to ensure that limit values were not exceeded, and often monitoring and some research and development requirements.

The decision-making according to the Water Act was based on individual discretion. There have been no general standards, such as general emission limit values or binding environmental quality objectives. Neither were there any lists of installations or hazardous substances automatically requiring a permit until the mid 1990s. Traditionally only those installations and activities, causing certain environmental consequences, defined in the ban to pollute water as explained earlier, needed a permit. Due to European Community law an obligation to apply for a permit irrespective of its impacts was inserted into the law. For example, discharges of all substances mentioned in 'the Black List' (List I) or 'the Grey List' (List II) of the framework directive on water pollution (76/464) always requires a permit and several substances mentioned in 'the Black List' are totally banned. Furthermore the discharge of municipal or industrial waste water (Directive 91/271) and discharges from activities regulated by the titanium dioxide directives require a prior permit irrespective of their impacts. This requirement of EC-law was implemented in the Decrees 363/1994 and 365/1994.

Despite the lack of legally binding general standards, non-legally binding objectives for different sectors, including the pulp and paper industry, have been set in the National Water Protection Programmes. Before these a special programme for the pulp and paper industry was issued (Sitra 1970). The time period of each of the three National Water Protection Programmes decided upon so far has been approximately 10 years. The latest programme specifies objectives for the year 2005 (Table 6). The Programmes have by their nature been general and they have not contained recommendations for individual decision-making.

The Water Courts considered permit applications stepwise. The first step was to examine whether there was an absolute obstacle to granting a permit. Threats to public health, far-reaching changes in natural conditions, significant deterioration in the conditions of local inhabitants or local economic life constituted an absolute obstacle according to the Water Act as enacted in 1962. Pursuant to the amendments of 1987 and 1994, two other absolute obstacles were intro-

duced. Finland's international agreements (the Helsinki Convention is the most relevant agreement in this context) in the field of the protection of waters of the sea could become an absolute obstacle. Pollution of the sea outside the territorial borders of Finland also constituted an absolute obstacle.

The second step was weighing of public and private interests. A permit was to be granted if the adverse effects of discharges were relatively minor compared with the total benefits gained. Different kinds of public and private interests (as described in Section 19 of Chapter 1, see above) were taken into consideration. A precondition for granting a permit to pollute was that the elimination of wastewater or some other substance polluting the water body was not possible at reasonable cost. Thus the applicant had to take all pollution prevention measures not causing excessive or unreasonable costs. This principle has a substantial connection to the Best Available Techniques (BAT) principle, which was introduced into the Act in 1994. The BAT principle was adopted as a consequence of international and EC law. According to the Government Bill concerning the amendment, the BAT level is required as a minimum standard. The impacts taking into consideration the sensitivity of the recipient body of water may require even higher level of environmental protection technology than the BAT level. (For a more thorough description on the Water Act, see Vihervuori (1998b, p. 72–103.)

5.3.1.2 Evolution of the permits

The first permits issued under the Water Act were in the form of qualitative statements, which were not exact. Since 1971, quantitative maximum limits for discharges have become common for pulp and paper production (Fig. 7), although limits relative to the production have also been used. Limits on discharges of suspended solids were the first maximum limits included in the permit conditions. These limits were soon followed by limits on the total biological oxygen demand, nowadays measured over seven days (BOD₇), earlier often measured over five days. Since the beginning of the 1990s most new permits have included limits on phosphorus discharges, while many permits issued in the end of the 1990s no longer contain any quantitative limits on the total discharges of suspend-

Table 6. Programmes containing goals for water protection. The three National Water Protection Programmes are in bold. (SITRA 1970, The National Board of Waters 1974, Ministry of the Environment 1989a, b; 1998). BOD = Biological Oxygen Demands, SS = suspended solids.

Programme	Goals for pulp and paper, except the quantitative goals for 2005, which are for all industries				
	Qualitative	Quantitative			
		BOD	Phosphorus	Nitrogen	Others
Pollution of the Environment and its Prevention (Sitra 1970)		BOD ₅ Sulphite 70–200kg/t (1970s) 50–70kg/t (1980s) 50–20kg/t (1990s) Sulphate 35 kg/t (1970s) 25 kg/t (1980s) 15–20kg/t (1990s)	–	–	SS 5–20kg/t (1970s) 5–15kg/t (1980s) 5–10kg/t (1990s)
Principles of Water Pollution Control up to 1985 (7.8.1974)	”New industrial sites should aim to stop emissions to the environment. The development of processes producing less waste and utilising raw material efficiently and other internal measures should be central...” The necessity of the products should be determined considering their environmental impacts both when used and after use. In addition new waste water treatment will be necessary.	BOD ₇ 650 t/day 1980 (–50 % of 1972) 400 t/day 1985 (–69 % of 1972)	1.5 t/day 1985 (–25 % of 1972)	15 t/day 1985 (same as 1972)	SS 200 t/day 1980 Lignines 500 t/day 1985
Water protection programme to 1995 (6.10.1988)	Action will first be taken with respect to the emission which is most critical for the particular receiving water course. Special emphasis should be on toxic substances and the functioning of technology.	BOD ₇ 160 t/day	1.5 t/day (–25 % of 1986) Specific load in sulphate prod 60 g/t	–	Sulphate COD _{cr} 65 kg/t
Decision on the Reduction of Chlorinated Organic Compounds (22.7.1989)	In accordance with the water protection programme to 1995, the Ministry of the Environment made a decision on the reduction of discharges of chlorinated organic compounds from the pulp and paper industry				Chlorine 1.4 kg per ton of bleached pulp
Water Protection Targets to 2005 (19.3.1998)	BAT. Minimum water use. Optimisation of utilisation of chemicals, especially those containing nutrients. Intensified removal of nitrogen is only required if nitrogen is the minimum factor. The targets are based on production estimates from 1996, differences in actual production should be reflected in the targets.	No sector specific quantitative goals, but it is obvious that for COD and nutrients (P,N) the major reductions are expected to come from the pulp and paper sector. Quantitative for industry as a whole:	–50 % compared to 1995 level	–50 % –50 % compared to 1995 level	COD _{cr} –45% compared to 1995 level

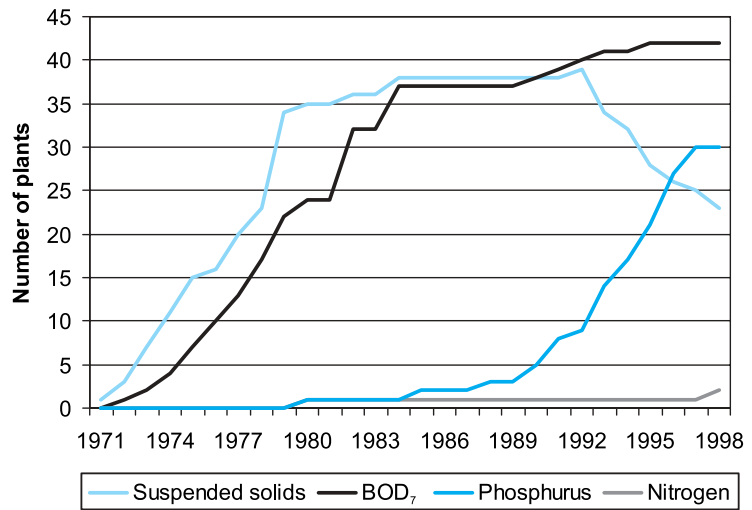


Fig. 7. Limits on total discharges included in permits of the Finnish pulp and paper plants operating in 1998. Some plants had limits on discharges per production some years before limits on the total discharges were included in their permits.

ed solids. Some permit conditions that will come into force during the next few years also include limits on nitrogen. In addition to the substances in Fig. 7, permits have also begun to include limits for chemical oxygen demand (COD). For pulp mills they currently include limits on chlorine discharges in the form of AOX, which is a measure of the amount of organic chlorine compounds.

There are 192 decisions concerning the permit limits of the pulp and paper mills that were operating in 1998. Four decisions cover several mills, but have separate sections determining the limit values for the discharges of each mill. These will be considered as separate decisions even though they are technically parts of the same decision. When this is taken into account the data consist of 213 decisions. Of these 166 were made by the Water Courts, 47 by appeal courts, which

were either the Water Court of Appeal or the Supreme Administrative Court. In four decisions by the Supreme Administrative Court new limit values were introduced, once for BOD, once for COD and twice for suspended solids. In all other cases the decisions contained limit values on the same parameters as before the appeal. The Water Court of Appeal has once changed a target value for COD to a limit value and once done the same for nitrogen. Four times phosphorus target values were changed into limit values. (Mickwitz 2000a)

The history of the key permit limits can be divided into three periods: a period when no permit decisions contained a limit on the discharges of a specific type; a period when both decisions with limit values and without were common; and a period when all permits issued contained a limit value (Table 7) (Mickwitz 2000a). Since only the

Table 7. Three phases describing the inclusion of permit limits for discharges of pulp and paper mills (Mickwitz 2000a).

Discharge	No limits ² in the decisions	Both decisions with limits and without	All decisions have limits ²
Suspended solids	1999–	1971–74 & 1991–98	1975–1990
BOD	–1970	1971–1974	1975–
COD	–1989	1990–1993	1994–
Phosphorus	–1986	1987–1997	1998–
Nitrogen	–1997	1998–	
AOX ¹	–1989	1990–1992	1993–

¹ AOX limits are only included in permits for mills producing pulp and thus the phases in the table are only for mills producing bleached pulp.

² Although these implementation phases have been called "No limits" and "All have limits" they are here determined so that clear exemptions are overlooked, e.g. earlier phosphorus and nitrogen limits for a plant that have discharges into a river running into what at the time of the decisions was the Soviet Union.

permits for some of the mills are decided each year it often takes many years after the policy has changed before all mills have a particular limit in their permit. Thus the last mills got their first AOX limits in 1996 (entered into force in 1997), although no decisions without AOX limits were made after 1992.

There has been variation in the time period for which the limit on the discharges is set. Most emission limit values (55 per cent) have been specified as monthly discharges, whereas 43 per cent have been for quarterly discharges. In eight cases the time period was six months and in two decisions one year. The yearly discharge limits give the greatest flexibility to the firm.

5.3.2 The Air Pollution Control Act

5.3.2.1 The basic structure of the act

The Air Pollution Control Act (67/1982) came into force October 1st 1982. Before 1982, certain aspects of air pollution were regulated by the Public Health Act from 1965 (reformed in 1995 (763/1994)) and by the Neighbourhood Relations Act (26/1920). The Environmental Permit Procedure Act (736/1991) combined the decision made under the Air Pollution Control Act with permits made under the Public Health Act, the Neighbourhood Relations Act and the Waste Management Act from September 1st 1992 onwards. The Waste Management Act was replaced by the Waste Act (1072/1993) in 1994. However, only the procedures under the different Acts were combined, the substantial legal basis for the decisions remained in the different Acts. Thus, only one application was needed and one decision was made, but that decision included several permits.

Under the Air Pollution Control Act norms and guidelines were issued and in this its intervention theory differed clearly from that of the Water Act (see above). To avoid any confusion with "regulatory instruments" the word "general norm" will be used, although especially in this context the word "regulation" would otherwise be preferable. Both the general norms and guidelines directed the decision-making, although only the norms were binding. The general norms and guidelines may have referred to e.g. quality of air or deposition; emissions to the air; composition of a substance, a preparation or a product produced, im-

ported, exported, delivered or used; and labelling of substances, preparations or products when necessary for identification. The most important general norms and guidelines with respect to the pulp and paper industry were the following: guidelines on air quality standards and target values of sulphur deposition (480/1996), norm on limit values and threshold values for air quality (481/1996), guidelines on the reduction of particle emissions from power plants and boilers (157/1987), guidelines and norm on the reduction of concentrations of sulphur compounds in emissions from sulphate pulp mills (160/1987).

There were two different types of permitting authorities under the Air Pollution Control Act. Decisions concerning large installations, such as pulp mills, were originally made by the Provincial Administrative Boards, and after March 1st 1995 by the Regional Environment Centres. Decisions concerning small installations were made by Municipal Environmental Committees. Contrary to the decision-making system of the Water Act, there were no separate bodies for decision-making and supervision. Thus the Provincial Administrative Boards, and later the Regional Centres, were also supervisory bodies for large installations. For small installations municipal environmental authorities carried the responsibility. There were no provisions in the law concerning co-operation during the *pre-decisional* phase. During the *decision phase* the provision of general administrative law applied, which left the decision on which other authorities should be heard to the decision-making body. Those whose rights were affected should always be heard or be given the possibility to be heard. During the *post-decisional phase* only the two authorities with supervision duties were involved.

The intervention theory of the Air Pollution Control evolved. Originally the Act on Air Pollution Control was based on a notification system. However, the notification system was gradually developed into a permit mechanism between 1992 and 1995. The procedure of handling a notification based on the Act was combined by the Environmental Permit Procedure Act, which came into force September 1st 1992, to certain other permits under the Public Health Act, Neighbourhood Relations Act and the Waste Management Act, from 1994 the Waste Act. The most important permit excluded from the common procedure was that of water pollution. The Environmental Permit

Procedure Act meant that the requirements of different Acts were set in one and the same decision (called an Environmental Permit), although the substantial provisions still were separated in different pieces of legislation. This led to a situation in which the decision taken under the Air Pollution Control Act was, functionally, more close to a permit than notification, although the exact expression used in the Act was not changed to a permit until 1995.

After the enactment of the Environmental Permit Procedure Act a legally binding decision was needed before the activity could be started. However, there still remained another difference between a permit and notification: a permit could be rejected, whereas a notification could not lead to a total rejection of the activity concerned. Between 1992 and 1995 the legal situation in this respect was not clear, but after the 1995 reform it has been clear that the Air Emission Permit could be rejected. However, in practice the crucial issue is not whether an activity shall be allowed or not, but on what conditions it shall be allowed. The development of the intervention theory from a notification system to a permit mechanism did not mean that all mills were regulated with a permit under the period studied. In fact, those mills which had made a notification before the 1995 reform were obliged to file a permit application either by the end of 2000 or by the end of 2002. Most of the mills included in this study belong to the latter group. Thus, many mills were not, in practice, regulated by a permit at any moment during the existence of the Air Pollution Control Act but by a weaker instrument, i.e. a decision, made on the basis of a notification.

In contrast to the water legislation the installations under the Act were listed in the Air Pollution Control Decree. The list included e.g. chemical pulp mills, plants producing inorganic industrial chemicals and plants using volatile solvents at a level of more than 50 tons per year, but not paper mills as such. As the Act did not include any other mechanisms for the control of air pollution than the notification/permit system, it was toothless with respect to those activities not included in the list (Kuusiniemi 1995, p. 121).

Pursuant to the 1995 reform Air Emission Permits were to be issued if the following preconditions were met: (1) the activity fulfils the requirements specified by the Act or secondary legislation; (2) the activity causes no risk or injury to

health, or otherwise significant pollution of air; and (3) the reduction of emissions corresponds to the level of best available techniques. The permit authority was able to impose specific air pollution control conditions in a permit. These conditions could be emission limits, other air pollution prevention measures as well as monitoring and control. In practice it is not possible to separate the preconditions to grant a permit and the conditions set up in a permit, because an operator could achieve a specific emission level either by meeting the preconditions or by introducing measures according to the permit conditions.

In addition to the preconditions, the conditions specified in a permit had to be based on (1) general guidelines, (2) general norms and (3) the considerations mentioned in Section 7, paragraph 2. The general guidelines were not binding, but have in practice been important. In contrast to general guidelines, general norms were binding. A starting point was that the conditions in a permit had to fulfill the general norm, but more stringent conditions could be imposed in order to meet the second precondition described above. Section 7, paragraph 2 includes a requirement to take into account the following considerations: the characteristics of the area where the effects of the activity will become evident, the effects of the activity on the environment, the significance of measures for the prevention of air pollution from the point of view of air pollution control and the technical and economic conditions for carrying out the measures.

Before the 1995 reform the types of conditions to be set up in a permit were basically the same as after the reform. However, the justifications were amended. Before the amendment air pollution control conditions in a permit had to be based on general guidelines or general regulations. In addition, it was possible to impose a condition in order to avoid evident pollution of air but there was no reference to e.g. best available technique.

5.3.2.2 Evolution of the permits

The Air Pollution Control Act was based on a list of installations which required a permit. Pulp but not paper mills were such installations. A paper mill could, however, include a listed installation. For example, a paper mill with a power station or a boiler plant of a certain minimum size was

obliged to acquire a permit. A single mill could require several permits if separate permits applied to different parts of a mill. In total there are more than 70 decisions for 43 mills.

Our data consists of 38 permits granted to the pulp and paper industry during the period 14.1.1991–29.9.2000. The data includes all permits granted after 1994 and approximately 50 per cent of the permits granted since the Air Pollution Control Act came into force in 1982. The data has been collected from the VAHTI database and the archives of the Finnish Environment Institute. In addition, information on the number and dates of all regulatory decisions made under the Act has been used.

The implementation of the Act proceeded slowly. Before 1987 only one mill had obtained a decision under the Act. By 1992 the number of mills with at least one decision was 18 and by 1997 the number was 29. By the end of September 2000, 34 out of 43 mills had obtained at least one decision.

Emission standards were the most common type of substantial conditions included in the decisions forming our data. More than every second decision included an NO_x limit value and limit values concerning particles, one third of all decisions included a SO_x limit value, and approximately one fifth a limit value on odorous sulphur compounds. Approximately one fourth of the decisions included technological requirements, but some of these were limited to a specification of the height of the chimney. The most common technological requirement concerned the type of filter for emission control. Several air permits also include input limits. These usually determined some characteristic of the fuel that could be used, e.g. an upper limit on the sulphur content of heavy fuel oil. Approximately one fifth of the decisions included at least one R&D obligation. Some permits included numerical reduction targets, whereas others only mentioned qualitative objectives.

5.3.3 The Environmental Protection Act

The integrated pollution control under the Environmental Protection Act (4.2.2000/86) replaced the sectoral system based on different Acts and several permits as of March 1st 2000 (Vihervuori 2000). The Air Pollution Control Act and the water pollution provisions of the Water Act were re-

pealed, although other parts of the Water Act are still in force as amended. The Finnish pollution control system has gradually been developed towards an integrated control system during the past decade, but the demands of the EU's Integrated Pollution Prevention and Control (IPPC) directive (96/61) finally led to the adoption of the system in Finland with corresponding changes in the intervention theory of the pollution control. The new intervention theory aims at integration and clarification of legislation on environmental health, waste, noise, water, air and soil pollution control, but has not aimed at significant changes in the stringency of existing laws. However, due to the changes of the framework for decision-making, not all existing permits necessarily meet the substantial demands of the Environmental Protection Act.

The three Water Courts were metamorphosed into three new independent Environmental Permit Authorities under the Ministry of the Environment. The permits for major installations are now granted by the permit authorities, e.g. for all pulp and paper mills. The Regional Environment Centres grant other permits except those concerning small installations, which are granted by the Municipal Environmental Boards. The division of labour between the Regional Environment Centres and the Environmental Permit Authorities is partly based on historical precedents and is not a strict division based on size or environmental significance of the installations. Thus some parts of the chemical industry, notably the production of industrial chemicals, are left to the Regional Environmental Centres. Similar to the Water Courts, the Environmental Permit Authorities are decision-making bodies without a supervisory function. The Regional Environment Centres and the Municipal Boards are both decision makers and supervisory bodies.

5.3.4 The Chemicals Act and its authorities

The Chemicals Act (744/1989) superseded the Poisons Act (309/1969). Major amendments were made in 1992 in response to the demands of EC-Law (Government Bill 1992/106). The purpose of the Act is to prevent and avoid adverse health and environmental effects and also to prevent fire and explosion damages and consequences to prop-

erty (Chemicals Act 744/1989, Section 1). In this study we have focussed on large-scale industrial handling and storage of dangerous chemicals, but it is obvious that there are close links between general safety regulations, the risk assessment of individual chemicals and the permits for the production and use of chemicals.

The Chemicals Act involves three Ministries and numerous other authorities (744/1989). The Ministry of Social Affairs and Health has responsibility for the general co-ordination of the legislation on chemicals, supreme management and guidance of preventing and averting harm to health and fire and explosion hazards caused by chemicals, and supervises regulations concerning the classification, warning labels and packaging of chemicals and the safety data sheet. The Ministry of Social Affairs and Health also submits a proposal for the Advisory Committee on Chemicals, which is a co-operation body appointed by the Council of State and which covers all the key actors in issues related to chemicals. The Ministry of the Environment has responsibility for the supreme management and guidance of preventing and averting harm to the environment caused by chemicals. The Ministry of Trade and Industry has responsibility for the supreme management and guidance of industrial handling and storage of dangerous chemicals and regulations concerning industrial handling and storage of chemicals.

The National Product Control Agency for Welfare and Health under the Ministry of Social Affairs and Health has responsibility for the supreme control of chemicals dangerous to health and of chemicals posing fire and explosion hazards, whereas the Finnish Environment Institute under the Ministry of the Environment has responsibility for the supreme control of chemicals dangerous to the environment.

The Safety Technology Authority (TUKES) has responsibility for granting licences for and supervision of large-scale industrial handling and storage of dangerous chemicals and for maintenance of the licence register. Since November 1995 TUKES has been the key actor in implementing the regulations on the industrial use and storage of the Chemicals Act. Industrial plants that manufacture, utilize and store dangerous goods are subject to supervision by TUKES. After examining and approving the necessary reports, TUKES grants statutory licences and authorisations. TUKES also checks that the responsible

persons have the required qualification and that the supervisory staff pays regular visits to the plants, and also monitors the importers, installation companies and inspection bodies. In its inspection work TUKES is also in close contact with the Regional Environment Centres, the Provincial Administrative Boards and the municipal supervisory authority for chemicals. In addition, Occupational Safety and Health Inspectorates supervise the classification and labelling of chemicals used at workplaces.

The municipal authority has responsibility for supervision of the retail trade of chemicals, supervision of small-scale industrial handling and storage of chemicals dangerous to health and the environment, supervision of the classification, packaging and labelling of chemicals to be placed on the market and for controlling that the safety data sheets have been compiled and notifications of new substances have been made.

The procedures for dealing with permit applications for large-scale industrial handling and storage of chemicals follow general administrative law. There are no provisions on co-operation during the *predecision phase* and at the *decision phase* it is up to the decision-making body to decide which other authorities should be heard. During the *post decision phase* the duties of supervision are divided among the provincial board, regional environmental authorities and municipal chemical authorities.

The key elements of the intervention theory for the Chemicals Act concerning industrial handling and storage are that the operator must live up to a set of safety rules, which have been specified for the chemicals he intends to use. A shift can be detected in the intervention theory in 1998–1999. In the amendments of 1998 (Government Bill 1998/221) the links between chemical permits and land use planning regulations were made explicit. Amendments in 1999 (Section 16 a, 1198/1999) introduced the obligation to choose the least dangerous chemical, thus creating an implicit connection to the concept of Best Available Techniques and therefore also to the Environmental Protection Act (86/2000). The amendments of the Chemicals Act have further stressed the responsibility of the operator by requiring detailed safety plans. Thus the role of the Safety Technology Authority has changed from detailed technical inspection towards more general process oriented inspection. The basis is, however, still in the

detailed specifications of the use of chemicals, which leave little room for negotiations on their safe handling.

5.3.5 Electricity Taxation and subsidies

Electricity is taxed in Finland in several different ways and for many reasons. Some of these reasons are non-environmental, e.g. to generate income, while others – e.g. the introduction of the world's first CO₂-tax in 1990 – were to a large extent justified by environmental concerns. Electricity taxation is in this context understood to cover the taxation of inputs used for the production of electricity, subsidies for electricity production and taxation of the end product, i.e. electricity itself.

After several minor changes the energy taxation was reformed in the beginning of 1997. The main justification for the reform was the liberalisation of the energy market that had taken place and the need to ensure the competitiveness of the Finnish energy producers. The greatest change in the intervention theory was that taxation shifted from taxation of the production of electricity based on the input fuels to the utilization of electricity. The inputs for heat production are still taxed and the tax rates are partly based on the carbon content, e.g. the tax rate for hard coal is higher than that for natural gas. The description of the electricity taxation below refers to the present situation, i.e. after the 1997 reform. (e.g. Ministry of the Environment 1997, Määttä 2000)

The electricity taxation in Finland is a rather complex combination of subsidies, different tax rates, exemptions and refunds. There are two tax rates: industry and professional greenhouse growers pay a lower tax and all other users a higher tax, which has been almost twice the rate for industry. Energy intensive industries, i.e. industries for which the paid energy taxes are more than 3.7 per cent of the value added of the industry, can get their tax partly refunded. Electricity that is produced for one's own use using wood or wood-based fuels or gases from metallurgic processes is exempted from the tax. Finally, electricity produced in certain ways, for example, with wind power, can get a subsidy, which is equal to the tax rate for non-industrial users. (e.g. Ministry of the Environment 1997, Määttä 2000)

In 1999 the electricity tax for industry was

0.025 FIM/kWh (0.0042 €/kWh), which corresponded to about eight per cent of the total price which industries using more than 2.5 MW were paying for electricity. The price was 0.312 FIM/kWh (0.052 €/kWh) in the beginning of 1999. The price for transmission of electricity has for industries using more than 2.5 MW been about 0.13 FIM/kWh (0.022 €/kWh). (Statistics Finland 2000b)

5.3.6 Environmental management systems

Several of the studied companies have used voluntary or self-governing instruments for their environmental management. The general ones are the European Union's Environmental Management and Audit Scheme (EMAS) and the ISO 14001. The Responsible Care programme of the chemical industry is not presented as a management system, but it will here be treated together with EMAS and ISO 14001 as they are all based on very similar intervention theories. The main feature of the intervention theory is that all stress systematic but voluntary approaches to environmental protection. The concept of continuous improvement is another key feature.

The Responsible Care programme is the oldest. It was initiated in Canada in 1984 and by 1999 many companies in 42 countries were members. In Finland the Finnish Responsible Care – "Vastuu Huomisesta" programme was launched on 19 May 1992 and has since expanded to cover most of the sector (Fig. 8). The programme was drawn up with special regard to Finnish conditions (Responsible Care 2000). The programme does not contain any direct involvement of authorities. Thus the participating industries are fully responsible for their commitment to the programme.

The EMAS is based on the EC regulation 1836/93 and in Finland it has been enacted as the EMAS Act (1412/1994). Although the scheme is voluntary the register of sites that have joined the scheme is kept by a competent body, which in Finland has the status of an authority. The scheme requires that external verifiers are used to confirm the adopted management scheme and to check the public environmental reporting demanded by the system. Continuous improvement of environmental performance is a core feature of the scheme. In January 2001 a total of 31 sites had an

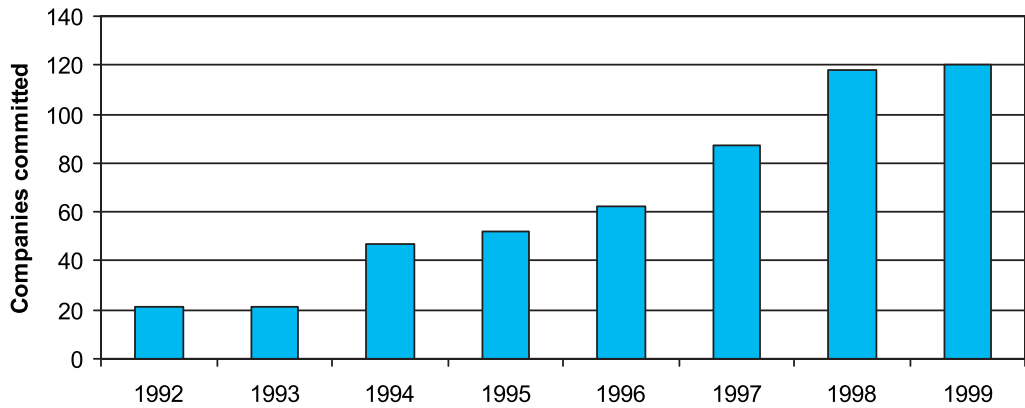


Fig. 8. The number chemical firms committed to the Responsible Care programme (Responsible Care 2000).

EMAS certificate in Finland (EMAS-ISO ajankoh-taiskatsaus 2000).

The ISO-14001 was launched by the International Organisation for Standardization 1996 as an environmental standard that specifies the elements of an environmental management system. The management system can be certified and it includes a commitment to continuous improve-

ment. No authorities are directly involved in the implementation or monitoring of the system. The accredited verifiers keep their own registers of the certified companies. By November 2000 altogether 526 sites had an ISO 14001 certificate in Finland. The pulp and paper sector had 52 ISO-14001 certificates. The corresponding figure for the chemical industry was 45.

6 Overview of pollution loads and the state of the environment

The general overview of the state of the environment in Finland shows a positive development with respect to regulated pollution from point sources.

6.1 Water pollution and the state of waters

The load of several pollutants has been reduced substantially. In the 1960s the biological oxygen demand of the waste waters from pulp and paper industries increased at the same rate as production (PI-Consulting 1997). Except for the fertiliser industry the chemical industry has not caused major direct discharges of nutrients or organic matters. An estimate made in 1970 of the total amount of point source loading causing oxygen deficit ranked the pulp and paper industry as the main polluter (75 per cent of total load), followed by human settlements (19 per cent), food industries (2.6 per cent) and the fertiliser industry (2.3 per cent) (Sitra 1970).

The production of chlorine using the mercury cell process was a major source of mercury loading in the 1960s and 1970s and the pulp and paper industries discharged significant amounts of toxic organic and organo-chlorine compounds. The sediments of the receiving water bodies display clearly the history of the pollution (Verta et al. 1999). Some of the major chemical industries were also significant local polluters, e.g. the two oil refineries and the associated industries and the titanium dioxide plant had clear impacts and were the source of controversies and conflicts.

Overall the state of Finnish waters was probably poorest in the 1960s and 1970s. In the late 1960s nearly all major watersheds had significant water areas classified as "poor", generally downstream from pulp and paper mills. In 1994–97 only 0.3 per cent of the lakes were classified as poor (Rosenström and Palosaari 2000). The change can be seen e.g. in the nutrient levels of the recipients. For example in southern Lake Saimaa, which has received wastewater from pulp and paper industries and municipalities (Haukiselkä), phosphorous levels reached 50 microgrammes per litre in 1970, whereas the levels in 1995 and 1998 were

below 14 and 13 respectively according to the data of the water quality register.

6.2 Air emissions and air quality

Indicators of regulated air pollution emissions display drastic declines in Finland. The import of ozone layer depleting substances declined from more than 3 000 tons in 1986 to insignificant amounts in 1995, and the emissions of acidifying substances from nearly 600 000 tons in 1980 to less than 100 000 tons in 1998. The area within which critical loads of sulphur are exceeded has declined to approximately five per cent of the country's surface (Syri et al. 1999). Improvements have also been registered in several air quality variables, although e.g. ozone levels have shown increasing tendencies (Jonson et al. 2001), mainly due to transport related emissions. Emissions of non methane volatile organic carbons show a decreasing tendency (Saarinen 2001) and the development is likely to continue. The same is true for e.g. particle emissions. The emissions of green house gases have continued to increase, but at a slower rate than previously (Ministry of Trade and Industry 2001).

6.3 Use and production of chemicals

The use of chemicals has expanded all over the world. According to Allanou et al. (2000) The Chemical Abstracts Service has attributed a Chemical Abstracts Service Registry Number (CAS RN) to approximately 16 million chemical substances. About 100 000 chemicals are in regular industrial use. The expansion in the use and production of chemicals can also be seen in Finland. Between 1964 and 1984 the chemical industry's share of the Finnish exports increased from 3 to 13 per cent (Haapaniemi 1986).

Despite very rapid increase in the number and amounts of chemicals, several indicators suggest a decline in the amount of specific chemicals released into the environment. For example the US toxic release inventory shows a decline of about 50 per cent from 1988 to 1995 in the direct releases, while the transfers of site more than doubled (Davies and Mazurek 1998, p. 274). Similar declining trends can be observed in indicators of toxic contamination in Finland (Rosenström and

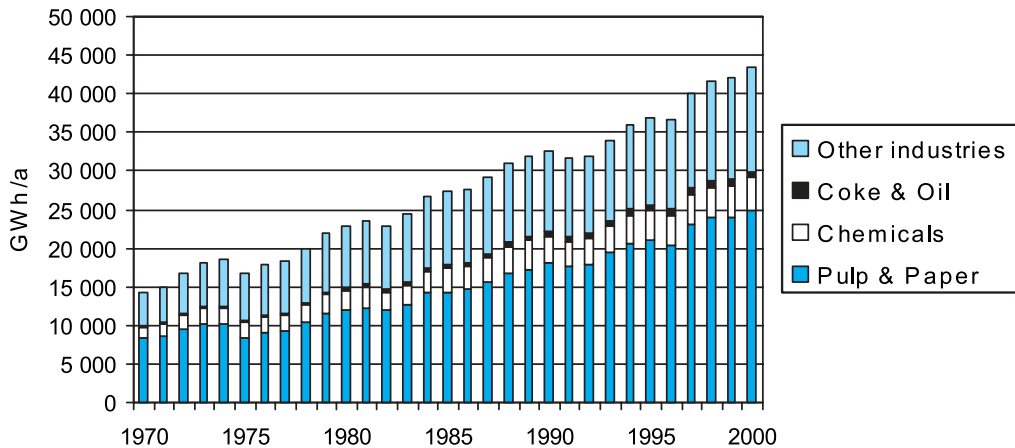


Fig. 9. The electricity used by industry in 1970 – 2000 (Statistics Finland 2001).

Palosaari 2000). The amounts of emission per unit of production also show downward trends. For example emissions of volatile organic compounds relative to the amounts used declined from around 0.12 per cent in 1988 to 0.04 per cent in 1999 (Responsible Care 2000). New chemicals may, however, cause a new burden on the environment. Due to the increasing use there may also be new pathways for chemicals to enter the environment.

The number of chemical accidents registered by the Safety Technology Authority has increased from 1995 to 1998, although this may be due to more efficient registration practices, which now give better coverage of chemical accidents (Muje 1999). The most common types of accident are

leakages and fires due to technical or organisational failures (Muje 1999).

6.4 Use of electricity

The use of electricity by industries has continuously been growing (Fig. 9). In 1998 some 19 per cent of the total energy consumed was produced with wood-based fuels. Industrial wood residues and byproducts accounted for 1 607 ktoe (five per cent of the total energy used in Finland), while black liquor and sulphite-based liquor account for 3 406 ktoe (eleven per cent of the total). (Statistics Finland 2001)

PART 3
MAIN RESULTS

7 Overview of effects

The longest data series and the most comprehensive information on effects is available for the regulatory instruments. It is nevertheless possible to identify different types of effects for all the instruments we have examined. The effects outside the target area and unanticipated effects are at least as important as the anticipated effects within the target area when examined in terms of environmental changes. In many cases it is difficult to draw the border between effects within and outside the target area because the policy instruments evolve and interact. What at some point has been an effect outside the target area may in subsequent revisions become part of the main objectives of an instrument.

7.1 Observed effects of regulatory instruments

When regulatory instruments are used the target population is rather well defined, but outcomes may nevertheless be difficult to connect unambiguously to an instrument. Using several different methods we have been able to show that the implementation of an instrument is in some but not all cases associated with specific measures to reduce pollution. In most cases measures to reduce pollution have been undertaken because operators have had a rational expectation that demands will become stricter, often following market pressures that have already been evident.

7.1.1 Improved state of the environment

Within the target area the desired main effects of all the examined instruments have been the reduction of adverse environmental changes. It is easy to verify the improvement in the state of water courses in the vicinity of major industries and the reduction of critical loads of e.g. airborne acidifying substances (Section 6, Hallanaro et al. 2000). Lack of data hampers the verification of the reduction in adverse environmental changes due to handling of chemicals, but sediment analyses show that the load of specific chemical pollutants clearly has been reduced in certain heavily polluted areas (Verta et al. 1999). The fact that the Chemicals Act is not about regulating emis-

sions but mainly about the reduction of risks complicates the assessment of its role in the reduction. One indicator of improvement is the observation that the number of environmental accidents has remained constant (Luntinen et al. 2000) despite a general increase in the use of chemicals. Another indicator of improved handling of chemicals is that incidents of contaminated soils due to industrial activities are mainly dated to the period before the 1990s and only relatively few new cases have been recorded (Haavisto 2000), although problems with leaking tanks in small scale handling of e.g. fuels have persisted (Emelie Enckell, Uusimaa Environment Centre, personal communication).

In general the use of emission control or, for the Chemicals Act appropriate safety technology, has been part of the desired main effect in the target area of the instruments. Our study shows that the permitting systems have worked in this direction. Issues related to process innovations and their diffusion have largely been an effect outside the target areas of the regulatory instruments and will be further discussed in Section 9.

Improvements in the state of the environment do not mean that all the problems that justified the introduction of regulatory instruments have been solved. Preliminary results of an analysis of the use of chemicals indicates that the increasing use of chemicals has outpaced improvements in dealing with chemicals. Thus chemical loads on the environment may have increased despite generally improved handling and control of production (Elina Karhu, Finnish Environment Institute, personal communication).

7.1.2 The role of regulation

For all regulatory instruments the problem of attributing the impact to the implementation of the instrument is obvious because several developments and societal changes have worked in the same direction as the desired main effects. Our study has, however, identified effects of all studied regulatory instruments during the time they have been in use.

In air pollution control the decline in the emissions of acidifying substances is evident (Fig. 10). Initially some of the old mills had emissions clearly above the limit value of 6 kg SO₂ per ton pulp specified in the Council of State Decision

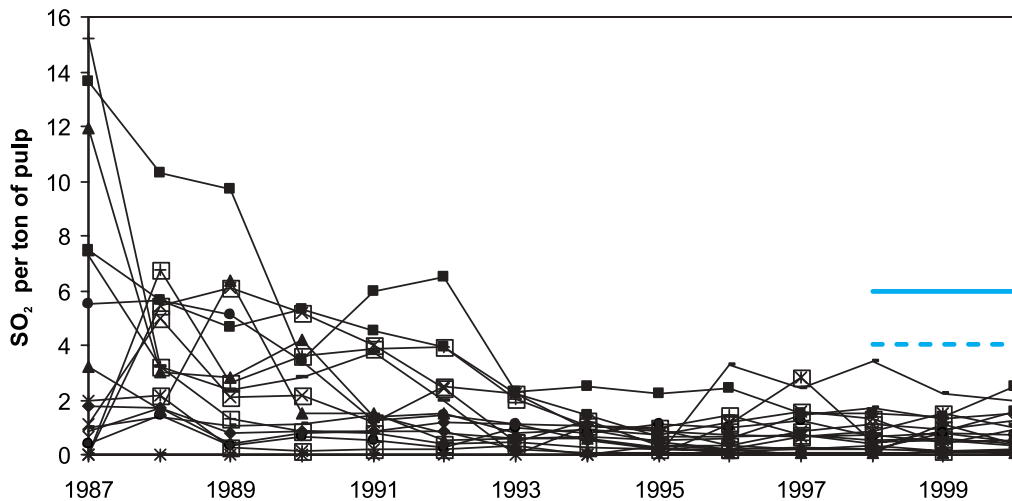


Fig. 10. The SO_2 emissions per ton of pulp produced in different mills (each line indicates an individual mill) and the limits for old (6 kg, solid green line) and new (4 kg, dotted green line) mills in the norm of February 12th 1987.

(12.2.1987/160), Fig. 10). According to the second report of the Sulphur committee (Ministry of the Environment 1993) the bulk of the reduction is due to a change in the basic production process, i.e. sulphite mills were substituted with sulphate mills. In addition, however, end-of-pipe investments have contributed to further reduction.

For three mills the Regional Environment Centre decided on stricter limits than those of the Council of State Decision (12.2.1987) for annual gaseous emissions of sulphur compounds. The first of these permit decisions was made in 1995, while the two others are from 1997. In all three decisions there were two limits; a limit of 3 kg SO_2 emissions per ton of pulp produced and a stricter limit of 2 kg. In two cases the stricter limit entered into force after a new production line or an enlargement was ready, while it will enter into force in the beginning of 2004 in the third permit. In two of the cases the permit limits became legally binding immediately after the decision entered into force, in one case approximately one year after the permit was issued by the Regional Environment Centre.

There is a clear difference between the situation when the Council of State Decision was issued in 1987 and that prevailing when the limits were included in the permits in 1995 and 1997. In 1987 more than one third of the pulp mills for

which data is available had emissions exceeding the future limit, whereas all three mills were below the future permit limit when decisions were made in the 1990s. On the other hand the transition period in the decision in 1987 was a decade, whereas there was no transition time for the 3 kg limits of the permits.

The analysis of water permits was able to identify a statistical connection between the reduction of loads and the introduction of limit values (Mickwitz 2000a) and this could also be verified using legal documents and interview data (Similä 2002). The mill-specific models (Table 8) have estimated the effects of the BOD limits by either utilising the BOD limit as such or the change in BOD limits. These models can only be estimated for the period during which the firm has a BOD limit and cannot thus be used to examine the effect of introducing the limit in the first place. Furthermore many of the time-series are quite short and no strong conclusions should be based on only the statistical results.

Another way of looking at the effect of the permit limits is to compare the development of the discharges of mills with a limit on their total phosphorus discharges with the development of the mills without any limit (Table 9). Here the comparison is made relative to the greatest discharge of each mill in the data series.

Table 8. Summary of the results of the mill -specific models – the number of mills with significantly^a positive or negative coefficients for the BOD limit (Mickwitz 2000a).

	Single equation of ln(BOD discharges)	Single equation of difference of BOD discharges	2 equation system ln(BOD & P discharges)	
			BOD equation	Phosphorus equation
> 0	9	5	10	6
~ 0	22	26	20	20
< 0	1	1	1	5

^a The significance is here defined as a less than 5 per cent probability of the coefficient being zero based on a t-test.

Table 9. Comparing the phosphorus discharges for mills with limits on their total phosphorus discharges and those without (Mickwitz 2000a).

Mills with a limit on their total phosphorus discharges in their water permits		Mills without a limit on their total phosphorus discharges in their water permits in force in 1998	
Mills with reported discharges in 1998:	30	Mills with reported discharges in 1998:	8
Reduction in discharges, when the discharges of phosphorus in 1998 are compared to the maximum discharges of the mill ^a		Reduction in discharges, when the discharges of phosphorus in 1998 are compared to the maximum discharges of the mill	
Mean reduction: (The average for the 30 Mills)	76.6 %	Mean reduction: (The average for the 8 Mills)	70.8 %
Maximum reduction: (The mill with the greatest reduction)	97.9 %	Maximum reduction: (The mill with the greatest reduction)	95.1 %
Minimum reduction: (The mill with the smallest reduction)	54.0 %	Minimum reduction: (The mill with the smallest reduction)	53.2 %

^a For each mill its maximum annual discharges is first calculated, after which the 1998 discharges are compared with this maximum.

Table 9 shows that all mills had considerably lower phosphorus discharges in 1998 than their maximum discharges. However, there is no clear difference between the mills that have had a limit on their total phosphorus discharges in force and those that have not. This can be shown by a t-test of the difference in means (t-value 0.995; critical value 1.812). One reason for the development in the total phosphorus discharges reported might be that the production has developed differently for the different mills. When the phosphorus discharges in relation to the production of the mill are analysed in the same way the results, however, remain. All mills have been able to reduce their phosphorus discharges per production compared to the maximum.

The reductions in nutrient discharges per production are on average greater than the reductions in absolute discharges. In the case of the absolute phosphorus discharges there is no clear difference between mills that have had a limit on their total phosphorus discharges in force and those that have not. (Mickwitz 2000a). These results are very dependent on the discharges in 1998. The advantage of the approach is that there is no ambiguity about the existence of a limit on total phosphorus discharges for this particular year. A disadvantage is that this analysis utilises only a very limited amount of the information that the discharge data contain. Therefore we have also estimated trends in the discharges for all the mills and examined whether there is a difference between the groups.

Table 10. Comparing the phosphorus discharges per production for mills with limits on their total phosphorus discharges and those without. The slope indicates the rate of reduction in discharges (Mickwitz 2000a).

N ^a	Mills with a limit on their total phosphorus discharges in their water permits		Mills without a limit on their total phosphorus discharges in their water permits	
	Phosphorus 31	P/Production 28	Phosphorus 10	P/Production 9
Mean slope:	-803.9	-0.0060	-81.0	-0.0007
Maximum slope:	462.2	0.0001	305.9	0.0004
Minimum slope:	-4020.3	-0.0412	-538.1	-0.0022

^a The difference in the number of observations is due to the lack of production data for some mills.

The analysis of trends indicates a difference in the slope for the mills with a phosphorus limit and those without (Table 10). Phosphorus limits were, however, on average introduced earlier for mills with high phosphorus discharges (Mickwitz 2000a). The mean phosphorus discharges per production were consequently on average more than seven times higher for the mills with a phosphorus limit than for those without one and therefore this is a probable reason for the faster decrease.

Further evidence of the effects of phosphorus limits can be obtained by using data for the mills that have had limits for at least 5 years. For these both log-linear and difference models were estimated with a dummy variable that took the value one for the years when a phosphorus limit was in force and zero before that. For all but 2 of the 11 mills the dummy variables in the log-linear models had negative signs and in 3 cases they were significant at a five per cent level. In the differential models only one mill got a negative and significant coefficient for its phosphorus limit dummy variable. These results thus support the finding that the limit values have had effects, but not on all mills.

In addition to the analysis at mill level some modelling for the aggregated pulp and paper sector can be used. It has been argued that when the phosphorus limits started to become common, mills which did not have a limit in their permit also intensified their action in order to reduce phosphorus discharges. In order to obtain information on this claim some models of the total phosphorus discharges were estimated. As explanatory variables we used the total production of pulp and paper (mechanical and chemical pulp was also examined separately), a trend and the number

of phosphorus limits (the number of mills with a phosphorus limit is used here but also the number of decisions with a limit as well as the share of the decisions that contained limits were used) (Table 11). A difference model was used because an ADF test for stationarity indicated strong trends in the variables.

The results in Table 11 indicate that the decrease in the sector's phosphorus discharges is largely explained by a negative trend. This has partly been counteracted by the increasing pulp production as shown by the positive coefficient in the model. The coefficient for the number of mills with phosphorus limits is negative indicating that discharges of phosphorus drop when the number of permits with phosphorus limits increase. The results should, however, be interpreted with care. The coefficient is not significantly different from zero and recursive estimations of the model show that the parameter values are very dependent on the sample.

Generally all interviewees from the mills viewed the water permits and the specific limits they contain as one of the reasons for the decline

Table 11. The results of a difference model of the aggregated phosphorus discharges 1983–98 (Mickwitz 2000a).

	Single equation of difference P discharges (t-values in brackets)	
Constant	50.89	(2.02)
Trend	-8.24	(-2.57)
Ln(Pulp production)	0.07	(2.64)
Ln(Paper production)	0.003	(0.15)
No. of mills with P-limits	-10.88	(-1.47)

in discharges. However, the role of the permit system is described differently by different persons, and sometimes even different comments by the same person were conflicting. Some interviewees explicitly recognised the difficulty to separate the effect of one factor – the water permits – from all the other factors affecting the general atmosphere that have contributed to the action taken by the industry. (Mickwitz 2000a)

Chlorine is used by all representatives of the mills as an example in which reduction in discharges has been driven mainly by the demand and where the permit system has had no direct, or only a very minor, role. Note that this does not mean that the environmental administration had no role in the development that reduced the use of chlorine. The adoption of new bleaching processes for pulp in order to reduce chlorine discharges is discussed in more detail in section 9.3.1. Going back further in history it is also obvious that a considerable improvement in the state of waters was achieved through the decommissioning of the sulphite mills, which had much greater emissions than the sulphate mills (Sitra 1970). The decommissioning was primarily due to economic factors, not environmental concerns. This was shown by the restarting of the notorious polluting mill of Lievestuore in the early 1970s when pulp prices increased rapidly and made even obsolete technology profitable. The restarting succeeded despite opposition from the National Board of Waters (Haila et al. 1971).

7.1.3 Costs of pollution control

Conceptually the total costs of an environmental policy instrument are *"the change in consumer and producer surpluses associated with the regulations and with any price and/or income changes that may result"* (Cropper and Oates 1992; p. 721). It is difficult to apply this conceptual definition in practice. Monitoring and enforcement costs of authorities are only a small part of the picture, because the capital and operating expenditures of the regulated industry are commonly far greater than the costs of the authorities. Furthermore there are many important cost items that are neither included in the costs of the authorities nor in the capital and operating expenditures of the regulated industries. These are costs which are often labelled general equilibrium effects and tran-

sition costs (e.g. Jaffe et. al. 1995), and include e.g. unemployment, obsolete capital and retarded innovations. The costs we have been able to study are thus only a subset of the total costs and even these cost items we have been able to study only partially. The same is obviously true for the benefits of the instruments.

The general costs of the environmental administration were briefly discussed in section 5.2. It is hard to divide the costs of the administration between the individual regulatory instruments, since tasks related to different instruments are partly financed by the same budgetary moment. It is even harder to split the administrative costs related to a particular instrument to the individual tasks of an act and sectors. For example, in the case of water pollution, pollution prevention is only one of the tasks of the water courts and attributing some share of the costs to water permits for the pulp and paper industry would be very challenging. A thorough analysis of the costs of the administration would have required a study of its own.

With respect to the environmental protection expenditures of the regulated industries the situation is easier, since Statistics Finland has published statistics for the years 1992 to 1997. The environmental protection investments have been between 18.3 and 7.7 per cent of the total fixed investments by the pulp, paper and paper products industry during 1992 to 1997 (Statistics Finland 1999, p. 22). The investments are reported per environmental media in Table 12. Another way to break down the investments is to divide them into end-of-pipe and process-integrated investments for environmental protection. For the forest industry the share of the end-of-pipe investments has varied between 35.8 and 52.3 per cent (Statistics Finland 1999, p. 26)

Based on the figures in Tables 12 and 13 we can make several observations. First, the direct costs of the regulatory instruments of the regulated industries are much higher than the costs of the administration. The internalisation of the environmental costs is in line with the adoption of the polluter pays principle, which was made explicit in a policy decision of the OECD in 1972 (Mickwitz 1998). Second, the annual environmental protection investments are very variable even at the industry level. For individual sites the variation between years is of course far greater. During some years the bulk of the investments

Table 12. Environmental protection investments in the pulp, paper and paper product industry (FIM thousand, nominal values)(Statistics Finland 1994, 1995, 1996, 1997, 1998, 1999).

	1992	1993	1994	1995	1996	1997
Air	221 312	113 135	110 319	156 278	175 174	200 786
Water	418 308	443 560	332 433	732 282	607 020	141 414
Waste	18 146	15 797	23 228	7 841	44 421	30 602
Other	1 632	149	3 000	238	1 088	3 285
Total	659 399	572 641	468 980	896 639	827 703	376 088
Total in 1997 prices	697 612	594 494	481 906	912 481	837 647	376 088
Total euro in 1997 prices	€ 117 330	€ 9 987	€ 81 051	€ 153 468	€ 140 882	€ 63 253

Table 13. Environmental operating expenditure in the pulp, paper and paper product industry (FIM thousand, nominal values)(Statistics Finland 1994, 1995, 1996, 1997, 1998, 1999).

	1992	1993	1994	1995	1996	1997
Air	7 503	12 943	22 946	41 083	42 015	53 471
Water	165 194	193 428	228 066	260 041	288 563	321 254
Waste	55 244	45 934	62 974	56 309	61637	88 326
Other	1 631	2 664	5441	1 994	4 065	4 111
Running and maintenance – Total	229 572	254 968	319 427	359 428	396 280	467 162
Other operating expenditure	52 066	63 317	70 830	49 290	35 737	53 253
Total	281 638	318 284	390 257	408 718	432 017	520 415
Total in 1997 prices	297 959	330 431	401 013	415 939	437 207	520 415
Total euro in 1997 prices	€ 50 113	€ 55 575	€ 67 446	€ 69 956	€ 73 533	€ 87 528

have been for water protection, while more investments have been made for air pollution control during other years. The operating costs have been more stable than the investments. The operating costs for the industry have increased, even when the change in the price level is taken into account. The largest share of the operating costs is related to water treatment but the operating expenditure of air pollution control has increased faster than costs for water and waste treatment during the period.

For earlier decades, information on investments and operating expenditures by the industry are less systematic. The information will not be discussed in detail here, but some general observations will

be made. During the 1970s the total water protection investments by the forest industry were about FIM 1 700 million (€ 286 million) at the 1980 price level. Annual investments varied between FIM 50 million (€ 8.4 million) and FIM 280 million (€ 47.1 million) and the annual operating costs were about 30 million (€ 5 million). The air pollution control investments of the industry as a whole during the 1970s were assessed to about 1 000 million (€ 168 million). (Wallin 1983, p. 56f.) During the years 1985 to 1988 the annual investments in water protection varied between FIM 128 and FIM 526 million (€ 21.5 and € 88.5 million) and in air protection between FIM 42 and FIM 110 million (€ 7 and € 18.5 mil-

lion) (Myrén and Anhava 1992). During the period 1985 to 1990 the annual running costs of waste water treatment plants increased from some FIM 100 million to about FIM 200 million (€ 16.8 to € 33.1 million) (Repo and Hämäläinen 1996). These figures are not fully comparable because they are from different sources, which used different methods of compilation. They do, however, give an indication of the levels of the different costs and their development.

7.1.4 Environmental information and awareness

All the studied regulatory instruments have increased the demand for specific environmental expertise both within the administration and in the private sector. This was evident already in the late 1960s when the need for generalist environmental experts was recognised (Sitra 1970). It can be documented in the number of experts involved (Mulders 2001). The response to this demand can also be seen in the higher education institutions. A strong indication that it is truly related to the regulatory demands can be seen in the fact that education of specialists in the different fields has received a boost with the introduction of the regulatory instruments.

Environmental awareness has been both a cause and an effect of the developing regulatory regimes and of the expanding environmental specialist education. It is an effect outside the target area and at least initially it was an unanticipated effect of the introduction of new environmental policy instruments. During the 1960s and 1970s several environmental issues were raised by independent scientists (Haila et al. 1971, Eskola 1972, Nuorteva 1976), but with the development of regulatory instruments and the environmental administration the number of studies and the width of scientific disciplines involved has broadened. Professional societies have also developed the education and the debate (Eskola 1972) and have acted as gate keepers for ideas developed elsewhere.

7.1.5 Links between environmental media

Regulatory instruments based on specific environmental media may have cross media effects.

This has been explicitly recognised in the Directive (96/61) concerning integrated pollution prevention and control (IPPC-directive), but has not been a major issue in older Finnish environmental legislation. The interviews confirmed the links between water protection, waste, air emissions and energy use. For example the production of thermomechanical pulp is beneficial from a water protection and wood resource use point of view, but is highly energy intensive. In the late 1960s thermomechanical pulp production caused around 15 kg BOD₅ per produced ton of pulp, whereas the corresponding figure for bleached sulphate pulp was 40 kg (Rosén 1971). At the end of the 1990s mechanical pulping required two to four times as much energy as chemical pulping (Ministry of the Environment 1997, p. 85). Partial trade-offs have also been raised for example between phosphorus loads and loads of biological oxygen demand for pulp and paper mills and between safety aspects and broader environmental concerns such as those of ozone layer depletion or climate change in the regulation of specific chemicals.

The interviews also emphasise several instances of positive cross media effects of different environmental measures. A case in point is the reduction of water consumption, which has reduced water discharges but also affected the water content of the sludge. Interviewees argued that burning of dryer sludge has improved the energy efficiency and decreased the sulphur dioxide emissions (Mickwitz 2000b).

7.1.6 The implementation of the instruments and the length of the processes

The Water Act and the Air Pollution Control Act, which both introduced significant new administrative tasks, including negotiations between operators and authorities, display lags and gradual adoption sometimes spanning more than a decade (Mickwitz 2000a, Similä 2002). There are two important features of the lags. First they may delay the implementation of new environmental measures, allowing pollution to continue. Second they give industries time to adapt to the new situation, which is important especially for large factories that may combine environmental investments with major investments in production.

The Air Pollution Control Act was implemented slowly in practice. Most of the factories were issued decisions as late as 10 years after the Act entered into force. When viewing cumulatively the accumulation of decisions according to the Air Pollution Control Act, it can be seen that only one factory received its decision before 1987, 18 received their decisions before 1992 and 29 factories before 1997. The implementation and adoption of new demands has proceeded more rapidly in the use and handling of chemicals. New safety regulations have entered rapidly into force and there have not been comparable lags in the permit procedures after the enactment of new legislation.

The length of the permitting processes was a largely unanticipated effect of the water and air pollution control legislation. The lengthy processes have generally been observed for the largest firms and this is confirmed by interviewees from the industry. In the regulation of chemicals the time lags between application and permitting have been shorter. The longest lags in water and air pollution control have been well above a decade and have been due to lack of resources, the learning process for new procedures both among authorities and firms, difficulties in determining compensations according to the Water Act, the changing external technological and economic context of the firms, the possibilities for negotiation and renegotiation between firms and authorities and the lack of specified time frames for firms and administration alike. The following statement by an environmental manager of one firm illustrates the complexity of the reasons for the long delays and indicates that shorter lags would not always have led to a faster reduction of emissions: *"... when in 1984 as I remember it, we made our notification to the authorities based on the Air Pollution Control Act, we got the decision as I remember in 1992. Sometimes we asked the authorities when the decision would be made and what limits would be set. The authorities once answered that they had not seen it as very urgent since we had voluntarily carried out most of the measures they find justified."*

The time between a decision on a BOD limit and its entry into force illustrates the time available for adaptation to new conditions. Sometimes – in 25 of 202 cases analysed – the limits on total BOD discharges included in a permit came into force immediately when the decision was made.

In most cases, however the mill was given time to adjust before the limit came into force. On average the limits, in decisions that were not appealed, came into force about one year and four months after the decision. The longest adoption time was six and a half years. For 110 limits the time between the decision and the date when the limit came into force was more than a year and for 92 limits it was less than a year.

The adaptation time of a factory is not limited to the time between the decision and its entry into force. The decision is an outcome of a process – often a lengthy one – and the factory applying for a permit receives information on the likely outcome before the final decision. Prior to making applications, factories may be in contact with the environmental authorities to obtain information on their likely standpoint (see Section 8). After the application is made the process takes some time and during this period the views on appropriate measures are discussed repeatedly. In some cases the time between the original application and the decision has been more than sixteen years. The longest lags were observed for decisions made in the 1970s, but lags exceeding 10 years were also observed in the 1990s. In these cases the application had been updated and revised several times by the applicant. When a permit decision is made by an appeal court the applicant naturally gets additional time to adapt to the likely outcome.

7.1.7 Opposition against reform of regulatory instruments

One of the interesting effects of regulatory instruments is that the administrative structures they require may increase opposition against new demands and further reforms. Thus the comprehensiveness of the Water Act with its associated administrative structures was an impediment to general reform of the environmental legislation. Solutions that would have challenged the working structure of the Water Act did not gain sufficient support until the entry into force of the Environmental Protection Act in 2000. The basic structure of the Water Act had thus remained intact for nearly 40 years, although for example the need to consider simultaneously different environmental elements was generally recognised in the early 1970s (Rosén 1971). The existing system of the Water Act was also one of the arguments

against a comprehensive environmental impact assessment procedure in the 1980s (Sairinen 2000). An analogous effect can be seen in the administration of chemical issues. The historical backgrounds in the administration and control of chemicals can be seen in a complicated administrative pattern involving two or three ministries and three different central administrative units. In the Air Pollution Control Act the original notification approach carried over in the form of temporally unrestricted permits.

7.1.8 Specific issues

Due to the history of the legislation there are effects which are specific to the individual instruments. The Water Act explicitly deals with conflicting interests in the use of waters and therefore aims at solving or regulating the conflicts of interest. The system of indemnities and other compensations has been elaborate and it has transferred funds to those who have suffered from pollution. Guidance for determining the compensations has been produced, but in individual cases the compensations have often been contested. In the 1990s the largest sums were paid to owners of waters with reference to loss of recreational value or loss of value of a water area. The payments to commercial fishermen have been lower. The largest sums of other payments were the water protection fees, which were levied on industries for the development of water protection and studies benefiting the protection of waters (Table 14). In general the sums have been small compared with

the investments and operating costs of pollution control (Section 7.1.3).

The early phases of air pollution control aimed simply at identifying and listing firms with potential air pollution problems. Thus a dominant effect was the increase in knowledge about the air pollution situation, and the early intervention theory of air pollution control resembled that of knowledge-based instruments. Effects were expected to arise from the increasing knowledge of an issue.

The Chemicals Act has its history in standard-based control of activities. Thus its main effects have arisen from a very detailed control and inspection mechanism, which has focused on specific features of the industrial activities. There has been little room for negotiation in the specific area of its application and in this sense it has represented strong command and control. Its effects have been restricted by the fact that it is concerned with specific parts of the production, i.e. the handling of chemicals and related risks, whereas the emissions of the normal production processes have not been dealt with.

7.2 The effects of regulatory instruments in relation to evaluation criteria

7.2.1 Relevance

Regulatory systems have been created out of general societal needs to address problems that have been perceived to be severe enough to justify pub-

Table 14. Indemnities to owners of waters and commercial fishermen, and other payments paid by industry pursuant to the Water Act 1990–1997 (FIM, nominal values). The sums cover several years of damage, typically more than a decade (Marja Hiitiö, Elise Sahivirta, Eira Ostamo, unpublished data).

Water Court (average number of years covered by the paid indemnities)	Indemnities for loss of recreational amenities	Indemnities for loss of value of water area	Indemnities paid to commercial fishermen	Other payments, including water protection fees, fisheries management
Northern Finland (22 years)	451 295 € 75 902	2 324 448 € 390 944	1 685 620 € 283 50	1 644 000 € 108 313
Eastern Finland (12 years)	4 825 786 € 811 639	4 962 394 € 834 615	269 003 € 45 243	2 292 120 € 385 507
Western Finland (13 years)	31 821 536 € 5 351 998	19 156 446 € 3 221 883	3 850 605 € 647 625	12 936 650 € 2 175 788

lic intervention and regulation. The increasing severity of environmental problems had been documented (Sitra 1970). A key question is whether the regulatory instruments addressed the most important environmental issues in the environmental regulation of industrial activities.

In Finland water issues were important for the development of environmental policy instruments. Several cities had experienced serious water pollution already in the early 20th century (Laakkonen et al. 1999), but the importance of water issues can also be linked to the private ownership of waters and the need to solve conflicts between owners and users. Pollution of waters was simply one example of conflicts of interest. The fact that only one chapter of the 22 chapters in the Water Act dealt specifically with pollution issues underscores this observation. It also explains the strong emphasis on negotiation, interest considerations and involvement of lay persons in the process. The lack of standards meant that pollution and pollution damages were in principle always negotiable. The absence of standards and strong supervisory authorities made the Water Act initially less relevant than it was to become later on after the founding of a strong central board and the preparation of guiding policies in the form of water protection programmes and guidance documents for supervision that emphasised the protection policy (Sections 4.3.1 and 7.1, Similä 2000).

Air pollution was for a long time regarded only as a local nuisance problem regulated by the Neighbourhood Relations Act (26/1920). Towards the end of the 1960s air pollution became a broader issue (Sitra 1970). The development was accelerated by the public recognition of long range transport of pollutants and e.g. acidification, but the difference between air and water issues was striking. In 1970 a major survey of the state of environmental protection in Finland devoted 94 pages to air pollution and 278 pages to water issues. In presenting recommendations the report devoted two short paragraphs to air pollution control and 5 pages to water (Sitra 1970). A part of the explanation for this discrepancy is probably that the foul smell around e.g. the pulp mills was not perceived to destroy property, whereas the pollution of water infringed on the rights of water owners. Water pollution had been seen as a very concrete issue and had been the subject of considerable public concern before the enactment of the Water Act in 1962 (Leino-Kaukiainen 1999).

Public regulation of chemicals has a long tradition (Marjanen 1998), but initially the emphasis was strictly on human health and technical safety. For a long time the burden of proof concerning the environmental dangers of chemicals was laid on regulators, not developers or users of chemicals. This situation paved the way for major environmental disasters such as those caused by indiscriminate use of e.g. agricultural chemicals and mercury. The environmental relevance of the Poisons Act was reduced by its reactive rather than proactive nature. The large number of potentially chemically polluted soils (Haavisto 2000) shows that the environmental relevance of the old chemical regulation was limited. In the Chemicals Act several steps have been taken towards a more proactive regulation, with requirements of risk assessments and safety plans for major users. The relevance with respect to chemical pollution is still somewhat limited due to the rapid development of chemicals and their use.

The focus of the regulation has followed issues that have been recognised as important. The regulatory systems with elements of discussion and discretionary case by case consideration do, however, display relatively slow reactions on the formal level. Data for the regulation of phosphorus emissions from pulp and paper mills show a transition period of more than a decade from the first emission limit for phosphorus to a general rule of always having emission limit values (Mickwitz 2000a). The regulation of chlorine bleaching through specification of AOX limit values only started in the early 1990s after the decision taken by the Ministry of the Environment in June 1989. It took until 1997 before all mills had AOX limits included in their permits. All AOX limits were set at levels well above the annual average during the year the decision was taken, and still on average one year and 4 months elapsed before the limits entered into force. At the time when all mills had AOX limits in force the average annual AOX discharges per ton of bleached pulp were about 0.2 kg mainly due to the customer demands that had forcefully influenced the choice of technology. A similar development had previously occurred in the regulation of emissions of mercury. The Water Act was only used as one of the arguments in negotiations leading to a voluntary agreement on replacing mercury-based slimicides in the pulp and paper industry reached on 27.11.1967. The Water Act could have been used for dealing

with damages caused to fisheries, but by 1976 authorities had not initiated a single process dealing with mercury pollution although this had been possible in the name of general public interest (Nuorteva 1976). A separate Act was eventually developed for dealing with the losses caused to fishermen (Act on Compensation to Fishermen Suffering from the Pollution of Waters 208/1974).

7.2.2 Impact

There is no doubt that the examined regulatory administrative instruments have had an impact in their target areas. The general tendencies in the development of the state of waters, the airborne pollution and the handling of chemicals have improved in accordance with the desired main effects, which were used as justification when regulation was introduced. Pollution levels have been reduced and the handling of chemicals has become safer. The Water Act has provided economic compensation to persons who in the event of no ex officio determination of compensation would probably not have received anything. There is greater uncertainty with respect to the impact in specific cases, in particular concerning the regulation of water and air pollution at the level of individual firms (Mickwitz 2000a, Similä 2002).

Mickwitz (2000a) and Similä (2002) have shown that there are clear cases in which the water permits, and the explicit limits they contain, have affected the discharges. This can be seen from the statistical analysis of BOD and phosphorus discharges, the analysis of the legal documents, as well as from the analysis of the interviews. At the same time cases have been found in which the permit limits have had no effect on the reduction of the discharges. The fact that many mills have been far below limit levels years before the limits have entered into force, the finding that 8 mills have only had one or two different BOD limits during their whole operative history, the modelling results and the analyses of the interviews justify this claim. A lack of direct effects of the limit values can most clearly be seen in the case of discharges of chlorine compounds.

A major difference between air and water pollution control lies in the nature of the permits. Permits issued according to the Water Act for polluting activities have since the 1960s in practice been given for a fixed period of time. This

has been the case, even though permanent permits were the legal starting point of the Water Act until 1987. Fixed time periods gave regulatory authorities and also other stakeholders opportunities to demand improvement in each new permit round with reference to monitoring results, without specifically initiating and justifying a new permit process. This has been important, because the monitoring has almost exclusively been based on self monitoring by the permit holders. Authorities approved the monitoring programmes and received the results, but did not play an active part, except in cases of accidents and disasters such as fish kills.

In air pollution control the initiative was in practice left almost entirely to the firms, with the exception of the general norms for emission limits. Initially only a notification was required of the firms, with some possibilities for setting limit values. Subsequently permits were issued, but since 1995 the default was to issue permanent permits. Thus only changes in the production processes or significant changes in production volumes opened the discussion on acceptable permit conditions. Under such a system the incentives to improve are clearly weaker than in a system which includes a revision procedure where permit conditions are made tighter, unless the general norms are adjusted downward faster than the permit limits in the revision process.

One of clearest impacts outside the target area has for all the examined instruments been the demand for know-how in several different disciplines from law to engineering and natural as well as social sciences. The importance of social sciences was recognised early (Sitra 1970), but no real attempts were made to institutionalise the research. Applied natural and engineering sciences were in contrast developed in specific sector research institutes. The regulatory policy instruments largely determined the need for information and consequently the demand for e.g. economists has been relatively low. Sairinen (2000, p. 262) states that: *"Many influential officials in the ME [Ministry of the Environment] were committed to the legalistic culture, and initially showed no interest in developing new measures."* This correspond to the Dutch situation where the policy processes *"tend to be dominated by judicially trained specialists who, in general, favour legal solutions to most problems."* (Bressers and Huitema 1999, p. 193). The regulatory instruments

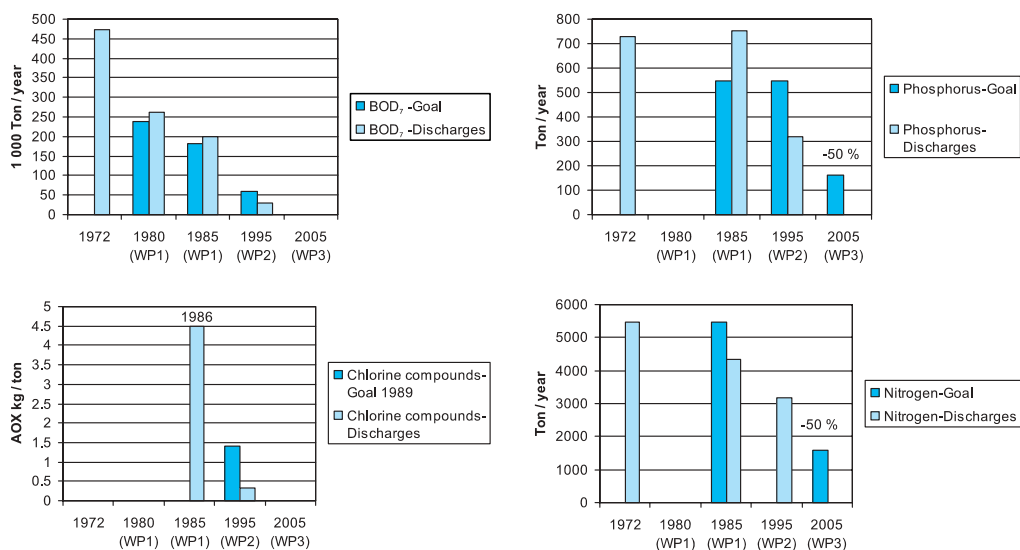


Fig. 11. Effectiveness of the implementation of the Water Act in attaining some of the Goals of the three National Water Protection Programmes. The 1972 discharges are based on the daily figures included in Table 1 of the first National Water Protection Programme. The other discharges are from the Monitoring and Environmental Loading Data System of the Finnish Environmental Administration (available graphically in e.g. Statistics Finland 2000c). The corresponding 1972 discharges from the data system of the Finnish Environmental Administration are about 6 per cent lower for BOD₇ and nitrogen and 11 per cent lower for phosphorus.

with their emphasis on public presentation of industry specific emission, impacts and corrective measures have, however, contributed to the increase of public awareness and the public discussion and debate of environmental changes. This effect outside the original target area was initially largely unanticipated, but has now become part of the intervention theory of recent regulations (EIA Act, Environmental Protection Act).

7.2.3 Effectiveness

The goals of water protection have been set in official programmes, of which the three National Water Protection Programmes decided in 1974, 1988 and 1998 are the most important ones (Table 6). These programmes included quantitative as well as qualitative goals. The quantitative goals of the two first programmes were set as tons per day especially for the pulp and paper industry, whereas they were determined as per cent reductions for the whole industry in the third programme. The first programme contained quanti-

tative goals for suspended solids (1980), BOD₇ (1980 and 1985), phosphorus (1985) and lignins (1985) and it stated that nitrogen should remain at the same level in 1985, i.e. 15 tons per day. The second programme had targets for 1995 for BOD₇ and phosphorus while a target for chlorine compounds was set in a 1989 decision by the Ministry of the Environment. The third programme contains targets for the year 2005 for the industry as a whole, but it is clear that the major contributions are expected to come from pulp and paper for COD_{Cr}, phosphorus and nitrogen. Fig. 11 shows some of the goals and the realised discharges.

The targets of the first National Water Protection Programme contained the largest reductions compared with the available discharge statistics at the time when the programme was approved. For BOD₇ the reduction was 50 per cent to 1980 and 69 to 1985 compared with the values for 1972. For phosphorus the reduction was 25 per cent until 1985 and for nitrogen the goal was to prevent the discharges from increasing. On the other hand the programme was approved at a time when the in-

vestments in waste water plant had been modest and when the first quantitative goals started to appear in the waste water permits. Although BOD₇ discharges decreased rapidly in the 1970s and early 1980s the goals of the programme were not reached. The phosphorus goal was also not reached, whereas nitrogen discharges actually were reduced below the target level.

The second programme contained a goal of a 65 per cent decrease in the BOD₇ discharges compared with 1986, which was reached. It restated the goal of the previous programme that phosphorus discharges should be below 1.5 tons per day, which was a 25 per cent reduction compared to 1986 and this goal was reached. It had no goal for nitrogen. Finally it stated that *"the Ministry of the Environment will set by the year 1992 a target value for total discharges of chlorinated organic compounds from the pulp and paper industry"* (Ministry of the Environment 1989a, p. 15). Such a decision was taken by the Ministry of the Environment in June 1989. This decision set the target for the annual mean chlorine discharges to be below 1.4 kg per ton of bleached pulp produced, determined with the AOX method (Ministry of the Environment 1989b). The total discharges of chlorinated organic compounds in 1986 were about 4.5 kg per bleached ton of pulp. In the beginning of the 1990s the actual development was much faster; by 1995 the discharges were less than one quarter of the target level.

It is too early to assess the third programme, since its targets are for 2005, but many interviewees from the industry expressed the view that its goals will be hard to reach. The programme explicitly states that the targets were determined based on production estimates of 1996. If the production develops differently this will have to be taken into account in future evaluations of the programme.

In addition to the target values contained in norms based on the Air Pollution Control Act there are also goals and targets for the reduction of some air emissions based on international environmental agreements. In 1979 the Convention on Long-range Transboundary Air Pollution was adopted in Geneva. This convention has been ratified by Finland and it entered into force in 1983. The Convention has later been extended by eight protocols, of which five have hitherto entered into force. Of these some contain emission ceilings and reduction goals and are thus important in this con-

text, whereas others contain other requirements such as monitoring obligations or technical requirements for different types of polluters. The Finnish targets contained in these protocols for sulphur, nitrogen oxides and Volatile Organic Compounds (VOCs), or to be precise all organic compounds of anthropogenic nature other than methane (NMVOCs), will be discussed.

For sulphur Finland adopted the goal of the Sulphur Protocol signed in Helsinki in 1985, which entered into force in 1987. The protocol stated that the emissions should be reduced by 30 per cent of the 1980 level by 1993, and Finland declared the goal of a 50 per cent reduction by 1995. In 1991 the Finnish government made a decision in principle to reduce sulphur emissions by 80 per cent compared to the 1980 level in ten years. The Oslo Protocol from 1994 also established a ceiling for sulphur emissions of 116 kt SO₂ per year from 2000 onwards, i.e. an 80 per cent reduction compared to 1980. The same ceiling, 116 kt SO₂ per year but from 2010, is also contained in the 1999 Gothenburg Protocol, that Finland has signed but not yet ratified.

For nitrogen oxides Finland committed itself to the goal of the Sofia protocol of 1988 of freezing the emissions at the 1987 level by 1994. A declaration that the target would be to reduce the nitrogen oxides emissions by 30 per cent by 1998, compared to the a freely chosen base year between 1980 and 1986, was also made. (The Ministry of the Environment 1993) In the 1999 Gothenburg Protocol there is an emission ceiling of 170 kt NO₂ per year from 2010, i.e. a 43 per cent reduction from the 1990 level.

A protocol on the emissions of Volatile Organic Compounds was signed in Geneva in 1991 and it entered into force for Finland in 1997. This protocol contains a target of reducing the annual emissions of VOCs by at least 30 per cent from the 1988 level by 1999. In the 1999 Gothenburg Protocol, which Finland has signed but not yet ratified, there is an annual emission ceiling of 130 kt VOC per year from 2010, i.e. a 38 per cent reduction from the 1990 level. (The Ministry of Environment 1998, UNECE 1999)

The sulphur emissions from the pulp and paper industries are related to energy production and pulp production. For sulphur the reduction goals were established for the economy as a whole. All the goals relating to sulphur emissions have been reached (Fig. 12). As already discussed in sec-

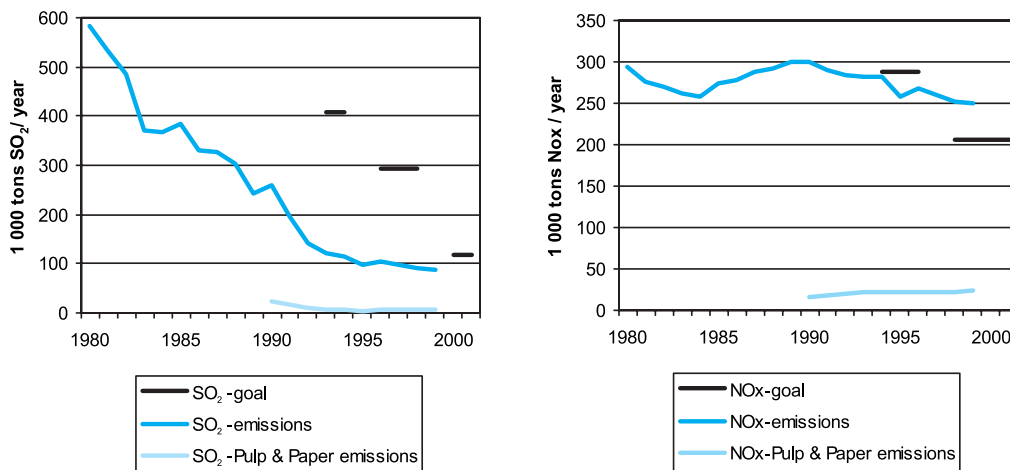


Fig. 12. The goals and total Finnish emissions of sulphur dioxide and nitrogen oxides and the emissions of the pulp and paper industry during the 1980s and 1990s (Statistics Finland 2000d, p. 61, 63f.)

tion 7.1.1 (Fig. 10), the sulphur emissions per ton of pulp have decreased sharply and thereby the total emissions have been reduced even though the production has increased. For nitrogen oxides the goal of the Sofia Protocol of stabilisation was reached, but the goal of the declaration of a 30 per cent reduction by 1998 was not reached during the 1990s (Fig. 12).

While the total emissions of nitrogen oxides decreased by about 17 per cent during the 1990s, the emissions of pulp and paper industries increased by 43 per cent during the same period. The Finnish NMVOC emissions were about 177 kt in 1999 (Saarinen 2001), which means that the target of a 30 per cent reduction by 1999, i.e. an emission level of about 150 kt, was not reached. In 1998 a committee made the assessment that the 30 per cent reduction of nitrogen oxides will be reached by 2004, and that the VOC goal was expected to be reached after the turn of the century (The Ministry of Environment 1998, p. 146, 149). The committee also expressed the view that nitrogen oxides as well as sulphur emissions will thereafter remain below the ceilings to which Finland has committed itself internationally.

The effectiveness of the Water Act can also at general level be judged by comparing the development in Finland to that in other countries. In Sweden the decoupling between emissions of BOD and pulp production occurred approximate-

ly five years earlier than in Finland: 1965 and 1970 respectively (Figures of Rosén 1971 compared with data from Finnish industries (PI-Consulting 1997)). Later the developments have been more similar for other pollutants. For example the AOX development is synchronous with levels of about 2.5 kg/t pulp in 1989 and about 0.2 kg per bleached ton of pulp in 1998 in both countries (Metsäteollisuus 1999, p. 9, Naturvårdsverket 1999, p. 37).

Emissions of sulphur oxides declined earlier in Sweden, i.e. in the late 1970s and early 1980s. Part of this lag in the Finnish reductions of emission can be attributed to the poorly developed regulation of air pollution. In Sweden, air pollution has been regulated together with water pollution since the late 1960s. However, other factors did also contribute. The Swedish energy production has had a greater share of hydro power and nuclear energy was used to a greater degree. The effects of airborne acidification became an issue earlier in Sweden and the consequences of "acid rain" were more severe than in Finland (Hordijk et al. 1990, Merilehto et al. 1998).

In Finland, implementation difficulties of the Air Pollution Control Act contributed to a slow initial reduction in emissions (Section 7.1.4). Authorities had little resources at their disposal and the notification system was clearly susceptible to regulatory capture at the factory level because the factories could largely dictate what they

were going to do. Further, the Council of State Decisions on air pollution control differentiated between old and new installations in order to avoid a sudden increase in costs for companies. This could have slowed down the emission control, but in practice the reduction of sulphur dioxide emissions was fast (Fig. 12).

Environmental concentrations of strongly regulated chemicals display declining trends. It is thus fair to say that chemical regulation has been effective in reducing some important risks to the environment. The well known problematic chemicals such as PCBs or mercury compounds are, however, only a small fraction of the total chemical load. In 1995 the 4th North Sea Conference in Esbjerg adopted the much more ambitious goal of "moving towards [the cessation of discharges of hazardous substances] within one generation (25 years)" (Anon. 1995). One can argue that this is in line with the spirit of the intervention theory for the chemical regulation, as its objective is not limited to reducing risks related to particular substances. At the same time there are clear indications that the chemical regulation has not been able to turn development in this direction. In fact it is unlikely that a regulation of industrial activities can ever achieve this kind of goal. A significant part of the discharges are now diffuse. Our results for paint manufacturing are also indicative of the changes. Discharges from several firms have decreased to a fraction of their previous levels, but it is not as clear that the discharges during the life cycle of the products have decreased, as traditional production discharges are now concentrated to central production units and to retailers and users of the products. The retailers and users are outside the scope of the regulation of large scale handling of chemicals.

7.2.4 Efficiency

Cost-benefit calculations are difficult to use in examining regulatory instruments, as the target area is largely concerned with public goods without clearly defined market values. The problems involved in valuation can be divided into two categories: conceptual and practical. Especially the valuation of environmental effects is problematic. Even though several methods such as "Willingness to pay" (WTP), "Willingness to accept" (WTA), the "travel cost method" and the "hedonic

price method" have been developed there are still problems. The practical problems of utilising economic criteria are often related to data availability. (e.g. Braden and Kim 1998) Furthermore, impacts cannot be unambiguously attributed to the instruments. The main concern is therefore often with cost-effectiveness of the regulation, rather than cost benefits. Cost-effectiveness can be assessed at different stages from the output through to the final outcome of the regulation. The costs can also be viewed from the point of view of the administration or of the operators, or of the economy as a whole.

If the goal of the cost-effectiveness analyses would be to compare the merits of different types of instruments, it would be important to look at outcomes, either costs in relation to pollution reductions or environmental improvements. This is because the direct costs of the operators are far greater than the costs of the administrations involved (Section 7.1.3). If, however, the cost-effectiveness criterion is used primarily to improve implementation of the administration it can be applied to outputs, e.g. permit decisions.

The pollution regulation according to the Water Act has been the most expensive in terms of public administrative costs as well as investments and operating costs of the operators. The higher public costs reflect different institutions as well as procedures. The cost recovery from the applicant was also less developed for water permits than for the Environmental Permit Procedures Act, which covered air pollution permits. The Water Act reflected an older legal tradition with a more narrowly defined polluter pays concept.

From the point of view of operators the administrative costs were lowest for permit applications according to the Water Act, but costs of preparing applications and the necessary investigations could be high. With the introduction of air pollution permits the costs of the operators increased, but only a few operators have been required to make extensive investigations of their emissions.

Monitoring of both air and water has predominantly been based on self monitoring by permit holders. From the point of view of the authorities the system has been cheap. It has also provided incentives to plan and carry out joint monitoring, in which several operators participate.

For the operators the costs of permit procedures and monitoring are small compared to the hun-

dreds of millions which the studied sectors use annually for investments as well as for operating expenditures. Hitherto all these cost items have been highest for water protection. The costs for the operators are, however, difficult to assess. Especially for process investments it is hard to determine the share that actually is environmental (Section 7.1.3). The real costs for the operators may in the long run be lower than the direct ones, since environmental investments often result in some efficiency gains through lower resource use and increased energy generation.

Our findings suggest that the total cost-effectiveness of a regulatory instrument will significantly depend on indirect costs, which are hard to assess. It is possible to imagine regulatory instruments which would have hardly any costs to the administration and no direct costs to the present polluters but which nevertheless could cause major indirect costs. If, for instance the pollution control would lead to a total ban on new emissions in an area, such control would imply no direct cost but could have indirect costs in the form of discouraged investment, retarded innovations, unemployment etc.. These types of general equilibrium costs are likely to be higher for regulatory instruments than for economic ones.

We have not been able to say very much on efficiency; more precise statements would have required a specific study on the issue. One such study was recently undertaken in Finland (Gynther et al. 1999). In the study the costs and benefits of the water, air and waste treatment investments by the Finnish pulp and paper industry were assessed. The value of the benefits from reduced water discharges from 1989 to 1997 was estimated to FIM 2 275 million (€ 383 million), whereas the investment costs were only FIM 619 million (€ 104 million). For the development during the years 1994 to 1997, the benefits were valued to FIM 434 million (€ 73 million) and the investments were FIM 229 million (€ 39 million). The costs of the investments in air pollution control between 1989 and 1997 were valued to FIM 244 million (€ 41 million) and the benefits of the reduced emissions to FIM 754 million (€ 127 million). For the period 1994 to 1997 the costs were FIM 85 million (€ 14 million) and the benefits FIM 309 million (€ 52 million). (Gynther et al. 1999, p. 60).

The results cannot directly be used to assess the efficiency of the regulatory instruments for water

and air emissions. This is because Gynther, Torkkeli and Otterström assessed the costs and benefits of the investments in pollution reduction by the industry without linking them to specific policy instruments and without considering other potential costs. Since there are also other reasons for environmental investments than the studied policy instruments (section 7.1.2), the figures overestimate both the costs and the benefits of the policy instruments. An assessment of the efficiency of the regulatory instruments would further require that other costs than the investment costs of the industry would also be taken into account (section 7.1.3). The results do, nevertheless, give a strong indication that the value of the benefits of the regulatory instruments has been greater than their costs in the case of pulp and paper production.

Many studies indicate that marginal costs differ substantially between sectors and sites. This would imply a clear sign of inefficiency, since then the same pollution reductions could have been achieved more cheaply with another distribution of abatement. However, in the case of emissions with local impacts the judgement is not straightforward, since only emissions that affect the same local environment can directly be compared in a cost-effectiveness sense. It is likely that the marginal costs of nutrient reduction have in many cases been higher for the studied industrial point sources than for non point sources, e.g. agriculture. If inefficiency is found, it should be remembered that there are also other evaluation criteria, and that the inefficiency might be justified for example by the equity outcomes.

7.2.5 Acceptability

None of the interviewees have explicitly questioned the existence of regulatory systems as such. The environmental awareness which in Finland has developed in interaction with the official environmental policy also suggests a general acceptance of pollution regulation through permitting procedures and supervision by authorities. In general the demand for (environmental) deregulation has not been a major issue in Finland, in contrast with the discussion in e.g. the US (Jeffreys 1995). Arguments related to the use of regulation have mainly been voiced in the context of new obligations. Thus existing regulations were used as arguments against the introduction of environmen-

tal impact assessment procedures (Sairinen 2000). When Finland joined the EU these arguments weakened considerably, as EU legislation must be implemented in the Member States.

7.2.6 Transparency

In Finland the transparency of the regulatory processes has long been a key feature. It was part of the Water Act and the inspection procedure, which involved lay persons and public display of relevant information. In the Water Act the background of the transparency has been the regulation of case-specific interests, but the openness has been adopted for other regulatory systems as well, such as the Air Pollution Control Act, although it does not give lay persons specific responsibilities.

The openness has provided easy access to environmental information and possibilities for detailed and intensive public scrutiny of individual factories (Haila et al. 1971) as well as free exchange of information between firms. The openness has provided feedback to the regulatory system so that the lack of standards, which has been a hallmark of the regulation according to the Water Act has, *de facto*, been based on something which has been loosely referred to as "the general policy" (Similä 2002).

The fact that the Finnish Forest Industries Federation has published annual mill-specific emissions data in an environmental report for more than a decade is a good example of the transparency. The Finnish system is one of the best developed examples of environmental information produced by the industry. Mill-specific emission data is nowadays also available on the Internet, for example in the environmental reports by the companies and the permit conditions issued by authorities. One interviewee claimed that the Finnish Forest Industries Federation started to publish the data due to the slow reporting on the part of authorities and argued explicitly that the industry would have benefited from more information being published in time. The fact that the time series of the key water discharges are only available in graphic form in publications by the Finnish environmental administration and not the actual numbers as a data table gives some support to this claim.

Finally, it should be noted that transparency is not only a question of the availability of data on

individual cases. A general transparency is also reflected in the kind of syntheses that are provided. This is particularly important in case-by-case decision-making, from which it is difficult to determine the overall effects and functions of the system. Until recently few overviews of the decision-making had been made available and despite some studies (Sairinen et al. 1999, Laakkonen et al. 1999, Varjopuro et al. 2000, Haila and Jokinen 2001), detailed comparative syntheses of how authorities have used the instruments to regulate different types of polluters are largely lacking.

7.2.7 Equity

Regulatory capture, i.e. the possibility for strong interests to have undue influence on the regulation, can affect equity. Our study has demonstrated a rather close relationship between supervisory authorities and the firms, but the relationship between the Water Court as a decision-making body and the companies has been at a more formal level. Interview results indicated that the firms have generally been satisfied with the procedures of the processes of the Water Act. The processes have been seen to be clear and straightforward, with clearly defined roles for each party.

The permit procedure of the Water Act has been based on *ex officio* expert assessment of damages in order to determine appropriate levels of compensation and indemnities. It has also provided opportunities for appeal. In practice this has meant that the rights of those suffering from the immediate effects of pollution have been guaranteed at least at a basic level of compensation (Section 7.1.4), but there are several examples of e.g. fishermen who have had to go through long and difficult legal processes before reasonable indemnities have been granted (Saiha and Virkkunen 1986).

The number of major public conflicts with respect to pollution at chemical industries and pulp and paper mills have diminished. Several industrial sites have been subject to public controversy: the titanium dioxide plant off Pori (Saiha and Virkkunen 1986), the oil refinery off Porvoo (Sairinen 1994), the pulp mill in Lievestuore (Haila et al. 1971) and several others (Laakkonen et al. 1999). In the 1990s no comparable conflicts have been observed at industrial sites. This reflects an improvement in the state of the environment,

which has increased the confidence in the ability of industry to deal with emissions, and also in the authorities and the regulatory processes. It may also indicate a shift of the public's interests towards other types of environmental issues.

7.2.8 Flexibility

There are several aspects of flexibility. Our primary concern is with the flexibility of an instrument to changing needs in relation to the outcomes. The changing needs may arise because new environmental problems are discovered or because the objectives of pollution control become more demanding. Another kind of flexibility is related to the scope for taking into account site or operator specific conditions, i.e. a flexibility with respect to the output of the instrument in addressing the need that motivated the instrument in the first place.

Because the environmental requirements of the Water Act were determined in a very general way and have not been guided by detailed secondary legislation, the Act has been remarkably flexible in dealing with increasing environmental needs and redirecting outcomes. The supervising authorities have been able to issue guidance to inspectors on a variety of issues without having to wait for revisions of the law. The initial notification mechanism of air pollution control was flexible with respect to the output, but suffered for this reason from effectiveness problems and a high risk of regulatory capture. The change to a permit system for air pollution control increased possibilities of regulation and also made it possible to cope more easily with new demands for stricter regulation. This is shown by the fact that permit limit values could be issued below the general norm set by the Council of State (Section 7.1.2).

It could be argued that the flexibility with respect to the needs of the Water Act and air pollution control has represented a "quantitative flexibility" well suited to dealing with stricter control of the same kind or to control of conceptually related parameters, i.e. new substances. The Chemicals Act has undergone some fundamental structural changes that shifted the work load from inspectors to the firms in order to be able to deal with increasing demands, as the system of site-specific control of details would have become extremely expensive.

Both air and water pollution regulation have only slowly adopted new environmental demands despite the general nature of the texts in the acts. Nothing in the acts would in principle prevent regulators from considering biodiversity issues in pollution regulation, but making new concepts and demands operational in a form that can be handled by regulation takes time. Methodological deficiencies mean that there are as yet no standardised approaches to deal with biodiversity in pollution control and it is unclear what form e.g. compensations for lost biodiversity should take. Similarly greenhouse gas emissions, which do not have local or regional pollution effects, cannot easily be dealt with in air pollution regulation. There are no end-of-pipe solutions which could be easily included in permitting conditions. Instead, interference in the use of raw materials and the production processes would be required. With the exception of regulating sulphur contents in fossil fuels, such regulation is largely outside traditional air pollution control and would probably have large negative effects (Hildén et al. 1999).

7.2.9 Predictability

The analysis of networks (see Section 8) stresses the importance of the preparatory phases of the permit procedures during which discussions and informal negotiations take place. The permitting procedures, which have been long both in water and air pollution control, also leave room for negotiation (Section 7.1.6). The preparatory phase and the long formal procedure make the output rather predictable in practice, even in the absence of norms (water pollution control) or with partly obsolete norms (air pollution). The gradual adoption of new permit conditions, for example limit values for phosphorus (Section 7.1.2), and the role of the national water protection programmes (Similä 2000) have contributed to the predictability.

In chemical regulation the site specific safety control permits are highly predictable due to unambiguous norms. The development of new norms concerning specific substances is slightly less predictable, as new scientific discoveries may raise new issues at short notice, but the development and approval of actual norms is a EU-wide task and therefore so slow that the output can be determined well in advance, thus allowing opera-

tors time to adjust. The drawback of the high degree of predictability is that it inevitably entails slow reactions on acute problems.

7.2.10 Sustainability

Sustainability is an integrating criterion that reflects several of the foregoing ones. To meet the sustainability criterion the regulation must have a positive impact which is not offset by other negative effects. The regulation must also be accepted, as positive impacts would otherwise dissipate due to non-compliance.

The studied regulatory systems have had a sustained positive effect on the local and, with respect to acidifying substances, the regional environment. These effects are generally in line with the objectives of the instruments. Effects outside the target area have in general supported the achievements in the target area. The sustainability of the outcomes have furthermore been supported by several factors, such as cost saving and customer demands, and the development environmental labels and environmental management systems.

The effects of regulation on education and general know-how have, perhaps even more than the direct legal regulation of emissions, contributed to sustained improved state of the environment in the vicinity of point source polluters. Here a synergistic effect can clearly be seen between the different regulatory systems. One manifestation of this are the changes in the union of professional environmental experts. In the 1960s and 1970s it started as an organisation for water and fisheries experts, but in the 1990s its field broadened and it became a general organisation for environmental experts.

7.3 Effects of electricity taxation

In 1990 Finland introduced an environmentally motivated CO₂ tax, which from the beginning of 1997 was replaced by a combined CO₂ and electricity tax (Government Bill 1996/225). The objective was fiscal, but possibilities to use the tax as an environmental policy instrument were also noted. This dual objective has remained during later revisions. Despite this it is evident that the main effect of the electricity taxation has been fiscal.

In 1999 the total tax revenue of energy taxation was about FIM 16 billion (€ 2.7 billion), most of which was collected as diesel and petrol taxes. Of the energy tax about FIM 2.2 billion (€ 370 million) is collected as electricity tax. (Statistics Finland 2000b) The interviewed firms have clearly not perceived it to be part of an environmental regulation but one of the factors affecting the working conditions of the firms by influencing the prices of production factors. Thus the main effect has been an additional cost to the operators, but this additional cost has been modest.

The energy use of the industry has increased during recent decades (Fig. 9), and the electricity consumption continued to increase in the 1990s after the introduction of the CO₂-tax. In the pulp and paper industry the increase in the 1990s was 34 per cent and in the chemical industries it was 15 per cent. Since the tax reform came in to force in 1997 the energy use of the pulp and paper industry has increased by about 18 per cent and that of the chemical industries by 4 per cent, when the use in 1999 is compared to 1996, i.e. the year prior to the reform. (Statistics Finland 2000b). These increases in energy use do not indicate that the tax has not had any effects, since the increased use is due to increased production. It could be argued that the electricity consumption would have increased even faster without the tax. There are, however, other indications that the electricity taxation has only marginal effects. The production of the most energy-intensive pulp has continued to grow at a rapid rate. Thermo-mechanical pulp production has increased by almost 40 per cent during the 1990s and lags only a little behind the increase in the production of sulphate pulp (42 per cent) (Finnish Forest Industries Federation 2001). The demand for specific pulp and paper qualities, the more efficient use of the raw material and the partial refunding of the energy tax have largely eliminated the effects of the electricity tax.

The interviewees from the industry generally stated that the energy taxes have had no or only a very small effect on their energy use. Some argued that the energy price has affected energy use, but the tax was seen to be so small compared to the total price that it had no effect. "Energy is already so expensive that all simple solutions to save energy have already been undertaken" is an example of one statement of this kind. If, however, the energy tax would be much higher than today some argued that it could have an effect, "...if it

were increased dreadfully, of course it would at that stage affect...". Other interviewees argued that their energy use was not sensitive to the price at all. Among this group were representatives of chemical firms which used very little energy, basically for heating and light. This view was, however, also expressed by one interviewee from a pulp mill that produced more energy than the mill used itself, but who argued that the electricity network operators charged such high prices that they had no incentive to save energy or increase their energy production. Some interviewees, however, said that the energy tax might have partly affected their fuel choices, mainly away from fossil fuels.

The interviewees representing the authorities generally had difficulties to express any opinions on the impact of energy taxation, as one representative of the national authorities said "*this is a question that maybe the representatives from the companies can answer best themselves*".

Very few of the representatives for the mills knew whether their mill had received any repayments of their energy taxes. This is likely to be due to the internal organisation: energy taxation is handled by those that otherwise also deal with financial transactions and not by those taking care of environmental issues.

As noted above, energy taxation has for most firms had only marginal cost effects. It has nevertheless contributed to the public discussion on energy. This has provided an impetus for energy saving and developing the use of waste products in the pulp and paper industries. The energy tax should be seen as an item in a broader discussion, which is fuelled by debate concerning the future of nuclear energy, the development of renewable energy sources, energy saving, energy self-sufficiency vs. open energy markets, the Kyoto obligation and the general industrial structure in Finland. Its role in the energy debate is stronger than its direct economic effects would justify.

7.4 Effects of electricity taxation in relation to evaluation criteria

The dual objective of electricity taxation means that criteria can be viewed in relation to the fiscal and economic objectives or the environmental objectives. Here we will focus on the environmental objectives of the instrument.

7.4.1 Relevance

The instrument as such is relevant from an environmental point of view because cheap energy is one of the reasons for wasteful use of resources. It could be argued that the present general electricity tax is less relevant from the point of view of regulating greenhouse gas emissions than before the reform in 1996. It could, on the other hand, be even more relevant from a general resource conservation point of view. A clear and deliberate reduction of the relevance has, however, been introduced by having two different taxation categories for electricity, with a lower taxation level for industry and commercial greenhouse growers. Furthermore there is a system for tax refund to the most energy intensive industries according to the amended section 8b of the Act 1260/1996. A company which has paid more than 3.7 per cent of its value added in energy taxes can get refunded for up to 85 per cent of the taxes, provided that these taxes exceed FIM 300 000 (€ 50 456).

7.4.2 Impact

A recent assessment of the Finnish energy taxation concluded that the CO₂ emissions would have been 7 per cent higher in 1998 without the tax instrument, but it also stated that the assessment is uncertain and is likely to indicate the maximum reduction (PMOPS 2000, p 47). Most of the reduction is due to the taxation on transport fuels, but changes in industrial structure and energy consumption in industry are estimated to correspond to a quarter of the reduction. The analysis does not, however, pay attention to the improvement in efficiency that would have occurred even without the tax, nor to other factors contributing to energy saving and a shift in the use of fuel for energy production.

Political signals provided by the tax have probably contributed to the interest in voluntary energy saving agreements. By 1999, 63 firms corresponding to approximately 75 per cent of the energy use in industry had entered voluntary energy agreements (Motiva 2000). By the end of 1999 a saving potential of 0.7 TWh per annum had been identified, of which half was likely to be utilised. This is around 1 per cent of the annual electricity use in industry. The costs of the programme have

been around FIM 20 million (€ 3.4 million). In 1998–99 altogether 17 energy audits were carried out in the pulp and paper industry and 3 in the chemical industry. (Motiva 2000).

A potential indirect effect of taxes is that they increase the costs of companies and may therefore divert resources from other environmental measures. Our interviews show, however, that such links are unlikely because taxes are perceived to be part of the costs of raw materials rather than an environmental cost. Thus the general economic performance of the companies, rather than a specific tax, has effects on the possibilities and willingness to invest in environmental measures.

7.4.3 Effectiveness

Energy taxation has reached its fiscal objectives. Some environmental objectives have also been achieved in the form of energy saving. The use of energy and electricity in particular has continued to increase, but at a slower rate than previously (Ministry of Trade and Industry 2001). This reduction in the growth rate of energy use on a national level can, however, only partly be attributed to the electricity tax. The general shift in production structure with an increasing share of the electronics industry is an important contributing factor.

In its Bill to the Parliament (122/1989, p.3) introducing the "CO₂ tax" in 1989 the Finnish Government stated the objective of reducing the overall growth in CO₂ emissions by 1 per cent compared with the development without the tax, and the emissions of nitrogen oxides and hydrocarbon by 2 per cent. An economic analysis suggests that this has been achieved (Section 7.4.2), with some reservations for the underlying factors. Studies for the national climate strategy envision that energy taxation will be used for reaching the greenhouse gas emission reductions (Ministry of Trade and Industry 2001), but its effectiveness will depend on the tax structure. In the past, energy taxes have been subject to several revisions. According to Määttä (2000, p. 130), this has reduced their effectiveness. Our observations suggest that the low level of the tax is a more likely explanation for its modest environmental effectiveness in the case of industry, although the lack of predictability may have contributed.

7.4.4 Efficiency

Energy taxes are, as long as they are kept simple, a cost effective way of collecting tax revenue because it is reasonably easy to measure the basis for the taxation. Monitoring and enforcement are also facilitated by the fact that the number of actors is limited compared with e.g. household taxation. As an environmental policy instrument, taxation can be highly efficient from the point of view of the environmental administration as it ties little administrative resources. However, in its Bill to the Parliament (225/1996) on reforming the electricity taxation, the Finnish Government stated that so far 50 to 55 persons at the customs authorities had been able to administer all the excise duties, but that the reform would require 40 new workers. The main resource need was due to the different tax rates for industry and to the refund system. To ensure its efficiency the effects of the tax and different tax structures should be analysed from an economic and environmental point of view. Such analyses of the Finnish system have been rare.

7.4.5 Acceptability

Acceptability of taxation is generally a function of the level of the taxation, given the historical context. This is shown by comparing the acceptability of taxation in high and low taxation countries. Changing conditions may lead to a rapid loss of acceptability as shown by the reactions to fuel taxation in the EU in the autumn of 2000. In several countries fuel tax levels were under heavy pressure and the taxation levels were no longer acceptable when costs were perceived to increase too rapidly.

Industries, especially energy intensive industrial sectors, are often against energy taxes. This opposition usually leads to politically feasible taxes, which include measures that ensure the acceptability of the energy intensive industry. Such measures include exemptions for some sectors, often in combination with direct or indirect subsidies. (Bressers and Huitema 1999, Brack et al. 2000).

Some of the interviewees from the companies, as well as the authorities, expressed arguments of principle against environmental taxes. "*Steering through taxes almost within production – it has*

this severe problem: as the investment money that has to be earned somewhere, this type of environmental tax will consume just the share [of the revenue] with which something [some investments] could be made” is an example of such a statement made at a mill. As noted above (Section 7.4.3), such direct adverse effects on environmental investments are, however, unlikely.

7.4.6 Transparency

The intervention theory of the present electricity taxation is complex, with its differentiated levels and refund systems. The system is far from immediately transparent although aggregate data is available on the tax levels and tax revenues. Firm level data cannot be obtained, in contrast to data on environmental regulation and emissions and therefore it is not possible to examine the effects or importance of the tax at the firm level using data available in the public domain.

7.4.7 Equity

Systems of exemptions and different taxation levels have placed the heaviest users of energy in a relatively advantageous position with respect to the tax. This feature has been a regular target for debate in the energy policy discussion. The lower tax rate for industry has been seen as unequal, for example by the Finance Committee of the Parliament (44/1996) (Määttä 2000, p. 164). The Finance Committee argued that the price of electricity paid by the industry is in any case lower than that paid by households and small scale production; that industry also benefits the most from the liberalisation of the energy markets in other respects; that services and small scale production was discriminated against; that the competitiveness of the large scale export industry was good anyway; and finally that the tax difference will result in implementation problems.

The tax rates and the details of the tax are decided annually in the state budget process, involving ministerial preparation, government level negotiations and finally a decision procedure with several steps in the Parliament. Not all groups have equal resources and possibilities to influence such a process. Large scale industry, which can concentrate its efforts and which can obtain clear ben-

efits for a few, appears to have an advantage over e.g. households when it comes to lobbying (Olson 1971, Wilson 1980, Mickwitz 1998).

7.4.8 Flexibility

Flexibility is in principle high, as energy taxation is part of the tax legislation with opportunities for annual revision. The most recent law on energy taxation has been revised twice since its entry into force in 1996. One of these revisions dealt with the tax refund (Section 8b). Attempts to use the instrument flexibly will be met by political resistance and demands for long term stable policies. The position of strong interest organisations is, however, not consistent: even sudden reductions are readily accepted whereas long term increases are met with opposition. The lack of self correcting or adaptive features in the face of fluctuating energy prices also means that increasing energy prices will lead to demands for tax reduction or more elaborate refund systems, but few will demand increasing energy taxes when energy prices decrease.

7.4.9 Predictability

Since the taxation can be changed on a yearly basis in tax laws its predictability is in theory low. In practice the predictability is not so low, as strong lobbies of energy intensive industry demand tax harmonisation throughout the EU (Brack et al. 2000). Finland's membership in the EU has thus increased the predictability of the taxation instrument and at the same time reduced possibilities for national experimentation.

A key characteristic of environmental taxes is that their environmental impacts cannot be directly predicted since they arise indirectly as a consequence of the costs. In contrast the marginal costs are perfectly predictable, which they are not for other instruments. (Weitzman 1974)

7.4.10 Sustainability

Electricity taxation is difficult to use as an environmental policy instrument, because it is highly sensitive to changing external conditions. The debate on fuel tax in the face of rapidly increasing prices of crude oil during the summer of 2000 shows how

easily the taxation becomes a political problem in which non-environmental concerns will dominate.

7.5 Effects of environmental management systems

7.5.1 Environmental awareness and concrete action

The popularity of environmental management systems has continued to increase. The number of EMAS sites has increased in Sweden as well as in Finland, although the rate of increase has been slower than for e.g. ISO 14000 certificates, which do not explicitly demand an environmental report. Since 1995 the number of EMAS registered sites has increased to 199 in Sweden and to 32 in Finland, but the numbers of ISO certificates have increased to 1120 and 462, respectively (EMAS-ISO ajankohtaiskatsaus 2000). The Responsible Care programme of the Chemical Industry already covers a large proportion of the chemical industry in Finland.

It is possible to verify a general environmental awareness in Finnish firms. The management systems are not the sole or even the main explanation for the environmental awareness, but they enforce the awareness and may be one way of translating a general awareness to concrete improvements. The results show that operators who have adopted environmental management systems are often forerunners in the environmental discussion among businesses. Ilomäki and Melanen (2001) made a similar finding. In this study it has not, however, been possible to rate the environmental performance in quantitative terms. Studies in other countries have suggested contradictory results (King and Lenox 2000).

In Finland there have been no formal links between the management systems and the regulatory or economic instruments. The Environmental Protection Act established a weak link through the Environmental Protection Decree (169/2000) Section 19, according to which the permit decision shall, as appropriate, include a mention of how environmental management systems have been considered in establishing the permit conditions. Thus the core of the intervention theory of standardised environmental management systems has not been to link with the regulatory systems but to provide firms with publicly credible and veri-

fiable ways of demonstrating their positive approach towards environmental issues. The intervention theory is built on the idea that a voluntary systematic approach to environmental issues within the firm will lead to continuous improvement of the environmental performance. The market is thought to reinforce the positive development by giving environmentally friendly companies a competitive advantage that arises from the fact that standardised environmental management systems are more than green washing.

The requirement to systematically examine a firm's activities and their environmental aspects is one of the most important main effects of the environmental management systems. This can lead to an improvement process that also improves the management system itself. A survey in Sweden demonstrated that significant improvements can be made (Zackrisson et al. 1999). Our study has also identified similar evidence of the effects of environmental management. An example is provided by a firm which replaced a printing colour after it found out through its systematic search for points of improvement that the use of one specific colour corresponded to a major proportion of the firm's total copper emissions in the waste water. In a pulp mill, problems with accidental air emissions from power production could be solved when the operators of the unit examined the causes of the accidental emissions. One interviewee stressed the systematic treatment of complaints and the increased transparency. He used the example of a complaint by neighbours on a particular noise, which resulted in redesign and investments. Similar examples of improved environmental performance have been found in the area of waste management of major industries (Kautto and Melanen 2000).

7.5.2 Environmental reporting

The EMAS differs from the other management systems by including an explicit demand to inform the public through verified environmental reporting. In Finland, environmental reports are provided by both EMAS and non-EMAS firms. The standard of reporting has generally improved, although 45 per cent of the firms on the Helsinki stock market main list do not provide any environmental reports at all (Lovio 2000). In Sweden, signs indicating a declining interest in environ-

mental reporting have been observed among firms (Anon. 2000). This observation may, however, be an artefact arising from the fact that firms have to send in their reports to participate in a competition for the best report, whereas the Finnish competition scans all available reports.

The results of our study indicate varying use of and expectations on the environmental reports (Box 1). According to interviewees the main role of the environmental reports is to provide some

background information and in many cases it is their existence, not their detailed contents that is important. Eighteen out of twenty interviewees considered environmental reports to be important as such. They argued without hesitation that the fact that a company has an environmental report is significant regardless of the contents of the report. One of the interviewed environmental managers said that the most asked question is "do you have an environmental report?"

Box 1. The functions of and expectations on environmental reports.

(Palosaari 2002)

Interviewees stated that nowadays it is assumed that every modern enterprise has an environmental report and if some enterprise neglects reporting this carries greater significance and more publicity than an excellent environmental report could ever have. Nevertheless few potential users of the reports look for specific information, but recognise the report as an expression of the firm's sincere commitment to environmental improvement. Thus the basic contents should be easily accessible and comparable across firms.

A more detailed analysis of the expectations concerning the reports shows that different groups of actors have widely diverging expectations on the contents of the reports. Some would like to see detailed accounts of impacts and measures to reduce these. Others demand a close connection to the financial reporting of the firm. Finally many stakeholders would like readable and interesting reports for non-specialists.

In general the interviewees considered reports to be reliable, although several recognised the possibility that the reports are not a completely unbiased account of all environmentally relevant issues. As one interviewee put it: *"That's the way it always is, that for different reasons, there are things that have been left out of the report... So it requires that you have to be able to pose the right questions, and read between the lines."*

Though it can be assumed that environmental reports give reliable facts about environmental performance, the actual environmental impacts remain unclear. Some interviewees stressed that it is impossible to understand all impacts through the information given in reports. As one interviewee put it: *"For example, what does it mean if one per cent of some solvents gets into the air as diffuse emissions, let's say in the factory area, what does it mean in practice?"*

Among the interviewees those who were very familiar with environmental management systems and reports recognised and expressed well the limitations of reports. However, they were also the ones who had the greatest faith in environmental reports. Most doubtful were those who did not seem to have any personal interest in environmental issues. Although representatives of authorities and NGOs presented most of the criticism, their opinion was that voluntary environmental management systems in general have very positive effects on the activities of enterprises. The authorities pointed out that management systems require that important environmental aspects and impacts are handled, and publishing the information is a big step forward. One representative of a NGO stated that environmental management systems have enormous importance from the psychological point of view because they guide the activities of enterprises in the "right direction".

The interviewees generally agreed that open reporting about the problems, accidents and difficulties with environmental issues increases remarkably the credibility of the reports. (*"You cannot just pretend that everything is OK"*)

According to the interviewees environmental reporting is, at least for big companies, a "must" if they want to succeed in business. The interviewees stated repeatedly that environmental reporting will be a crucial condition for success in the future. Especially the representatives of mutual funds stressed that investing in environmental issues provides an indication of the management's ability to foresee the future. Besides the willingness to be a modern company, taking care of the environmental aspects indicates that the company has everything well under control. The interviewees generally stated that environmental progressiveness creates a general impression of careful, responsible and systematic activity.

7.5.3 Market and network effects of environmental management systems

Environmental management systems may in some sectors become a "must" in marketing (Box 1). If a significant number of large operators have adopted management systems the others in the sector or even cluster have little choice but to adopt a management system as well. Similarly major customers may through a domino effect force not only a producer but also those delivering components or raw material to the producer to adopt management systems. This chain effect was seen in some of our case firms. Similar findings have been made by Ilomäki and Melanen (2001) and Kautto et al. (2000).

The environmental management systems give birth to a new breed environmental experts – the environmental management consultants, whose approach is quality and management oriented. These experts differ from traditional environmental consultants, whose market has been investigations connected with permit procedures, environmental planning and estimation of effects or environmental risks. Management oriented environmental consultancies are largely offered by new types of firms such as standardisation bodies, e.g. in Finland SFS-standardisation, and classification firms such as Det Norske Veritas.

The EMAS differs from the other voluntary management systems by being closely connected with the authorities. The main purpose of this close connection has been to ensure the credibility of the certification. It has, however, also established new types of contacts between firms, verifiers, accreditation bodies and competent environmental authorities. These contacts create new flows of information. Environmental reporting may further enhance these contacts, eventually supporting the company's development towards "active citizenship".

A simple example of increasing cooperation is seminars with participants from firms, several different authorities and researchers. Although it could be argued that such seminars would be organised in any case, it is evident that the existence of EMAS has demanded an active input on the part of authorities. In this respect there is a clear difference compared with the Responsible Care programme of the chemical industry. The Responsible Care programme encourages con-

tacts, but the initiative is in the hands of the industry. For EMAS important development initiatives come from authorities or through political bodies such as the European Commission or Parliament.

7.5.4 Costs and other unwanted effects of environmental management systems

Within the Finnish public administration the EMAS has annually required 2–4 person years of work since 1995. This effort has also covered the administration's involvement in ISO 14000. With EMAS the main work has been related to the establishment of the registration functions, including the necessary legal background, the distribution of information and the development of accreditation functions and the negotiations at the EU-level. A minor part of the costs have been recovered in the form of registration fees.

For firms the greatest costs arise internally, as the establishment of a verified management system will demand active effort from a large part of the staff. Additional costs arise from the use of external consultants in setting up the management system and in verifying it. Production, printing and distribution costs of the environmental report add costs. The costs of the external services in setting up and running EMAS or ISO 14000 at a site can be significant. The registration fee, which for EMAS is € 1 700 (until January 1st 2002 it was FIM 10 000) for large companies, € 1 000 (earlier FIM 6 000) for firms with less than 50 employees and € 500 for companies with less than 10 employees, is small in comparison.

One of the most unwanted effects in addition to costs is the risk of internal bureaucracy. The external bureaucracy is generally not a problem. Authorities have not interfered in or retarded the adoption process and the registration time of EMAS certificates is less than 2 months. Within firms the amount of bureaucracy depends on the skills of the external consultant and the ability of the employees to make the system a part of their daily work, integrating it with other related demands on health, safety and quality.

One of the concerns voiced by firms relating to the partly authority-dependent voluntary schemes such as EMAS is that the difference between goals and real performance possibilities

becomes confused. The fear is that ambitious goals of environmental performance, which may depend on the successful deployment of some as yet poorly known technology, are suddenly translated into environmental limit values with legal status. If this risk is perceived to be significant, firms may prefer to play it safe and not set too ambitious goals. This may lead to a rather pedestrian advancement in environmental performance, without possibilities for major leaps. The Responsible Care programme does not have these kind of strings to the permit systems and can thus evolve completely independently of authorities in response to market pressure.

The lack of real sanctions may attract poor environmental performers to the environmental management systems. These poor performers are likely to seek public credibility in a greening market without having to alter production processes or general environmental attitudes. Our study has not been able to identify this kind of effects of the environmental management system, but King and Lenox (2000) have observed that the Responsible Care programme has led to such opportunism in the US with poor environmental performers joining the programme simply to gain credibility. Eventually such free-riders could undermine the whole programme.

7.6 The effects of environmental management systems in relation to evaluation criteria

7.6.1 Relevance

The basic assumption of the intervention theory is that the likelihood of identifying possibilities to improve environmental performance increases when activities and processes are systematically examined. Our observations and related studies, e.g. Zackrisson et al. (1999), have demonstrated that this assumption is generally correct. The relevance of internal management systems has also increased because the marginal costs of end-of-pipe solutions increase rapidly as demands on emission reduction become more stringent. Significant improvements will therefore often depend on changes in the running of processes or in new technical solutions. Such improvements have been reported by our interviewees (Section 7.5.1).

Another aspect of relevance of environmental management arises from the increasing public concern for the environment, which makes environmental issues interesting from a marketing point of view. Environmental management and auditing according to specified rules is necessary in order to achieve and maintain credibility. Standardised voluntary environmental management systems are highly relevant in this respect. The greatest relevance of the management systems is in the relationship between firms and between firms and authorities (Section 7.5.3). On the retail market, environmental labelling of products has greater relevance.

7.6.2 Impact

Our study has demonstrated that management systems are likely to identify possibilities for environmental improvement and is thus in line with the findings of other similar studies (Kautto et al. 2000, Ilomäki and Melanen 2001, Zackrisson et al. 1999). It could therefore be argued that the greatest positive impacts probably arise when the system identifies areas of improvement that hitherto have not been recognised. The possibility of such unexpected effects may greatly increase the motivation to implement management systems.

The risk of bureaucracy within firms can be minimised as firms gain more expertise and self confidence in using the system. The risk is greatest when the systems are set up by external consultants with too little experience of the specific characteristics of the firm. Under such circumstances it is likely that the focus will be on the formal elements of the system rather than on the substance.

7.6.3 Effectiveness

Those environmental management systems, such as EMAS and certified ISO 14000 management, which include external revision have a built-in check of effectiveness. This check focuses on the operation of the system, but it does not ensure that effects corresponding to the intervention theory are achieved. Our results have shown that the perception of continuous improvement varies considerably, from a slightly haphazard collection of things to improve to a systematic and

comprehensive view of present environmental effects and possibilities for reducing them (Luoma 1999). The effectiveness can be improved with the development of environmental networks between firms, which transmit not only general information on environmental performance but also demands on environmental loads. These can arise from the published goals for improvement of environmental performance, but hitherto specific goal-based pressure on e.g. the chemical industries has been moderate (Section 8.3.3). One of the main criticisms against the Responsible Care programme is that it lacks efficient external mechanisms for ensuring effectiveness (King and Lenox 2000).

7.6.4 Efficiency

It is difficult to evaluate the efficiency of environmental management systems, as they are based on the idea of being an integral part of the overall management. Depending on the structure of the overall management the environmental management can be perceived to be a considerable burden or a minor addition. One Swedish survey of firms which have adopted EMAS and ISO 14000 indicated remarkable cost efficiency. Half of all environmental goals had a pay-back period of one year or less (Zackrisson et al. 1999). These results may, however, indicate a transitory phase rather than a sustained efficiency. With time it may become more difficult to identify areas of improvement and significant improvement may require true innovations, which are unlikely to arise as the result of a management system, unless it is supplemented by an active and substantial R&D effort.

Environmental management systems have been perceived to be costly, in particular for SMEs (Zackrisson et al. 1999). This agrees with statements of interviewees in our study. At the same time environmental management systems have in certain segments become unavoidable from a marketing point of view (Section 7.5.3). With increasing use of management systems, costs may go down when firms become less dependent on external consultants in setting up the systems and when competition among consultants increases. Use of e.g. the Internet for producing and publishing environmental reports may also contribute to a cost reduction.

7.6.5 Acceptability

Acceptability of voluntary management systems has several different aspects. First there is the acceptability of the system as perceived by those firms which consider joining it. In this respect a system created by the industry itself is likely to be perceived as the most acceptable. This is partly the explanation for the success of the Responsible Care programme (Section 4.3.6). ISO 14000 has been developed in close co-operation with the industry, whereas the EMAS is the result of a political and parliamentary process and can thus be perceived to be the most difficult to accept from the point of view of firms considering options for environmental management systems. This is in agreement with the observed rate of expansion of the management systems; EMAS has clearly expanded much more slowly than the industry-based systems. An additional explanation is that ISO has a competitive advantage because ISO is a well established organisation which is already known worldwide from many standards. EMAS is limited to environmental management within the European Union.

From the point of view of authorities and the public the acceptability order may be opposite to the view of the companies; the greatest suspicions are felt for systems entirely run by the industry. Firms which only use the industries' own management principles may be suspected of attempting to "green wash" simply for marketing reasons. A rigorous review system such as that included in the EMAS may increase public credibility.

Within firms the managerial commitment is the key to acceptability (Halme 1997). All systems have commitment of the management as a starting point and an essential part of the intervention theory. Over time, acceptability within the firm may be lost if the system is perceived to be bureaucratic and if external verifiers focus on formalism rather than issues. On the other hand positive results of the management may enhance development and lead to a genuine shift in the management paradigm (Halme 1997).

7.6.6 Transparency

The intervention theory of the EMAS aims specifically towards transparency, whereas transparency at the firm level is optional with ISO 14000

and Responsible Care. In practice all systems are reasonably transparent in Finland at the firm level, as environmental information is distributed openly. This is particularly true of the pulp and paper industries, which have a very well developed system for environmental reporting at the firm level (Section 5, Finnish Forest Industries Federation, <http://www.forestindustries.fi/>).

The Responsible Care programme produces aggregate information, whereas the firm level information displays greater variation. Some representatives of the chemical industry have produced very high quality reporting (Lovio 2000), but these have generally developed their environmental management according to ISO 14000 or EMAS.

At a societal level the EMAS is the most transparent, with all key requirements made available in the public domain. ISO 14000 is available at a cost, as the standards are subject to copyright and sold. RC documentation is freely available through the Internet. Interviewees generally regarded reports produced by the management systems to be reliable and transparent, although several recognised that firms may choose not to report on some issues (Section 7.5.2).

7.6.7 Equity

Environmental management systems aim at giving those firms adopting the systems a competitive advantage. The Responsible Care programme differs from this in that its purpose is to give chemical industries an equal opportunity to improve their environmental credibility. This is also indicated by the observation that chemical industries in the US which have joined the RC tend to be those with greater discharges than those which have not subscribed to the system (King and Lenox 2000). In Finland the situation is not comparable, because all the largest chemical firms have joined the programme. The majority of non-subscribers are small firms.

In considering equity, a key issue is the relation to other policy instruments. In Finland regulations have not formally recognised voluntary management systems. In the new Environmental Protection Decree (169/2000, Section 19) the first cautious reference has been made to the possibility of some consideration, but there is as yet no information on what this will mean in practice.

Business representatives have repeatedly stressed that firms should get some advantages especially from EMAS, which is the heaviest in terms of resource requirements. The dilemma is one of equity and also of defining the nature of any advantage. Once a firm has a permit its costs are reduced to the monitoring costs, which are necessary for a management system as well. In Finland the firms pay no fees for inspections, in contrast to e.g. the Norwegian system. The inspections are not a heavy burden on the activities as they are limited to superficial site visits.

7.6.8 Flexibility

In principle environmental management systems are highly flexible because they should fit into the management structure of the firm. Standard requirements can also be interpreted in a rigid way. This risk of rigid interpretation is greater, if external consultants dominate when setting up the system. The built-in principle of continuous revision and audit makes the systems reasonably easy to change and to revise when external conditions change. An example of this flexibility is that the sale of a part of a production unit of one EMAS-registered colour-producing firm led to the development of an EMAS for the new unit within a relatively short time span. This also reflected the environmental awareness that had developed within the firm. When environmental know-how and confidence increases, flexibility can also be expected to increase.

7.6.9 Predictability

From the point of view of the participating firms the management systems are predictable in the sense that the firm knows and can influence the requirements that it has to meet. External verification of systems introduce an element of unpredictability at a practical level, as there are few possibilities for appeal. Instead the systems relies on negotiations.

From the point of view of authorities the environmental management systems can be rather unpredictable (EMAS). There is no formal guarantee that a firm will live up to the targets it has established and authorities are offered no insights into the system beyond what the firm chooses to

reveal. In connection with a permit requirement and permit inspections the management system may, however, become a mechanism for increasing the predictability of the permitting.

7.6.10 Sustainability

The intervention theories of the environmental management systems include the idea of sustained positive effects through the concept of continuous improvement. However, the systems may become non-sustainable due to fatigue and to perceived lack of reward/benefit. This has been suggested as one of the reasons for the slow growth of EMAS registrations in Europe; firms defect at a rate close to the entry rate of new firms. In Fin-

land the growth has been slow, but so far only one firm has been removed from the register, and only due to practical reasons (sale and split of activities). Interviews suggest that large firms which have joined the system are unlikely to quit, as long as the environment is important on the marketing agenda (Section 7.5.3). The problem of sustaining interest in the EMAS is likely to be greater than for ISO 14000 and RC because the required effort is greater and the perceived benefits are at the same level, or for firms operating outside the EU, even smaller. This could change if demands on e.g. inspections were to become stricter in the regulatory systems and the links to the management systems more explicit so that voluntary external verifications could replace part of the mandatory ones.

8 The role of interorganisational networks

8.1 The analysis

The main network dimensions used in this analysis are: membership (types of actors), the structure and resources of the environmental administration, and intensity (integration) in terms of contacts and conflicts between various actors. The networks are studied in various stages of the decision-making processes; i.e. the pre-decision, decision and supervisory stages (Section 3.3 and Fig. 4). Within these stages four aspects are of special interest: a) general network characteristics, b) effects on decisions, c) effects on implementation procedures and d) differences between the instruments. The following analysis of the actual networks will be structured according to these aspects.

The general characteristics of the networks are based on the results of the thematic interviews and of the survey of administrators, whereas effects of decisions and implementation procedures are also analysed in terms of the permit decisions. The primary focus lies on regulatory instruments, although energy taxation and environmental management systems are also discussed briefly. Basically the analysis is restricted to the interactions in the permit processes. Sometimes it is extremely difficult to separate these from general exchange of information, i.e. interactions existing regardless of the permit procedures. These general information networks are discussed in Section 8.5. Finally it should be stressed that the focus is on inter-organisational networks, but henceforth we shall simply use the word "network".

8.2 Regulatory instruments

8.2.1 The pre-decision phase

The importance of discussions before the formal applications is, by and large, stressed by all the actors. However, this does not mean that the preliminary discussions necessarily determine the outcome in terms of decisions, but – when occurring – they have an effect on the interactions throughout the decision-making process. In terms of actors, the water permit system appears to be

the most inclusive and the chemical system the least inclusive one.

8.2.1.1 General network characteristics

The pre-decision phase contains the events occurring before the application is formally handled by the appropriate authorities (Section 3.3). One of the main results of the analysis is that the difference between the pre-decision and decision phases is in many cases blurred. All actors stress the importance of the pre-decision phase in general, but especially the firms tend to emphasise the importance of continuous negotiations before the application and the quality of application for the result of the permit processes. As one operator said; the application "...has to contain almost everything. It is the largest effort, in which most of the available knowledge will be gathered. I see this as quite important, as well as the discussions with the Environmental centre". The regional authorities tend to stress the decision phase – preparation of decisions – more than the operators, although the importance of continuous interactions is frequently acknowledged. The views of the local administrators fall somewhere in between. They vary depending on whether the municipal level is the decision-making body or not. The frequency of permit processes also appears to make a difference. In municipalities with a large number of industries and extensive permit procedures the following view is typical: "*the most important phase is definitely before the application has been written*".

Concerning main partners of co-operation, the administration tends to regard the operators as main actors, whereas the operators to a surprisingly large extent stress the importance of their 'own networks' such as clients, other firms and suppliers (Fig. 13); "... if we are making renewals then we contact the suppliers and they always have good information on what kind of techniques they have delivered to others". Such interactions, although not necessarily related to permit processes, of course tend to affect the need for permits as well as the general level of information. It seems evident that the potential effects of such general information networks, discussed in Section 8.5, should not be underestimated. Specifically regarding the permit decisions, primary interactions are directed towards the permit grant-

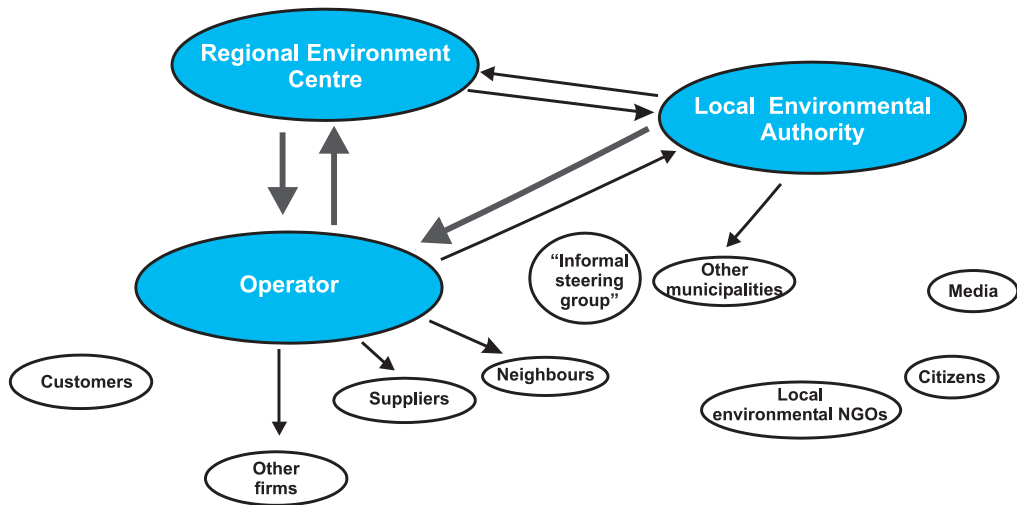


Fig. 13. The main interactions during the pre-decision phase in addition to the formal links established by the regulatory system. Based on interviews with the operators, the regional and the local environmental authorities. An arrow from A to B indicates that A perceives the interaction with B as important. (Bold arrow = typical interactions, normal arrow = occasional interactions)

ing authorities, which for the larger operators normally are the regional environment centres. The following statement is a relatively typical perception by the regional authorities of most important co-operation parties: "... it is the local environment authority /.../ And then of course the operator, who is also more or less a partner."

Secondary collaborators of the firms are the municipal authorities and those affected by the industry in question. The local environmental authorities appear to be of importance regardless of whether they are decision-making bodies or not, but in the latter case mainly on the basis of information exchange; "we have the board of environment visiting us occasionally, so that we can tell them where we are going and they have an opportunity to ask."

The mechanisms maintaining the contacts between actors vary in terms of institutionalisation. Especially small municipalities with limited administration tend to stress discussions and visits to firms as important means. There are, however, examples of more permanent solutions, i.e. informal bodies, in larger municipalities for instance informal "air councils" (ilmaryhmä), containing representatives from various parts of the

local environmental administration. Even more interesting is the fact that associations in some cases (association of water protection, association of industries) serve as a coordinator between industries and affected neighbours surrounding, for instance, a watercourse. As one operator said in a case in which the local water protection association had been the centre of these interactions; "that is where we meet these people and deal with the matters, which leaves them the responsibility for the preparation. But then we of course act as a steering group and work out what has to be done. The Water Protection Association is a link, or a place where we deal with these matters." The picture of the interactions emerging so far is one in which the local administrative activities appear to be relatively strongly determined by the administrative resources and conditions and the industrial ones by the general co-operation patterns of the operator, regionally as well as in terms of the operative field of the industry in question. The main interactions are summarised in Fig. 13. The marked (bold) relations are dominant ones, in the sense that a majority of the interviewees stressed the importance of the relationship in question.

8.2.1.2 Effects on decisions

The effects that the pre-decision interactions have on the actual decisions are difficult to estimate. Despite some variations of emphasis, reliance on these interactions is strong among all actors. The general assumption is of course that the discussions will simplify the decision-making procedures. As one municipal administrator said; *"if it is a more experienced operator, he comes to us for discussions and we go through the procedures in advance; this and that statements are needed, hear these neighbours in advance, that makes the whole thing faster"*. However, the importance of the pre-decision phase does not mean that the operators can dominate the process and pursue their interests regardless of the interests of the authorities. Both parties stress the importance of the discussions as a mutual process and none of the interviewees indicated conflicts at this stage. The general impression is non-conflictual rather than conflictual. It also means that the operators can make use of the pre-decision interactions in the subsequent phases of the process.

The preliminary discussions and the relative unanimity do not, however, mean that the decision phase loses its significance. The sample of permit decisions for which the interactions were analysed indicates that the permit decisions at least to some extent deviate from the application in almost all cases (see also Similä 2002). The statements from supervisory authorities also require some kind of additional measures in a majority of the cases, particularly in the case of the paper and pulp industry.

8.2.1.3 Effects on implementation procedures

All actors stress the importance of the pre-decision phase of the process to a far greater extent than could be expected on the basis of the intervention theories. The firms stress the importance of qualitatively "good" applications and their own analyses as a background for such applications. As one representative of a firm put it: *"The authorities really should know when they get a good application in their hands"*. Especially the local authorities deliver a similar picture in so far as they rely heavily on discussions with the operators as the main instrument of the pre-decisional

processes. This also seems to be the case regardless of the instrument in question. In that sense the strong emphasis on the pre-decision phase tends to reduce the formal differences between the instruments. This is however also dependent on the relationship between the contextual factors. In a context characterised by low complexity – for example a small municipality with a homogenous industrial structure perhaps dominated by one large company – the interactions tend to approach the formal implications of the legislation (Section 8.2.4.).

Moreover, there are reasons for stressing the importance of more or less institutionalised patterns of co-operation also at the beginning of the application process. These will be discussed more thoroughly under the decision phase. All in all, the features of the pre-decision phase do not necessarily determine the outcome of the other phases, but the interactions do, when they occur, affect the subsequent procedures and appear to be relatively continuous through out the process.

8.2.1.4 Differences between instruments

As for the importance of the pre-decision phase, the perceived differences between the various instruments are small. There are, however, differences regarding inclusiveness. The number of actors involved in the preparation of chemical permits is more limited and the contacts between firms and authorities are – according to the interviews with chemical industries – of a more ad hoc nature than within the other permit systems. Although the importance of the contacts is acknowledged they are *"... pretty occasional. If there is something on one side or the other then we are in touch, but not regularly in any way..."* These firms also stress the importance of the local expertise (local administration): *"...they know the environment, they know the entity much better than one [authority] that gets a statement from the local authorities."*

The impression of a more limited system is also confirmed by the local authorities, although their views naturally differ depending on whether or not they have to do with chemical permits. The local level implementation of the Chemicals Act is considered to be complicated, requiring more knowledge and resources than the other instruments. Furthermore the pre-decision discussions

are more internal and restricted, which affects the general openness of the system. Permanent patterns of co-operation cannot be found, apart from the interest organisations of chemical industries.

The impressions concerning water- and air-permits are somewhat contradictory. On the one hand the water permits are, especially by the firms, considered to be handled in more exact and transparent processes. On the other hand the Water Courts and the Regional Courts have apparently not been particularly open to discussions with or information from local authorities. To some extent this is quite natural, as the courts are not regarded as negotiating bodies. The new permit system is expected to develop in a more interactive direction. By and large, it seems evident that the transparency of the regulatory processes associated particularly with the Water Act, as well as the relative flexibility of the instrument, have promoted continuous interactions. The fact that the permits have generally been issued for a fixed period of time is another feature with similar effects. The same goes for the lengthy permit procedures. These incentives for interaction were initially less important and less inclusive in air pollution control, as the initiative was left primarily to the operators.

8.2.2 The decision phase

Especially the operators tend to stress the importance of continuous interactions also in the decision phase. In this respect it is obvious that the Water Act has been the most inclusive one and an incentive for institutionalising the interactions between the concerned actors. This does not mean that all divergent interests would be mediated through these interactions. Almost all permit decisions deviate in some respect from the application and presuppose some kind of additional substantial measures of the operator. This reflects one of the key differences between a permit procedure and a pure notification system.

8.2.2.1 General network characteristics

The patterns of cooperation in the decision phase of the process are partly determined by the legislation. The primary collaborator of the operators, as well as the authorities, is largely dependent of

what is the decisive level for the application in question. The ways in which the operators stress the pre-decision phase became clear above. Their interactions in the decision phase are primarily directed towards the permit-granting authority (Fig. 14). However, the close interconnectedness between the pre-decision and decision phases should be borne in mind. All the actors stress the importance of continuous discussions, which means that the initial networks have possibilities to influence throughout the process.

As stated before, the Water Courts have in this respect been in a special position; "... *the Water Court has not been able to take part in discussions, as it is clearly a judicial authority...*". In this sense the new system is expected to bring about changes: "... *the activities of the Water Courts and in the future the Environmental Permit Authorities will in the context of the permit conditions be strongly affected by the regional environment centres, in many cases also the [regional] supervisory authorities for fisheries, the [regional] Employment and Development Centres and the local [municipal] environmental boards.*"

The regional authorities tend to stress the contacts with the local supervisory units, in addition to discussions with the operator. Especially at the local level there appears, however, to be considerable differences depending on the size of the municipality and the administrative structure. Integrated models, for example with integrated technical and environmental divisions, appear to increase the internal administrative interactions but also, perhaps contrary to what would be expected, external interactions with research centres, local organisations and those affected by the industry. The municipalities also stress the preparation of statements and the notification procedures. As one local administrator said: "*The phase when we collect statements from those who live here is an important stage, one informs and gets informed...*"

Concerning the other aspects related to the decision phase it is worth mentioning that one of the regional environmental centres considered transparency to be a problem. This is not a dominant feature. Usually the permit systems are regarded as fairly open. Neither do the interviews deliver an impression of conflictual decision-making, rather the opposite is the case also in the decision phase. As one regional administrator put

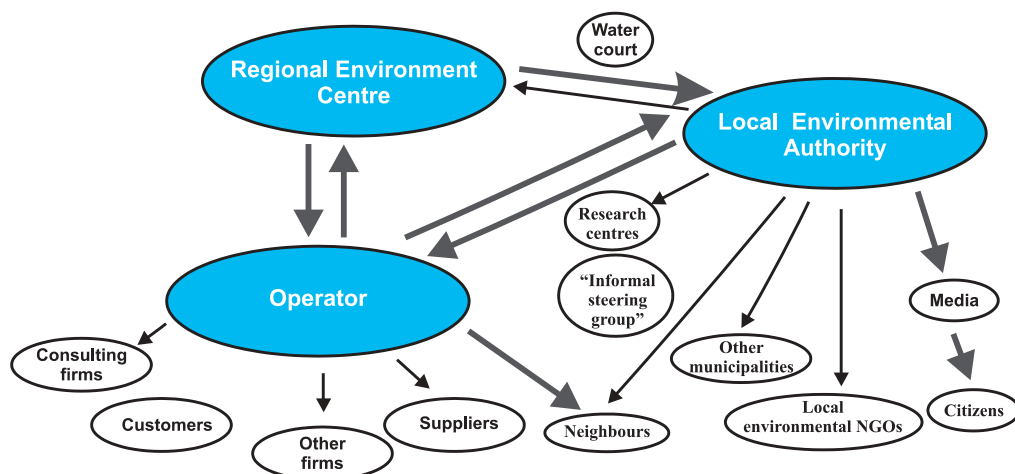


Fig. 14. The main interactions during the decision phase in addition to the formal links established by the regulatory system. Based on interviews with the operators, the regional and the local environmental authorities. An arrow from A to B indicates that A perceives the interaction with B as important. (Bold arrow = typical interactions, normal arrow = occasional interactions)

it: "There were much more [conflicts] before./.../ it has to be something new to get people excited." When conflicts arise they are related to affected actors or local environmental organisations. Moreover the municipalities have problems of integrating small – especially chemical – firms in the procedures, which is one aspect where it can be questioned whether the spirit of the legislation is fulfilled.

8.2.2.2 Effects on decisions

An interesting question is to what extent the features of the permit systems discussed above are reflected in the actual decisions. The sample of permit decisions concerning interactions within the chemical and pulp and paper industries (Section 4.5.1) is relatively limited and does not include all types of permits analysed in this report, but it gives at least indications of the importance of the various mechanisms discussed earlier. In all cases a regional environment centre is the permit-granting authority. The sample gives an impression of more restricted processes than do the interviews. Negotiations, for instance, do not according to the documents occur between other parties than the permit-granting authority and the operator. Statements from the concerned municipi-

palities have been requested in all cases, frequently also from regional authorities. Hitherto the procedures seem to be relatively neutral administrative processes, which could partly be a result of more intensive informal discussions in the pre-decision phase of the processes.

As already noted, divergent interests are not entirely mediated before the decision stage. The fact that the statements to a considerable extent deviate from the applications is one indication of that. A majority of the statements request either substantial measures or more thorough investigations concerning some aspect of the application. Furthermore municipalities can, when they are not the decision-making body, use general argumentation based on local perceptions to influence the decisions. On the basis of the decisions made the paper and pulp sector appears to be more interactive than the chemical one. It seems, however, that regional differences in procedures are a strong explaining factor concerning differences in permit procedures between the chemical and pulp and paper industries.

8.2.2.3 Effects on implementation

It seems inevitable that especially the water permit systems have generated more or less formal-

ised patterns of cooperation affecting the process as a whole. Examples of such mechanisms on the municipal side are for example regular meetings between the units within the environmental administration, informal "permit councils" and cooperation within water protection associations. Similar examples can to a lesser extent be found within the air permit system. As noted before, this feature does not in general increase the conflict level within the system. When conflicts arise, they are individual cases primarily related to neighbours concerned, although several firms as well as administrations stress the importance of environmental organisations for the general awareness concerning protection activities. Only one municipality mentioned administrative conflicts in relation to the permit systems, apparently due to a recent administrative reform. Other indications of administrative conflicts with perceived direct effects on the permit procedures were not found.

8.2.2.4 Differences between instruments

Both in the pre-decision and decision phases the systems differ in terms of inclusiveness. In the case of the actors and cooperation activities the water permit system appears to be the most inclusive and the chemical system the least inclusive. When conflicts arise, they also – partly on natural grounds – tend to relate to water permits. Informal patterns of cooperation in the local bureaucracy tend – again naturally – to arise in larger municipalities with a relatively complex environmental administration (Section 8.2.4), as an effort to concentrate expertise. In the industry, it is difficult to find differences between the systems concerning the ways in which they stress their own networks. One additional feature related to the nature of the legislation is, however, important in this context. Especially the industry appears to perceive the water permit system as a more definite and compulsory one, whereas for example the general regulations and guidelines associated with the Air Pollution Control Act are seen as important in terms of anticipating the development and thereby affecting the strategic planning of future activities. Such effects are less immediate and may reduce the necessity of external networks compared to the water permit system. In such a case the decision is turned into a matter of negotiations between the permit granter and the operator.

8.2.3 The post-decision phase

The most important conclusion concerning the post-decision phase is that there are considerable regional and local variations in supervisory activities. The system is largely dependent on the activities of the operators (Fig. 15), whereas the authorities face information and resource problems in fulfilling their supervisory obligations.

8.2.3.1 General network characteristics

In a formal sense, the supervisory phase includes several mechanisms; inspections, auditing and reporting obligations of the firms. Concerning the regional level authorities, the inspecting and auditing activities mentioned deliver a relatively formal and routinised picture; *"Well, we check that they have met the permit limits. That's the first check. Then we make annual summaries /.../ We have the same data, the industry, the Federation of Finnish Forest Industries and ourselves."* Permits granted by the regional environment centres include an obligation for the operator to deliver reports on emissions on a yearly basis. As one operator said: *"...if someone notifies them [the regional environmental centre] that something has happened and they have not heard from us, they will definitely react..."*.

The authorities are – mainly due to resource problems – relying heavily on these reporting obligations of the firms. Especially municipalities frequently admit that locally initiated follow-ups and inspections are of an ad hoc nature – sometimes even non existent; *"...we follow the annual reports/.../ has the change been positive or negative compared to the previous year?"* Problems of dealing with and utilising the reports are also acknowledged, which is a problem when related to the spirit of the legislation; *"...no one catches you if you put the report in a folder /.../ if you have an application to prepare it comes first."*

There are indications that the regional and local variations are considerable. A study of the regional environment centres' notifications on environmental crimes and offences (Aakkula, 2000) supports that impression. The number of notifications on offences is low. On the basis of survey data it is estimated to "more than 26" in the years 1995–1999, which is about 3 per cent of the total number of environmental permits granted by the

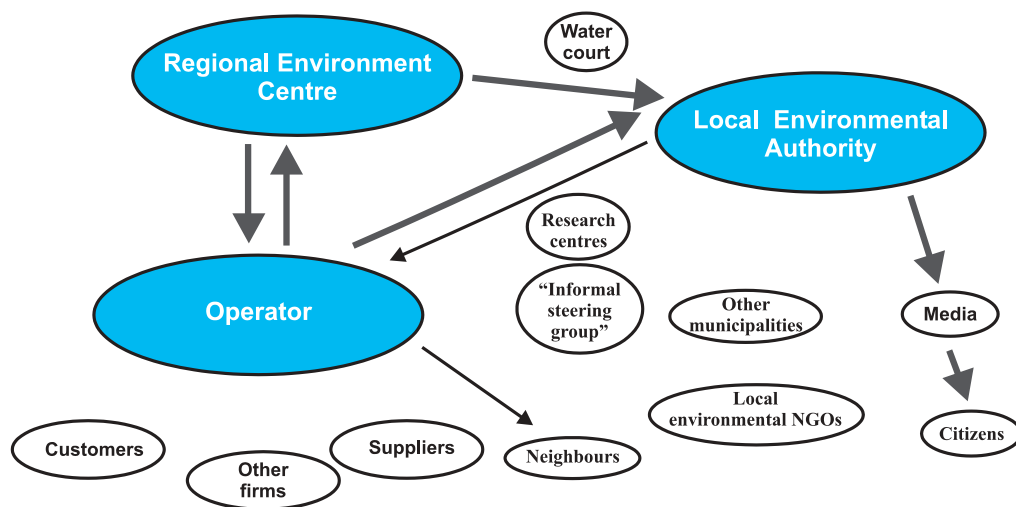


Fig. 15. The main interactions during the post-decision phase in addition to the formal links established by the regulatory system. Based on interviews with the operators, the regional and the local environmental authorities. An arrow from A to B indicates that A perceives the interaction with B as important. (Bold arrow = typical interactions, normal arrow = occasional interactions)

same authorities (Aakkula 2000, pp. 21–27). An important conclusion of the study is that the extent to which notifications are made or not is dependent on the official's personal attitudes towards environmental offences, his motivation and the traditional practices of the authority. Another surprising result is that several of the environment centres were not aware of the fact that the legislation concerning notification obligations on environmental crimes has been strengthened. They were applying old directives. This indicates insufficient central steering, particularly from the Ministry of the Environment (Aakkula 2000, p. 107).

Our findings do not necessarily mean that the control systems are totally arbitrary, but they do open the possibility of considerable variation. On the other hand the control systems especially within large industries are extensive, including for example supervision plans and supervisory groups. As for distribution of information, the reports are in general treated by the local environmental boards once a year and thereby also distributed to the press. However, with regards to the public attention there appears to be considerable local variation. In this respect the plants confront the problem of delay in delivery of information. In some cases it has taken up to one year before

the information has been distributed. From the firm's point of view such information is out of date and might even be counterproductive.

8.2.3.2 Effects on decisions

A specific question is, to what extent previous permits – and the extent to which the permit conditions have been met – affect new permit decisions. Such a dependency is stressed especially by the regional authorities; *"they [the previous permits] have an enormous effect. If they can make it essentially below limits, that's where the next permit will be"*. Or as another administrator said: *"what's the use of supervision if [the results] would not have effects. Of course they have."*

8.2.3.3 Effects on implementation

The post decision/supervisory phase is, in terms of implementation, not just a matter of control of the permit decisions in an instrumental sense. It is also a question of how the information systems are used and of the expectations regarding the effectiveness of these information systems at various administrative levels. In all these respects,

there appear to be important differences between various actors, especially between the views expressed by regional actors compared to local ones. From the point of view of regional actors, the potential problems are related to information. The permit systems are considered to be effective, provided that there is enough information to define exact emission limits. As the permits are operative over a relatively long time, such information does not necessarily exist. In such situations there are no guarantees that the permits over time are related to the actual emission problems. One solution in order to achieve long term effects on the implementation of the instruments is to define exact limits as well as long term objectives. This gives the operator at least some information on the future level of the emission limits and also means that the information from the supervisory phase is used continuously in the decision-making processes.

This picture of a relatively close connection between the decisional and supervisory phases is however not confirmed by the local administrations. As the regional actors face an information problem, the local administrators suffer from resource problems in terms of difficulties in obtaining all the information which the system provides. A frequent perception is that the permit-granting activities take up all the available time and that the supervisory role is restricted to obtaining an approximate picture of the long term changes. It is evident that the strong regional and local variations discussed above question the spirit of the legislation and the intervention theories. These variations are also confirmed by the central level authorities discussed below in Section 8.2.5.

As for supervision, all three permit systems rely heavily – apart from inspections – on the reporting obligations of the industry. The general impression is that there is no conflict in views between the administrative actors and firms concerning the basic principles. By and large the administrations seem confident that the industries meet their obligations and the firms tend to regard the supervisory activities as a guarantee of the quality and functioning of the processes.

8.2.3.4 Differences between instruments

One interesting difference between the instruments relates to the interdependence between water and

air permits. One reason behind the success of Finnish water protection is the relatively intensive cooperation between industries, authorities and research institutes, which started already in the 1970s. It seems possible that the system with a permit-granting authority relatively restricted to its legal role (Water Courts), along with the fact that the system was based on individual discretion, increased the informal interactions between other actors. The recent administrative reform is also expected to improve the negotiations in relation to the new permit-granting authorities. As noted before, the water permit system is more extensive, whereas the air permits are considered to be a more direct result of negotiations between the permit granting authority, the local environmental authorities and the plants. These differences of course also affect the utilisation of feedback mechanisms and information. The chemical permit system has been more vertically organised, also resulting in less intensive local level interactions concerning supervision. The central and regional authorities are of greater importance as information sources for the local supervisory authorities than within the other permit systems. A separate question is to what extent the environment management systems (EMAS, ISO 14001) have affected the interactions and networks (Section 8.4).

8.2.4 The network extremes

The purpose of the analysis in the previous sections was to deliver a general picture of the interactions surrounding the instruments. It should be noted that there are deviant cases – or network extremes (elaborated in more detail in Sjöblom 2001) – which are of interest particularly concerning the following aspects; a) the institutionalisation of informal contacts, b) the relationship between the phases of the decision-making process, and c) the balance of information between various actors in the network.

The sample of municipalities used in the analysis represents a variation in complexity in two dimensions; administrative and industrial structure. Administrative complexity characterises the larger municipalities and occurs within two administrative models; one in which the local environmental authorities are concentrated under one division and another in which they are divided

between several divisions. The extreme form of industrial complexity would in this context be a municipality with several relatively important industries representing both the chemical and pulp and paper sectors. Mainly the municipalities fall in the extremes representing relatively high or low complexity on both dimensions, apart from two municipalities falling in between the extremes.

Institutionalisation of informal contact patterns can be observed in complex environments, particularly within the water permit system. This concerns both the operator and the administrative side. In one such example the operator stresses the importance of a network including the municipalities and firms around the watercourse as a whole and which has applied for a single water permit for the whole area. The participants in these interactions vary depending on the agenda. It should be stressed that these arrangements concern the water permits only, and its relevance within the new system is perceived as unclear. For instance, one example shows relatively institutionalised interactions and a network including the operator, other firms affected neighbours and authorities as well as other municipalities. The Federation of Forest Industries is also mentioned as an important source of contacts and information, as well as of consultants in extensive issues. It is, however, unclear to what extent the permit-granting authorities are represented in the operator's network, and it is an interesting fact that the network is not mentioned by the local authorities. Nor is the importance of the pre-decision phase stressed as such; rather the process as a whole; "getting through the process so that some kind of result can be reached."

The operators tend, as we have seen, to regard the activities within the various phases of the process as highly integrated. The views of the administrators are slightly more formalistic, although the importance of the continuous interactions in general is acknowledged. The perceived obligations relate to the decision phase. Especially the local environment authorities acknowledge the possibility of influencing the permit decisions even when they are not permit granters. Particularly the examples of more complex administrative structures show that the local authorities try to promote the resources for such interactions through more or less informal groups such as "permit boards" and "planning groups", involving the leading administrators within the environmental

division. Thus high administrative complexity tends to intensify the interactions of the administration internally as well as externally. Within the limited organisation such interactions are partly compensated by contacts with other municipalities in the decision phase.

Especially the features of the complex networks turn us to the question of a bipartite network and the balance between the industrial and administrative poles. To some extent they appear to balance each other and also develop more or less institutionalised interactions. But if we imagine a very limited administrative system confronting a well integrated industrial network, it could mean that the possibilities of the administration to control or question the activities and information of the firms could be rather limited. Such a situation would indicate an imbalance within the network, which however does not necessarily result in an imbalance in terms of quality of decisions. The dominant feature of the Finnish system – continuous negotiations – might at least to some extent compensate for such imbalances.

8.2.5 Differences in perceptions between administrative levels

The above analysis has been strongly focused on regional and local level interactions. Concerning the importance of local networks there might be different conceptions on a central level when compared to regional and local levels. To some extent that is also the case. Below, the most important central level characteristics are summarised according to the aspects used in the analysis of the decision phases. Regarding *actors and interactions* related to the decision-making processes, the conceptions at central state level (Ministry of the Environment, Finnish Environment Institute) confirm the local level picture. The interactions between permit-granting authorities, operators and control authorities are stressed. Moreover the superior knowledge of the industries, particularly at group level, with respect to technological solutions is acknowledged. These characteristics primarily concern the air and water permit systems. Again the chemical permit system seems to be a somewhat divergent sector. Apart from regional co-operation, the central supervisory authority (Safety Technology Authority, TUKES) also stresses the municipal contacts

in terms of advisory and consultative activities. Contrary to the picture delivered at local level, informal coordination mechanisms are also of importance within this system. Such activities are maintained through a chemical commission including the authorities, as well as representatives of industry and trade. There are indications that the interactions as a whole have moved in a more extensive direction within a previously relatively restricted and specialised system, with the Safety Technology Authority and the Ministry of the Environment as crucial actors at the central level.

In terms of *mechanisms*, several actors argue that the systems have developed in a more interactive direction, particularly the water permit system, which relies heavily on the ambition to include all those concerned in the process by way of the notification procedures. A similar development can be seen within the chemical permit system. Due to a change in legislation in 1992, new industrial sectors, particularly the pulp industry, were included in the chemical permit system as users of chemicals harmful to health. This change widened the networks of the safety authorities (now TUKES) in terms of industrial contacts. The amendments of 1998, strengthening the links between chemical permits and land use planning regulations, are also perceived to reinforce the role of local planning authorities, at least in the future.

Although the interactions have developed in a more vertical direction, particularly within the water and chemical permit systems, the central level authorities rely on their own *information* sources rather than on interactions with authorities at other levels. This fact is also confirmed by the survey data referred to below. The most crucial *perceived problems* relate to the *control procedures* indicating great regional as well as local variations and overlapping procedures. The problem is especially related to the water permit system. This is a somewhat problematic feature, as the municipalities frequently refer to resource problems and rely on the reporting obligations of the industries, which means that the risk of divergent procedures increases.

In terms of changes over time, the main alterations have occurred within the chemical permit system in the 1990s, and are related to the legislative changes referred to above, but also to the strengthening of the perceived consultative role of TUKES vis-a-vis regional and local authorities. The water permit system has also become

more inclusive over time, partly because of the adopted practice to engage all potentially concerned parties in the processes.

A crucial difference between the instruments is that the informal network within the chemical system is vertically organised to a much larger extent than those related to the other instruments, thereby diminishing the importance of horizontal interactions at local level. Due to the changes referred to above, it seems obvious that the importance of horizontal interactions will increase in the future. Hitherto the informal horizontal networks have, with the exception of the chemical system, been of crucial importance in implementing the instruments. This has led to regional and local variations in procedures and resources particularly concerning the control procedures. Such differences are materialised above all within the water permit system. The differences could, at least in theory, be balanced through intensive exchange of information between the various administrative levels. In that sense it is something of a problem that the information exchange appears to be relatively concentrated to contacts within and not between the administrative levels. Such general differences are presumably reflected in the attitudes of the administrators concerning major cooperation activities and information sources. This question relates to the general information networks discussed in Section 8.5.

8.3 Electricity taxation

No immediate effects of taxation on interactions and networks can be observed on the basis of the interviews, apart perhaps from an increased awareness concerning energy use within the industries. This is natural, as the taxation is only seen as an additional cost on the inputs and there are no parts of the taxation that are negotiable. Networks do, however, arise in the context of voluntary energy saving agreements and surveys, which can partly be seen as a result of the societal interest in the use of energy.

8.4 Environmental management systems

It seems clear that the voluntary instruments have had the most immediate effects on the networks

of the operators, particularly on the relationships with the main suppliers and customers. As a representative for one large paper industry said: *"we presuppose that a supplier of chemicals has an environmental management system. If they don't have one, then we have a plan and a schedule when we go auditing that they meet, for instance, the essential ISO 14001 environment criteria."* And as for the customers: *"many of our customers have been developing these systems and I think that from their point of view they have increased the reliability"*. Beside the relations to suppliers and customers, the voluntary systems have – from the operator's point of view, affected the interactions with other reference groups and the administration in two respects. One relates to the registration procedures of the systems and the other has to do with the fact that the management systems are used as a "frame" or "check list" for dealing with environmental issues with the authorities. Thereby the general assumption appears to be that the management systems also serve as a guarantee of quality vis-a-vis the authorities and the public. *"...if we think about the public in the neighbourhood /.../ the fact that everything is registered, also the contacts, if problems occur, then it means that someone here deals with them and they are treated in the inspections by the management..."* These appear to be the most common conceptions of the operators. It should however be noted that alternative views have also been expressed *"... I can't see that they have had any effects on the pulp industry because they are not developed for us. They totally lack the idea of a process industry..."*

At the administrative level the immediate network effects of the voluntary systems are perceived as relatively limited. As one representative of the regional authorities said *"...the patterns of co-operation have been formed before these EMAS and others, they just confirm the prevailing procedures."* Primarily the systems are perceived to improve the acknowledgement of environmental issues among the personnel and the implementation of environmental standards within the industry.

At local level the view is slightly different. The voluntary instruments are regarded as useful tools especially for supervision. *"... personally I believe strongly in these environmental quality systems, especially regarding the process, if we need to know something we just look in the table of con-*

tents...". Or as another local administrator put it: *"... they make our work easier, but I don't think that they have affected our cooperation..."*. By and large the effects of the voluntary systems regarding interactions can be described as indirect rather than direct.

8.5 General information networks

In addition to the interactions directly related to the permit processes, the analysis so far gives cause for underlining the importance of the general information networks of the various actors. These are not necessarily directly related to the permit processes but their potential influence on the decisions may of course be considerable. Sometimes they materialise in more or less institutionalised and rather inclusive contact patterns. Particularly this has been the case within the water permit system. Concerning chemical permits such interactions are more vertically organised, whereas the feature is less tangible in the air permit system. Despite such integrative features, which are largely dependent on local industrial and administrative conditions, there are on the basis of the interviews some indications that the general exchange of information is most intensive in rather than between the administrative levels, and – concerning the operators – within the operative field. The questionnaire that was sent in 1997 to civil servants within the environmental administration and Water Courts in Finland delivers a similar impression. It clearly stresses the importance of the internal contacts within the various administrative bodies.

The main interactions of the operators are not in general directed towards the administration and they do not get their information from the administrative actors. Their main interactions are within their operative field and are of an external as well as internal nature. The competitors are one important source; *"...we observe our competitors all the time, what kind of solutions others adopt, monitoring and benchmarking of our emissions, to see how we are situated compared to others./.../ And in Finland the exchange of information has been quite open..."* Consultants and own initiatives are also important sources. As one operator said; *"The consulting firms have a considerable role today. And then we have our own planning division, which observes the development of*

technical devices and participates in it. But today we buy a considerable part from the consulting firms, from outside."

Other sources are research centres (especially TEKES and VTT) and their own firms. *"... research is done mainly at group level and within research centres, I would expect. And then the suppliers of technical devices on their part. But we don't develop technical devices, we apply available devices and undertake applied research."* Professionalisation can also be observed within the industries in that environmental specialists are considered to be important actors, especially at the group level. The administrators are not mentioned in this context. They are regarded as important specifically in relation to the permit procedures.

The differences in contact patterns between the administrations was quite congruent with the level of decentralisation of the specific administrations. For the Environmental Administration as a whole, the most important contacts were perceived to be the Regional Environment Centres, the ministries, the public and the municipal administrations. However, there were major differences between the different environmental administrations. For example, the civil servants of the Ministry of the Environment most often mentioned other ministries, Regional Environment Centres and directorates and boards on a national level as important contacts, whereas employees of the Finnish Environment Institute, in addition to Ministries and Regional Environment Centres, more often perceived universities and research institutes to be important. Civil servants at the Regional Environment Centres were more interested in contacts with the public, municipal administrations and in contacts within their own structure, as well as other Regional Environment Centres, whereas administrators at Water Courts perceived regional agricultural authorities to be important, in addition to the Regional Environment Centres and the public.

Looking exclusively at the permit-authorising civil servants, both employees at the Water Courts

and the Regional Environment Centres perceived internal contacts, or contacts with civil servants at other Regional Environment Centres, to be the most important contacts, followed at the Regional Environment Centres by municipal civil servants. At the Regional Environment Centres the municipalities were particularly important for the permit-authorising civil servants at the centres. Permit-authorising civil servants at the Water Courts perceived regional agricultural authorities – nowadays the department of Agriculture at the Employment and Economic Development Centres – to be the second most important contact. Furthermore, more than 50 per cent of the permit-authorising civil servants mentioned the public as important contacts, whereas the permit-authorising civil servants at the Regional Environment Centres also seemed to find Ministries and consulting firms to be important. Overall, the survey indicated that permit-authorising civil servants at the Regional Environment Centres perceived external contacts to be more important than their counterparts in the Water Courts. This is also confirmed by the interviews.

According to the results of the questionnaire to civil servants, personal experience, professional literature and professional colleagues were perceived to be the *main sources of information*. In the Regional Environment Centres 66 per cent, and 82 per cent of their permit-authorising civil servants, mentioned courses to be an additional source of knowledge. At the Water Courts 92 per cent perceived their own training to be a source of information, although courses were, to a lesser extent, also mentioned.

Permit-authorising civil servants at the Regional Environment Centres viewed contacts with clients as an important source of knowledge, whereas they did not see actors that are not a part of the environmental administration, such as the public, the media, environmental organisations and industrial branch organisations as sources of information. Interestingly, these groups were more often perceived as sources of information by civil servants at the Ministry of the Environment.

9 Innovations, and adaptations and policy instruments

9.1 Innovations considered to be important

The interviewees mentioned many innovations and their diffusion that have had major environmental impacts during the past three decades. Some have been primarily environmental innovations, whereas others have primarily been production innovations with important environmental impacts. A detailed listing of all the innovative changes is outside the scope of this report, but the general direction of the innovations is clear. The development has generally increased resource efficiency and reduced emissions, especially in the development of specific processes.

The diffusion of the sulphate process and the gradual abandoning of the sulphite process had major effects on the BOD discharges. In pulp and paper mills, improved recycling of water, recovery and recycling of solids, improved combustion and dry barking have also contributed to improved environmental performance, but they have also, and in many cases primarily, been innovations driven by gains in resource efficiency. In the chemical industry, reduced use of solvents and more efficient use of water are related to comparable innovations. The abandoning of mercury cells in the production of bleaching chemicals has also been an important step.

Chlorine-free bleaching of pulp, storage tanks for accidental discharges, improved safety devices, replacement or containment of volatile compounds, collection of toxic waste, activated sludge waste water treatment or pretreatment of waste water before sending it to municipal plants, and electrostatic precipitators and scrubbers have been the result of environmental demands and have in most cases increased the production costs.

Most interviewees only mentioned the recycling of water and the decreased water consumption in the context of reduced water discharges, whereas some also connected it to the dry solid matters of the sludge. Drier sludge was argued to have improved the energy efficiency and decreased sulphur dioxide emissions.

In addition to specific technologies, many interviewees made general references to improved processes and recycling. These represent incre-

mental improvements rather than radical innovations but may nevertheless improve environmental performance. In fact, many interviewees stated that the most important changes have been in the values and approaches of the companies. The values and approaches are then reflected in their managerial processes.

9.2 The effects of regulatory instruments on innovations and their diffusion

There are three main ways in which the water and air permits could affect innovations and their diffusion. First, emission limits or other strict demands on the operations could force technologies to emerge or spread. Second, operators could be required to carry out R&D work to achieve improved environmental performance. Third, the permitting process could reshape networks, thereby exposing operators to new information. The network effects were dealt with in Section 8.5. To be exact, the regulatory approach under the Air Pollution Act gradually developed from a notification system to a permit system between 1992 and 1995 as explained in section 5.3.2.1. What here has been said about permits applies in principle to the notification system as well.

Regulation of emissions through emission limit values has been the core of the permits. In the case of pulp and paper production the inputs have not been regulated at all in the water permits. Processes are in practice regulated with a gentle hand, e.g. through demands on risk management, and thus effects on technology are of minor importance. The air permits contain input as well as process requirements in addition to the output limits (Section 5.3.2.2). In addition, permits often contain R&D-obligations, which directly require operators to carry out R&D-projects. These are considered, due to their explicit link to new technology, although their role was not emphasised in the interviews.

Regulatory instruments may affect innovations and diffusion by changing the participants in the networks as well as the interaction patterns (intensity, frequency, form etc.) and thus making new information available to the polluting company. This could affect access to information on technological solutions and environmental consequences of the production. The networks can also

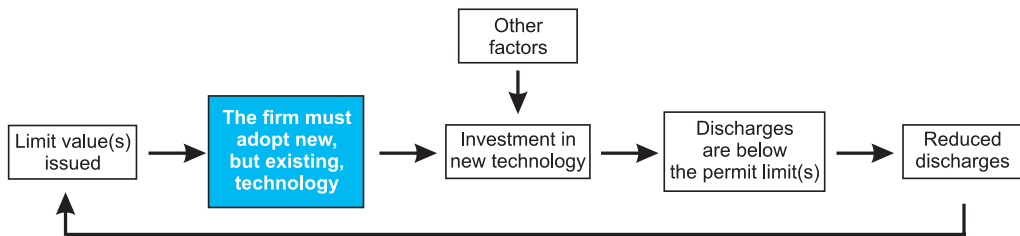


Fig. 16. A model of the logic of the effects of permit limit values on the diffusion of innovations (Mickwitz 2000b)

distribute information on the views of the administration, e.g. concerning technical solutions or the importance they give to different environmental effects. Our results indicate that the role of the administration in the networks is primarily to provide environmental information. The information on technical solutions is distributed effectively through the industry by industry networks and is based on a general openness (see Section 8).

9.2.1 Emission limit values and comparable strict demands

In principle, quantitative emission limits or comparable demands may be designed so that they force firms to innovate, encourage or enforce the diffusion of innovations, or allow firms to continue with business as usual. As noted in Section 3.3, the distinction between innovation and diffusion is not always sharp. Once emission limit values have been set up, the industry is free to choose the means to comply with the values.

Limit values in Finland have not been aimed at forcing operators to innovate in order to achieve the emission limits, but rather to assist the diffusion of innovations. In specifying limit values the administration considers the links leading to reduced emissions (Fig. 16). As emphasised earlier, investments may take place before limit values are issued and still be caused by the limit values, due to anticipation. There is thus no temporal dimension in Fig. 16, only a description of influence. The limit values and other features of the permits have thus been designed on the basis of technological solutions considered available to the operators (see also Box 2). The firm's strategy depends strongly on the other factors (Sections 3.4.2 and 9.2.2) which influence the choice of solution and investment.

Emission limit values or safety regulations that an operator can achieve with available technology do not as such create additional economic incentives for the operators to innovate (Derzko 1996). However, an individual emission limit value is not set up in a vacuum. Even though an individual limit value may appear not to provide incentives for innovation, the existence of the regulatory system creates markets for innovations that help industries meet permit limits and other environmental requirements at the lowest possible cost (Section 7.2.4).

The industry is aware of the fact that emission limit values are tightening with each permit and they are set up partly on the basis of the so-called general "policy line" (see Section 5.3.1 and Mickwitz 2000a). This gives a further implicit incentive to innovate technological solutions which fulfil anticipated future emission limits. This anticipatory effect may be important in a system with a high degree of transparency. However, the incentive to invest significantly in research and development that would change the production processes purely from an environmental point of view is weak, because environmental authorities judge each production process primarily on its own merits (Section 9.2.2 below).

The anticipated effects of a limit value in a permit on the diffusion of technology (Fig. 16) is based on the assumption that the administration knows the technological possibilities available at reasonable cost and that the permit decision is made or known before the crucial investment decisions have been made by the operator. Although the technological solutions are proposed by the industry in its application for a permit, it is the task of administration to assess the acceptability of the proposal. The asymmetry of information on the technological possibilities between the administration and industry is generally acknowl-

edged by the administration. As one interviewee put it: *"As a whole the administration does not know the technological solutions as well as the industry, because who else could know how to manage the mill as well as the operator. The operator always has the best know-how."* (Similä 2000)

Due to the reactive nature of the permitting process the administration is bound to the time schedule of the industry. According to a decision by the Supreme Administrative Court (Box 2) the emission limit values must be designed on the basis of existing process technology, even when the administration could foresee developments of process technology. Although it is possible, in principle, to set emission limit values which force the operator to adopt new end-of-pipe solutions, the process technological solutions are usually already in place and they may have a much great-

er effect on the final outcome (see Box 3).

Both the Water Court material and the interviews showed the impact on the diffusion of end-of-pipe technology. With the respect to 6 mills, Similä (2002) evaluated the coercive impact using two criteria:

- (1) Did the final limit values and other conditions of a permit become more stringent than originally proposed by the operator in the application or agreed during the administrative process; and
- (2) Did the more stringent conditions force the operator to adopt a new technological solution.

The coercive impact was observed in approximately half of the cases studied. The coercive impact is stronger for end-of-pipe technology than for process technology, although the distinction

Box 2. An example illustrating the reactive nature of permitting.

(Similä 2000)

The case concerns the establishment of a new production line in a sulphate mill. The plan of the operator included, among other things, the establishment of a new sulphate pulp line (the so called 2nd sulphate pulp line). During the administrative process, which lasted several years, the environmental authorities pointed out that the technology may improve significantly in the coming years.

The Water Court gave its decision in 1994 and in that decision concluded that, due to a variety of technical and other reasons, the 2nd sulphate pulp line would not start operating before the year 2000. The Water Court refused to issue a permit for the 2nd sulphate pulp line on the grounds that the technology of sulphate pulp production and wastewater treatment may develop significantly in the coming years. The Court explicitly referred to a closed waste water treatment process. The Court argued that if a permit had been issued, the conditions of the permit would possibly already be out of date before the 2nd sulphate pulp line was taken into operation.

The operator appealed to the Water Court of Appeal, which did not change the part of the decision dealing with technological change. Thereafter, the operator made a petition for leave of appeal to the Supreme Administrative Court, which was granted. In its decision (KHO 2.10.1996 t. 3085) the Supreme Administrative Court set aside the decision of the Water Court of Appeal and returned the matter to the Water Court. The Supreme Administrative Court considered that it is not justifiable to refuse to issue a permit on the grounds that the technology may improve in the future. **This exemplifies the reactive nature of the permitting, the permitting process only reacts on the development that has already taken place, it neither predicts nor tries to force technological development.** In addition, the Court pointed out that in a permit the operator may be imposed to make a revision application after a short period of time.

Despite the problems related to permitting, e.g. asymmetric information and its reactive nature, the previous sections (Sections 6 and 7) show that there has been significant reduction of discharges despite the increase in production during the past 30 years. The statistical data and the interviews show that the permits have clearly been one, but only one factor affecting this development. It is also possible to find examples of diffusion of technology at a concrete level, i.e. at the level of an individual permit, both on the basis of court material and interview material.

is not always very clear. Four of the five mills for which Similä (2002) could make a judgement permit by permit were once forced to adopt a new major end-of-pipe solution. Three times a new purification plant was established and once the

operator solved the problem by leading its wastewater to a municipal wastewater treatment plant. The impact of permitting on the sixth mill, where no major coercive impact on end-of-pipe technology was found, is discussed in Box 3.

Box 3. A mill for which no coercive major impact on the end-of-pipe technology was found. (Similä 2000)

The case is an industrial integrate including several mills (e.g. a sulphate mill, a paper mill, a cardboard mill). Two mills (a sulphite and a sulphate mill), which were in operation before the new permit was granted, were closed and replaced by a sulphate mill with greater capacity than that of the old mills together. In addition, the production capacity of other mills, e.g. of a paper mill, was increased. Thus in this case a major technological reform was carried out. The permitting procedure lasted several years from the end of 1977 until 1985.

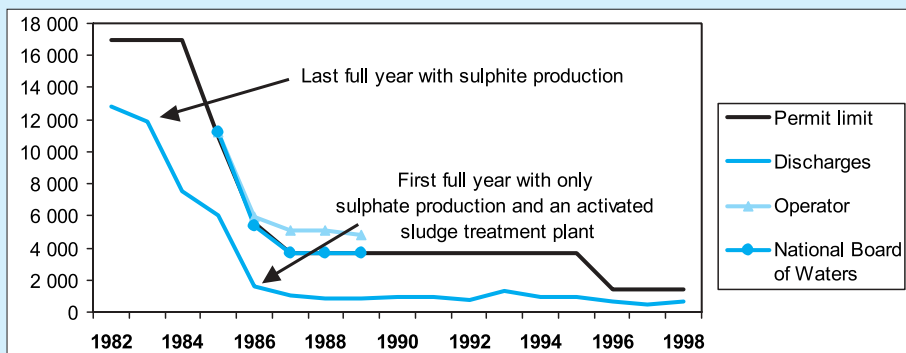


Fig. 17. Proposals and decided BOD₇ limit values as well as discharges of a case concerning major technological reform. "Permit limit" refers to the limit value in force, "operator" to the operator's response to the draft permit prepared by the ad hoc Inspection Board and "National Board of Waters" to the response of the supervisory authority to the draft permit.

As a result of the major technological changes the BOD load, which at that time was considered the critical parameter, was reduced remarkably as can be seen from Fig. 17. As a reaction to the draft permit prepared by the ad hoc Inspection Board, the operator accepted radical tightening of the BOD limit; according to the operator the BOD₇ limit should have been decided so that it would have gradually tightened to 12 t/d instead of BOD₅ 40 t/d in the preceding permit. The radical tightening was partly possible due to improvements in environmental technology. However, another factor, the change of the general production method from sulphite to sulphate pulping was *also* crucial. The sulphate pulping process resulted in a remarkable reduction of the BOD load.

According to one interviewee, who is an employee of the company concerned, permitting had an impact on the environmental technology adopted by the operator. The interviewee mentioned that the limit value on oxygen consumption forced the operator to adopt an activated sludge plant technology. It is also worth noticing that – according to the interviewee – the purification plant was the first activated sludge plant in a pulp mill in Finland. The impact on the diffusion of technology can be confirmed on the basis of documents. According to the Water Court material the supervisory authorities required emission limit values based on an activated sludge plant instead of an aerial lagoon as originally planned by the operator. However, in its response to the draft permit prepared by the ad hoc Inspection Board, the operator communicated its willingness to adopt an activated sludge plant as well as to improve the process technology by extended pulping and more efficient washing. These changes in technology were the basis for the emission limit value which the operator considered reasonable (BOD₇ 12 t/d). Thus diffusion of the technology was based on anticipation.

The diffusion of activated sludge treatment plants is seen by most of the interviewees from the industry as a result of permit limits that were based on an implicit standard technology. An example of such a statement is: "...the permit limit was determined so that it was at the level which is reached by an activated sludge treatment plant, since it is currently considered that everyone should have one of that kind...". Some, however, viewed the role of the permits as less direct for their decision to build an activated sludge treatment plant at a particular point in time, and stressed the role of customer demands. (Mickwitz 2000b, Similä 2002)

Although we have found cases in which permit limits have reduced discharges through the diffusion of new waste water treatment plants, the situation has not been the same for all mills. Cases have been found in which the permit limits have had no effect on the reduction of the discharges. Combining the finding that 8 mills have only had one or two different BOD limits (one mill got its first limit value in 1995) with the fact that many mills have been far below the limit levels years before the limits have come into force and with the modelling results and the analyses of the interviews justifies this claim. (Mickwitz 2000a, Section 7)

Compared with the water permits the air permits contain more input and technology requirements (Section 5.3.2.2.). The technology requirements generally specified the type of filter to be used for emission control or the height of the chimney. The input conditions determined some characteristic of the fuel that could be used, e.g. an upper limit on the sulphur content of heavy fuel oil. Air permits could thus have affected diffusion and innovations through output limit values or input conditions requiring the adoption of new technology, or directly by the technology requirements. A requirement to use a particular technology may in theory also slow down the diffusion of more efficient technologies.

All interviewees representing the industry saw the investment in electric filters as clearly induced by the air regulations. The investments were generally said to be caused by the emission limits, mainly on sulphur and nitrogen oxides. That investments in new filters which had been required for old combustion boilers was sometimes questioned. "...it is sometimes a little questionable for some old boiler, when the permit requirements

state that from a particular day an emission must be no more than a particular limit, and if the boiler has only some years left and it requires some ten millions in investments, then it might be a situation in which the required investment is not necessarily very wise."

No interviewee mentioned any investments that had been made because of the input conditions or technological requirement, which does not mean that such investments have not been made. One interviewee mentioned that a mill had changed over to natural gas because of the input limit values in its permit.

One central question is how often the Finnish permitting systems have just confirmed the practices already adopted by the industries and thus allowed them to continue as before without adopting innovations they would otherwise not have adopted. One indicator of this is the frequency of permit decisions, in which the future permit limits have been higher than the emissions at the time of decision-making. Mickwitz (2000b) shows that, for example, in the case of BOD the average pollution at the time of the decision was less than the future permit limit in 109 out of 162 cases. However, the interpretation is not straightforward, since even if the discharges have on average been below a limit the firm may have to take some action in order to ensure that the highest discharges remain below the limit. This is important, since most permit limits have been defined for average monthly or quarterly discharges (Section 4.4.1). Another difficult issue is anticipation; in many cases the discharges have been below the future permit levels because investments have already been made to achieve the limit at the time of formal decision-making. Anticipated increases in production may also in some cases lead authorities to set future emission limits higher than current emissions.

In this context it is worth noting that the intervention theory of the Air Pollution Control Act has gradually developed from a notification system to a permit system between 1992 and 1995 as explained in section 5.3.2.1. The basic difference between a notification system and a real permit system is that under a notification regime the regulated activity may have been in operation while the environmental requirements were set up by the authorities but a permit is granted before a mill, or in the case of an existing mill, a new investment, is taken into operation. It is far more

difficult for a decision-maker under a notification regime to influence the process technology. The decision-maker must always take into consideration the costs of environmental investments and the cost varies depending on the moment of decision. It is usually cheaper to make adjustments before construction than during operation of an activity. Because operators know this they may be reluctant to anticipate the requirements of authorities. Thus a notification system has weaker influence on the process technology than a permit mechanism. This observation is crucial with respect to the Air Pollution Control Act, because the change from a notification system to a permit system has not yet had full impact on the administrative practice. Those mills which have made a notification before 1992 were not obliged to acquire a permit unless they do not make an investment which requires a permit. Thus, in practice there are many mills which were not regulated by an air pollution control permit at any moment during the existence of the Act.

9.2.2 Market forces, regulation and innovations

The adoption of new bleaching processes for pulp in order to reduce the discharges of chlorine compounds is used by all representatives from the mills as an example in which the diffusion of new processes has been driven mainly by the demand and in which the actual use of limit values in the permit system has had no, or a very minor, role. *"When the customer wants chlorine-free pulp, the customer gets chlorine-free pulp"* was a phrase used by one mill representative. Another one expressed the same idea *"The chlorine question is, in my opinion, a schoolbook example of what it means when we say that markets affect the development."* (Mickwitz 2000a) This is in sharp contrast with the view expressed by some, but not all, working for the environmental administration, who have stressed the role of the decision taken by the Ministry of the Environment in June 1989 in inducing the adoption of new bleaching processes. This shows the difficulty of attributing causes and effects. It is clear that chlorine became a societal problem that was addressed in different ways. Authorities played a role in the societal discussions, but our results show that the regulatory system reacted slowly and its direct contribution

to the solution of the problem through specified permit conditions was small at best. The existence of the regulatory system may, however, have contributed, because it could at some point have been used to force the industry to abandon chlorine bleaching. This effect on the anticipation of the industry may have been a contributing factor to the rapid abandoning of chlorine bleaching.

Although there is a general consensus concerning the role of market demand for the reduced use of chlorine, some variations were observed in how the role of the permit system was described. One interviewee stated that they got a permit limit only recently, even though they had been working on reducing discharges for years. At another mill the interviewee said that *"although the water permit now contains organic chlorine compounds, it came so late as a permit limit that we had already for other reasons abandoned the use of chlorine"*. A third interviewee, although first stating that the permit limit did not directly affect their investments since their AOX limit was "loose enough", pointed out that the possibility of a stricter limit in the future was a factor restricting the options. (Mickwitz 2000a)

The representatives of the industry cited examples of inventions of process technology, although none of them indicated that operators have adopted a process technological solution only in order to fulfill the requirements of a permit. This is an indication that coercive impact is not strong with respect to the process technological solutions. According to the interviewees a decision to adopt a new process technological solution is typically motivated by several reasons. An emission limit value is only one of these. However, there is an economic link between end-of-pipe technology and process technology. Interviewees pointed out that e.g. improved water recycling has made activated sludge plants cheaper to establish. Thus, an operator is motivated to improve process technology in order to avoid increase in the cost of end-of-pipe technology.

The amount of discharges does not depend only on the environmental technology, but also on the general technological structure of the industry. The general technological structure in this context means e.g. different kinds of methods to produce pulp. Similä (2000) was not able to find any support for a hypothesis that the general technological structure had been affected by permitting. Instead, counter arguments were found. No exam-

ple of an impact on the general structure of the technology was given in interviews, although an example of closing of a mill mainly on environmental grounds was mentioned. However, the decision to close the mill was not made by the administration or during the permitting process, but by the company itself.

Basically the design of quantitative limit values is based on an assessment of each type of technology on its own merits. The question of the authorities is thus: When this kind of general technology is used, what kind of environmental measures should be considered reasonable?

The Water Courts have only once refused to issue a permit for a mill in the field of pulp and paper industry, although in other fields of regulated activities a refusal has been "more than a statistical exception" as one of the interviewees put it. The permit application was refused because the operator wanted a future option to expand production using what was then current technology. The Water Court decided that such permits could not be granted, because it could mean excessive pollution in the future in relation to what the Court considered likely to be achieved with process improvement. This indicates that permit authorities do not wish to tie their hands, but wish to have a theoretical possibility to affect the choice of technology.

The relationship between regulations, innovations and competitive advantage of firms is complex. It is a common misunderstanding that firms always oppose regulations. This is clearly not the case. Some firms can gain competitive advantages when regulations are introduced and these firms are likely support or even sometimes actively demand new regulations. It is obvious that producers of a certain environmental technology, e.g. a filter, will experience increased demand if the technology they sell becomes a mandatory standard or if limits are tightened on such emissions that can be reduced by the technology in question. In addition firms that already have invested in environmental solutions and whose production has less emissions than those of competitors could benefit from regulations. This is one key aspect of the Porter hypothesis (Porter and Linde 1995b). These indirect competitive benefits are, however, limited if the regulation is national but the market is global. This is largely the case for the pulp and paper industry but also for many firms in the chemical sector. The structure and func-

tioning of the regulatory system also affects the degree to which it may contribute to a competitive advantage of some firms. Thus a system such as the Finnish Water permit regulation which lacks uniform standards has limited effects on competition. Standardised limits on pollution such as the air norms are likely to have stronger effect, for example standard emission limits that affect the choice and cost of fuel may provide firms which have already adopted low emission fuels and related technologies a certain advantage.

In addition to the incentives possibly provided by the environmental policy instruments for the regulated operators to innovate, it is clear that the existence of an environmental policy and tightening demands over time will affect the market for environmental technology. It is thus possible that permitting systems and electricity taxation have been factors behind an increased demand for more efficient and cheaper environmental technology. The existence of these policy instruments as well as the tightening policy might even be crucial for new innovations, although equipment providers only recognise the demand from the companies using the environmental technology, and regulated operators primarily see the innovations provided by the suppliers. The present study provides several indications that such indirect links exist between policy instruments and innovations. A more detailed analysis of these links would have required an in-depth examination of the whole innovation system, which was outside the scope of this study.

9.2.3 Research and development obligations

As it is possible to regulate directly substantial environmental requirements, it is also possible to regulate directly the research and development activities of an operator. A permit authority may require that certain kinds of research and development activities must be carried out and the authority may take into account the outcome of the activities when issuing the next permit.

In order for the R&D requirements to have effects on innovations or the adoption of innovations by the operators they must increase or redirect the R&D efforts by the regulated firm. New R&D is a necessary but not a sufficient condition for the R&D requirements to have an effect. If

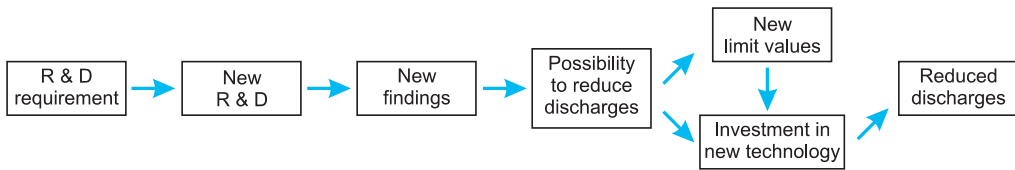


Fig. 18. Anticipated effects of the R&D requirements contained in the water permits (Mickwitz 2000b).

R&D efforts are redistributed according to the requirement this could have positive or negative effects on the environment. Adverse effects arise if the required R&D tasks have no or only small environmental effects, while diverting resources from real environmental improvements. To be effective the R&D requirements must lead to new findings which make new environmental improvements possible. The findings must further lead to investments either directly or due to more stringent limit values based on the findings. Only then will the diffusion or innovation initiated by a R&D requirement have an effect on the discharges (Fig. 18).

Even where R&D requirements have not had the anticipated effects, it is possible that they have contributed in some rather loose way to technological development. Some of interviewees pointed out that R&D-obligations have improved the common know-how of the administration and the industry. Because interviewees were not able to give concrete examples of the relevance of improved know-how, it is still an open question whether there has been such an impact.

Similä (2000, p. 17) gives an example in which a water permit limit for phosphorus issued in 1994 had been preceded, a decade earlier, by a R&D

requirement to reduce the phosphorus discharges below such a limit. However, in this case it is evident that the R&D requirement did not cause the adoption of the new solution. Although the phosphorus discharges were reduced as a consequence of the new technology, which was adopted after the permit limit had been issued, it cannot have been due to the particular R&D effort undertaken. This is shown by the fact that the results of the R&D indicated – wrongly as we know with hindsight – that it was not possible to reduce the phosphorus discharge to the proposed level.

R&D requirements have been included in some water permits since the beginning of the 1970s. There has been an increase in the R&D requirements without quantitative goals in the 1990s (Table 15). There has been no clear tendency for the R&D requirements with quantitative goals. There were, for example, six years in the 1970s during which no R&D requirements with quantitative goals were included in the permit decisions, while there were four such years in the 1980s and five between 1990 and 1998.

Seven out of thirty-one examined air permits for paper or pulp mills included R&D requirements (Table 16). An example of a R&D requirement in an air permit without a quantitative goal

Table 15. R&D requirements in the water permits of the pulp and paper mills (Mickwitz 2000b).

	1970s	1980s	1990–1998
Number of permits (N)	73	58	71
Share with R&D requirement without a quantitative goal	13.7 %	34.5 %	43.5 %
Share with R&D requirement with a quantitative goal	9.6 %	19.0 %	14.1 %
Share with R&D requirement for phosphorous without a quantitative goal	2.7 %	8.6 %	13.0 %
Share with R&D requirement for phosphorous with a quantitative goal	2.7 %	12.1 %	14.1 %

Table 16. R&D requirements in the air permits included in the VAHTI-database for pulp and paper mills.

	1991–2000
Number of permits (N)	31
Share with R&D requirement without a quantitative goal	12.9 %
Share with R&D requirement with a quantitative goal	16.1 %

is: *“The applicants should determine the methods, costs and timetable by which it is possible to further reduce the untreated odorous gases from the pulp mill.”* (Lapland Regional Environment Centre, Permit 15.06.1999) An example of a R&D requirement with a quantitative goal from the same air permit is: *“The applicants should determine the methods, costs and timetable by which the emissions of particulate matter from the k-10 boiler can be reduced to the level 50 mg/m³ (n).”*

Most of the R&D obligations in the permits examined by Similä (2000) were imprecise and unspecified. However, their quality had improved in the course of time. The most developed obligation defined the exact target to be achieved. There is no reason to over-emphasize the relevance of the research and development obligations. Well developed obligations are seldom used and they are difficult to implement. There is no mechanism which ensures that the operator invests significantly in the projects. There is no proof that research and development obligations have resulted in new innovations, even in cases where more information has been produced.

Some representatives of the administration suggested that R&D obligations are used as a signal of a new parameter or a tighter level of emission limit values in the next permit cycle. This could motivate an operator to take the obligation into account. In the case of phosphorus limits the years 1987–93 were the period when the policy changed – before this period phosphorus limits were only included in exceptional cases, afterwards almost all permits had a phosphorus limit. Mickwitz (2000a) modelled the permit decisions during this period in order to find which variables explain whether a phosphorus limit was included or not. In order to test whether R&D requirements indicate new parameters in coming permits, Mickwitz (2000b) expanded the models to include a dummy variable, with the value of one if the previous permit included a R&D re-

quirement for phosphorus and zero otherwise. Of the 56 decisions during 1987–93 there were eight that had been preceded by a R&D requirement mentioning phosphorus. The results of the Logit and Probit models clearly showed that the inclusion of a R&D requirement for phosphorus in a permit did not explain in any way the inclusion of phosphorous limits in the following permit. Of course this does not mean that there are no individual cases for which a R&D requirement has been a signal that a phosphorus limit will be included.

9.3 Electricity taxation and innovations

High and fluctuating energy prices and uncertainties with respect to future energy policies are likely to create incentives for energy efficient innovations and to motivate industries to carry out energy auditing. In this context the electricity taxation is a minor factor. It may, however, indicate that electricity or energy in general could be subject to increasing tax rates, especially in the light of demands to shift taxation from labour to other sources of fiscal income. In this indirect way the energy taxation may have contributed to the diffusion of energy audits and voluntary energy agreements.

9.4 Environmental management systems and innovations

Environmental management systems are primarily instruments for everyday improvements and management of operations. Thus they cannot be expected to produce innovations on their own. They may, however, identify promising areas of significant environmental improvements. Our interviews show that this kind of “innovation scanning” takes place. It is not a new phenomenon,

but the management systems have made it more systematic and also engaged a larger proportion of the employees. One Swedish study suggested that the management systems frequently pay attention to transports. Other important issues have been energy, waste management and the use of raw materials (Zackrisson et al. 1999).

This study has highlighted significant differences between different firms in their approach to environmental management systems (Luoma 2000). Ilomäki and Melanen (2001) and Kautto and Melanen (2000) have made similar findings.

Ambitious goals of improvement could create pressure to innovate but the interviews suggest that actors outside the firm have hitherto paid relatively little attention to the goals. Our interviewees considered it interesting but too laborious to follow up the firms' goal setting (Palosaari 2002).

Critical views on the hype surrounding environmental management systems have also been expressed. One interviewee working for a client of chemical firms suggested that too much attention is put on the systems, thus diverting resources and attention from the reduction of emissions.

PART 4
DISCUSSION AND CONCLUSIONS

10 General evaluation of the policy instruments

10.1 Regulatory instruments

There are five important elements in the intervention theory of the examined regulatory instruments. First: all are based on the assumption that it is possible to improve the environmental performance of operators by external regulation of activities. Second: specific goals can be set for improvement in environmental performance, and for air and water pollution control, also for the state of the environment. Third: regulatory instruments will have to be adapted to the particular setting of the operator and his activity. Fourth: transparency and public participation ensure that public interests are taken into account. Fifth: regular contacts between operators and authorities are necessary for the functioning of the regulation. The importance of the different elements varies somewhat from instrument to instrument. In the following we will examine the elements one by one. Finally we examine the implicit assumptions of the intervention theories concerning the socio-political environment within which the instruments are implemented.

10.1.1 Environmental improvements are partly – but only partly – due to the regulatory instruments

The claim that it is possible to achieve environmental improvements through regulations is supported by our study, but not unconditionally. Pollution from the pulp and paper industry and chemical industry has decreased significantly during the last 30 years. The development is a result of many factors. The regulatory instruments, which have had a dominant role in the environmental policy during the period examined, have clearly had an impact on the emissions, but it is not possible to attribute the whole development to the policy instruments.

The role of different factors explaining the overall development varies. This can be exemplified by water discharges. Resource efficiency is a basic interest of any operator, but its importance has increased when inputs or the treatment of externalities have become more expensive. Resource efficiency has thus been at least as important as

the policy instruments with respect to many process changes that have improved the use of raw materials and increased recycling of substances. The demands of customers, especially during the last 15 years, have become more important. One example is provided by the reduced chlorine discharges in pulp production. It is nevertheless clear that both the Water Act and the Air Pollution Control Act have had significant impact on some of the pollutants which have been selected as targets for the regulation. There are, however, also examples of difficulties in regulating new problems which have emerged and become new targets (Sections 7.2.1 and 7.2.8).

Markku Ollikainen (1995, p. 313) does not give the Finnish permitting system much credit for the reduced discharges. He writes *"the majority of the water permit limits are non-binding⁵, i.e. the true discharges are less than the limits. ...The authorities have dragged behind the development without any special honour of steering the polluters, not to speak of cost efficient control. The significant results achieved by the pulp and paper industry in water protection are due to other factors: it makes the production more efficient and it adjusts actively to the emphasizing of environmental issues on the side of demand for paper."*

Our study has shown that the observation that permit limits for most mills are, and most of the time have been, non-binding is correct if one looks at the annual values. However, most limits are set as monthly values and the monthly discharges from the mills are highly variable. The partly stochastic nature of the discharges gives the mills an incentive to reduce discharges, even when they are on average below the permit limit. Brännlund and Löfgren (1996, p. 230) also found that in the case of stochastic pollution the risk of exceeding the limit is reduced if the pollution is reduced further than the limit, and therefore permits may have

⁵ Non-binding is here used in the mathematical sense, i.e. as the concept is used in optimisation theory. A constraint is a condition that narrows the range of the objective function. A non-binding constraint is a constraint that in fact does not affect the maximum of the objective function because of other constraints or the shape of the objective function. The exact mathematical definition is: in a problem $\max f(x)$; s.t. $g_i(x) \leq 0$, for $i = 1, \dots, k$. "If, at a particular x^* , a constraint $g_j = 0$, then the j^{th} constraint is said to be binding" (Varian 1984, p. 319). Otherwise it is called non-binding. In this sense a permit limit can well be non-binding even if it is legally binding.

impacts even if emissions are observed to be below their limits.

Our study clearly shows that permit limits generally become tighter over time – as absolute discharges, as well as in relation to production. Thus, a mill that has reduced its discharges even more than required is prepared for the next, tighter limits and will have an easier task to increase its production, without the permit limits becoming a restriction. This *“dynamic incentive”* is, however, reduced by the observation, made by many interviewees, that discharges far below the permit limits are more likely to result in tighter permit limits in the future, than discharges close to the present permit limits. (Mickwitz 2000a, Similä 2000).

In addition and above all, the impact of permitting cannot be assessed simply by comparing permit limits and discharges. As this study shows, the permitting process may have an impact on the discharges although the permit limits are non-binding at any given moment. The mill operators themselves have often stated that in practice their permit content had forced them to adopt e.g. a new and more effective type of a purification plant, although afterwards it may not be possible to find permit limits to have been binding because the technological solutions have been adopted before the new limits entered into force.

10.1.2 Goal achievement effectiveness of regulatory instruments is high, but who sets the goals

The achievement of many environmental goals supports the assumption that environmental policy and its instruments have been effective. Effectiveness defined as goal achievement is, however, not the only possible definition; in addition effectiveness could be assessed compared to the achievements in other countries or over time. Goal achievement is a kind of *“static effectiveness”*, while it is also possible to examine a *“dynamic effectiveness”* which not only achieves goals but creates new opportunities through innovations and their diffusion. This issue will be discussed in Section 11.

Implementation problems have decreased the effectiveness of the examined policy instruments. It took a decade after the Water Act entered into force in 1962 before the permits started to con-

tain quantitative limits. The last pulp mill to receive quantitative limits became regulated as late as 1995. Although the Air Pollution Control Act entered into force two decades later than the Water Act it again took more than a decade before permits started to spread. Implementation problems also arise when the permit processes are delayed. Even in the 1990s, several water as well as air permit decisions have been based on applications made ten or even fifteen years earlier.

Despite implementation problems it is reassuring to find that the goals of environmental programmes have been approached and several have been met in due time (Section 7.2.3, Fig. 11 and Fig. 12). The observed effectiveness could be a result of the level of ambition in goal-setting. A key civil servant from the Ministry of the Environment has stated that: *“In Finland the politically decided goals for the environmental administration and environmental protection have generally been realistic or actually cautious. Accordingly, accomplishing them has seldom imposed big problems.”* (Ojala 1997, p. 75) One should therefore not conclude that in cases or countries where goals are not achieved the policy is less successful; it might instead reflect higher ambitions. It is worth noting that with respect to the newest Water Protection Programme (in force until 2005) some of interviewees – both from the industry and the administration – viewed the goals as ambitious and thus difficult to meet.

The effectiveness of the policy instruments may also be determined in relative terms. In a comparison of the permitting procedures in Canada, Finland, New Zealand, Sweden and the United States (OECD 1999b, p.18) it is concluded that: *“Despite the differences in permitting approaches, the available information on effluent quality, from kraft mills in the five countries reviewed, show similarities with respect to BOD and AOX discharges.”* The decoupling between emissions of BOD and pulp production occurred approximately five years later in Finland than in Sweden. Bressers (1988) has also shown that until the beginning of the 1970s industrial production and oxygen-consuming industrial wastewater pollution grew hand in hand in the Netherlands, but a dramatic decoupling took place in the early 1970s, i.e. at the same time as in Finland for the pulp and paper industry.

The observations of almost simultaneous decouplings of certain emissions and production

suggest two alternative but equally provocative conclusions. The first is that emission reductions occur when emissions have been recognised as a problem and a policy instrument is applied. The exact form of the instrument does not matter greatly as long as there are suitable mechanisms of implementation. The second provocative conclusion follows that of Ollikainen (1995): regulation merely registers what would have happened in any case in a market economy. Our findings of genuine effects of the regulatory instruments and small but significant lags between emission reductions that match those of the introduction of policy instruments tend to support the former conclusion.

10.1.3 Flexibility of permitting – an opportunity and a threat

Our study has confirmed the flexibility of the Finnish regulatory instruments and the fact that operators and authorities consider flexibility to be important. The instruments, particularly the Water Act, have been very flexible, with large amounts of discretion. Flexibility has meant differentiation of requirements according to local conditions and features of the industrial site concerned. The differentiated requirements have been set up on the basis of negotiation, which stresses the importance of networks. With respect to the Air Pollution Control Act, the amount of flexibility allowed by the law has been smaller in comparison to the Water Act. This largely reflects the nature of the environmental problem.

The environmental effects of the water discharges are far more local, whereas air emissions are often spread even to other countries and sometimes, e.g. in the case of CO₂ are truly global. In practice this has meant smaller variation in parameters and strictness of emission limit values between different mills and environments. The Chemicals Act was originally not particularly flexible, but the development towards regulation of safety plans rather than technical details has increased the flexibility. At the same time pan-European or global requirements concerning individual substances has reduced the possibilities for site-specific variations.

The practised flexibility has strengths as well as weaknesses. The strengths relate to potential efficiency gains in comparison to uniform requirements. With differentiated requirements, deter-

mined on the basis of informed negotiations and consultations, the abatement and damage costs may be smaller and, thus, the efficiency greater, in comparison to uniform requirements, even though administrative costs are higher. Such efficiency gains require that abatement costs or benefits from abatement vary between sites. Most of the Finnish pulp and paper mills discharge their waste water into lakes or rivers. For these it is clear that the sensitivity of the recipient water body to for example phosphorus and nitrogen as well as other discharges vary from one mill to another. For example, phosphorus contents of the watercourses immediately receiving the discharges varied from 17 to 190 µg/l during 1975–80 and from 9 to 58 µg/l during 1994–97. However, the analysis of the inclusion of phosphorus limits into the permits did show that the phosphorus content had no effect on whether a phosphorus limit was included or not.

Mills situated along the shore and discharging into the Baltic Sea, however, had a reduced probability of being allocated a phosphorus limit. This has been the result of the mill specific decision-making, that has treated mills along the shore differently during specific periods and in particular issues. An interesting comparison to Sweden can be made. In Sweden, mills located by the Baltic Sea have had different requirements based on an explicit policy decision (OECD 1999a, p. 62). The Swedish system has resulted in systematic differences in discharges between pulp mills along the shore and those situated inland, which cannot be found in Finland (OECD 1999b, p. 67).

Although economists often criticise regulatory instruments they recognise that especially when some of the effects of the pollutants depend on the locality of the polluting resource rather than only on the total amount of pollution, regulations may be the most appropriate type of instrument to use (Oates, Portney and McGartland 1989). Our recognition of efficiency gains of permits designed case-by-case is in line with the conclusion of Brännlund, Hetemäki, Kirström and Romstad (1996, p. 30) who for waste water permits used in the Nordic countries stated that *“Under these two conditions [varying marginal abatement costs and largely local impact], the reduced costs from applying incentive based regulations over firm specific command and control may be far less than those indicated in previous studies”*.

Another major strength of the flexibility in addition to efficiency gains is that it allows for

local and site-specific negotiations, which have reduced the risk of major conflicts of a politico-administrative nature at high political levels that would undermine the general premises of the permit systems. The studied regulatory instruments have largely been able to avoid the full blown political conflicts that have recently characterised for example nature conservation planning in the context of the Natura 2000 network (Hildén et al. 1998). Thus flexibility to deal with local concerns one at a time has increased the acceptability of the regulatory instruments.

The weakness of the flexibility is the risk for regulatory capture (Section 3.1.4) at the level of individual decisions. When one recognises several decision variables and the possibility of different legitimate preferences it is difficult, even theoretically, to determine when a particular interest has been prioritised over the public interest. Some clear cases can, however, be recognised. An example is the restarting of an obsolete pulp mill in the early 1970s, when short term economic interests clearly dominated over environmental concerns and made it possible to restart the mill without even a permit process. (Haila et al. 1971). The handling of mercury pollution in Finland as described by Nuorteva (1976) also shows many characteristics of regulatory capture. An important finding with respect to regulatory capture is that the power of an interest group not only depends on its stakes but also on the kind of influence it tries to obtain. Groups aiming at making regulations less efficient are generally more powerful than those aiming to make them more efficient (Laffont and Tirole 1993, p. 492).

The data on which a permit is based are always to some extent uncertain and open to various interpretations. Not only the industry but also the administration pointed out that the operators have the best information on the possibilities to reduce emissions. Thus, the authorities must to a large extent rely upon the information – particularly on technological solutions and their costs – given by the operator. The resources of the administration to acquire information are small in comparison to those of the industry. It is rational to assume that any actor, including the operator, takes into account its own interests while assembling and presenting information. The frequent contacts between the operators and the administration, shown by the network analysis, imply that life is easier for an individual regional or local

civil servant if conflicts can be avoided. Conflict avoidance may lead to regulatory capture by the more powerful actors.

Theoretical analyses have established that the power of industry to capture environmental regulations is reduced when environmental interests are organised (Laffont and Tirole 1993, p. 488ff). The pulp and paper and the chemical industry are among the industries in which the focus of environmental NGOs have been greatest. An important feature generally reducing the risk of regulatory capture is transparency (see next section).

10.1.4 Transparency strengthens the effectiveness of regulatory instruments

The regulatory instruments have been rather transparent and the public has considerable rights to take part in decision-making in water and air pollution issues. Chemical regulation is more technical and expert based. The unrestricted access to permit decisions and partly also their background material and the availability of factory-specific emissions is in Finland self-evident. It is an important explanation of why regulatory capture is difficult despite many features that seem to make regulatory capture likely. Internationally, a comparable degree of transparency is far from the rule.

There are different kinds of mechanisms aiming at strengthening transparency and participatory rights. The principle that the public has access to the information held by the authorities has a long tradition in Finland and is not restricted to environmental matters. Authorities are obliged by law to inform the public on permit applications and hearings. In the latest reform of the environmental protection legislation in 2000, non-governmental organisations were given the right to start administrative proceedings against an operator who violates the law.

The amount of influence of transparency and participatory rights on an individual decision is difficult to measure. Our results strongly suggest that the transparency and the participatory rights have been crucial for the formulation of the so called consistent "*policy line*" appreciated by the industry as well as the administration. In addition, the participatory rights have enabled those affected to defend their rights. Asymmetry of information and resources means, however, that the partici-

patory system is unlikely to completely balance problems related to regulatory capture. Our study has clearly revealed differences in resources and networks between authorities, particularly at the local level. In addition, the crucial pre-decision phase is not very transparent due to its informal nature. Involved actors may in advance discuss strategies for coping with external demands in the subsequent phases of the process, thus reducing somewhat the effects of "formal" transparency.

The findings of this study thus support that of the OECD (1999a, p. 16) which stresses the role of transparency and participation: *"an otherwise sound permitting programme will be inefficient if it has not been designed to encourage public participation and involvement. /.../ experience has shown that permittee compliance and environmental performance is substantially improved when the public is sufficiently informed about and associated with the permitting process. Permitting processes should be made as transparent as possible..."* Furthermore the role of Pollutant Release and Transfer Registers and transparent monitoring and compliance data is stressed (OECD 1999a, p. 89). It has actually been argued (e.g. Fung and O'Rourke 2000) that sometimes much of the impacts of environmental policy instruments is due to them making information public that has not been available before. This effect could even override the effects of other requirements that policy instruments impose on operators.

10.1.5 Interactions outside those formally required are important

All intervention theories of the studied instruments assume regular contacts between operators and authorities either through regular revision of permits and/or through some form of inspections or other reporting to the authorities. The official justifications and the examined laws largely lack explicit reference to the pre-decision phase, which in our study is also identified as critical with respect to conflict resolution.

Our results show strong linkages between the three phases of the decision-making processes of regulatory instruments. Especially the operators stress the importance of continuous exchange of information throughout the process, but the factors affecting the nature of the various phases are different. Incentives for continuous interactions

have been strongest within the water permit system. When such interactions are well established, in some cases even informally institutionalised as "Councils" or "Boards" in which authorities can participate to a varying degree, they may affect and influence the outputs and the outcomes of the regulatory instruments.

It is obvious that the pre-decision interactions do not reduce the decision phase to administrative ritual. Not all divergent interests are mediated through the discussions in the pre-decision phase. The decision phase does as a rule lead to requests for additional environmental measures. These demands may be raised by the same actors who participate in the pre-decision phase.

10.1.6 The implementation environment is characterised by low conflict

There are several reasons for describing the present interactions related to the permit systems as nonconflictual rather than conflictual. This can be seen by examining the different actors' views of the regulatory systems and their acceptability, the nature of conflicts that have been observed and the actors' perception of these.

There do not seem to be major divergencies in the perceptions of operators and the administrations concerning the general goals and premises of the permit systems. Conflicts have generally – when they have occurred – not been of a broad politico-administrative nature that would have questioned the foundations of the systems. They relate primarily to those immediately concerned in the target area. In this the situation has changed compared with that in the 1960s and 1970s, when environmental issues were first introduced on the political agenda. The long birth of a Ministry of the Environment is a case in point. Now even the number of conflicts is perceived to be relatively low. Especially administrators perceive that the conflict level has been decreasing rather than increasing during recent years.

The interactive features of the systems has probably reduced conflicts, although the extent of that impact is difficult to estimate. Increasing complexity could pave the way for conflictual interactions, but our interviews do not indicate that administrative or industrial complexity as such has increased the conflict levels. Interviewees do, however, perceive that the usefulness of the in-

teractions are related to the administrative clarity and the transparency of the instruments.

The examined regulatory instruments implicitly assume a socio-cultural environment which combines low levels of conflict with low ambiguity concerning e.g. decision-making structures and roles of actors. This is indicated by the completely dominant role of the administration in all the examined regulatory instruments. There is no direct political involvement as in the regulation of e.g. nuclear power, in which all key decisions are made by politically elected bodies (Council of State and Parliament, Act on Nuclear Energy 990/1987). Our evaluation suggests that the implicit assumptions concerning the implementation environment have by and large been valid during the period covered by our study, from 1962 until 2000. As indicated above, conflict levels appear to be low at present. This suggests that the main determinant of the success of the policy instruments would be related to the availability of resources (Section 3.3). We find that this has largely been the case and that several of the implementation problems can be referred back to a discrepancy between the tasks created and the availability of resources. Although the resources of the specialised environmental administration have increased in real terms (Section 5.2), there have been several cases of serious resource deficits. The Inspection procedure of the Water Act and the implementation of Air Pollution Permits show this clearly. Obvious resource problems have also been encountered at the local (municipal) level and more generally in the supervision of environmental requirements (Section 8.2.3).

Although the characterisation of the implementation environment as administrative appears to capture key features of the examined policy instruments, other kinds of environments have arisen during the history of the instruments. The regulation of mercury is an example of a high conflict case in which political power in the form of public pressure played a crucial role and forced the industry to change its practices (Nuorteva 1976). Chlorine regulation can be characterised as a case of high ambiguity and high conflict. It led to public discussions that also involved authorities, but the role of the Water Act was mainly symbolic, because market mechanisms that caused technological change solved the problem much faster than the regulatory decisions could be made (Section 7.2.1). Of the new issues the regulation of

greenhouse gases can clearly be characterised as a high ambiguity, high conflict issue in which symbolic implementation is likely and where the real implementation will depend on the strength of coalitions. Entirely new types of policy instruments may arise in the process and the role of the regulatory instruments may be greatly reduced. The same may be true for issues related to integrated product policies and regulation of new chemical substances.

10.2 Weak environmental signals from the electricity tax

The basic feature of the intervention theory of economic instruments such as taxes is that the instruments shift the cost curves so that environmental effects are internalised to a greater extent. From a theoretical point of view even a small tax may have effects, if it changes the marginal costs and behaviour is cost sensitive. To have an observable impact the signal must be sufficiently strong that a significant share of the operators takes the cost element into account.

The available data on the electricity tax and its implementation suggest that it has not given a strong signal to the operators. Thus, the main impact relates to increase of the revenue of the tax. Environmental impacts have been mainly indirect. The main reason for the lack of direct impact relates to design of the instrument. The tax level has been low; it has been lower for industry than for other electricity users and the system has included various exemptions and subsidies. One of the main goals of Finnish energy taxation has been not to damage the international competitiveness of Finnish export industries (Määttä 2000, p. 151ff.)

Similar results were obtained in a recent analysis of the Swedish carbon tax. Johansson (2000, p. 88) found several reasons for the small effects on industry: the lower tax level for industry; the small share of energy supply to industry based on fossil fuels already when the tax was introduced; the reduction of the total taxation level on fossil fuels for industry in the 1991 tax reform; and the fact that for most industries fuel costs are only a small share of the total costs and thus have low priority. Actually the different tax rates for different sectors resulted in industry selling their by-products to district heating while using fossil fuels themselves (Johansson 2000, p. 89).

Energy taxes could in principle result in reduced competitiveness. Brack, Grubb and Windram (2000, p. 72ff), however, argued that this is seldom a major issue in practice since due to political realities energy taxes have been accompanied with measures that offset real or perceived effects on competitiveness. Such measures are exemptions or rebates for specific sectors, recycling of revenues and border tax adjustments. This conclusion is in line with many other studies of environmental taxes put into practice (e.g. Bressers and Huitema 1999).

Although few effects were found of the electricity taxation in the studied sectors, this does not imply that environmental taxes could not be effective. A recent assessment of the Finnish energy taxation concluded that the CO₂ emissions would have been 7 per cent higher in 1998 without the tax instrument (PMOPS 2000, p. 47. Section 7.4.2). There are several international examples on the effectiveness of environmental taxes. The effects of fuel taxes on fuel consumption and the effects of differentiated tax rates on the diffusion of cars with engines using unleaded petrol are frequently used examples (EEA 2000). It must thus be stressed that the impacts observed in this study do not make taxation an irrelevant instrument with regard to CO₂ emissions. Energy taxation has clear advantages in dealing with greenhouse gases over regulatory instruments for the same purpose. The tax rates and the tax collection, including recycling of excess tax revenues, would have to be designed, but as there are no problems related to excessive local pollution (hot-spots) there is no need for local negotiations. It is the total amount of CO₂ emission that counts and a CO₂ tax would be a cost-efficient instrument to reduce emissions. A tax would also provide the industry with continuous incentives to develop energy-saving technology and technology based on renewable energy. The problems of using taxes to address global environmental issues are related to the political problems involved in designing a global, or even international, tax and the problems for small open economies to use taxes unilaterally.

10.3 Environmental management systems

Crucial questions concerning environmental management systems are whether they actually lead

to improved environmental performance, have any detrimental or perverse effects, and whether the information they provide about activities actually has any significance.

10.3.1 Environmental management systems help firms to find no-cost or low cost improvements

Our study has demonstrated that management systems are likely to identify possibilities for environmental improvement and is thus in line with the findings of other similar studies (Kautto and Melanen 2000, Ilomäki and Melanen 2001, Zackrisson et al. 1999). It could be argued that the greatest positive impacts arise when the system identifies areas of improvement that hitherto have not been recognised. The potential for such findings are greatest where the interests of the operator and the public environmental interest are in line, i.e. in win-win situations, since then the mechanisms of the environmental management systems are supported with other incentives. The possibility of such unexpected effects may greatly increase the motivation to implement management systems.

However, our study has also shown considerable variation in the perception of key concepts such as "continuous improvement" (Luoma 1999). The management systems are furthermore not the sole or even the main explanation for the environmental awareness in firms, but they enforce the awareness and may be one way of translating a general awareness to concrete improvements.

The effects of environmental management systems on other actors, such as subcontractors, are common and important. Major customers, such as a pulp and paper mill or large chemical factory, may force not only a producer, but through a domino effect also those delivering components or raw material to the producer, to adopt management systems. This chain effect was seen in some of our case firms. Similar findings have been made by Ilomäki and Melanen (2001) and Kautto et al. (2000). The increased availability of commercial environmental management consultants is also likely to contribute to a positive environmental development as they bring in new views that differ from those of traditional environmental consultants. An adverse effect is the increase of bureaucracy within firms in certain circumstances.

10.3.2 Environmental management systems could have detrimental effects

The lack of real sanctions may in theory attract poor environmental performers to environmental management systems. This could happen if management systems would appear to provide an easy way of increasing public credibility on a greening market without having to change general environmental attitudes or actions in practice. Our study has not been able to identify this kind of effects of the environmental management systems because generally high standards prevail. Other studies suggest that in fact top environmental performers are likely to join the systems first (Kuisma et al. 2001). In the US King and Lenox (2000) observed that the Responsible Care programme has led to certain opportunism in the US, with poor environmental performers joining the programme simply to gain credibility. They also found that environmental improvement among the companies that had joined was slower than among those not members of Responsible Care.

The risk of free riders may for many reasons be relatively small in Finland. We have identified close networks of operators and the contacts between authorities and operators are also relatively close. Thus beneficial effects seem to dominate. Environmental management systems have had immediate effects on the networks of the operators, particularly on the relationships with the main suppliers and customers. Moreover, especially local authorities see environmental management systems also as useful tools supporting supervision.

10.3.3 The value of environmental reports is their existence

Many firms have become less dependent on external consultants for their environmental reporting. In general the interviewees considered reports to be reliable, although several recognised the possibility that the reports are not a completely unbiased account of all environmentally relevant issues. The results of this study indicate that many view the main role of the environmental reports to be provision of some background information. In many cases just their existence, not their detailed contents, is important. This supports the view that environmental reports should not be

judged in isolation but rather as a part of the total information provided by a firm of its activity. The success of the management system should consequently not be judged on the basis of only one of its outputs, but rather in relation to the overall environmental performance and the totality of environmentally relevant information provided through the management system.

10.4 Interaction between the instruments

10.4.1 Overlapping regulations may cause problems

The approach based on environmental media (water, air, soil) in pollution control has been considered to be problematic when the aim is to reduce all negative environmental effects (Rosén 1971). The introduction of the Finnish Environmental Protection Act in 2000 has in principle solved this problem at the policy instrument level. The practice of integration has not yet developed, but pilot studies give guidance for authorities and operators (Silvo et al. 2000). Seen in this perspective, it was interesting to find that the industry presented more often and more clearly practical solutions to integration problems than the administration. This confirms the assumption that there has been asymmetry of information between authorities and the industry. The development of new networks around the Best Available Techniques concept may help in overcoming some of these asymmetries.

The focuses of the Chemicals Act and the other regulatory instruments on pollution control are becoming closer to each other. Best available technique concepts have been introduced in the Chemicals Act and the safety plans that are demanded are closely related to environmental management systems. There are also formal links to land use planning through demands to protect groundwater resources. On the other hand, a risk analysis requirement is becoming a standard condition in pollution permits. It was more often the representatives of the industry than those of the administration, who pointed out the link between two instruments.

If the links and overlaps between instruments are not recognised sufficiently in the practical implementation, a waste of resources may be an

unfortunate consequence. The changing situation clearly puts new demands on the networks between authorities as well as the networks between authorities and operators.

10.4.2 Environmental management systems supplement regulatory instruments

The interaction between regulatory instruments and the environmental management system can be seen from two perspectives. First, the costs of managerial obligations related to both may be reduced if they are co-ordinated. Second, the two instruments may complement each other functionally. The environmental performance is often reported in environmental management reports in

relation to permit conditions. Without a point of reference, such as a permit condition, the environmental management system is less credible. In addition, environmental management systems may also motivate the operators to continuous improvement between permit cycles. Our interviews showed that the very nature of the environmental management systems make them suitable for identifying win-win situations. Under these circumstances the interest of an operator agrees with that of the public environmental policy. As all environmental improvements are unlikely to represent win-win solutions (Palmer et al. 1995), too great reliance on environmental management systems could be problematic. Problems of freeridership are also likely to be aggravated if environmental management systems are used as a justification for not developing and revising regulatory instruments to meet changing demands.

11 Fostering or obstructing innovation through policy instruments

11.1 Regulatory instruments and innovations

The studied regulatory instruments have not been developed for or used as instruments that would force innovations at the level of individual operators. However, the use of the instruments has not been found to obstruct innovations either. This "innovation neutrality" has been a consequence of the reactive nature of the regulatory action combined with flexible permitting practice. With respect to innovations the main purpose of the policy instruments has been to enhance diffusion, which can be seen in the introduction of the BAT concept. It is, however, important to distinguish between the instrumental use of a policy instrument and the effect of its existence as part of the environmental policy. The environmental regulatory instruments and the possibility of regulation have clearly contributed to the technological development and improved environmental performance (Sections 9 and 10.1.2).

In some cases the diffusion of end-of-pipe technology has been clearly accelerated by specific regulatory decisions at the operator level, whereas in other cases no or very little impacts were found. It seems clear that the diffusion of for example modern water purification plants and air filters was faster with the regulations in place than it would have been otherwise, whereas the diffusion of chlorine-free bleaching would have taken place at the same rate anyway. The abandoning of mercury is an intermediate case: the existence of regulatory instruments gave a signal, but the rate of the development was not greatly accelerated in the pulp and paper industry.

Authorities developing and implementing regulatory instruments in Finland have not subscribed to the idea of technology forcing. Thus the water protection programme for the pulp and paper industry of 1970 did not foresee the abandonment of the sulphite process, but only indicated a need to improve the environmental performance of the process (Sitra 1970).

11.1.1 The regulatory instruments have indirectly contributed to technological innovations

Economists have claimed that regulations might

be set so that they directly deter innovations (Fisher et al. 1996, 413). Porter and van der Linde (1995a,b) argued that regulations should focus on outcomes, not processes, be stringent and be developed in close collaboration with industry; that industry should be given time to make fundamental innovations instead of just adding existing end-of-pipe solutions; and that there should be flexibility to allow trials and demonstration projects.

Our results in Section 9 indicate that the purpose of the limit values of water and air permits has been to foster the diffusion of existing technology to reduce water discharges and air emissions (alternative b in Fig. 19). The technical regulations according to the Chemicals Act have had a similar function. In practice, however, limit values have often been set at such a level that the firm could have continued as before, without adopting new technology (alternative c in Fig. 19). This is in conflict with the Porter and van der Linde recommendations (1995a,b), which instead are based on the idea that limit values should force companies to innovate (alternative a in Fig. 19).

Our results are thus in line with those of many other studies, which indicate that although regulations could be used to encourage innovations they seldom do. For example Kemp (2000, p. 41) writes "*Emission requirements were often based on available end-of-pipe technologies and provided little incentive for the development of new, more effective technologies; they merely stimulated the diffusion of existing technologies.*" This does not mean that there are no links between regulation and innovations: the regulatory systems enhance competition among suppliers of technology by creating and improving markets for end-of-pipe technologies and this provides incentives for innovations. Competition may also develop between firms providing process solutions and those providing end-of-pipe technologies. A full analysis of the innovation system is, however, outside the scope of this study.

The finding that the conditions of the Finnish waste water permits have been tightening over time means that there have been some incentives for the operators to innovate, especially since operators wish to increase production over time (Section 9.2). Short term fluctuations of discharges may have similar effects because measures by the operator to ensure that it is able to stay within limits even during peak discharges also reduce the average discharges. These incentives are howev-

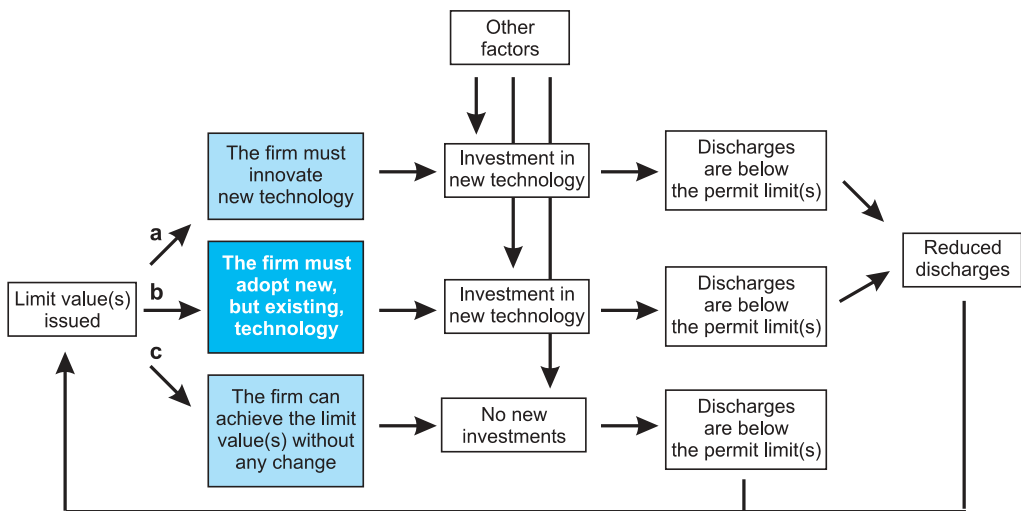


Fig. 19. Possible effects of limit values on innovations and diffusion.

er reduced by some features of the applied practices. First, many interviewees expressed the view that voluntarily reduced discharges could only lead to tighter limits in the next permit negotiation. Second, although almost all permit limits have become tighter over time, some industries obtained their first quantitative limits as late as in the 1990s. Eight pulp and paper mills have had no more than two quantitative limits on any parameter until the end of the year 2000, which means that the regulatory systems have given weak signals to innovate.

The flexibility of the Finnish permitting practice has made it easy for operators to obtain temporary reliefs in their permit conditions during demonstration periods or pilot phases of new end-of-pipe technology. This explains why innovations have not been hindered in a way that limit values in theory could do. The Finnish system has thus had informal "innovation waivers", which have avoided the bureaucratic traps that have made the formal innovation waivers in the US inefficient (Derzko 1996).

In theory environmental regulations can also hinder technology innovations and diffusions that could increase the production without increasing the emissions, if a production increase triggers a new permitting process that leads to tighter and more expensive permit conditions. Similä (2000) showed that the practice of the Finnish Water

Courts has been much "lighter" for applications by the operator to increase production but leave all other conditions unchanged. These processes have not resulted in changes in emission limits or other conditions related to absolute environmental performance.

Innovations that have been made or introduced for economic reasons despite or independently of regulatory instruments have contributed to better resource use and lower emissions. The chlorine-free bleaching is a borderline case: public discussions and market demands created economic incentives to innovate, but the possibility of future regulation also played a role. However, there are also some examples in which permit requirements may have helped operators to identify potential cost savings. Recycling of water and materials are among these. One interviewee described the path leading to recycling of materials in the following way "it is more and more a question of raw material economics[...], if we think about the question of fibre, first came the requirement based on legislation, which results in an external sedimentation basin, if one exaggerates slightly, and the recovered material is taken to the dump, which at that time was much easier than today. After that someone starts to think why on earth do we take it to the dump...". It does, however, remain an open question whether the mill would have noticed this cost saving if the regulations had not have required

treatment in the first place. It could be interpreted as a weak support for innovation induced by regulation in line with the Porter-hypothesis, but the critics of the Porter-hypothesis also acknowledge that there are instances when regulations result in efficiency gains (Palmer et al. 1995). The disagreement concerns the frequency and magnitude of the effect. A deeper analysis would have to consider the type of markets and competitive conditions faced by the firms (see 9.2.2). Our present empirical material cannot settle the dispute.

Our conclusion is that the permits of the Finnish regulatory instruments have features that could be used to foster innovations even at the level of individual operators, but we find little evidence that these features have actually been used actively by the regulators. One important explanation is that the basic technological choices of the industry have been taken for granted by the administration and thus each technology has been assessed on its own merits. The existence of regulatory instruments and an active environmental policy more generally has, however, indirectly contributed to innovations.

11.1.2 Regulatory instruments have had observable effects on diffusion of innovations

Diffusion of end-of-pipe technology has in many instances been promoted by both water and air regulations (Section 9.2.1). The diffusion has, however, often been slow and reduced by the reactive nature of the permitting. This is also due to the nature of the industry. The pulp and paper industry is a typical heavy industry with large investments and long-term perspectives. As already discussed in the section on impacts on emissions (Section 10.1.1), the regulatory instruments are far from the only factors that have affected the diffusion of environmental technology. Other important aspects are cost savings for the operator resulting from improved resource utilisation and customer pressures. The fact that some mills have adopted end-of-pipe solutions several years before they have been required to do so by permit conditions suggests that other benefits have justified the extra costs.

An interesting observation is that although our results show that the regulatory instruments have

affected diffusion of technologies, more or less the same technologies have also been adopted in other countries using other policy instruments or implementing regulations and especially permits differently (OECD 1999b). Both Bressers (1988, 1995) and Kemp (1997, 1998) have studied the diffusion of waste water treatment plants in the Netherlands and have found diffusion during about the same time as in Finland but mainly caused by effluent charges and not the regulatory instruments.

The diffusion of chlorine-free bleaching is an example of a process in which public environmental concern lead to a market driven development which individual permit limit values only confirmed. This is in line with the assessment of the OECD that kraft mills in Canada, Finland, New Zealand and Sweden all discharged very small amounts of AOX, some mills even below 0.1 kg per ton, although permit limits generally were 1–2 kg per ton. The report states *"The above performance is believed to be due to companies adopting technologies for economic and market reasons."* (OECD 1999b, p.68). In an assessment of the Finnish and Swedish chlorine negotiations in the late 1980s, Auer (1996, p. 695) concluded that *"this smashing success can not be credited directly to either the content of the HELCOM recommendation nor the process of reaching consensus. Steep declines in chlorine consumption and AOX emissions are driven by ever-expanding European markets for various 'chlorinefree' pulp and paper products."* The 1989 decision by the Finnish Ministry of the Environment on the reduction of the discharges of chlorine compounds, as well as similar decisions in e.g. Sweden and HELCOM, helped to reinforce the demand pressures by showing that the authorities also took the issue seriously and were prepared to take action.

The adoption of end-of-pipe technology, especially waste water treatment plants and air filters, cost millions for the operators. While some innovations and diffusions induced by the regulations have resulted in net-cost savings, the overall impacts appears to have involved costs. Brännlund et al. (1996, p. 31) have earlier made the same observation: *"Most of the current environmental regulations in the pulp and paper industry have led to increased production costs."* These costs do provide an incentive to innovate and to use innovations that achieve the same result at lower costs.

11.1.3 No direct effects of R&D requirements on innovation and diffusion

Research and development requirements have been included in water as well as air permits. Many of these requirements have been imprecise but there have also been some R&D requirements with quantitative targets. No direct effects on either innovation or on diffusion could be found. It is, however, possible that the R&D requirements have had an indirect effect by helping to generate capacity to deal with environmental issues within the companies.

The lack of impact of the R&D requirements in permit conditions is not surprising, considering the fact that the decisions generally only specify the research question without demanding adequate resources. Systematic follow-up on the part of authorities is also virtually absent. Thus there are few incentives for the firms to invest significant resources in the R&D tasks, unless the firm can expect other benefits than those associated with the permit procedure. The R&D requirements could have a greater role if they were clearly focused on specific questions and also had a connection to future permit conditions. Too strong direct links to specific permit conditions may, however, create strong incentives to bias results.

11.1.4 Environmental authorities are not gate keepers in the dissemination of information on innovations

In principle it is possible that the existence of regulations reshapes interorganisational networks in such a way that they enhance the spreading of knowledge and the diffusion of innovations. Our analysis clearly established that the companies do not get their information on available environmental technology primarily from authorities or through processes related to permitting. Companies do not even mention authorities in the context of innovations. The information on environmental technology is considered to be freely available and spreading rapidly among the companies and this openness has been important in improving the environmental performance of individual factories. Other important actors in the knowledge network of the companies are the customers, the equipment providers, consultants, research institutes and universities. Sometimes part of the fi-

ancing has been obtained through public programmes or institutions, e.g. the National Technology Agency (TEKES). Especially equipment providers seem to play an important role in the diffusion of environmental innovations.

The IPPC directive (1996/61) and the Best Available Techniques reference documents aim at enhancing the diffusion of knowledge of environmental technology and its performance levels. Our findings indicate that authorities are the main beneficiaries of this enhanced information distribution. The industry has an incentive to participate in the network primarily because it provides an efficient forum for airing the points of view of the industries and also for obtaining early information on new developments in regulation.

The existence and development of the major regulations have clearly increased the demand for research and expertise in these fields. The supply of degrees from universities in the relevant areas has increased to meet this demand as the result of a conscious effort (Sitra 1970). Indirectly, this has promoted the width as well as quality of the participants in the interorganisational networks that the operators utilise to find information on environmental technology.

11.2 The electricity taxation has not been a strong driving force for innovations

Most theoretical studies argue that taxes and other market-based approaches provide most incentives for innovations and diffusion, because they provide continuous incentives to reduce emissions and thereby save costs. (e.g. Milliman and Prince 1989, Jaffe and Stavins 1995) They are also less dependent than regulations on the present availability of pollution control technology (Kemp 2000). Finally, economic instruments stimulate process innovations as well as technological innovations.

Astonishingly, our interviews showed that no one representing the industry gave the electricity tax any role in either promoting innovations or in enhancing the diffusion of energy-efficient solutions (Sections 7.3, 7.4, 9.5 and 10.2). This result could of course be false. It is easy to argue that industry will oppose environmental taxes (e.g. Keohane et. al. 1998) and thus their answers may be tactical. It is also possible that the picture we

got was incorrect because the people we interviewed were less familiar with energy issues than with discharges and emissions. The interviewees did not directly handle tax payments, whereas they were directly involved in making permit applications. These factors could explain part of the results, but we believe they only explain a small fraction, and that the main answer lies elsewhere.

Many empirical as well as theoretical studies that take the political process of tax setting into account reveal that the effects of taxes in general, as well as on innovation and diffusion, are often far smaller than anticipated (e.g. Bressers and Huitema 1999, Brack et al. 2000). In practice, environmental tax rates are almost always far lower than suggested by theory. They include exemptions for sectors they otherwise would affect and they may be combined with subsidies, indirectly reducing their effects. Taxes are also often introduced without removing already existing regulations, which reduces the potential of flexibility gains. These designs are a consequence of the low political feasibility of theoretically "optimal" environmental taxes in the real world. (Bressers and Huitema 1999). Consequently there will also be attempts to show that the issue of energy use is taken care of by the industry on a voluntary basis such as voluntary energy saving programmes.

The Finnish electricity taxation fits this pattern very well. As was shown in Section 4.3.5, the tax rates have been low – they have been lower for industry than for other electricity users – and the system includes various exemptions and subsidies. It is thus our interpretation that the conclusion that the electricity taxation has not had any major effect on innovation and diffusion is correct and that this is mainly due to design of the tax and its low level. The main argument for the actual design has been "not to damage the international competitiveness" (e.g. Määttä 2000), i.e. the interests of the exporting industry, of which pulp and paper is a large fraction. This does not imply that all environmental taxes in Finland have been without influence on innovations; neither does it imply that future taxes could not enhance innovations in the industry.

Almost identical results to ours have been obtained for Sweden. In a recent analysis of the

Swedish carbon tax Johansson (2000, p. 91) concluded: "*there are reasons to believe that the relatively low taxes on industrial energy use have resulted in only minor improvements in energy efficiency within the industry.*"

11.3 Environmental management systems generate incremental innovations

The systematic approaches contained in the environmental management systems are assumed to increase the probability that cost saving or income increasing changes in the processes will be found. Some examples of market innovations with environmental benefits were found in the study. Examples in which the systematic treatment of complaints made it possible to find ways to reduce negative environmental externalities are also reported. However, all the cases found were incremental changes, whereas there was no clear evidence of innovations or diffusion resulting in major environmental improvements resulting from environmental management systems. Similar conclusions can be drawn from the study of Zackrisson et. al. (1999), although some of the possibilities for improvement were very impressive in an economic sense.

In a longer time perspective the environmental management systems may also turn out to be important for innovative processes. Halme (1997) suggested that a learning process needs change-agents who are able to engage in discussions with interest groups that have different ideas on how activities can and should be carried out. If management systems are successful in increasing constructive dialogues between firms and interest groups, they could increase the likelihood of major innovations. It is, however, unlikely that the management systems would on their own lead to significant innovations. A new "theory for action" that can be transferred to new settings and situations must emerge in the firm (Halme 1997). If it does not emerge there is a risk that the management system will become a bureaucratic burden that may even hinder innovations and their diffusion.

12 Methodological aspects

12.1 Only multiple methods can cope with the impact problem

Establishment of the role of one factor when many factors change and interact is a difficult task common to almost all policy evaluations. This empirical difficulty has been coined "the impact problem" (Scriven 1991). Emissions of several substances, the general state of waters and air close to factories and the risk management in handling of chemicals have all developed favourably, but what is the role of the environmental policy instruments? The problem is particularly difficult in the context of environmental policy, because of the complexity, uncertainty, time lags and strong interactions between different policy instruments as well as between policy instruments and external signals from the market and society at large.

Approaches in which several methods are used instead of just one have been recommended for addressing the impact problem (Bartlett 1994). Our study strongly supports this argument. A single method, e.g. the statistical analysis of permit conditions, was not able to demonstrate for example the importance of the networks and discussions that precede a permit application and that constitute an important part of the impact of the examined regulatory instruments. The detailed analysis of legal documents was then able to substantiate the evolution of the permit procedure. Thus a phenomenon can be better understood when several methods are used, because these can illuminate different aspects of a policy instrument. Our approach has, for example, provided new insights into how emission limit values affect a company's decision-making in environmental matters. On the other hand multiple methods are also difficult, because different methods may yield conflicting results and weighing different explanations may depend on the availability of information rather than providing a fully neutral examination of "all" relevant evidence.

Multiple methods have contributed to the evaluation of the innovation effects of regulatory decisions. A case-by-case examination of all factors affecting innovations was impossible due to partly insufficient material and prohibitive resource demands. Interviews can identify the importance of economic and in particular marketing considerations, and a general environmental awareness

that is linked to the development of environmental policy instruments, but the experience of the interviewees does not cover the whole period examined. It is furthermore unlikely that the interviewees remember all details of the cases in which they have been involved. The documented decision-making material also has its limits as a source of information.

It is possible to examine the coercive impact by studying the court material, but the examination of noncoercive impact is difficult because the motives behind the anticipation are not easy to identify. Indirect innovation effects are also difficult to document when the focus of the study is on specific instruments, the operators and the administration. Some operators may have their own research and development activities, but many innovations are often made by suppliers of technology. For them the existence of regulatory systems may be vital in creating markets, although they are not directly affected by the individual decisions. For example, suppliers of environmental technology have demanded stricter environmental policies (EUCETSA 2001). These effects of the regulatory systems have only been partly captured by the material of our study.

In some cases one method can identify an interesting hypothesis, which can be tested by other methods. An example is the claim arising from interviews that research obligations have signalled future emission limits. In the case of phosphorous this hypothesis could be rejected using the statistical analysis.

Our conclusion is that complex evaluations should be undertaken not using only qualitative and quantitative methods but also by employing truly different scientific disciplines in examining policy instruments. At the same time we recognise and acknowledge the difficulties this entails. Sufficient information is difficult to gather and individual parts of a multi- or interdisciplinary study can be criticised for not being deep enough when viewed from the viewpoint of a single discipline (Rosenhead 1989).

12.2 The broad analysis of effects deepens the understanding of policy instruments

Many important effects of environmental policy instruments occur outside the main explicit tar-

get area of the instrument, but these effects have often been neglected in evaluations (Vedung 1997, p. 45 ff). Our findings show that a broad effects approach is able to deal with many of the key issues in a comprehensive evaluation of environmental policy instruments. One example is the link between the policy instruments and innovations. Fostering innovations has not been a major objective of the environmental policy instruments used so far, but some effects become obvious when the evaluation is based on a broad understanding of the different types of effects that can arise. The diffusion of innovations has been an explicit part of the intervention theory of the more recent policy instruments, but individual examples indicating an impact of a permit on the diffusion of technology do not reveal how often this kind impact has occurred.

12.3 Multiple criteria must be used to capture the complexity of effects

In judging the merit, worth or value of policy instruments a single criterion can easily be used for rhetoric purposes, for example administrative costs can be related to output as an argument for inefficiency (Hildén 2000). Multiple criteria give a broader understanding of the effects. They also support a more balanced discussion of key issues concerning the implementation of the policy instruments (Baldwin and Cave 1999). Using multiple criteria it is not possible to identify an instrument which is best with respect to all criteria, because there will always be trade-offs. Our purpose has been to highlight characteristics of policy instruments that are relevant for a policy discussion without proclaiming a "winner".

The difficulties in using multiple criteria are related to the availability of data and also to the complexity of many criteria. Availability of data hampers especially the use of quantitative criteria such as detailed measurements of cost effectiveness. It can, however, be claimed that in a policy discussion general information viewed from many different angles is more useful than extremely detailed data viewed from a very narrow point of view.

The complexity of many criteria demands a systematic approach to the available data, because several criteria can be used for many different purposes. For example flexibility can be viewed

as a characteristic that allows the adjustment of outputs in relation to local needs and conditions, as when taking into account social and economic conditions in setting permit requirements, or it can be viewed as a characteristic that allows adjustment of the outcome, e.g. the state of the environment, in response to changing societal preferences. These two different interpretations of flexibility may lead to conflicting conclusions concerning the merit, worth and value of a policy instrument.

12.4 Intervention theories are important tools in focussing evaluations

The contrast between actual practice and the intervention theories as deduced from official documents is one of the clues to identifying effects and the examination of effects in relation to evaluation criteria. The differences between these intervention theories and different actors' perception of how the instruments should work or have worked are also important in understanding implementation practices and difficulties. Several authors have argued that early evaluations were not sufficiently based on theory, but approached the evaluation task from an entirely empirical point of view (Shadish et al. 1995).

Intervention theories have a special role in evaluations of environmental policy instruments due to the complexity of issues (Mickwitz 2000c). An extensive collection of empirical data without a foundation in the intervention theory of the instruments is likely to lead to haphazard conclusions (Rossi et al. 1999). Ideally intervention theories of environmental policy instruments should be based on science and an understanding of key cause-effect relationships. However, this is challenging in many ways, especially when it comes to complex ecological issues for which there may be several and partly conflicting theories. Then it is not immediately obvious which assumptions have been used in developing an instrument. Due to the long time frames of many environmental problems, data on final outcomes may also not be available. The intervention theories can in these cases nevertheless be used to identify analogies with other situations for which outcomes are known. The use of information-based policy instruments is a simple example. In the environmental field they are relatively new

but they have been extensively used in other fields.

12.5 Interorganisational networks and their variation should be recognised

A part of the methodological debate concerning networks has dealt with the question to what extent "policy networks" can become more than a metaphor. It seems evident that the strength of network approaches hitherto has been in describing rather than explaining policy making (Daugbjerg 1998, p. 26). Our study supports the view that network analysis is a useful descriptive tool. The network metaphor has played down the importance of formal/constitutional differences be-

tween societal actors, thereby recognising several features of contemporary public administration such as the increased mobilisation of competing interests, increased scope of state policy making, the fragmentation of the state and the blurring boundaries between public and private (Jordan & Schubert 1992, p. 11). Our study shows that the network analysis can, in combination with other sources of data, become more than a simple illustration of the relationship between actors. It can, for example, explain why the risk of regulatory capture would be significant in a regulatory instrument based on case-by-case negotiations, unless the transparency and opportunities to participate were well developed. Thus the network analysis supports the use of several important evaluation criteria (transparency, equity, acceptability).

13 Conclusions

We defined four main objectives for this study (Section 2): to conduct a general evaluation of specific environmental policy instruments; to explore the relationship between the environmental policy instruments and innovations; to investigate the role of interorganisational networks; and to examine appropriate evaluation methods for environmental policy instruments. What are the findings?

Our conclusion *on the general evaluation of the policy instruments* is that they have had several positive effects in the context of directing major industrial point source polluters towards solving environmental problems. The environmental policy has, however, been only one of the factors reducing emissions. There have also been serious effectiveness problems, in particular in the early years of introducing the regulatory instruments. Some of these have been caused by inadequate resources of the administration to cope with the tasks created by the instruments, whereas others can be traced to a lack of political will to proceed with environmental protection at a rate that would otherwise have been technically and economically feasible. The principle of granting environmental permits for an indefinite time has reduced the effectiveness of air pollution control permits. The regulatory instruments have in general been rather flexible in dealing with increasing environmental demands, but have had obvious difficulties with respect to qualitatively new kinds of environmental problems and demands. In electricity taxation the deliberate reduction of effectiveness is seen in the low taxation rates. The transparency has been an important factor ensuring the success of the policy instruments and in avoiding the regulatory capture that could have thrived in a system largely based on negotiations between operators and authorities. The transparency has made it easy for Finnish firms to adopt environmental management systems and an open attitude to environmental reporting.

Our conclusion concerning *the relationship between the environmental policy instruments and innovations* is that the permits based on regulatory instruments have neither fostered nor hindered the discovery of new innovations to a large extent, but that they have contributed to the diffusion of end-of-pipe innovations. The instruments have contributed to innovations by expanding the

market for environmentally better technical solutions. In addition they have also indirectly contributed to innovations by creating a demand for environmental experts and environmental education in universities and polytechnics. The electricity tax has not at its present level fostered innovations, but it has probably contributed to the diffusion of voluntary energy saving commitments by contributing to a societal discussion on energy and energy policy. Voluntary management systems are by themselves innovations that have diffused rapidly in the late 1990s and they have clearly contributed to incremental improvements of environmental performance. It is too early to say whether they will contribute to radical innovations, but on their own they are unlikely to do so. They may make a contribution, if there are functioning links between the management systems and the R&D work of the firms so that problems identified within the management systems become objects of systematic R&D work and not only a management notification.

In our *investigation on the role of interorganisational networks* we have found that networks have clearly developed as a consequence of and in response to regulatory instruments. We conclude that these networks appear to have their greatest significance prior to the permit procedures and that the success of the communication in the networks prior to the presentation of an application is a key to smoothly functioning permit processes. We have further found that authorities are largely outsiders in the networks contributing to innovations and the diffusion of innovations, except when an innovation becomes a de facto standard for permit conditions. The introduction of formalised BAT networks is unlikely to change this situation fundamentally, although the BAT networks probably will reduce the information imbalance between authorities and operators. The electricity tax has not created any significant networks and is unlikely to do so. The networks related to energy savings are, however, important for the energy discussion. Environmental management systems have by contrast created new actors and also introduced new actors in the environmental field. These actors, management consultants and verifiers of management systems may in the future be increasingly important for the diffusion of environmental innovations.

In the course of the evaluation, elements of *appropriate evaluation methods for environmen-*

tal policy instruments have emerged. The different kind of effects, the complexity of consequences and the uncertainties with respect to causes and effects mean that evaluations aiming at evaluating the overall worth and merit of an environmental policy instrument should never be structured from a single point of view using only one method. Multiple criteria should be used. The draw-

back of the multiple approach principle in evaluation is that the evaluations will run into data problems and all the difficulties of multi- and interdisciplinary research, thus putting the scientific credibility at risk when viewed from the point of view of a single discipline. Our conclusion is that the risk is worth taking.

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Yhteenveto

Yhteiskunnallisen ohjauksen arviointiin on kiinnitetty enenevässä määrin huomiota 1990-luvulta lähtien. Vuosituhannen vaihteessa on Suomessa julkaistu useita nimenomaan ympäristöpoliittiseen ohjaukseen keskittyviä tutkimuksia. Tämä tutkimus jatkaa tätä ympäristöpoliittiseen ohjaukseen keskittyvää arviointia. Tavoitteena on ollut:

- tehdä yleinen arviointi valikoiduista ympäristöpoliittisista ohjauskeinoista. Arvioinnissa ohjausta ja sen vaikutuksia tarkastellaan yleisen arviointikriteerin valossa. Tarkastelun kohteena on sekä tavoitellut että muut vaikutukset.
- tutkia ohjauskeinojen ja innovaatioiden suhdetta. Kiinnostuksen kohteena on missä määrin ohjaus edistää tai estää innovaation syntymistä ja innovaatioiden leviämistä.
- selvittää organisaatioiden välisten verkostojen merkitystä ohjauksen toteuttamisessa. Verkostotutkimus tarkastelee eri verkostojen merkitystä ja kehittymistä ohjauksen seurauksena ja osana sitä.
- pohtia ja kehittää ympäristöpoliittisten ohjauskeinojen arviointimetodiikkaa. Erityisesti on pyritty tekemään johtopäätöksiä ympäristöohjauksen erityispiirteiden vaikutuksesta arviointitutkimukseen.

Tutkimuksen kohteeksi valitut ohjauskeinot ovat: vesilain, ilmansuojelulain ja kemikaalilain sääntelemät ennakolliset valvontajärjestelmät sekä sähkövero ja yritysten vapaaehtoiset ympäristöasioiden hallintajärjestelmät (EMAS ja ISO 14000). Tutkimuksessa on keskitytty massa- ja paperiteollisuuden sekä kemian väriteollisuuteen. Tutkimus pohjautuu erilaisiin metodologisiin lähestymistapoihin: lupa-ehtoja ja ympäristön tilaa koskevien tietojen analysointiin tilastollisten mallien avulla, lupapäätösten laadulliseen analyysiin sekä teollisuuden ja hallinnon edustajien haastattelujen laadulliseen analyysiin. Tutkimuksessa on pyritty valottamaan ohjauksen historiallista kehitystä, joskin päähuomio erityisesti haastattelututkimuksessa on kohdistettu aikaan juuri ennen uuden ympäristönsuojelulain voimaantuloa.

Johtopäätös tutkittujen ohjauskeinojen yleisestä arvioinnista on, että merkittäviin pistekuormitajiin kohdistunut ohjaus on saavuttanut eräitä keskeisiä tavoitteita. Ohjaus on myötävaikuttanut

päästöjen vähentämiseen ja pilaantumisen estämiseen. Isoista teollisuuslaitoksista peräisin olevien päästöjen merkittävään vähentymiseen viimeisten 20–30 vuoden aikana ovat ohjauskeinojen ohella vaikuttaneet myös muut, vain välillisesti ympäristöpolitiikkaan liittyvät tekijät, kuten markkinat ja teknologian yleinen kehitys. Tarkastelu on kuitenkin myös osoittanut, että ympäristöasioiden ohjaus ei lupajärjestelmissä aina ole ollut helppoa.

Tutkimuksessa on myös voitu havaita vakavia vaikuttavuusongelmia, erityisesti uuden ohjauksen käyttöönoton jälkeen. Tämä ”sisäänajovaihe” on vesiensuojelussa ja ilmansuojelussa ollut varsin pitkä, jopa yli vuosikymmenen. Osa ongelmista on johtunut puutteellisista voimavaroista huolehtia niistä tehtävistä, joita uusi ohjauskeino on edellyttänyt. Tämä on näkynyt mm. lupakäsittelyn ruuhkautumisena. Osa ongelmista on johtunut omaksutuista lainsäädännöllistä ratkaisuksista. Esimerkiksi ilmansuojelulain täytäntöönpanon hitaus palautuu osaltaan alkuperäisen lain ilmoitusmenettelyyn perustuvaan heikkoon ohjaukseen. Osa ongelmista on johtunut poliittisesta haluttomuudesta edetä ympäristönsuojelussa niin nopeasti kuin se olisi ollut teknisesti ja taloudellisesti mahdollista. Tämä näkyy mm. siinä, että eräiden keskeisten päästölähteiden rajoittamisessa oltiin mm. ilmansuojelussa selvästi jäljessä verrattuna Ruotsiin. Esimerkiksi toistaiseksi voimassa olevat luvat ilmansuojelussa rajoittivat lupajärjestelmän vaikuttavuutta.

Lupiin perustuvat järjestelmät ovat olleet verrattain joustavia ja ovat kyenneet mukautumaan tiukkeneviin ympäristövaatimuksiin. Joustavuutta voidaan todeta myös muissa tarkastelluissa ohjauskeinoissa. Sähkövero on periaatteessa erittäin joustava, mutta nopeat muutokset ovat siinä vähentäneet verotuksen ympäristönsuojelullista vaikuttavuutta, vaikka verokertymätavoitteet ovatkin toteutuneet. Sekä verotuksellista että ympäristönsuojelullista vaikuttavuutta on kuitenkin tietoisesti rajoitettu alhaisilla ja suurkuluttajia suosivilla veroporrastuksilla ja veron palautejärjestelmällä.

Johtopäätöksemme ympäristöohjauksen ja innovaatioiden välisestä suhteesta on, että yksittäisissä lupapäätöksissä ei ole pyritty pakottamaan esiin innovaatioita. Lupamääräykset eivät kuitenkaan ole estäneet uusien innovaatioiden syntymistä. Sen sijaan ne ovat edistäneet erityisesti puhdistusteknologian käyttöönottoa ja luoneet markkinoita ympäristöystävällisemmille ratkaisuille.

Tällä tavoin ne ovat epäsuorasti tukeneet innovaatiotoimintaa. Ohjaus on myös epäsuorasti edistänyt innovaatiotoimintaa luomalla kysyntää ympäristöasiantuntijoista, joka on heijastunut yliopistojen ja korkeakoulujen koulutusohjelmiin ja tutkimukseen. Emme havainneet lupiin sisältyvien tutkimusvelvoitteiden synnyttäneen varsinaisia innovaatioita. Tutkimusvelvoitteet olivat usein myös muotoiltu siten, että tällaisen vaikutuksen syntymistä ei voida pitää todennäköisenä.

Sähkövero ei ole nykytasolla edistänyt innovaatioita, mutta se on todennäköisesti myötävaikuttanut vapaaehtoisten energiansäästösojmuksien syntymiseen, koska se on osaltaan ylläpitänyt yhteiskunnallista keskustelua energiasta ja energiapolitiikasta. Teoriassa oikealle tasolle asetettu vero muodostaa teollisuudelle tehokkaan kannustimen uusien innovaatioiden tekemiselle.

Vapaaehtoisia hallintajärjestelmiä on otettu laajasti käyttöön. Ne ovat nostaneet yritysten ympäristönsuojelun tasoa tunnistamalla yksittäisiä parannuskohteita. Niiden tavoitteena ei ole ollut innovaatioiden tuottaminen emmekä löytäneet esimerkkejä siitä, että hallintajärjestelmien käyttöönotto olisi johtanut uusien merkittävien ympäristönsuojelua edistävien innovaatioiden syntymiseen. Vapaaehtoiset hallintajärjestelmät saattavat kuitenkin myötävaikuttaa innovaatioiden syntymiseen, jos ympäristöasioiden hallinnan ja yrityksen T&K toiminnan välille luodaan yrityksessä kiinteä yhteys, joka huolehtii siitä, että hallintajärjestelmän havaitsemat parannuskohteet tulevat yrityksen systemaattisen T&K toiminnan kohteeksi. Riittävä ja systemaattinen panostus T&K toimintaan on olennaista.

Organisaatioiden väliset verkostot ovat tärkeitä ympäristönsuojelun ohjauksessa. Verkostot kehittyvät ja muuttuvat ohjauksen myötä. Epävirallisten verkostojen merkitys on lupajärjestelmissä suuri, koska ne tukevat lakisääteisten menettelyiden sujuvaa soveltamista ja yritys- ja paikkakuntakohtaisten asioiden huomioonottamista. Mitä innovaatioihin tulee tutkimus osoittaa, että viranomaiset eivät näyttele merkittävää roolia, paitsi kun jokin innovaatio saavuttaa tosiasiallisen standardin aseman. Näissä tapauksissa viranomaisten toiminta ja viranomaisten ja yritysten väliset verkostot edistävät innovaation leviämistä. Parhaimman käytettävissä olevan tekniikan (BAT)-verkoston ansiosta viranomaisten tietotaso voi kohota.

Suurteollisuudessa tieto prosessi-innovaatioista kulkenee kuitenkin edelleen ennen kaikkea tutkimuksessa todetuissa tärkeissä yritysten välisissä verkostoissa ennen kuin lupaviranomaiset voivat käyttää ja jakaa sitä edelleen. PK-yrityksissä tilanne voi olla toinen.

Sähköveroon liittyen ei ole syntynyt mitään varsinaisia organisaatioiden välisiä verkostoja, eikä niitä todennäköisesti synnykään. Sen sijaan energiasäästösojmuksien ympärille syntyneet verkostot ja niissä käytävä keskustelu on tärkeä energiapolitiiselle keskustelulle. Ympäristöasioiden hallintajärjestelmät ovat tuoneet uusia toimijoita ympäristönsuojelun kenttään ja luoneet aivan uusia verkostoja.

Johtopäätöksemme arviointitutkimuksesta on, että ympäristöohjausta tulisi aina arvioida käyttämällä useita menetelmiä ja aineistoja. Ympäristöpolitiisilla ohjaukskeinoilla on lähes aina monenlaisia merkittäviä vaikutuksia. Samalla vaikutuksiin liittyy epävarmuutta ja syy-seuraussuhteiden yksiselitteinen osoittaminen on erityisen vaikeaa, jos arvioinnissa käytetään vain yhtä menetelmää, esimerkiksi tilastollista mallintamista tai haastatteluja. Ohjaukskeinojen arviointi on perusteltua tehdä monen kriteerin avulla, koska näin saadaan monipuolisempi ja laaja-alaisempi näkemys. Päätöksenteko, joka perustuu vain yhteen kriteeriin, johtaa todennäköisesti vääristymiin ja erilaisiin ongelmiin. Todellisuudessa päätöksenteko ei perustukaan yhteen vaan useampaan kriteeriin, vaikka näitä ei aina avoimesti lausuta julki tai edes tiedosteta.

Monitieteisen lähestymistavan ongelmana on, että arvioinnissa kohdataan vaikeuksia aineiston keruussa. Tutkimuksessa havaittiin, että tietojärjestelmät eivät vielä ole sillä tasolla, että niitä voitaisiin helposti käyttää arvioinnissa. Monitieteellisissä tarkasteluissa joudutaan paneutumaan laajasti monentyyppisiin aineistoihin. On luonnollista, että silloin ei voida paneutua kaikkiin yksityiskohtiin. Toisaalta erityiskysymyksen paneutunut tutkimus tuottaa aina rajoitetun näkökulman. Johtopäätöksemme tutkimuksessa havaittujen monenlaisten vaikutusten perusteella on, että ohjaukskeinojen kehittämisen tulisi pohjautua mahdollisimman kokonaisvaltaiseen näkemykseen. Tällaisen näkemyksen kehittymistä voidaan edistää laaja-alaisilla arvioinneilla, joita yksityiskohdalliset tarkastelut voivat täydentää.

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