

Voluntary Agreements – Implementation and Efficiency

The Danish Country Study

Case Studies in the Sectors of Paper and Milk Condensing

by

Katja Sander Johannsen

Anders Larsen

AKF Forlaget
March 2000

Preface

This report is a country case study for Denmark of the implementation of voluntary agreements in industry. The case study is carried out in the sectors of paper and milk condensing. It is one out of several reports from the project: Voluntary Agreements – Implementation and Efficiency (VAIE). The report is written by Katja Sander Johannsen with minor contributions by Anders Larsen. The authors wish to thank the interviewees who contributed to this report for their cooperation.

The VAIE project investigates the conditions under which voluntary agreements can be expected to achieve environmental targets in an efficient way. This has been carried out through developing models based on economic theory, case studies of voluntary agreements in five countries, an analysis of the actual outcome of the voluntary agreements in relation to the base line, and finally an analysis of the role of EU vis-à-vis the member states regarding execution of voluntary agreements in member states and at EU level.

The project is supported by »DG XII; Science, Research and Development« through the »JOULE Programme« (Contract No JOS3-CT97-0021). Several national institutions have also financially supported the project. The views expressed in this report are the authors' alone. The project began February 1998 and ended February 2000.

Copenhagen, March 2000

Anders Larsen

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Summary

Research Questions, Theory, Methodology and Data

This report deals with voluntary agreements between the Danish Energy Agency (DEA) and Danish energy-intensive firms. It is a part of the project Voluntary Agreements – Implementation and Efficiency (VAIE), mainly financed by the European Commission (cf. Appendix 1). The overall aim of the project is:

1. To improve the understanding of Voluntary Agreements (VAs) dealing with energy efficiency and CO₂ reduction.
2. To discover under what conditions VAs can be expected to achieve environmental targets in an efficient way.
3. To give recommendations on how to improve the policy mix to be used to cope with energy efficiency and CO₂ reductions in industry via the identification of VA best-practices.

In this report we focus on two generic research questions which are closely related to these objectives:

1. What are Voluntary Agreements?
2. How do Voluntary Agreements work?

The *theoretical* starting point used in the analysis is a policy-making and implementation model. We distinguish between three phases: Policy formulation, negotiations and implementation. The implementation model is combined with a network approach emphasising the importance of the actors, their interpretation of the agreement and their mutual relations.

The *methodology* employed is the case study. In this way the report will

supplement other parts of the VAIE project. The main empirical basis for the case studies is 22 semi-structured interviews. In addition to these, the case studies are based on existing evaluations, written material from the Danish Energy Agency (DEA), The Danish Dairy Board (DDB) and the analysed plants.

One case study was carried out in the pulp and paper industry. This sector was chosen mainly to enhance comparability among the five country case studies of the VAIE project. Furthermore, as a Danish speciality, the milk condensing sector was chosen. The agreement in this sector is a combination of a sector agreement (like e.g. the Dutch scheme) and a firm-specific agreement (the typical Danish case).

The Danish Agreement Scheme

In the Danish agreement scheme companies with energy-intensive processes can enter a three-year agreement with the DEA in order to qualify for a lower tax rate. After the three years the agreement must be renewed. Two kinds of agreements can be made: Individual agreements and collective agreements.

An agreement specifies an action programme comprising:

- investment projects
- energy management
- special investigations.

The basis for the action programme is an *energy audit*. In theory, all profitable energy savings must be described in the audit report. Payback periods of up to four or six years (lowest for heavy processes) are considered profitable. If no profitable energy savings are identified in the energy audit the companies are considered energy efficient, and as a consequence these companies need not carry out further investments in energy efficiency in order to obtain the reduced tax rate. They must, however, still introduce energy management and perhaps carry out special investigations.

The collective agreements are made with groups of companies from an industrial subsector with similar production processes. The idea is to reduce administrative costs of entering an agreement. Negotiations with the DEA are conducted by the industrial organisation, but each individual company has to sign – and is committed to – the action programme. After the signa-

ture the company must carry out its obligations and report the progress in an annual report.

The DEA has been eager to improve the scheme. Two early evaluations and much internal work in the DEA have been devoted to learning from the experience with the agreement scheme (AS).

Relation to Previous Regulation

Traditionally, Danish energy regulation towards industry has been based on informative measures, e.g. free electricity audits, guides to energy-efficient equipment etc. or positive economic measures, i.e. subsidies for energy-efficient investments. However, in 1993 a tax on CO₂ emissions was introduced and in 1996 the tax was increased. In order to protect the competitiveness of the energy-intensive industry an exemption scheme was introduced in 1993 and agreements giving a tax rebate were introduced in 1996 and modified in 1997.

The design of the 1996/1997 agreement scheme studied in this report is quite similar to the CO₂ tax exemption scheme applied to energy-intensive companies in the years 1993-1995, though the latter was not called a voluntary agreement scheme. In fact, *continuity* rather than radical change characterises the relation between the 1993 exemption system and the 1996/97 agreement scheme. Both systems are concerned with activities carried out at the plant, rather than the outcomes in terms of actual energy savings or emission reductions.

Relation to Other Initiatives

There are four supporting initiatives interacting with the agreement scheme. The first initiative is the CO₂ tax. The Danish agreement scheme is part of a larger CO₂ package designed to reduce the CO₂ emissions from trade and industry. In the CO₂ package, agreements work as a supplement to a multi-level CO₂ tax scheme. In year 2000, when the Danish CO₂ package is fully phased in, the effective level of taxation will be the highest in the world for industry. The revenue derived from the tax is expected to be of approximately 325 million i , corresponding to approximately 1% of the total state revenue. The revenue is recycled mainly through lowering the non-wage labour costs, but in a transition period also through investment subsidies for projects improving energy efficiency. The importance of this tax is crucial,

as the tax rebate is the single most important incentive for the firm to enter an agreement.

The second initiative is the SO₂ tax due from 1996. The SO₂ tax can amount to almost as much as the CO₂ tax rebate. The fact that the plants cannot obtain rebates in relation to the SO₂ tax means that it will affect the profitability of energy-efficiency improvements and especially of the profitability of conversion from, e.g. coal to energy sources with low sulphur and CO₂ contents.

The third initiative is the investment grants and subsidies for energy audits. The subsidies and the investment grants are by the industry perceived as intimately related to the agreement scheme.

A fourth supporting initiative with limited impact on the specific cases is a number of informational measures, e.g. Demand-Side Management (DSM) activities carried out by the local electricity distributor, information campaigns regarding energy management etc.

The Analysed Cases

Three paper mills have entered an agreement in 1997. Out of these three mills, we chose the one with the largest energy consumption and production volume (Paper Mill East)¹ and the one with the smallest energy consumption and production volume (Paper Mill West).

The milk condensing sector consists of nine production plants of which five are owned by the largest Danish cooperative dairy group MD Foods. Our case Milky was chosen randomly.

In 1997, the energy consumption at the three plants was: Paper Mill East: 1490 Terajoule (TJ), Paper Mill West: 160 TJ and Milky: 460 TJ, corresponding to 1.2%, 0.1% and 0.4% of the energy consumption of the Danish industry respectively. The two paper mills consume about 50% of the energy consumption in the Danish paper industry, and Milky's energy consumption amounts to approximately 10% of the energy consumption in the milk condensing sector.

The specific agreement for the two papers mills contained: Investment projects amounting to, on average, 4.5% of the energy consumption, special investigations and energy management comprising, e.g. energy accounting, targeting and procedures for purchasing new energy-efficient equipment. Milky's part of the sector agreement also contained investment projects

(expected to reduce Milky's energy consumption by 5%), and energy management, but no special investigation was carried out at Milky. An energy efficiency target of 4% improved specific energy efficiency over three years was set for the whole milk condensing sector.

The Outcome

As for the specific investments, most are carried out according to the agreement in the two paper mills, whereas Milky's projects have been altered radically in the implementation process. The actual outcome of the investment projects has not been measured. Measured in TJ, the major part of the investments would have been realized anyway. The special investigations have been carried out according to the plan, and have in some cases led to the implementation of energy-conservation projects (ECPs).

Regarding the energy management, the paper mills report to the DEA and Milky reports to the DDB as prescribed in the agreement. The implementation has not been completed, but all three plants work to improve the systems as to make energy management a real management tool, even after the expiration of the agreement. The plants' problems with energy-efficient design procedures and their considerations about the quantitative targets set in the energy management indicate that in spite of modest results so far, they take energy management seriously.

The two cases (paper mills and milk condensing) show that even in this very structured scheme full compliance does not necessarily lead to results much beyond the base line. However, at Paper Mill West the complex procedures taking the mill through an energy audit and the implementation of energy management have proved to be relevant, as the mill actually took a step forward in both knowledge about and organisation of energy efficiency as a result of the agreement. In the milk condensing sector the existing network has been reinforced, new knowledge has been provided through the energy analysis and the implementation of energy management at Milky has been successful.

Provision of New Knowledge: The Energy Audit and the Role of the Consultant

The consultant's role in relation to the provision and dissemination of new knowledge varies. Even when the consultant has some experience with the

technology in a specific sector he often lacks crucial knowledge about the particular production processes at the individual plants. However, at both paper mills the consultant played an important role as a communicative link between the DEA and the mill, and the firms rely on the consultant to know the rules and requirements in relation to audit reports and agreements. It is the opinion of both paper mills that applications and other communications with the DEA are more successful when handled by the consultants. In the milk condensing sector the consultant played a role in the diffusion of knowledge about energy-efficient production in the milk condensing sector.

New Procedures

At Paper Mill West the agreement has been important in terms of immediate organisational changes and improved knowledge about energy efficiency. But the long-term effects on energy practice that are expected to rise from the energy-management activities may fail to appear if the pressure from the DEA decreases. At Paper Mill East, the technical changes (as compared with the base-line scenario) are small, but Paper Mill East has the organisational resources needed to carry out the planned activities in the future. At Milky the technical changes in terms of investment projects are not a direct result of the agreement, but the agreement has led to improved knowledge and awareness of energy efficiency, and new investment projects have been defined in the energy-management group.

A general observation concerning technical changes can be made from the case studies: the major investments that can reduce energy consumption and CO₂ emissions substantially are not carried out due to the agreements, but due to the overall strategy of the companies. These investments concern the replacement or improvement of larger parts of the production equipment, e.g. a drying tower at Milky, increased production capacity and reducing the no-load loss. On the other hand, the agreements seem to affect the decisions concerning the replacement of ventilators, pumps, electric motors etc. as these investments are often »pure« energy-efficiency projects.

Overall Assessment of the Danish Agreement Scheme

Increased Energy Efficiency and Cost-Effectiveness

The overall impact of the *Danish agreement scheme* cannot be assessed with in-depth case studies in two sectors and three production plants. But

previous analyses show a net impact of the projects in the agreements of approximately 0.5% improved specific energy efficiency per year. Further savings are expected since several companies have agreed to a number of special investigations. The special investigations are assessed to add another 0.5% improved specific energy efficiency per year for the Danish industry (Togebjerg and Hansen 1998). That is, the investment projects and the special investigations add up to 1% improved specific energy efficiency per year (excluding more dynamic effects).

Turning to the findings in the case studies, a question is whether the increased energy efficiency is reached with least cost. The same payback criterion is used in all firms, i.e. a firm with many profitable projects has to realize relatively large savings, a firm without any profitable savings now and in the future (as long as the perspective of the audit) is loaded neither with investment projects nor special investigations. Thus, in principle, the Danish scheme is far from »the nightmare of efficiency«: the general percentage rollback.

But at the end of the day, whether an obligation for a firm to carry out many projects and special investigations is due to a big potential of profitable investments, or other reasons, e.g. an interested staff or a coincidence, is hard to say. Our cases tell us both; the consultant is not blind and will find something. However, cooperation with internal staff is a precondition to include large savings projects in the agreements.

The Danish scheme is flexible in the sense that the energy-efficiency improvement demands can be adjusted to the firm specific saving potentials. But it is not as efficient as it looks at first glance. The search costs are high, and they are remarkably higher for the individual agreements than for the sectoral agreement. As for monitoring, control and prevention of free-riding we can give the Danish scheme fairly high marks.

Dynamic Considerations

As for flexibility over time, the Danish agreement scheme can be perceived as rather inflexible. However, the period of validity is limited to a maximum of three years, and when conditions are changed, the obligations can be renegotiated.

It is a weakness in the Danish AS, in general, that the scheme does not stimulate communication and diffusion of knowledge between firms,

because most agreements are individual and the consultants' ability to secure the diffusion of knowledge is limited. In contrast in the milk condensing sector, the consultant and the sector organisation have been working actively to motivate the firms, and the sector energy analysis for the milk condensing sector has been discussed among the firms with the intention of lowering the search costs.

The special investigations in the individual agreements and the development projects in the milk condensing sector are, potentially, fit to stimulate the development and diffusion of new energy-efficient technology. The special investigations sometimes lead to the implementation of investment projects, but the projects rarely involve development of new technology, and the results are not communicated to other firms. In the milk condensing sector, the development projects are designed to be of relevance to more than one firm in the sector. The consultant participates in the implementation of the development projects and the branch organisation diffuses the results by distributing reports and organising meetings concerning the projects.

Institutional Demands on the Regulator and the Regulated

The institutional demands in the AS are relatively high, but in the DEA the necessary human resources are available for the administration of the scheme. The firms use the consultants to lower the institutional demands, but this may reduce the »soft« effects of the agreements. However, the procedures are generally followed, the investments carried out and the reports written, but some of the more dynamic elements (e.g. energy management and long-run targets concerning energy efficiency) may not be as important in the firm's everyday life as one should think from reading the energy-management report.

Political Considerations

The Danish agreement scheme creates a lot of activity related to a problem on the political agenda, with few distributional consequences and with some effect. However, the political value of the AS cannot be evaluated without considering the whole CO₂ package, as the efficiency of the scheme may depend on taxes creating the economic incentive to enter into an agreement. Passing the taxes through Parliament will usually be the politically difficult

part.

Risk

The most important risk aspect in relation to the Danish agreements is that the agreements may not lead to the achievement of the national targets for CO₂ mitigation. However, as there are several supporting initiatives and continuous evaluations and adaptations of the scheme, much is done to limit this element of risk.

All in all, we can give the Danish AS fairly good marks regarding prevention of free riding, environmental effectiveness and flexibility over time and in the demands to each individual plant. In contrast, the administrative costs are high. Also, the scheme analysed in this report is better suited to lift up the rearguard than to motivate the vanguard.

Endnote

1. As this report contains very detailed information about the plants we have chosen not to use their real names. The names mentioned here are cover names.

1 Introduction

Definitions and Research Questions

This report deals with voluntary agreements between the Danish Energy Agency and Danish energy-intensive firms. It is one part of the reporting from the VAIE project (ref. Appendix 1). In this study, we *define* a voluntary agreement as a commitment referring to an environmental objective undertaken by firms and/or industrial organisations. The commitment is the result of negotiations with public authorities and/or explicitly recognised by the authorities. As we look into agreements at different levels of implementation, it is necessary to specify more clearly the term of agreements. When we talk of an *agreement scheme (AS)*, we refer to agreements used as a policy instrument – not specific agreements between two (or more) parties. When using the term *voluntary agreement (VA)*, we refer to a specific example of either a collective or an individual firm agreement. Finally, when talking of *energy-conservation projects (ECPs)*, we refer to specific technical and/or organisational activities aimed at energy efficiency at firm level and initiated by a specific voluntary agreement.¹

This terminology, the employed theory, the methodological approach and the assessment criteria are discussed more thoroughly in Kræmer and Hansen (1999). Kræmer and Hansen establish a common framework for the five country studies in the VAIE project.

The overall objectives of the VAIE project are:

3. To improve the understanding of VAs dealing with energy efficiency and CO₂ reduction.
4. To discover under which conditions VAs can be expected to achieve environmental targets in an efficient way.

5. To give recommendations on how to improve the policy mix to cope with energy efficiency and CO₂ reductions in industry via the identification of VA best-practices.

In this report we will contribute to the achievement of these objectives through the investigation of the Danish VAs on energy efficiency. The research questions of this report are:

1. What are VAs?
2. How do VAs work?

In our attempt to answer these general questions for the Danish case and enhance the comparability with the Dutch, Swedish, French and German cases, we relate our empirical findings to a set of hypotheses and assessment criteria which are common for all the country studies in the VAIE project. They are:

- a. A set of normative criteria for evaluating agreement schemes (chapter 2)
- b. Common hypotheses for the AS, VA and ECP level (chapters 2, 4 and 5)
- c. Assessment of the impact of the agreements at firm level (chapter 6)
- d. A general set of criteria for the evaluation of policy instruments (chapter 6).

The Theoretical and Methodological Approach

The *theoretical* starting point used in the analysis is a policy-making and implementation model. Various descriptions of the policy formulation and implementation process exist. In this report we distinguish (inspired by Winter 1994) between three phases: Policy formulation, negotiations and implementation at the AS, VA and ECP levels. A particular set of actors and a particular decision-making arena are related to each of these phases.

The implementation model is combined with a network approach used in technology studies and emphasising the importance of the actors, their interpretation of the agreement and their mutual relations. The different actors' understanding of the agreements, their relations and the organisational and institutional context they operate in are analysed at different

stages of the implementation process from the policy formulation, over the negotiations, to the implementation of agreements. A general assumption underlying this approach is that when a new phenomenon is introduced, actors will approach it through three steps: meaning (what is this?), identity (who am I in relation to this?) and practice (how do I use this?). Agreements can be seen as such a new phenomenon which is introduced to various actors in different contexts and interpreted into the existing understanding and routines of these actors. Thus, the different actors may ascribe different meanings to the phenomenon agreements, just as they may or may not establish new relations and practices to deal with the VA or integrate it in their existing relations and practices. For instance, an industrial plant may be part of a network concerning production technology which involves its suppliers, consulting engineers and sister plants and this network may be activated and reinforced when a new issue like an agreement on energy efficiency is introduced. The integration of the agreement in the network and everyday practices may in turn facilitate the implementation and make long-term changes more viable. However, if the agreement or parts of the agreement are in conflict with established understandings, network relations and routines, the smooth implementation of the agreement is less likely to occur. Thus, whether and how VAs are integrated in existing networks, practices etc. is important.

In this study we investigate the implementation process from the agenda setting in the work of a ministerial committee, to the implementation of specific investment projects and organisational changes at an individual plant. The policy-making and implementation model's concept of arenas shows how different actors and contexts are in play and influence the AS at each stage in the implementation process, while the network approach throws light on how the original ideas and concepts are specified and modified, interpreted and reinterpreted through this process and how the actors' relations and expectations influence the outcome of the agreements.

To investigate the phenomena emphasised by this combined approach, the *methodology* employed in this report is the case-study method. In this way the country studies will supplement other parts of the VAIE project (cf. Appendix 1). The case studies are based on existing evaluations (Krarup et al. 1997; Ingerslev et al. 1998; Buhl Pedersen et al. 1998), interviews with civil servants carried out as part of related studies, written material from the

Danish Energy Agency, a sector organisation (the Danish Dairy Board) and the analysed companies, e.g. annual reports, descriptions of projects carried out, data sheets concerning energy consumption and production. But the main empirical basis for the report is semi-structured interviews carried out at all levels in the implementation process, see table 1.1. The data collection was (with a few exemptions) ended spring 1999.

Table 1.1 Interviews carried out

Case	Danish energy agency	Industrial organisation	Firms (persons interviewed)	Consultants, technical experts and verification agents	Total
Paper and pulp	111	111	630	521	12
Milk condensing					7
General, e.g. Federation of Danish Industries					3
Total	3	2	9	8	22

1. The Danish paper industry has no branch organisation.

The choice of the pulp and paper industry for case study was mainly made to enhance the comparability among the five country case studies of the VAIE project. The milk condensing sector agreement was chosen as a Danish speciality. It is a combination of a sector agreement (like e.g. the Dutch scheme) and a firm-specific agreement (like the typical Danish case).

The use of energy in the selected sectors compared with the total Danish energy consumption and with the total industrial use of energy is shown in table 1.2

Table 1.2 Energy consumption in TJ. 1997

	TJ
Denmark ¹⁾	631000
Industry ¹⁾	125000
Paper and pulp ²⁾	3500
Selected cases in paper and pulp ³⁾	1650
Milk condensing ²⁾	5350
Selected case in milk condensing ³⁾	470

Source: 1) Energistyrelsen (1998). 2) Computer runs from Statistics Denmark. 3) Information from the case plants. There are uncertainties especially concerning the comparison between the data from the different sources.

The energy consumption of the paper and pulp sector is approximately 1/2% of the total Danish consumption and approximately 3% of the Danish industrial energy consumption. The energy consumption of the two case plants is approximately 50% of the energy consumption in the sector.

As for the milk condensing sector the energy consumption is approximately 0.75% of the total Danish consumption and approximately 4% of the Danish industrial energy consumption. The energy consumption of the case plant in the milk condensing sector amounts to approximately 9% of the consumption of the sector, i.e. a minor fraction compared with the case plants in the paper and pulp sector.

The choice of the specific plants for the Danish case studies is discussed in chapter 3.

The Structure of the Report

In this report, the implementation of the Danish agreements on energy efficiency in industry is analysed in many steps and as our numerous evaluation criteria correspond to different steps in this implementation process, assessments at the different levels (AS, VA and ECP) are placed in the corresponding chapters. Therefore, the structure of this report is as follows: In chapter 2 the Danish agreement scheme on energy efficiency in industry is presented. After the presentation of the scheme, the policy-making and implementation process is analysed in the three phases *policy formulation*, *negotiation* and *implementation* (see above) and some reflections concern-

ing the relation to previous regulation are made. We concentrate on the administrative implementation of the AS in this chapter as the implementation in the form of actual agreements and energy-conservation projects is discussed in chapters 4 and 5. Chapter 2 is closed with the testing of a number of hypotheses at the scheme level and a preliminary assessment of the scheme based on normative criteria for the negotiation and content of agreement schemes.

In chapter 3 our two cases, the paper industry and the milk condensing sector, are presented. In this chapter you can find some facts about the sectors and the case plants, two paper mills and a milk condensing plant and their agreements.

In the following chapter, chapter 4, the VA level is analysed. This means that we examine the *policy formulation, negotiation and implementation* phase of the two individual agreements between the Danish Energy Agency and the paper mills and the sectoral agreement between the Danish Energy Agency and the milk condensing sector. Chapter 4 ends with the testing of a set of hypotheses concerning the VA level.

Chapter 5 deals with the ECP level. Three ECPs (one in each of the three case plants) are described and analysed. When describing the ECPs we deviate from the structure in the chapters 2 and 4, as the distinction between three phases is excessively heavy when studying the microlevel. The description of the implementation of the ECPs is followed by the testing of a set of hypotheses concerning the ECP level.

In the final chapter, chapter 6, we assess the two case studies as regards technical and organisational changes in the plants, the relation to supporting initiatives and the fulfilment of the agreements' own targets. We conclude with a discussion of the performance of the AS with regard to static efficiency, dynamic efficiency, institutional demands, political considerations and risk.

Endnote

1. For the Danish agreements the word voluntary is normally omitted, as the Danish firms normally have a very big incentive to enter into the agreements, due to the CO₂ tax rebate. To use the same terminology in all the reports we include the word voluntary here.

2 The Danish Agreement Scheme

In the two first sections of this chapter, we will describe the Danish CO₂ policy package and the agreement scheme on energy efficiency in industry from a somewhat formalistic viewpoint. The actors and relations involved in the implementation of the agreement scheme are described in section 2.3. How the scheme came into being through a complex political process, how it relates to other regulation, which problems the scheme is supposed to solve etc. will be dealt with in more detail in section 2.4. In section 2.5 a set of hypotheses for the AS level will be tested. Finally, in section 2.6, we will discuss the agreement scheme in relation to the normative demands for the design of agreement schemes presented in Kræmer and Hansen (1999). The information in this section has been obtained from interviews with actors involved in the policy-making and implementation process (see chapter 1) and from both published and unpublished written material.

2.1 The CO₂ Package

The Danish Agreement Scheme (AS) is part of a larger CO₂ package designed to reduce the CO₂ emissions from trade and industry. In the CO₂ package, agreements work as a supplement to a multilevel CO₂ tax scheme. A brief description of the CO₂ package will therefore serve as a necessary framework for the more detailed description of the AS below.

In year 2000, when the Danish CO₂ package is fully phased in, the effective level of taxation will be the highest in the world for industry. The revenue derived from the tax is expected to be of approximately 325 million i, corresponding to approximately 1% of the total state revenue. The revenue is recycled mainly through lowering the non-wage labour costs, but

in a transition period also through investment subsidies for projects improving energy efficiency (Johannsen and Togeby 1999).

Normally, a flat-rate tax scheme with this kind of recycling of the revenue would have had an important effect on the distribution between business sectors, as it would have been to the benefit of the labour-intensive trade and services, whereas industry and particularly the energy-intensive companies would suffer from increased costs. Furthermore, such a scheme would most likely deteriorate the international competitiveness of the industry. In the Danish scheme this effect is counteracted by the distinction between three categories of energy use and five different tax levels offering a low level of taxation to the energy-intensive production plants and by the possibility for these plants to enter an agreement with the Danish Energy Agency (DEA).

The level of taxation depends on the purpose of the energy use. The energy use in industry is divided into three categories corresponding to three levels of taxation: Space heating, light processes, and heavy processes. Table 2.1, below, shows the distribution of the energy consumption in industry on these three categories. Heavy processes comprise 35 energy-intensive processes, e.g. melting, concentration and drying in relation to the production of cement, mineral wool, condensed milk, and sugar. Light processes are energy consumption related to lighting, office machinery and other non-intensive processes (Ministry of Finance 1995).

Table 2.1 Distribution of energy consumption in industry

Space heating	Light processes	Heavy processes
11%	27%	61%

Source: Danmarks Statistik 1998.

If the energy-intensive companies enter into an agreement with the DEA they are offered further tax reduction for energy consumption in relation to production processes (both heavy and light), while no reductions are offered in relation to space heating. Table 2.2 shows the different tax levels.

Table 2.2 Levels of taxation with and without agreements by year 2000, i /ton CO₂ (100 i = 750 DKK)

i /ton CO ₂	Space heating ¹	Light processes	Heavy processes
Without agreement	80	12	3.3
With agreement	80	9.1	0.4

Source: Ministry of Finance 1995.

5. When energy is used for space heating the CO₂ tax of approximately 13 i /ton CO₂ is combined with a general energy tax which is refunded for energy used for light and heavy processes. This tax is defined from the energy content. Since the carbon content varies with the energy source the tax varies when it is expressed in i /ton CO₂. The 80 i /ton CO₂ is the average actual tax level resulting from these two taxes.

The CO₂ package also comprises a flat-rate tax on sulphur. The tax is of 1.3 i /kg SO₂. As this tax is not reduced as part of the voluntary agreements, the sulphur tax can be more important than the CO₂ tax for companies with agreements if they use coal or other fuels with a relatively high sulphur content (Johannsen and Togeby 1999).

The reduction of the CO₂ emissions resulting from the CO₂ package (CO₂ and SO₂ taxes, investment grants and agreements) is expected to be 4.4% of the Danish CO₂ emissions in relation to their 1988 level by year 2005. The effect of the agreements is expected to be a reduction by 0.4% of the total Danish CO₂ emissions, corresponding to 0.4 million ton CO₂, see table 2.3 (Finansministeriet et al. 1999).² In an ex ante evaluation Buhl Pedersen et al. (1998) estimate that the *isolated* effect of agreements will be a reduction by 6.3% of the CO₂ emissions from the companies with an agreement in relation to their 1996 level by year 2005. Such estimations, however, are subject to considerable uncertainty.

Table 2.3 Estimated effects of the CO₂ package by 2005

Policy instrument	Reduction, % of total Danish emissions (1988 level)	Reduction, millions of ton CO ₂ per year
Tax on space heating	0.8	0.5
Tax on heavy and light processes	0.8	0.5
Agreements	0.6	0.4
Investment grants	1.1	0.7
Tax on SO ₂ emissions	1.0	0.6
Total reduction	4.4	2.8

Source: Regeringen 1995 and Finansministeriet et al. 1999.

2.2 The Agreement Scheme

Companies with energy-intensive processes can enter a three-year agreement with the DEA in order to qualify for a lower tax rate. After the three years the agreement must be renewed. Two kinds of agreements can be made: Individual agreements and collective agreements. Agreements can be made for both heavy and light processes. While companies with heavy processes are entitled to enter an agreement with the DEA automatically, companies with light processes are defined as energy intensive – and obtain this right – only if the calculated tax of the energy consumption amounts to at least 3% of the value added. Another condition for entering an agreement is that the calculated tax must exceed a certain minimum value³ (Ministry of Taxation 1998; Johannsen and Tøgeby 1999). Table 2.4 shows the number of agreements concluded under the AS.

Table Number of agreements

2.4

Type of agreement	1996	1997	1998
<i>Individual agreements</i>			
Heavy processes	21	41	20
Light processes ¹	-	21	10
<i>Collective agreements²</i>			
Condensed milk factories	9	-	-
Greenhouses	40	46	21
Brickyards	-	-	21
Total number of plants covered by the agreements	70	108	72

Source: Johannsen and Togeby 1999.

1. Many of the companies with agreements for light processes also have an agreement for the heavy processes.
2. The figures show the number of plants/production sites covered by the agreements in the three sectors. Some greenhouses are covered by agreements concerning both heavy and light processes.

An agreement specifies several activities which the individual company must undertake to qualify for the reduced tax rate. The company's commitments must be enumerated in an individual action programme. The basis for the action programme is energy-audit reports. An energy consultant or company staff can carry out the audit.

In theory, all profitable energy savings must be described in the audit report. Payback periods of up to four or six years (lowest for heavy processes) are considered profitable by the DEA. If no profitable energy savings are identified in the energy audit the companies are considered energy efficient, and as a consequence these companies need not carry out further investments in energy efficiency in order to obtain the reduced tax rate. They must, however, still introduce energy management and energy-accounting systems (Krarup et al.1997).

The energy-management system must be described in an annex to the agreement. According to the guidelines from the DEA (Energistyrelsen 1995)⁴ the energy-management system should include:

- energy policy and energy-efficiency targets
- energy accounting
- procedures for energy-efficient procurement and design
- education and motivation of staff.

The collective agreements are made with groups of companies from an industrial subsector with similar production processes. The idea is to reduce administrative costs of entering an agreement. The collective agreements are not based on energy audits performed in the individual companies. Instead, an analysis of energy consumption and production processes in the sector is made to identify general potentials for improving energy efficiency in the companies. The result of this analysis is reported to the DEA and used to formulate an action programme. Negotiations with the DEA are conducted by the industrial organisation, but each individual company has to sign – and is committed to – the action programme (Johannsen and Togeby 1999).

The aim of an agreement is to ensure that the companies act energy efficiently. Therefore, the definition of »an energy-efficient company« and the way in which this is interpreted in the agreements is a key issue. In principle the definition of an energy-efficient company is objective, but in practice it is very much influenced by the problem of asymmetric information: One negotiating party – industry – has detailed information on the opportunities and limitations in relation to energy savings in their specific production. The other party – the DEA – has little detailed information and must rely on other sources, such as the energy audit.

In reality the energy-audit report (for collective agreements the report on energy-efficiency potentials in the specific sector) determines whether the company is considered energy efficient or whether it has to carry out major investments in energy-saving measures in order to enter an agreement. Therefore, the energy audit plays an important role as a basis for negotiations between companies and the DEA and it is essential that the audit is of high quality (Krarup et al. 1997).

While in the first year relying on the approved consultants and the expertise of the officials in the DEA to judge whether the audit reports were of sufficient quality, the DEA made verification of the audit reports obligatory to all companies by 1997. The companies bear the cost of the verification, but they can apply for subsidies of 30-50% of their expenses for both the energy audit and the verification (Energistyrelsen 1997a). All energy audits are thus verified by an independent and certified verification agency in order to ensure an acceptable quality standard. If the audit report is not approved, it cannot serve as the basis for an agreement. Consultants who perform audits of low quality are put on an observation list by the DEA, and

these consultants may lose their right to perform energy audits if future energy audits lack high quality.

Companies with an agreement must deliver a yearly progress report to the DEA. In this report the fulfilment of the agreement must be reported together with a status for the energy management.

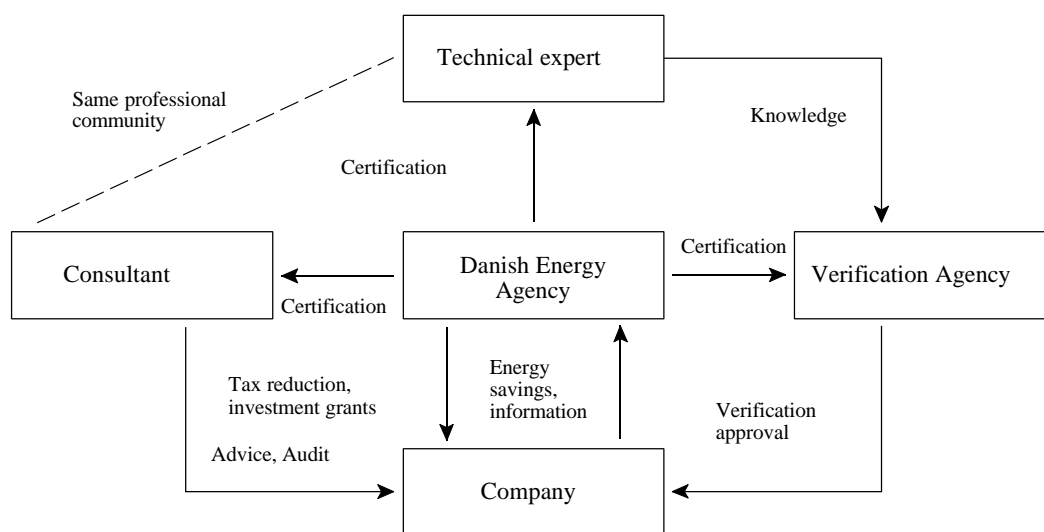
As the AS works as a supplement to the CO₂ tax scheme, there are built-in economic sanctions in the scheme. In cases of non-compliance the DEA can decide to deprive the company of the tax reduction for a whole year. Also, a board of appeal with representatives from both authorities and industry has been appointed, but no cases have yet been tried by the board.

2.3 Actors and Relations in the Implementation of the Agreement Scheme

In the process of preparing, negotiating and enforcing the agreements, different actors play different roles. Below we describe the role of each of these actors and how they interrelate in the typical course of an agreement. See also figure 2.1.

Figure Actors and their relations in the implementation

2.1 *The energy-intensive companies⁵ begin the process by notifying the DEA*



that they intend to enter an agreement within the next six months in order to qualify for a CO₂ tax reduction. The company immediately obtains a conditional tax reduction. The company then choose a *consultant* to carry out the energy audit or the audit is carried out by company staff. In the audit report all profitable energy-saving projects should be listed. The *company* then choose a *certified verification agency* to verify the audit report.

Once the audit report is approved, negotiations between the company and officials in the DEA begin. Negotiations concern, e.g. the timetable for the realisation of the projects, whether or not special investigations should be carried out, whether or not the company has to improve its energy-accounting or energy-management system etc., but the basic elements of the agreement are laid down in the consolidated act and specified in the guidelines. However, it is possible to consider the individual case and to renegotiate the agreement if the implied conditions (e.g. volume of production, quality of available raw materials etc.) are changed (Krarup et al. 1997).

The agreement listing all the company's obligations (investment projects, special investigations, energy management and energy accounting) is signed by the company manager and the DEA. After signing the company must carry out its obligations and report the progress to the DEA in an annual report. *In the collective agreements* the companies are not necessarily involved in negotiations with the DEA, nor do they have to carry out an individual energy audit. Instead negotiations take place between the companies and organisational staff within the industrial organisation.

The *consultants* (usually from private consulting engineers' companies) are approved by the DEA. When consultants carry out the energy audits they are often very dependent on the cooperation of the company staff as the consultants lack specialised knowledge concerning the production processes of each individual company. But the consultants have general knowledge about energy efficiency and the guidelines from the DEA. In some cases the consultants also advise the companies about the establishment of energy-management systems related to the agreement.

The *certified verification agency* verifies that the energy audit has been carried out according to the rules. Like the consultants, the verification agent is chosen and payed by the company from a list approved by the DEA. The verification agencies also handle cases of certification of environmental and quality management systems. The verification agent is no technical

expert, though. He mainly checks that the audit report meets the documentation requirements. In order to check the technical quality of the audit report, a technical expert (a consultant, specialised in certain production processes) is chosen by the verification agents from a list of experts recognised by the DEA. The technical experts carry out audits in other companies themselves. Thus, the verification involves a kind of peer review.

Industrial organisations at a subsectoral level are involved in relation to collective agreements (and sometimes at an informal level in relation to individual agreements). The industrial organisations coordinate collective agreements and negotiate with the DEA. The organisations can coordinate the annual reporting to the DEA and be involved in sector-specific investigations, but they are not obliged to assist the DEA in enforcing the agreement. The agreement must be signed by each individual company, and it enumerates the obligations of each individual company. The industrial organisations have also helped their member companies in their struggle with the tax authorities who administer the rules concerning the distinction between the three types of energy use. With or without an agreement, having a large part of the energy consumption defined as heavy process can reduce tax payments dramatically for some companies.

The Danish Energy Agency (DEA) is the government agency in charge of the implementation of the AS. In 1995, three new offices were set up for this task and the employees have been sent to courses in negotiation techniques in order to be prepared to meet the company managers. The numbers of offices working with agreements have now been reduced to two offices. The technical skills of the officials vary. Some are engineers, others masters of social or political science or law. Some effort has been put into providing the officials with information on energy-saving potentials and technologies, and the officials usually work in teams of two - one technician and one generalist. However, the officials – like the consultants – are usually not experts in the specialised production processes in industrial companies.

The DEA is known to have close relations to both energy consultants and the regulated industry. Traditionally, much is done to avoid conflicts and the concerned parties are usually consulted before guidelines etc. are issued, (Helby 1997). This was also the case when the DEA issued the guidelines for both the energy audits and the energy management (cf. above). The guidelines are essential for the outcome – the actual agreement – because

if the company meets the requirements in the guidelines, the DEA cannot reject to enter an agreement reducing the company's tax payment, even if the officials suspect that more energy savings could be obtained. The guidelines, and especially the documentation requirements, have been tightened up during the first years, and the approval of the audit reports is now in the hands of independent verification agents.

In the process of carrying out the energy audit and in the process of negotiation, the officials in the DEA and the company can be in touch quite frequently, as the companies have the same case officer during the whole process. The officials in the concerned offices also administer the investment grants available to the industry, and the companies often profit from their relation with the agreement case officer to clarify questions concerning investment subsidies (Krarup et al.1997). When the agreement has been signed the DEA does the following-up. This includes checking the progress reports from the companies, pointing out and sanctioning non-compliance, renegotiating in cases of changed conditions etc.

The *environmental organisations and the public* in general are not involved in the negotiating of agreements, nor are they informed of the content of the final agreements. The agreements contain confidential information on the individual companies, and therefore they cannot be made public. However, it is possible to apply for access to documents concerning the agreements.

2.4 The Policy-Making Process

2.4.1 Policy Formulation

In September 1993, the Danish government led by the Social Democrats appointed a committee of government officials from several ministries to examine the possibility of extending the use of green taxes on trade and industry *without losing international competitiveness* and jobs in trade and industry. In the committee mandate it was made clear that the aim of the green taxes was to contribute to the solution of environmental problems by changing the firms' behaviour, not to provide government with new revenues. Therefore, the revenue derived from the green taxes should be re-

cycled to the companies (Finansministeriet 1994).

Green taxes were, to a great extent, already levied on households, and the committee argued that further taxation of households without increased taxes on industry would lead to economically inefficient investments. For instance, the first Danish tax on CO₂ introduced in 1993 was levied on energy consumption in both households and trade and industry, but to trade and industry a general 50% of the tax was refunded. Large companies with energy-intensive production could submit themselves to an energy audit and get their tax payment reduced to a maximum of about 1300 i per year (see below). The effective level of the CO₂ tax on trade and industry was only 35% of the level of taxation on households (Ravn et al. 1994).

The areas where green taxes were to be introduced were not pointed out in the committee's mandate, but it was clear that new initiatives were necessary if Denmark should conform to commitments made in the national energy plan Energi2000 and in Toronto⁶ and in the EU.⁷ Therefore, an increased CO₂ tax on trade and industry became an important issue (Finansministeriet 1994). In a preliminary report, the ministerial committee suggested to increase the flat-rate tax on CO₂ for trade and industry from 13.3 i to 26.7 i per ton CO₂ and to repeal the exemptions and reimbursements due to which the effective level of taxation for industry was only 4.6 i per ton CO₂.

A large number of organisations, both consumers, environmentalists, unions and trade associations, were invited to participate in discussions concerning the green taxes, but after their first positive feedback, the environmentalist and consumers were decoupled from the negotiations (Johannsen et al. 1995).

While the environmentalists' and consumers' organisations were pleased with the proposal, industry, represented first and foremost by DI (the Confederation of Danish Industries), immediately protested against it and called for voluntary measures. Studying the possibilities of introducing voluntary measures was not originally part of the committee's mandate, but DI (supported by other interest groups) pushed for the inclusion of this possibility in the negotiations. The DI referred to the Dutch AS and claimed that estimates made by the IEA show that taxes are not an effective policy instrument in relation to CO₂ emissions.⁸ The ministerial committee dismissed the argument, and concluded that voluntary measures like

agreements could only be used as a supplement to the taxes, not as a substitute for the taxes (Embedmandsudvalget om grønne afgifter og erhvervene 1994).

Adding to the difficulties in getting voluntary agreements on the agenda in the ministerial committee was the fact that the decision-making bodies in the DI were sceptical as to whether the organisation could enter into agreements on behalf of the members. The organisation has no possibility of sanctioning member behaviour and thus hesitated to make commitments. Therefore, DI was not able to launch a pro-active voluntary strategy for CO₂ mitigation.

2.4.2 **Negotiations**

In February 1995 the ministerial committee delivered its report to the government, and parliamentary negotiations were intensified. Many models of taxation – none of them including voluntary agreements – had been proposed and discussed by the ministerial committee, but it proved to be difficult to find a majority willing to vote for any of them.

The massive opposition to the increased tax on industry was supported by many political parties concerned with the competitiveness of Danish industry. It was argued that the energy-intensive companies were already energy efficient and that if the objective was to change the behaviour of firms and not to provide new tax revenues, then these companies which cannot reduce energy consumption without reducing production should be kept free of taxation. The right-wing parties also advanced the idea of using voluntary agreements instead of taxes.

It was important for the small centre-right party in the government coalition, CD, to keep the left wing out of influence and to stress its concern for industry. Therefore, the opposition from the right-wing parties pushed CD to reject the suggestions in the report from the ministerial committee and call for voluntary measures or exemptions for industry. However, other members of the government were not prepared to abandon the tax scheme. Therefore, the idea of offering agreements giving access to a lower tax rate as a special option for energy-intensive plants came in handy (Johannsen and Togeby 1998).

Thus, while the ministerial committee insisted on the opposition to agreements, the agreements were accepted as a means to offer the energy-

intensive industries a reduced tax rate when the government took over the negotiations with industry. The fact that agreements, as suggested by industry, became a part of the CO₂ package gave CD an »excuse« for accepting the taxes and the compromise with the left-wing parties.

Concerning the design of the agreements, the government and the left-wing opposition (which eventually constituted the majority who adopted the bill) agreed that if agreements were to be introduced, there should be sanctions in case of non-compliance (Johannsen et al. 1995).

A group of government officials travelled to the Netherlands to study the Dutch AS. The scheme had been recommended by industry, and the Ministry of Trade and Industry found it interesting. However, the officials from the Ministry of Finance were not convinced that the Dutch scheme included any real sanctions.

The question of sanction was not only important because the Danish government did not believe in a completely voluntary solution. As the agreements are connected with a tax rebate, the government risked having problems with the EU legislation on distortion of the competition. Instead, a scheme with many similarities with the existing exemption scheme was designed, see section 2.4.4. Thus, in the difficult negotiations in Parliament giving a revised version of the former exemption scheme the name »agreements« became the solution that made the introduction of an increased CO₂ tax possible.

Parliament and government were not directly involved in the specific design of the scheme. This was handled by the officials in the DEA who consulted experts, and representatives from industry and utilities. DI did not want to participate in formal negotiations as the organisation was strongly against the tax scheme and did not want to legitimise it by participating in negotiations. In reality, the organisation was consulted and the scheme turned out to be acceptable to DI.

2.4.3 **Administrative Implementation**

Developing the Concept

The overall concept for the AS was formulated at ministerial level before the CO₂ law package concerning the increased tax on CO₂ emissions from trade and industry was tabled in Parliament. The concept was presented in a small publication in April 1995. The law provided for the establishment

of an AS covering the energy-intensive industry. The law also included provisions for a board of complaints. The payback period rule, identifying and including specific investments in energy efficiency in the agreements, was already part of the concept. Thus, from the very beginning it was the practical work concerning the identification and realisation of energy-saving projects that was at the heart of the AS.

The details concerning the formulation of the firm level action programmes specifying the exact obligations of the individual companies were not described in the bill. The DEA has often made use of the expertise of private consultants, e.g. also in relation to the development and evaluation of the exemption scheme. Therefore, it was quite in line with existing practice when, in the autumn 1995, the DEA established several working groups consisting of representatives from industry, utilities and some private energy consultant companies in order to make suggestions for the specific agreement design.

In a more detailed consolidated act issued in November 1995 it was made clear that the basis for the formulation of an action programme was to be energy-audit reports. The guidelines for both the energy audits and an energy-management system were elaborated by the DEA based on technical recommendations from private consultants. The first (preliminary) guidelines for the energy-audit reports were issued in December 1995.

The guidelines for the energy audits left a lot of room for interpretation – and this was a deliberate strategy. The DEA hoped to achieve better results from being flexible and letting the companies' own ideas guide the audit than they could obtain by sticking to a set of strict rules. They wanted – in full accordance with government policy – to establish a positive dialogue with industry. The role of the officials should be one of motivating the companies, by convincing them of the benefits of energy management,⁹ discussing different energy-saving possibilities and negotiating a solution that would be to the benefit of all parties.

Negotiation Strategy

The idea of a negotiation process taking place in a spirit of cooperativeness does not imply that the DEA has not been eager to get the most out of the agreements while at the same time making sure that the companies fulfil their obligations. For instance, when negotiating the timetable in the action

programmes, it is part of the administrative practice to aim at getting as many projects (investments) as possible carried out in the first year of the agreement. The idea is not only to get the benefit in the form of the CO₂ reduction as soon as possible, but also to avoid that the companies take advantage of the weaknesses in the provisions concerning non-fulfilment of agreements. These provisions make it possible for the DEA to deprive a company of the tax reduction of the past year, in severe cases of non-fulfilment. Thus, if all investments are planned in the last year of the agreement, a company can receive the tax reduction for three years without giving anything in return in terms of realised energy-saving projects and the company would only risk losing the reduction of the last year.

Even if the AS draws heavily on the experience with the exemption scheme applied in 1993 to 1995 (see below), the officers in the DEA were prepared to make something new out of the scheme. The officers expected the negotiation process to provide an opportunity to communicate with companies in a trustful way and hoped to bring the entering of agreements beyond the mere routine of rule following.

Thus, a concept of »alternative« projects was developed by the DEA to allow the companies to carry out more profitable or relevant projects than the ones the companies were obliged to carry out according to the four years payback period rule. The alternative projects can include projects concerning the light processes in a company entering an agreement concerning heavy processes, major alterations of production processes, reducing CO₂ emissions by converting to another energy source etc. The basic principle in the concept is that the activity-related goal (realisation of all projects with a payback period of less than four years) is transformed into a quantitative target (reduction of CO₂ emission by x tons). To do this the estimated CO₂ reduction that would be obtained if all the projects in the audit report with a payback period of up to four years were realised is calculated and used as a quantitative target for the agreement.¹⁰

Using this concept, the DEA expected to obtain the largest possible CO₂ reduction at the lowest possible cost, but in spite of the effort put into the development of the concept, it has not been applied extensively in practice. Instead, the companies have accepted the »obligatory« projects with a payback period of less than four years without much negotiation.

Another issue likely to be discussed in the negotiation process is the

question of projects that are subject to uncertainty. If there is considerable doubt concerning the feasibility or profitability of a project the negotiation strategy of the DEA is to have the projects included in the agreement anyway, if convenient as a special investigation. If, following further investigations, the company can document lack of feasibility or profitability the DEA can (and will) free the companies of their obligations. The advantage of including the projects in the agreement is that burden of proof lies with the company.

Relation to the Subsidy Scheme

As a part of the CO₂ package a subsidy scheme for investments in energy efficiency is established. All companies – both with and without agreement – can apply for subsidies for either standard projects or individual projects. The requirements for the companies with an agreement, however, are more strict than for the companies without an agreement. The companies without an agreement can obtain grants to projects with a payback period of minimum two years whereas the limit for companies with an agreement is three years. The reason for this is that the investment projects carried out by companies with an agreement are considered as a quid pro quo for the tax reduction. On the other hand, as part of the negotiations in relation to the agreements, the DEA can promise the companies to reserve funds (investment grants) for the projects in the agreement. In reality, this advantage for the companies with an agreement has not been very important as there has not been scarcity of funds.

2.4.4 Learning from Experience – Relations to Existing Regulation

Traditionally, Danish energy regulation towards industry has been based on informative measures, e.g. free electricity audits, guides to energy-efficient equipment etc. or positive economic measures, i.e. subsidies for energy-efficient investments. The design of the 1996/97 agreement scheme is quite similar to the system applied to energy-intensive companies in the years 1993-1995, though the latter was not called a voluntary agreement scheme. In fact, *continuity* rather than radical change characterises the relation between the 1993 exemption system and the 1996/97 agreement scheme. Both systems are concerned with activities carried out in the company,

rather than the outcomes in terms of actual energy savings or emission reductions. The idea is that by putting emphasis on the activities one can *establish new routines and practices* concerning energy-efficiency improvements within the companies. The hope is to start a dynamic and lasting process (Helby 1997). In spite of the similarities some differences exist between the two schemes. In general, the 1996/97 agreement scheme is more strict than the previous system.

Concerning the *definition of energy intensiveness and reimbursement*, the ratio between calculated tax and value added was used as a measure of energy intensiveness in the 1993 system. All calculated tax exceeding 1300 i per year was reimbursed to the energy-intensive companies that submitted themselves to an energy audit, realised certain standard projects and reported their energy-accounting activities to the DEA, regardless of their energy consumption (and the calculated tax) in absolute terms. Through this system companies could speculate in changing the formal organisation of a company by separating particularly energy-intensive entities from the rest of the plant and obtain the tax reimbursement for these entities. Therefore, the system could lead to distortion of competition between Danish companies. With the 1996/97 scheme, a fixed percentage of the tax is reimbursed and therefore the tax payments (in absolute terms) increase with increased energy consumption even for companies with an agreement. Furthermore, the energy-intensive companies with heavy processes are defined as energy intensive because their production involves one or more of the processes that are enumerated on the so-called process list, regardless of their actual energy consumption and the formal organisation of the company. However, the ratio between calculated tax and value added is still used as a measure of energy intensiveness for companies with light processes (Ministry of Finance 1995)

The core dynamic element in both schemes is the *energy accounting and energy-management systems*. Unfortunately, this element has also shown to be difficult to implement. No immediate results from the efforts can be guaranteed and the implementation of such systems touches the internal organisational processes in the individual company and are often met with reserve by the companies. The guidelines concerning these processes have been vaguely formulated and without any clear rules the authorities are often left to try to promote the ideas through information campaigns and the

like. The effect of such measures varies (Helby 1997; Krarup et al. 1997; Ravn et al. 1994). There has been a tendency to downgrade the expectations of the energy management and rely more on concrete projects in the 1996/-97 agreements, but the introduction of more precise guidelines from 1997 and the discussion in relation to an evaluation carried out in 1998 show that the concept has definitely not been abandoned in the AS. In the new scheme that entered into force in January 2000, certified energy management systems play a prominent role and the identification of energy-saving investment projects is expected to follow from good energy-management practices instead of comprehensive energy audits (Energistyrelsen 2000b).

In the 1993 system *the energy audit* mainly concentrated on service equipment, because the documentation requirements were strict for this part of the audit. The heavy processes were less systematically examined than the service equipment. The guidelines concerning this part of the audit were vaguely formulated, and therefore the companies as well as the consultants perceived it as more or less optional if one wanted to examine these parts with as much zeal as the service equipment or not (Ravn et al. 1994). If energy-saving potentials were identified, the companies only were obliged to carry out certain standard energy-saving projects if the payback period was less than two years, while no obligations existed in relation to energy consumption in the core energy-consuming processes. In this field the 1996/97 scheme goes further. With the new scheme it is made clear that the energy audit should comprise all energy consumption, and the emphasis is put on the heavy processes. Also, not only standard projects for the service equipment, but all energy-saving projects with payback periods of less than four years (six years in relation to light processes) must be carried out by the companies (Krarup et al. 1997).

The concept of »*special investigations*« is a new element in the 1996 scheme. The concept of »special investigations« can play an important role in the process of negotiation. If the DEA forced the companies to go through with the projects under uncertain conditions, the DEA could be held responsible if things went wrong. The concept of special investigations gives the DEA an opportunity of having the companies investigate the possibilities for energy savings more thoroughly in complicated or uncertain cases, before they reject them. The investigations often lead to the implementation of energy-efficiency projects (Togeby and Hansen 1998).

The inclusion of special investigations in the agreements is often a result of the verification process: If the technical expert finds that important energy-saving potentials have not been examined thoroughly in the audit report, special investigations are often used to avoid that the agreement process is delayed.

The *monitoring and sanctioning efforts* of the 1996/97 scheme are quite comprehensive as compared to the 1993 scheme. There are several indications that the guidelines were not followed in relation to the implementation of the 1993 scheme and little was done to control or sanction the implementation (Ravn et al. 1994; Helby 1997). In contrast, in 1997 not only the verification of the energy audits, but also the follow-up in the form of progress reports has led to sanctions: eight consultants who had delivered energy-audit reports of a low quality have been put on an observation list and they risk losing their authorisation to perform energy audits if future audits lack high quality. Also, one company that did not comply with the agreement has been deprived of the tax reduction.

Evaluations and Modifications of the Scheme

The DEA has been eager to improve the scheme. Two early evaluations and much internal work in the DEA have been devoted to learning from the experience with the AS. When the first agreements were closed in the late summer and early autumn of 1996, an internal follow-up was made in the DEA. The case officers were interviewed about their experience with the AS. In general, the officers were content with the principles in the scheme, whereas the guidelines for the energy audit were subject to criticism. The companies and consultants had problems understanding it and the flexible system had not proven to inspire the average company to do more than was required. Instead, some companies tended to put only a minimum of effort into the audit. Therefore, the lesson learned by the DEA was that the guidelines had to be more strict and more explicit in their requirements.

The question of the independence and qualifications of energy consultants was also an important issue. As the officials in the DEA are not technical experts, they found it hard to determine whether or not the audit report gave a misleading picture of the energy-saving potentials of the company. They also found it difficult to insist in discussions with the consultants and the companies, if they suspected that energy-saving

potentials have not been investigated thoroughly. The case officers feel that the consultants are loyal to the companies, emphasising their role as advisers rather than acting as an extension of the DEA by controlling companies. Different ways to ensure a higher quality of audit reports were discussed, among others a model including an obligatory verification of the audit reports. This was the solution which was later to be decided upon. Despite the criticism of the consultants, the DEA still agreed that provided the consultant is qualified, it is an advantage to have a consultant carry out the audits. Thus, when the obligatory verification was introduced in January 1997, so was the possibility of applying subsidies for the consultant.

The case officers in the DEA were not impressed by the results of the first agreements in terms of CO₂ abatement. Even the energy management, which was supposed to be the dynamic element in the agreements, was not easy to force upon the companies. The energy management is regarded by the DEA as a way to ensure long-term energy-efficiency improvements. In the negotiations, however, it proved to be difficult to make demands on the energy-management systems. As was the case with the audit, imprecise description of energy management in the guidelines, makes it difficult for the case officers to get through with demands. In order to remedy this problem both information on energy management and more specific guidelines has been considered and produced.

2.5 **Testing of Hypotheses for the Agreement-Scheme Level**

On the basis of the description of the Danish agreement scheme, the policy process leading to it and administrative measures taken in order to implement it, we will now discuss five hypotheses put forward in Kræmer and Hansen (1999) concerning the use of agreements as a policy instrument.

- *Industrial organisations basically support agreements in order to avoid stricter regulation, e.g. emission standards, in the future*

We can find evidence in the Danish case to support this hypothesis. Underlying the hypothesis is an assumption that the initiative leading to the use of voluntary agreements comes from these industrial organisations. This

has also been the case in Denmark. But the Danish agreement scheme was not conceived by some pro-active industrial organisation at a time when the field of opportunities concerning the choice of policy instruments was open. The threat of stricter measures, in this case increased taxation, was very real. The trade organisations tried to avoid the increased taxes by proposing the use of voluntary measures instead, but only the energy-intensive firms have the opportunity of entering agreements.

- *Politicians primarily support agreements to actively work for environmental protection without overburdening the firms*

In the Danish case the politicians certainly supported the agreements to find a way to protect the competitiveness of energy-intensive firms. The alternative was a general tax, but with a massive campaign from industry, showing how a few large firms would be forced to move their production abroad, the pressure to find a less harmful alternative was immense. The agreements became the solution.

- *Agreements as a policy instrument exclude the influence of parties not directly involved in the process, e.g. environmental organisations*

The overall design of the scheme was passed through Parliament, but the environmental organisations did not engage in a debate on this issue. The important thing for Parliament was the institution of a scheme including sanctions. In the Danish agreement scheme, agreements are based on energy-audit reports that contain confidential information. Thus, no other parties than the firm, the consultant, the verification agency and the DEA officials have access to the negotiations, nor are the exact content and outcome of the agreements available to the public. Any citizen may apply for access to the documents concerning the agreements, but if the application is granted, any sensitive information about the plants can be withheld.

- *AS is a continuation of the logic of previous energy policy towards industry*

As we have shown above (cf. section 2.4.4), the Danish agreement scheme is very similar to the system of reimbursement of energy taxes for energy-intensive firms which was applied in the years 1993-95. Furthermore, in a

more general perspective the AS also draws on the tradition of energy regulation towards industry that tries to motivate the firms in a positive way (through information and subsidies) rather than forcing them with strict administrative measures (emission standards etc.) or taxes. The new thing actually is the increased taxes, not the exemption for the industry. Therefore, the agreement scheme can be seen as a policy instrument that ties together the traditional energy policy and the new tax scheme.

- *The effects of agreements in terms of energy savings are very close to the base line scenario*

Different estimates of the effect have been made, all of them showing an effect above base line, but not far from base line. In the estimations made by the Danish Ministry of Finance the *isolated effect* of the agreements is expected to be a reduction by 0.4 million tons CO₂/year (Finansministeriet 1999). This corresponds to a reduction by 0.6% of the total Danish CO₂ emissions. As only about 200 firms are expected to make agreements this reduction at the national level corresponds to a much larger reduction at the firm level.¹¹

2.6 Evaluation of the Agreement Scheme Based on Normative Criteria

Below we will discuss how the Danish AS compare with the normative demands presented in Kræmer and Hansen (1999). The point of departure for setting up these criteria is the recommendations and considerations of the European Union research network on market-based instruments for sustainable development (Ekins (ed.) 1998). The criteria concern both the organisational prerequisites for and the content of agreements.

Criteria for the Organisational Prerequisites

- *A clear statement should be articulated concerning the role, rights and responsibilities of all parties*

In the Danish AS the distribution of roles, rights and responsibilities is clear. Obligations in the form of investment projects and special investigations to be carried out are formulated at company (plant) level,

even in collective agreements, and the tax rebate is granted to the individual company. The role of industrial organisations in collective agreements is to coordinate and facilitate negotiations and administration, and the organisation can also play a role in relation to diffusion of knowledge, but the organisation has no or few formal obligations. The DEA administers the agreements and can deprive the companies of their tax rebate in cases of non-compliance. Furthermore, a board of complaints is in place to handle the case, should any disagreements over the interpretation of the agreements persist between a company and the DEA. The very formal nature of the Danish AS is due – not only to a demand for accountability from Parliament – but to both EU and national regulation of state subsidies (i.e. the tax rebate).

- *The government should have an agency close enough to industry to understand both the concerns and the potential of business, but in turn under the control of an upper administrative branch to limit collusion (agency capture) between agencies and the industrial interests*

The DEA is potentially very close to the companies due to bilateral negotiations and in the DEA's administrative practice emphasis is put on the positive relation between the DEA and the companies. However, the verification of audit reports adds an independent third party to the list of actors in the negotiation process. The administrative procedures of the DEA have been checked by Rigsrevisionen (1998) (the National Audit Office of Denmark) and several evaluations of the scheme have been carried out. The Danish Competition Authority has not treated any cases concerning distortion of competition due to the agreements, but as industrial companies must enter an agreement to obtain the tax rebate and the access to enter into an agreement is limited, the question of competition is relevant. The access to entering an agreement is administered by the tax authorities, not by the DEA. Since the coming into force of the bill, a growing number of companies have obtained the right to enter into an agreement, as their production processes have been recognised as heavy processes. Sectoral organisations and DI have been actively involved in this process.

- *The jurisdiction in question should have an administration to interpret the terms of an agreement scheme*

The daily administration of the scheme is managed by the DEA with both technical and legal advisors among its staff. A board of complaints is established to handle disagreements between firms and the DEA concerning the interpretation of the overall rules and the specific agreements. No complaints have yet been treated by the board.

- *Environmental interests should be sufficiently organised and informed concerning the environmental performance and potentials of firms and industrial sectors*

Environmental interests were only involved in the negotiation of the CO₂ package at a very early stage and their participation was limited to discussion of the taxes. Environmental interests are not involved in neither the negotiation nor the monitoring of the agreements. The actual agreements are confidential and the DEA has not done anything to inform the public about the agreements. Information on the performance has only been available due to the evaluations (Krarup et al. 1997; Buhl Pedersen et al. 1998; Finansministeriet et al. 1999) and here the performance is only discussed at the aggregate level.

- *A system involving concerned parties, independent of industry, should be established to monitor and verify progress towards, and achievement of, targets*

The monitoring is handled by the DEA based on (documented) self-reporting from the companies. In addition to the ordinary monitoring activities, several evaluations have been made by external parties. As no quantitative targets for the isolated effect of the agreement scheme were stated ex ante, determining the success or failure of the scheme is difficult. Cf. above.

Criteria for the Content of the Agreement Scheme

- *Improvement targets and procedures should be transparent, known and understood by the key stakeholders involved*

The Danish agreements are implementation-based agreements. They specify activities (investment projects and special investigations to carry out and

energy-management systems to implement) to be undertaken instead of quantitative emissions reduction targets. Making sure that the obligations in the agreement are clear and unambiguous is part of the technical expert's job. The projects and special investigations should be well described in order to avoid disagreement over the fulfilment of obligations. Until now, no disagreements have been sent to the board of complaints.

- *There should be a mechanism for imposing sanctions in the event of non-compliance*

It is possible for the DEA to deprive companies that do not comply with the agreement of their tax rebate. This has only happened once, but the DEA is aware that it is necessary to sanction poor performance to set an example and make companies take the agreements seriously.

- *Before adopting reduction targets, procedures or investment criteria, an independent estimation of business as usual should be made to give a counterfactual that is a likely outcome in the absence of a VA*

No estimations of business as usual have been made prior to the adoption of targets. The energy-efficiency potential is, however, identified through the energy audits.

- *Obstacles to restrain free riders should be implemented when an AS involves a collective of firms*

Possibilities of free riding are non-existing in the Danish AS. Obligations and advantages (tax rebate) are individual for both individual and collective agreements. This is a very deliberate strategy: When connected with the tax rebate, the AS cannot allow free riding to take place.

Endnotes

2. No official estimation of the isolated effect of the agreements dating back to 1995 can be found in the documents concerning the scheme. At least two such estimations were made at the time, but due to disagreement between the DEA, the Ministry of Taxation and the Ministry of Finance, they were never published. Instead, and as a compromise, an estimation of the effect of agreements and investment grants was made public. The 0.4 million ton estimate figures in the official report (Finansministeriet et al. 1999) evaluating the effect of

the green taxes on trade and industry.

3. 1,333 i in 1996 increasing to 2,667 i in 2000, 100 i =750 DKK.
4. In 1996 firms with a BS7750 or EMAS certification were not obliged to make any additional energy-management plans. This was changed in 1997, when the guidelines were tightened up (Energistyrelsen 1997b). With the new guidelines new aspects, e.g. evaluation of the energy-management system, were included in the requirements and several of the existing demands were specified in more detail.
5. Many of these companies have already obtained tax reductions and carried out energy audits under the exemption scheme (1993-1995).
6. Reduction of the Danish CO₂ emissions by 20% in relation to their 1988 level by year 2005.
7. Stabilisation of CO₂ emissions at their 1990 level in year 2000.
8. The publication referred to by DI is the 1994 edition of »World Energy Outlook«. The ministerial committee did not accept DI's interpretation of the figures in the report.
9. Referred to as »a cheap and efficient way to reduce energy expenses in the companies«.
10. The same principle is used in relation to renegotiations when companies are unwilling or unable to carry out one or more projects in the action programme. In such cases, the original project can be replaced by an alternative project. The alternative project then must lead to a CO₂ reduction that corresponds to what would have been realised if the original project was carried out.
11. In an evaluation made for the DEA, Buhl Pedersen et al. (1998) estimate that the *isolated effect* of agreements will be a reduction by 6.3% of the CO₂ emissions in the firms with an agreement by year 2005.

3 Presentation of Cases

3.1 The Pulp and Paper Industry

The pulp and paper industry has been chosen to enhance comparability with the country studies in Sweden, the Netherlands and Germany. The pulp and paper industry in Denmark consist of five small and medium-sized paper mills. They have all signed agreements with the DEA.

The Danish pulp and paper industry has experienced several years of turbulence in the 1990s. Deficits have been common and most paper mills have changed ownership once or twice during these years. The industry has no branch organisation.

The Danish pulp and paper industry relies on imported pulp and recycling of waste paper in the production. The plants in the pulp and paper industry must have an environmental permit. Like firms in other industrial sectors, they must pay energy taxes, SO₂ taxes and CO₂ taxes. As the pulp and paper sector is energy intensive, the plants in this sector have had the possibility of avoiding the CO₂ tax by joining the exemption scheme from 1993 to 1995.

We have chosen two paper mills with individual agreements in this sector. As this report contains very detailed information about the plants we have chosen not to use their real names. Thus, in this report we call the two plants Paper Mill West and Paper Mill East. As only five plants have entered an agreement, the possibilities of choice were limited. The Danish agreements expire after three years and some important alterations of the AS were made in 1997.¹ Therefore, in order to study agreements that are entered after the adjustments of the AS and still in effect, we decided to find our cases among plants with an agreement from 1997.

Only three paper mills have entered an agreement in 1997. We have

chosen a maximum variation design to explore how differences in the importance of the energy consumption may affect the mills' approach to agreements on energy efficiency. Thus, out of these three mills, we chose the one with the largest energy consumption and production volume (Paper Mill East) and the one with the smallest energy consumption and production volume (Paper Mill West). Table 3.1, below, shows some key figures for the two case paper mills. The figures illustrate the great difference between the two paper mills: Whereas the energy cost is the single most important cost for Paper Mill East, it is only a minor cost for Paper Mill West, in spite of the lower energy intensity of the paper produced at Paper Mill East.

Both paper mills have production processes listed on the so-called »List of processes« enumerating approximately 35 heavy processes (cf. section 2.1). Thus, the two paper mills have both been entitled to enter an agreement and receive a tax reimbursement since January 1996. Nonetheless, they both waited till 1997 before concluding an agreement.

Table 3.1 Key Figures for the Paper Mills East and West

100 i =750 DKK	Paper Mill East ¹	Paper Mill West
Turnover (i /year)	60,000,000	15,466,667
Energy consumption (TJ/year)	1,488	162
Volume (ton/year)	194,000	11,900
Employees	160	135
Energy consumption GJ/ton	7.7	13.6
Energy cost share of turnover %	40	5
Tax rebate (i /3 years)	400,000	60,000

Source: Interviews with and written material from the paper mills.

1 Figures concerning Paper Mill East are from 1996, figures concerning Paper Mill West are from 1997. Both paper mills expect to increase production volume and turnover in the coming years.

Both mills have been suffering poor economic results in the 1990s. They have both been sold quite recently and reduced their staff, and new managers (a.o. energy managers) have been appointed recently. The mills' uncertain future and poor economic performance also resulted in a low

investment rate during the early 1990s. Both mills have paper machines with very old machine parts (some parts are from the end of the nineteenth century).² These machines have been optimized through numerous alterations.

3.1.1 **Paper Mill West**

Paper Mill West is an SME, established in 1844, with approximately 135 employees. Since autumn 1996 the mill has been owned by a German company. Before that time it was owned by the Swedish company Stora.

The mill produces high quality paper for special purposes: Paper with watermarks, paper used for stamps, cheques, passports, train tickets etc. The mill has specialised in the production of paper with individual watermarks in small quantities. It is crucial for the mill's competitiveness that the paper is of high quality. The mill uses virgin fibres only, and the pulp is imported from different countries. The production volume is modest: 15,000 tons approximately in 1999. The production as well as the turnover are, however, expected to increase during the coming years. Paper Mill West exports its products to the whole of Europe and Asia.

In its hometown Paper Mill West has a good reputation as a very special old Danish firm and the mill is not under strong pressure over environmental issues in its local community. The mill has an environmental permit and cleans its waste water for chemicals. The mill's most important environmental problem is noise, as it is located in an urban zone.

The mill produces its own steam in a turbine which also produces a small quantity of electricity. A hydro-powered turbine also produces electricity. The rest of the electricity is supplied from the grid. The annual energy consumption is of approximately 9,000 MWh electricity and 36,000 MWh natural gas per year.

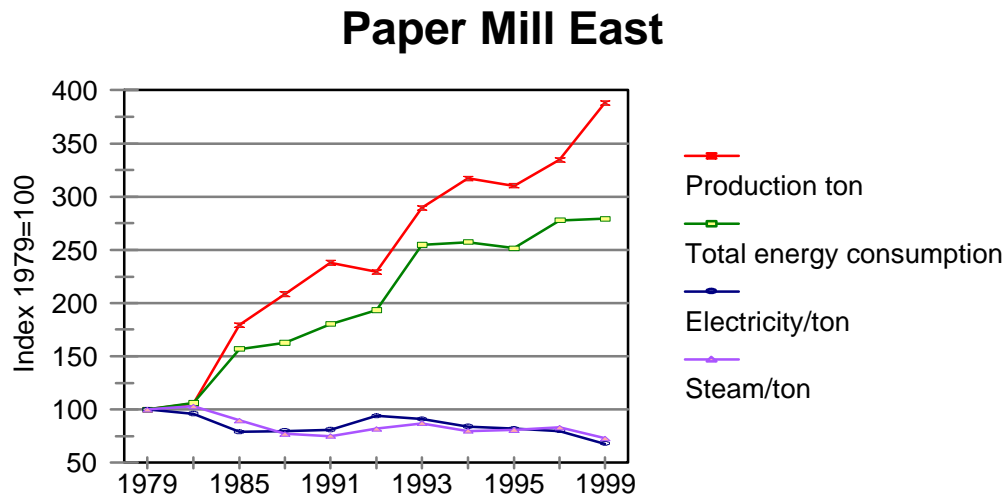
3.1.2 **Paper Mill East**

Paper Mill East was established in 1956 and has around 160 employees. The paper mill's main products are test liner and fluting (all products »packaging paper« in the FAO categorisation). The paper mill only uses waste paper (and paper board) and the pulping is an integrated part of the production. In contrast to Paper Mill West, Paper Mill East produces large quantities. The production volume in 1996 was 194,000 tons. See figure 3.1

for the development in the production volume and specific energy consumption (SEC) at Paper Mill East.

Figure 3.1 Production and energy consumption

Over the period 1979 till 1997 the production has increased by nearly



Source: Paper Mill East

400%, and the energy consumption is increased with nearly 300%. This corresponds to a 25% reduction of the specific energy consumption. The figure thus illustrates the difference between energy consumption and specific energy consumption.³

Paper Mill East is a very energy-intensive paper mill. The energy costs accounts for about 40% of the paper mill's turnover. In 1996 the energy consumption was 1156 TJ steam (5.9 GJ /produced tons) and 92,100 MWh electricity (484 kWh/ produced tons). The mill is the largest energy consumer in the pulp and paper sector in Denmark. The electricity is delivered from the grid and the steam is delivered from a local combined heat and power station. The mill also has boilers of its own, but they are only used in cases of failing supply from the local CHP station.

Potentially, the production in Paper Mill East can be the cause of environmental problems, but Paper Mill East has a closed process water system which has reduced problems with waste water disposal. Furthermore, the paper mill tries to minimise its water consumption from

the local water supply by using rain water, water from a stream etc. Paper Mill East has an environmental permit and publishes environmental (green) accounts. Therefore, the paper mill is used to openness in relation to environmental issues and energy consumption. Like Paper Mill West, Paper Mill East is placed in an urban zone and the most pressing environmental problems are noise and smell.

The customers are mostly concerned with classical environmental problems, but the paper mill has a reputation in the field of energy efficiency among other firms from different network activities. Paper Mill East sells 50% of the production to the domestic market and the rest is exported to Northern Europe.

3.2 **The Agreements**

In order to demonstrate the kind and dimensions of the obligations assumed by the case paper mills, their agreements will be described in more detail below. It should be noted that the projects described below are the projects mentioned *explicitly* in the agreement. During the energy audit, due to energy management or ordinary investment decisions, other projects may be identified and carried out. As an example, a project concerning Paper Mill West's hydro-powered turbine is not included in the agreement, because it concerns the supply side and not the production.

3.2.1 **Paper Mill West's Agreement**

Paper Mill West's agreement was signed in October 1997 and includes four energy-efficiency investment and three special investigations to be carried out and an energy-management system to be implemented. In table 3.2 some data concerning the investment projects are displayed.

Table 3.2 Investment projects in Paper Mill West's agreement

Project	Investment ¹	Payback period	Energy saving	CO ₂ reduction
10. On/off drive of compressor	0	0	59 MWh/year	41 tons/year
11. Sectioning of compressed air system	7,467	5 years	34 MWh/year	24 tons/year
12. Closing down rectifier	–	–	250 MWh/year	175 tons/year
13. Improving transportation of rolls and packing procedures	–	3.1 years	597 MWh/year	218 tons/year

Source: Paper Mill West and DEA. The energy savings cover different energy sources, therefore the relation between the energy savings and CO₂ reductions varies. The CO₂ reduction per saved MWh is assumed to be 700 kilo (ref. Munksgaard and Larsen 1996).

1. In i . 100 i =750 DKK.

Investment Projects

1. *On/off Drive of Compressor*

The project was carried out before the agreement was signed, but is a part of the agreement, as it was identified in the energy audit.

2. *Sectioning of Compressed Air System*

Carried out in June 1998. This investment project has been chosen as our case ECP at Paper Mill West, analysed in chapter 5. The main reason for the selection of this project is that it was practically the only project carried out by the time of data collection. Other projects, particularly the special investigations, may lead to more fundamental changes in energy practices.

3. *Closing Down Rectifier (Abandoning Use of Direct Current)*

The project concerns the abandoning of the use of direct current and closing down the rectifier. The implementation has been delayed because the lifts at the mill use direct current and must be replaced before the rectifier can be closed down. However, this has not yet been possible due to a bottleneck problem in the lift service sector. To be implemented before April 1, 1999.

4. Improving Transportation of Rolls and Packing Procedures

Originally, this project was not part of the agreement. When entering into the agreement the mill scrapped and reprocessed about 20% of the paper produced. Reprocessing the paper is costly and increases the energy consumption per unit sold. By reducing the amount of paper to be reprocessed due to damages resulting from rough treatment, a lot of energy can be saved. After the agreement was signed, the mill found out that new procedures for packing and an improved transportation system could lead to a reduction of the amount damaged paper, and be a profitable investment. When the mill applied for an investment grant for the project, the officials in the DEA insisted that the project became part of the agreement. This is now the case. The project should have been realised before the end of 1998, but has been delayed.

Special Investigations

1. Mapping of steam consumption. New meters will be installed and connected to the production control & monitoring system. This should facilitate the energy accounting and make it possible to make a more correct distinction between heavy and light processes. Furthermore, the investigation will allow the mill to make a more precise cost-based price-setting.
2. Optimal stirring time in pulpers. (This investigation has been completed. The stirring time has been reduced by 60%, and the energy consumption has been reduced by approximately the same share.)
3. Electrical brake on roll works. The consultant and the mill staff disagreed about the profitability of this project. Further investigations are made. The mill does not expect the investigation to lead anywhere, but the DEA is more optimistic.

Energy Management

In addition to the investment projects and the special investigations, the mill must implement an energy-management system. A report describing the energy-management system of Paper Mill West and how and when the different parts will be implemented is enclosed in the agreement. In

accordance with the guidelines from the DEA, Paper Mill West's energy management as described in the plan will include the following six elements:⁴

1. Energy Policy and Targets

The mill must have an energy policy with targets for the development in the energy consumption. These targets can be both qualitative and quantitative. Paper Mill West's energy policy is to reduce the specific energy consumption continuously. Paper Mill West has set three quantitative targets for the period 1997 to 1999:

- To reduce electricity consumption per ton paper by 3% in relation to the 1996 level annually.
- To reduce fuel consumption (exclusive of fuel for steam turbine) per ton paper by 3% in relation to the 1996 level annually.
- To reduce the percentage of scrapped and reprocessed paper to 20% 1997, 19% in 1998 and 18% in 1999.

2. Organisation

An energy group has been established and is expected to meet 3-4 times a year. An energy manager has been appointed and his responsibilities have been specified.

3. Energy Accounting

Energy consumption data are registered daily and compared with the data for the previous days. The energy key figures for each day should be compared with days with similar production volume. The energy key figures will be used to identify energy-saving potentials and to calculate the energy costs related to different products.

4. Procedures for Energy-Efficient Design and Purchase of Energy-Consuming Equipment

When designing projects with a considerable energy consumption (more than 100 MWh electricity or 300 MWh steam a year) Paper Mill West will examine a draft project in order to identify energy-efficiency potentials. Paper Mill West does not expect to purchase much energy-consuming equipment in the coming years, but when replacing motors the mill will

purchase energy-saving motors, and suppliers will be asked to give at least one more energy-efficient tender in addition to their standard tender.

5. Education and Motivation of Staff

When the plan was formulated, Paper Mill West just launched an education programme with the intention of reducing the amount of scrapped paper (but without a more general energy-efficiency approach). In addition the energy manager is expected to participate in courses on energy efficiency a couple of days a year. Also, staff will be informed about the targets and the development in the energy consumption through the internal magazine.

6. Evaluation of the Energy-Management System

The energy management will be evaluated and revised by the energy group once a year.

3.2.2 Paper Mill East's Agreement

Paper Mill East's agreement was signed in August 1997 and includes four investment projects and eight special investigations as well as an energy management. The specific content of the agreement is described below. Table 3.3 shows data concerning the investment projects.

Investment Projects

1. Replacement of a Pump

To be implemented before the end of 1998.

2. Insulation of Process Pipes

To be implemented before the end of 1998.

3. Optimization of Paper Machine 1 (PM1) – Part two

Originally, the third project concerned the belt drives. The idea was to replace all V-belts with flat-belts. The estimated energy saving was 115,000 kWh/year and the project should have been carried out before the end of 1998. The energy manager fears that the replacement will wear the machines down faster and lead to increased maintenance costs and decreased production stability. Therefore, the mill applied for a permission to substitute the project on the belt drive with a project concerning the preparation of the raw materials (optimization of starch boiling). This project was the result of a special investigation. The reduction in energy consumption was estimated to 1,048,000 kWh/year, but the payback period

was 7.5 years. Therefore, the mill is not automatically obliged to realise the project. The DEA accepted the project as a substitute. Before the starch boiling project was carried out, an experiment with enzymes began to look promising. If the results are positive, the production process may be changed, and render the starch boiling project superfluous. Therefore, a new project concerning the optimization of PM1 has been suggested by the mill. The mill expects the DEA to accept this solution, but negotiations have not been terminated.

4. Optimization of PM1

To be implemented before the end of 1997. This investment project has been chosen as the case ECP at Paper Mill East due to its large size and early deadline. The implementation of the project is described and analysed in chapter 5.

Table 3.3 Investment projects in Paper Mill East's agreement

Project	Investment ¹	Payback period	Energy saving	CO ₂ reduction
1. Replacement of pump	13,600	6.1 years ²	51 MWh/year	36 tons/year
2. Insulation of process pipes	10,400	0.75 years ³	300 MWh/year	407 tons/year
3. Optimisation of PM1, part two	1,600,000	-	15,768 MWh/ year	8,457 tons/year
4. Optimisation of PM1, part one	1,666,667	5.1years	13,850 MWh/ year	5,316 tons/year

Source: Paper Mill East and DEA. N.B.: the energy savings cover different energy sources, therefore the relation between the energy savings and CO₂ reductions varies.

1. In i . 100 i = 750 DKK.

2. Payback period of the project carried out. Payback period estimated in the audit report: 4.4 years.

3. Payback period of the project carried out. Payback period estimated in the audit report: 4.2 years.

Special Investigations

Most of the eight special investigations in the agreement concentrate on the optimization of another paper machine, PM3. There are, however, also investigations concerning, e.g. lighting and pulp preparation.

Several special investigations are finished and the mill has carried them out as energy-saving projects. Data exist concerning one of these projects:

Optimization of PM3

Investment: 848,267 i

Estimated reduction in energy consumption: Electricity: 440,807 kWh/year, heat: 5,793,075 kWh/year.

Estimated CO₂ reduction: 2,526 tons/year.

Payback period: 7.5 years.

Energy Management

At Paper Mill East the energy management is integrated in the environmental management and quality management system, and the energy manager is responsible for the development of all three systems. Paper Mill East's obligations concerning energy management are described in a fairly detailed plan for the elaboration of the energy-management system at Paper Mill East. Below, the main content of this plan is summarized. The practical implementation of the plan will be discussed in section 4.1.3. The plan consists of six elements:

1. Energy Policy and Targets

Paper Mill East's energy policy is integrated in the environmental policy. The statements are ambitious, but the targets are difficult to measure. For energy, the aim is »to be one of the most energy-efficient mills of all mills in Europe in the production of fluting and test-liner«. When the plan was made, Paper Mill East did not have any quantitative targets for the development in energy efficiency. As a part of the agreement more specific (measurable) targets must be set before the end of October 1997.

2. Organisation

A plan for the organisation of the energy management with definition of the tasks of each key staff member in relation to energy management has been made. An energy group in charge of the energy-management system has been established and an energy manager also occupied with the environmental management, has been appointed.

3. Energy Accounting

In Paper Mill East, data concerning the consumption of electricity and steam are registered in a computerized system and complemented with data

collected manually. The registration and processing of energy data are done monthly. The mill wants to improve its energy-accounting system to be fully automatic. When the new system is in place, processing of data will be done on a weekly basis. For each paper making machine the specific energy consumption is calculated and the development analysed. Based on the analyses, an energy-activity plan is made. The activity plan is revised quarterly and a report is made annually.

4. Procedures for Energy-Efficient Design and Purchase of Energy-Consuming Equipment

In August 1997, when the energy-management report was edited, Paper Mill East did not have any formal procedures concerning the purchase of energy-consuming equipment, neither for the purchase of standard equipment nor for the design of large investments. According to the plan, Paper Mill East will make the instructions for purchasing energy-efficient equipment and for energy-efficient investment design before the end of May 1998.

5. Education and Motivation of Staff

At Paper Mill East key staff members have participated in a course on energy management prior to the agreement and several other courses are planned. The aim is to make all staff members aware of the importance of the energy consumption and how they can influence the energy consumption through their own work.

6. Evaluation of the Energy-Management System

The mill management must evaluate the energy-management system annually – in relation to the reporting to the DEA. In addition to this, Paper Mill East plans to carry out internal audits of every part of the energy-management system at a frequency adjusted to the importance of the individual element, but at least once a year.

3.3 The Milk Condensing Sector

We have chosen to study the sectoral agreement in the milk condensing

sector as a national speciality. The sectoral agreements in the Danish AS are different from most other sectoral approaches in that the plants engaged in the agreement have individual legal obligations as a result of the agreement. The milk condensing sector was the first sector to enter a collective agreement on energy efficiency. Only two other sectors have made collective agreements: greenhouses and brickyards. The reason for not choosing any of these two sectors is that the greenhouses are not industrial companies and the brickyards did not make an agreement before 1998 making a study of the implementation more speculative.

In the negotiations, the milk condensing sector was not represented by an organisation of its own, but by the Danish Dairy Board (DDB) which is also representing conventional dairies. The DDB takes care of the interests of the companies in relation to the authorities. The milk condensing sector consists of nine production plants of which five are owned by the largest Danish cooperative dairy group MD Foods. The remaining plants are owned by large foreign companies like Nestlé or other Danish cooperative dairies.⁵

The milk condensing sector is the most energy-intensive subsector represented by DDB. The most energy-consuming production processes are spray drying and condensing. The production facilities in the sector have been installed over a long period of time and when the agreement was negotiated it was estimated that important energy savings could be realised through optimisations, replacements, implementation of new (but existing) technology. However, an improved process management and capacity utilization can also contribute to energy savings, as the starting up and cleaning consume lots of energy.

Our case plant, for reasons of confidentiality called Milky in this report, produces about 25,000 tons of milk powder a year. For this part of the plant's production the price is the crucial parameter in the competition with other plants. In addition to the milk powder, the plant also produces different specialised nutritive products, and in this field the quality is more important than the price. The plant exports most of its production to the Middle East, Africa, South America and Asia and its most important competitor on the world market is Nestlé.

The plant is part of a Danish cooperative dairy group which has its own environmental policy covering both working environment, the external environment and use of natural resources, including energy consumption.

According to the plant manager, the environmental policy is important for the domestic market, whereas it is of no particular importance for the export market. The plant has no major environmental problems.

3.4 The Agreement

The VA was concluded between the Danish Energy Agency (DEA) and the Danish Dairy Board (DDB) and the plants in the milk condensing sector in September 1996. Like all agreements within the Danish AS, the agreement concluded with DDB lasted for three years, that is until January 1999.⁶ Due to uncertainty about the future requirements related to revisions of the AS, the agreement has been prolonged until July 1, 1999.

The agreement resulting from the negotiations enumerates 29 energy-saving *investments projects* to be carried out in the sector and 12 so-called potential energy-saving projects. The latter are optional as they have payback periods above four years. The idea is that a potential project is implemented if one of the obligatory projects is not implemented. Most of the investment projects concern improved energy efficiency in the standard technologies in the sector such as variable speed convertors in spray driers, multi-step condensers and evaporators, optimization of cooling processes and heat recovery projects. Similar projects are carried out at several plants. Other projects are individual projects related to the particular technology at one particular plant.

In addition to this, four *development projects* are included in the agreement. The development projects concerning new technology or experiments aiming at diffusion and adaption of existing technologies to new areas. The development projects concern production integrated energy accounting and energy-efficient cleaning⁷ and drying. The projects are carried out at one plant, but as these processes are common in the milk condensing sector the results are expected to be applicable in other plants in the sector.

Finally, the participating plants are bound to implement *energy management* as described in the guidelines from December 1995. An energy-management plan covering 1) energy policy and targets, 2) organisation, 3) registration of energy consumption and formation of key

figures (energy accounting) and 4) education and motivation of staff.

The sector has formulated a common energy policy stating that the sector aims at being among the most energy-efficient plants in Europe and strives to increase energy efficiency through improved energy accounting, investments in energy-efficient equipment, motivation and education of staff and through the collection of energy indicators. The sector as a whole committed itself to a 4% reduction in specific energy consumption over three years. If all the projects in the agreement are carried out according to the plan and the estimations of the effect on the energy consumption are correct, no further efforts from the plants will be needed to reach this target. This commitment is not legally binding.

Concerning the organisation, all plants commit themselves to undertake the following activities: appoint an energy manager and delegate the responsibility and competences related to energy consumption, make procedures for the collection, processing and utilization of energy and production data, make motivation and education programmes for relevant staff and make procedures for the procurement of energy-efficient equipment.

A common plan for the registration of energy consumption and the formation of key figures has been formulated by the consultant. The plan implies that the registration becomes gradually more detailed over the years 1996 to 1998 and that more key figures are specified.

Regarding education and motivation of staff, an existing in-service training committee for the dairy sector will organise courses in energy management for managing staff as well as other relevant staff. The courses are carried out in 1997 and 1998.

Milky's Commitments

Milky is committed to carry out two investments projects:

1. Variable speed convertor on spray drier

2. Waste heat recovery from CHP plant

None of the projects in Milky's part of the agreement have been carried out entirely as planned. However, the ECP studied in chapter 5 of this report is a project concerning waste heat recovery, i.e., it is a modified version of this

project.

A potential project is also included:

3. Plate cooler as evaporator in ice water production facilities

Table 3.4 Investment projects in Milky's agreement

Project	Investment ¹	Payback period	Energy saving	CO ₂ reduction
1. Variable speed convertor	52,000	2.9 years	364 MWh/year	250 tons/year
2. Waste heat recovery	266,667	3.2 years	5,870 MWh/year	1,183 tons/year
3. Plate cooler	50,000	4.9 years	208 MWh/ year	150 tons/year

Source: Milky. N.B.: The energy savings cover different energy sources, therefore the relation between the energy savings and CO₂ reductions varies.

1. In i . 100 i = 750 DKK.

Milky is not involved in any of the development projects but the plant is committed to the energy-management plan like any other plant in the milk condensing sector.

Endnotes

1. Stricter guidelines and obligatory verification of audits.
2. Even if the East mill was not established before 1956, some parts of the machines at the paper mill are older.
3. It also gives some hints concerning the use of bench-marking. Does a good score in bench-marking tell something about the energy efficiency of the technology or does it tell something about the use of the installed production capacity?
4. The implementation of the energy-management system will be described in section 4.1.3.
5. The owner structure in the sector has been centralised further after the agreement was signed, as MD Foods has taken over another plant and MD Foods and Kløver Mælk the second largest cooperative dairy group merged.

6. Even if the agreement was not signed before September 1996, the milk condensing sector received a tax rebate from January 1 1996 and thus expires in January 1999. The reason is that in the Danish AS, the tax rebate is given immediately after the plant/sector sends a letter of intent to the DEA, whereas the agreement should be signed after 6 six months (i.e. after the audit and the negotiations). In the case of the milk condensing sector, the signature of the final agreement was delayed.
7. According to the consultant, due to the importance of hygiene in the milk condensing sector the plants in the sector tend to overdo the cleaning and consume a lot of energy in cleaning processes. The same holds for cooling, which is also overdone by some plants.

4 Voluntary Agreements in the Sectors of Paper and Milk Condensing

4.1 The Policy-Making and Implementation Process in the Paper Industry

In this section we describe and analyse the implementation of two VAs in the paper industry through three phases: policy formulation, negotiation and implementation. In each of these phases we investigate the actors involved, their relations, their understanding of the VA and how they acquire different kinds of knowledge etc. The theoretical framework for this analysis is described in Kræmer and Hansen (1999), see also chapter 1.

4.1.1 Policy Formulation

Distinguishing between policy formulation and negotiation in the process of entering into an agreement is no easy task, when it comes to the description of specific cases. In the Danish case we will discuss the mills' decision to make an agreement, the energy audit and the verification of the audit report as policy formulation, whereas the section on negotiation concentrates on the negotiations between the firm and the Danish Energy Agency and the specific content of the agreement. In the section on implementation we discuss the mills' work with energy-conservation projects, energy management etc.

Motivation

In both paper mills, the decision to enter into an agreement was made at the plant level without interference from the parent firm. The primary motivation for the mills to enter into the agreements was the economic benefits: reduced energy costs due to the tax rebate and energy savings. In addition to this both mills tend to perceive the investment grants and the

agreement as closely interlinked. None of the firms have discussed the decision with their industrial organisation. One of the mills was contacted by an energy consultant who suggested that they enter into an agreement and offered to carry out the audit. The other mill was looking for general cost savings and the agreement was an opportunity to cut energy costs while developing the energy-management system and being environmentally sound. In contrast, ideas about changed relations with the DEA or particular benefits from being pro-active were not in play.

Relation to Previous and Existing Regulation

Both plants are subject to an environmental permit system and both plants have also been exempt from the CO₂ tax from 1993 to 1995. However, the records of Paper Mill West's experience with the former exemption scheme are rather vague. A large part of the staff has been changed since that time. The plant was at the time owned by another company, which handled the formalities related to the exemption in 1993. The parent company was, however, already planning to sell Paper Mill West and did not want to invest large amounts in improving the production equipment. Therefore, even though an energy audit was carried out in relation to the exemption scheme, it did not have any effect in terms of specific investment projects or energy-management activities. Thus, even if Paper Mill West has gone through the process of having an energy audit, of reporting to the DEA etc., due to changes in key staff members, the experience from this process has not been stored in the organisation.

In Paper Mill East, some continuation between the former exemption scheme and the current agreement scheme can be noted. Whereas the mill manager and the energy manager have little specific knowledge about the former scheme as they have been appointed to their current positions recently, another staff member and former energy manager states that the new scheme did not introduce any new ideas that had not been dealt with in relation to the exemption scheme. Consistent data concerning the development in energy consumption from the 1970s till today exist and the firm has participated in several other programmes and energy-efficiency activities.

Paper Mill East has worked with energy efficiency for a long time and participated in other voluntary programmes, but some of the existing

activities in the field have been laying dormant and planned activities have been delayed due to organisational changes. Paper Mill East has been in contact with the consultant and the DEA from time to time over the last couple of years due to applications for investment grants.

Generally speaking the discontinuation in the work with energy efficiency in the firms seems to stem from internal organisational changes – especially replacement of key staff members – rather than from major changes in the policy instruments.

Knowledge

The DEA's consideration about the need for information and exchange of knowledge in the policy formulation process is reflected in the guidelines for energy audits and the description of energy-management systems. The gathering and processing of this information are largely in the hands of consultants.

In Paper Mill West, the energy audit was carried out by an energy consultant who has some experience with the energy efficiency in paper production from doing audits and other analyses in five paper mills in Denmark. The consultant also carried out the energy audit in 1992, but this has not been mentioned by the current staff at Paper Mill West. The consultant's knowledge about the paper industry is seen as an advantage by the firm, even if his knowledge about the specific processes in Paper Mill West is limited. The energy manager estimates that approximately half the projects in the audit report have been initiated by the energy consultant, whereas the rest are based on suggestions by internal staff. The consultant in Paper Mill West has made successful suggestions concerning the core production processes and not only concentrated on service equipment. A limited number of staff members were involved in the audit and the consultant did most of the work. The energy manager was the consultant's contact in the firm, and he and the consultant met 6-10 times during the audit process, but the production manager and other technical staff did also contribute with their ideas. The consultant also played a role in Paper Mill West's sharing experience with another paper production plant.

In Paper Mill West's case the audit did lead to the provision of new knowledge and the identification of energy-saving potentials. Some of them are not included in the agreement for various reasons, e.g. the optimization

of the water turbine. The consultant also suggested special investigations. The mapping of the firm's energy consumption is appreciated by the firm, as it renders a more precise price setting possible. Also, due to this mapping, the firm became aware of the large energy consumption in the refiners.

Shortly before the decision to enter into an agreement, the new top management at Paper Mill East decided to change supplier. In cooperation with the new supplier, an investigation was launched in order to investigate into the possibilities of increasing production capacity. The consultant making the energy-audit report was not involved in this investigation, but concentrated on the service equipment. In relation to the core production processes the consultant could neither contribute with practical nor tacit knowledge. The investment projects concerning Paper Mill East's heavy processes came into being due to the work and ideas of internal staff and the supplier, and – in relation to these projects – the task of the consultant was to estimate the energy savings to be obtained. The staff at Paper Mill East is not impressed with the amount of new insights obtained from the audit. The mill manager claims that the systematic analysis in the audit and the consultant's questions give them an occasion to reconsider old routines and truths. It is, however, not clear whether this occasion led to any changes in practice.

If the consultant's role in relation to the provision and dissemination of new knowledge varies and is sometimes more efficiently handled by mill staff and suppliers, the role of the consultant is, however, not without any importance at all. In both mills the consultant play an important role as a communicative link between the DEA and the mill, and the firms rely on the consultant to know the rules and requirements in relation to audit reports and agreements. It is the opinion of both mills that applications and other communications with the DEA are more successful when handled by the consultants.

Handling the Problem of Asymmetric Information

The audit report must be verified by an independent verification agency, who checks that the guidelines have been followed. In the case of Paper Mill East, the technical expert considered that parts of the energy-saving potential was not described thoroughly in the audit report. This potential

had been investigated into and considered by the firm, but the formal description of these considerations and the results was missing. This was pointed out to the firm, who agreed to include some suggestions for special investigations in the audit report.

In the case of Paper Mill West, the technical expert disagreed with some of the conclusions in the report. He and the consultant had discussions over the matter, but the discussions did not lead to any results. Neither of the two cases is completely typical, as the communication in relation to the verification is usually handled by the verification agent instead of the technical expert. The technical experts agree that direct communication facilitates the process and that the verification can contribute to exchange of knowledge between consultants. Also, even if the verification agent does not provide new knowledge to the process, the technical expert who examines the technical quality can add more (theoretical) knowledge to the process, even if he does not visit the plant.

Actors and their Relations

The DEA's role in the policy formulation process in relation to the specific VAs is limited to informing the mills about the possibility of having an agreement concluded on the terms described in chapter 2. In the specific cases, one firm made its decision without consulting external parties, whereas the whole process was initiated by the consultant in the other mill. Both firms rely on their consultant to handle the relation with the DEA and to know the rules. The DEA is not perceived by the mills to be a partner and advisor in the endeavour to enhance energy efficiency, as the DEA itself would like to be. The DEA is perceived as a – generally speaking flexible and reasonable – governmental agency with the task of sanctioning firm behaviour in relation to the agreements, the investment grants and the tax rebate. The consultant is chosen and paid by the firm and his loyalty is normally with his client. For the consultant, the technical expert peer review can act as a counterbalance to any pressure to lower quality from the part of the firm.

4.1.2 Negotiation

Room for Interpretation

As we have seen, a lot of discussion concerning the energy-saving potentials takes place before the negotiations between the firm and DEA begin. Actually, the main interpretation of the AS takes place before the negotiations with the DEA in relation to the editing of the energy-audit report and the formulation of an action programme. This is a process involving the consultant and the firm staff and most controversies concerning technicalities, profitability of projects and the like are settled in this forum or in some cases, during the verification when the technical expert suggests alternative projects or special investigations.

The audit report and the action plan based on the audit report limit the room for interpretation. In relation to the energy management the guidelines are also quite detailed and the room for interpretation is limited. The procedures concerning monitoring and sanctions are also predefined.¹ However, when it comes to the number of special investigations and the timetable some negotiation is possible.

Consensus and Controversies in the Negotiations

In the case of Paper Mill West no real negotiations between the DEA and firm took place before the agreement was signed. The consultant handled the issues related to the audit report and the energy-management system. Mill staff only met with officers from the DEA once, before the audit report was written. Similarly, a meeting between the DEA and Paper Mill East was held about six months before the agreement was signed.

At these meetings, the DEA informed the mills about agreements and investment grants, and commented on their draft energy-management plans.

Shortly before the agreement between Paper Mill East and the DEA was signed, another meeting, involving bargaining, took place. According to the consultant the negotiator from the mill was talked into committing the mill to practically all the special investigations in the agreement during the negotiations. Most of these investigations had been suggested by the technical expert. Many of the investigations had already been concluded and turned into investment projects when the agreement was made, but the formal commitment resulted in demands for documentation and paper work.

The mill was not aware of the workload connected to special investigations when the agreement was signed.

The energy manager at Paper Mill East was surprised that bargaining with the DEA actually took place. As a result of the negotiations one investment project was to be carried out at an earlier stage than first suggested. In return for this, the firm got off committing itself to an additional special investigation.

After the first meeting between the DEA and Paper Mill West, all communication was handled by mail or by telephone. One of the special investigations in Paper Mill West's agreement is a result of discussion between the mill and the consultant prior to the editing of the energy-audit report. The consultant estimated that a project could be carried out with an investment of max. 13,333 i whereas the mill management estimated that the price would be 10 times as high. Due to the uncertainty about the profitability of the project it was included in the agreement as a special investigation instead of as an investment project.

If little negotiation took place before the agreement between Paper Mill West and the DEA was signed, some negotiations have been going on in relation to the implementation of the agreement. The fourth investment project (concerning transportation of paper rolls and packaging procedures) was included in the agreement as a result of such negotiations.

The negotiations between the mills and the DEA involved less bargaining than the DEA expected in the first place. However, several controversies over the interpretation of the agreement scheme and the profitability of specific projects have been handled both before and after the formal negotiation phase. The mills did not expect negotiations with the DEA to change the content of the action programme in the agreement substantially. Rather, they expected the process to be one of rule following. In accordance with their expectations, the consensus between the parties has been predominant.

Exchange of Knowledge

The exchange of knowledge that took place during the negotiations basically consisted of the mills sending their audit report and an energy-management report. Through these reports the DEA gets very detailed information about the mills. This information is, however, not used for other

purposes than the negotiation of the agreement. The mills' benefits from the negotiations are, in terms of new knowledge, limited to the field of energy management. The DEA has corrected the plan for the implementation of energy management for both mills, but it has not meant a big deal for the mills. Paper Mill East has been invited to and has participated in a one-day seminar on the implementation of energy management.

Actors and their Relations

In both cases the negotiation takes place between two parties: the mill and the DEA, and the result as well as the process is confidential, because very detailed information about the mills can be revealed during the negotiations. Environmental groups and other interest groups are excluded from the negotiations, but there have been no claims for public participation. Paper Mill East chose to involve their consultant in the introduction meeting with the DEA as the mill thinks that the presence of the consultant facilitates the communication with government. However, the consultant was not present at the final meeting where the real negotiations took place. In Paper Mill West the role of the consultant was not less important. The consultant formulated the energy-management report (after consultation with the mill staff) and took care of the relations with the DEA during the audit process. He was also involved in the handling of specific questions in relation to the negotiation process as he knows »cases of reference« and communicates well with the DEA.

4.1.3 Implementation

New Practices in Relation to Information and Knowledge Gathering

The energy-management plan contains guidelines for the gathering and processing of information. At Paper Mill West, the plan was formulated by the consultant who »translated« the guidelines from the DEA. The mill will continue to discuss the energy-management system with the consultant once a year. The improved energy-accounting system has been delayed due to problems with the meters, but the energy accounting is already more detailed than before the agreement. Paper Mill East has formulated its own energy-management plan with the intention of integrating energy

management and environmental management. At Paper Mill East, the improvements of the energy-accounting system have concentrated on the formation and analysis of energy-related key figures.

Both mills are planning to improve their production monitoring and managing systems. These systems will improve the control of the energy consumption, because it will render monitoring of the energy consumption connected to the ongoing production process possible. This means that it will be possible to act on information immediately. The difference between the current practice and the future practice is that the energy-accounting system will pass from being a registration tool to being a management tool.

An important issue in relation to the gathering of information is the institution of procedures concerning energy-efficient investment design. In both mills, this particular part of the energy management has caused problems, because the procedures very easily become very complex and require a lot of work compared to the results in terms of energy savings.

At Paper Mill East, most of the work with design is made by one single person. After his first attempt to make instructions to comply with the standards of both energy and environmental management systems, the result was enormous forms to fill out. These instructions are now being revised to make them more simple and to adjust them to the conditions at Paper Mill East, e.g. having only one supplier for paper machines, dealing with suppliers not knowing the DEA's standards for energy-efficient electric motors etc. These particular conditions mean that rather than gathering information from different tenders and picking the supplier with the most energy-efficient equipment available, Paper Mill East needs to enter into a dialogue with a single supplier to get more energy-efficient equipment.

At Paper Mill West, the energy-manager questions the need for formalised procedures, as the energy consumption is already included in calculations of profitability along with the input of raw materials and because only few people are involved in purchasing and designing decisions.

New Practices Regarding Performance

As part of the energy management, the mills must set targets for their energy-efficiency performance. Paper Mill West had set these targets before the agreement was signed. Having energy-efficiency targets was new for

Paper Mill West when the agreement was made, but both the energy manager and the consultant perceive the targets as realistic. To meet the targets, Paper Mill West had formulated a plan including the projects described in the agreement and the development of a more advanced production monitoring and managing system. One of the quantitative targets in the agreement is to reduce the percentage of scrapped paper to 20 in 1997, 19 in 1998 and 18 in 1999. During the implementation, the energy manager has come to see a mismatch between this target and the organisational setting of the energy management in Paper Mill West. The fact that the scrapping and reprocessing of paper influence the energy consumption is not contested, but the target can only be realised in the production line. The energy manager points to the fact that the competence to make the decision and change the routines necessary for reaching the target is separated from the responsibility for reaching the target. This could, however, be solved by integrating the energy management more in the management of production.

At Paper Mill East the quantitative targets were formulated after the agreement was signed. The targets are: Reduction of the specific electricity consumption by 4% over three years and reduction of the specific steam consumption by 6% over three years. The energy manager considers them realistic, and not too ambitious. When Paper Mill East sets the targets, it wanted to be sure to be able to reach the targets, and this can be done by implementing the projects in the agreement. No additional measures are currently planned to meet the targets except the improved energy-accounting system and the measurements carried out by the local power station.

New Practices Regarding Organisation

Both mills have difficulties implementing the education and motivation of staff required in the guidelines for energy management. At Paper Mill East only the energy group has participated in energy-management courses. In relation to the other staff, including energy consumption as a parameter in the wage system has been discussed, but so far it has not been implemented. At Paper Mill West, no educational activities have been carried out, but a suggestion box allows staff members to make suggestions concerning energy efficiency, and the management informs staff about the activities

through the mill magazine. Both mills plan to improve the motivation of staff when the more advanced production monitoring and managing systems displaying energy-consumption data simultaneously are implemented. One of the energy managers explains that it is important that the operators can actually see how much energy is spent and preferably also how much money that costs.

Some improvements have been implemented in the organisational field: An »energy group« has been established to do the follow-up. The energy manager emphasises this as an important development, because a forum for the discussion of energy issues now exists, even if the group only meets twice or three times a year.

At Paper Mill East, the establishment of an energy group also constitutes the most important organisational change. This group meets once every four weeks, and has established a fixed agenda including discussion of energy key figures, taking stock of the agreement and finally discussing new energy-related initiatives at the mill.

Understanding of the Agreement

The mills are both very aware of the overall purpose of the agreements being to reduce CO₂ emissions from industry. But the individual interviewees' understanding of the agreement varies. The energy managers in both mills are aware of the DEA's hope to change firms' attitude, which these two quotations can illustrate: »The primary aim is to reduce CO₂ emission, but also to induce a change of attitude towards the energy issue in firms« (Paper Mill East), and: »The part called »management's evaluation« in the progress reports is probably included to make sure that the management is involved and that it is not just something taking place in a small corner of the firm. That is fair enough, but I would not do it spontaneously, if nobody demanded it of me« (Paper Mill West).

At Paper Mill West, the production manager perceives the economic benefits as the most important aspect of the agreement, whereas the energy manager emphasises the structuration of the work as the most important aspect.

The mill manager at Paper Mill East perceives the agreement as a flexible policy instrument that allows the mill to work with energy efficiency on its own terms. However, in his view the agreement will take firms further

than to the business as usual level. »The obligation to implement the projects is important, because even if it is easy to sit down and agree on some projects, things and priorities can easily change within six months time. Once the agreement is signed, there is no way out. You have committed yourself and you have to fulfil your commitment. I think we need that pressure to get things done.« Quite in line with this argumentation the energy managers at both mills are content with the yearly reporting to the DEA as it works as an internal deadline for implementing energy-conservation projects and evaluating the energy-management system.

In contrast to the positive opinion expressed by the energy manager and the mill manager at Paper Mill East, another interviewee, who has been working at Paper Mill East since the seventies, does not regard the increased activity in the energy field as a result of the agreement. Rather, he perceives it as a continuation of activities which have been interrupted due to organisational chaos.

However, the overall picture is that interviewees are quite aware of the combining of short term investment projects with long term changes in energy management in the AS, and to some extent they believe this combination works.

Relation to Other Policies

The agreements are perceived as intimately related to the investment grants by the mills, and the possibility of obtaining subsidies influences their attitude towards the scheme in a positive direction, even though the projects for which investment grants are obtained would have been carried out without subsidies. The production manager in one of the mills perceives the subsidies as the most important element in the scheme. The mills do not relate the agreements to any other policy spontaneously, not even the exemption scheme 1993 to 1996. The tax rebate was, as mentioned in section 4.1.1, an important motive for entering into an agreement, but in spite of this, the mills have not complained about the remaining tax payments. In relation to environmental issues, Paper Mill East has chosen to establish some connection by integrating the energy policy in the environmental policy and by using the same external expertise in relation to both issues. Regarding the mills' internal investment policy, the energy issue and the agreement are still subordinate to considerations concerning

product quality and production capacity, but the energy consumption always enters into their calculations in relation to new projects.

New Practices Regarding Relations

For both mills, entering an agreement has consolidated existing relations to the consultant, who is involved in advising about energy management, applications for investment grants and reporting to the DEA. Both mills point to the advantages connected to the continuation of relations with one particular consultant who gets to know the mill's production processes better, even if exchange of tacit knowledge is beyond the consultant's scope. Thus, the mills both have rather stable relations with their consultants, through which theoretical and practical knowledge is exchanged.

The agreements have had a limited impact on the relations between the mills and the DEA. This is partly due to the fact that the consultant has played an important role in handling the communication with the DEA. However, both the energy managers and the officers in the DEA state that relations are a bit closer now and that the increased interaction has been positive. However, the exchange of knowledge is primarily a control measure imposed on the mills to make sure that the DEA gets something in return for tax rebates and subsidies.

Both mills have engaged in new networks with exchange of theoretical and practical knowledge about the implementation of energy-management systems, after entering an agreement. However, according to the mills, the agreement has not led to increased interaction with other firms in other ways. Paper Mill East already had close relations involving massive exchange of knowledge with a supplier before the decision to enter into an agreement. After entering an agreement Paper Mill East has also established relations with the local power station to measure flow, pressure and energy consumption in the mill's pumps. This is not required in the agreement.

The internal relations in the mills have not changed dramatically, but especially at Paper Mill East, where the management is most actively involved, it has been possible for the energy manager to earmark some of his time to energy-efficiency activities such as networking due to the agreement.

4.2 The Policy-Making and Implementation Process in the Milk Condensing Sector

In this section we will take a closer look at the policy formulation, negotiation and implementation of the agreement concluded between the DEA, the nine production plants in the milk condensing sector and the Danish Dairy Board. Some facts about the sector, our case plant and the agreement can be found in sections 3.3 and 3.4. The analysis of the policy-making and implementation process of the VA with the milk condensing sector consists of three parts. Firstly, the policy formulation investigates the scene into which the agreement is introduced. This includes among others motives of the parties to enter the agreement and their expectations. Secondly, the negotiations of the agreement are analysed. This part includes clarification of, e.g. the exchange of knowledge and controversies and consensus. Finally, the implementation is investigated, uncovering changes and effects.

4.2.1 Policy Formulation

With the introduction of an increased CO₂ tax in 1995, the possibility of entering an agreement on energy efficiency emerged. The DDB and the nine plants in the milk condensing sector worked together to influence the policy-making process and ensure that the milk condensing sector was defined as heavy process. The milk condensing sector and the DDB were successful: All processes related to evaporation, drying and condensation were listed at the heavy process list, and the plants in the milk condensing sector therefore had the possibility of entering an agreement concerning the energy consumption on these processes.²

Motivation

The initiative to conclude an agreement was put forward by the DDB. The DDB held meetings during 1995 to inform the plants about the changed legislation. The DDB proposed the plants to enter an agreement at sector level. The most important *motive* for entering an agreement was the expectation of a cost reduction. Also, concerning the choice of a sectoral agreement, financial considerations played a role. It was expected that a sectoral agreement would be less expensive compared to individual

agreements due to the fact that individual energy audits are replaced by an energy analysis of the sector as a whole (Krarup et al. 1997).

To our case plant, the economic incentives, i.e. the tax reimbursement, were the sole motive for entering an agreement, and Milky preferred to enter a collective agreement to reduce the cost and workload related to entering an agreement. Milky is very discontented with the tax scheme and the fact that the installation of 40 meters was necessary to document the difference between heavy and light processes. This negative experience influenced the plant's expectations concerning the agreement. Thus, Milky had very low expectations regarding possible benefits from the agreement other than the tax reimbursement. In fact, the management expected »a very inexpedient system and a lot of unfortunate investments without any profit which would be carried out only to get the tax reimbursement«.

Relation to Previous and Existing Regulation

Only two plants within the sector had experience with the exemption system of 1993. To the other plants in the sector, the former agreement scheme was not attractive, as there were economic benefits for them to obtain. As described in chapter 2, the plants participating the 1993 system should carry out an energy audit mainly on the energy for auxiliary equipment (lighting, ventilation etc.). Although the AS in 1996 focussed on energy consumption in the processes, these energy audits were used when mapping the energy consumption as a whole in the sector. Thus, experience from the previous system served as an input of knowledge in the 1996 system. It is not clear whether other kinds of experience from the 1993 system could be transferred to the implementation of the AS of 1996. However, the fact that the plants were already working together facilitated the process. Thus, when the agreement was negotiated an existing network among the plants and the DDB was mobilized. Milky was not among the plants who had previously had an energy audit and tax reimbursement.

Knowledge

The perception of the need for knowledge for the sector to enter an agreement was to some extent blurred by the rather vague guidelines for the energy analysis. Preliminary guidelines were issued in December 1995, but some uncertainty about the depth and the width of the sectoral energy

analysis existed among the plants. The preparation of the energy analysis was made simultaneously with the negotiations and was linked to these and therefore, the preparation is discussed in more detail in the following section. A contributory explanation to the blurred ideas of entering the agreement was that the sectoral agreement with the milk condensing sector was the first of its kind and therefore, the DEA had no experience to draw on.

Actors and their Relations

The plants in the sector have a long tradition of cooperation, and the DDB has traditionally played a role in relation to the common marketing efforts. However, now the most important role of the DDB is to keep the plants abreast of new regulation and to lobby for the plants' interests. Milky believes that the DDB is better fit to handle the relation to government: »The way we express ourselves can sometimes widen the gap between us and the authorities more than if the DDB handles the communication«.

The actors in the policy formulation are the sector organisation and the nine member plants and the DEA. The VA is perceived by the plants as an opportunity to reduce energy costs. The choice of making a sectoral agreement was also motivated by economic incentives. The cost of administration, negotiation and especially identification of the energy-saving potential is remarkably lower with the sectoral approach. Thus, the link between the plants and the DDB can be characterised as a resource link. From the DEA's viewpoint, the idea of entering and motive for the agreement is to inspire the plants to focus more on energy efficiency without overburdening them, and the sectoral approach is welcomed by the DEA as a less expensive way of handling agreements.

4.2.2 Negotiation

The negotiations began formally by sending in the declaration of intent of the nine milk condensing plants in December 1995. They ended in September 1996 when the agreement was signed and the tax reimbursement granted. About six meetings were held between the DDB and the DEA between January and September 1996. The DDB was represented by one person, the DEA was represented by two persons and the consultant participated in the meetings. Concurrently with these meetings, the DDB

and the consultant met with representatives from the milk condensing plants. In addition to the meetings, the representatives from the DEA have visited one of the plants.

Room for Interpretation

In comparison with the predefined procedures used in relation to the agreements with the paper mills, much more room was left for interpretation when the sectoral agreement with the milk condensing sector was negotiated. No ready-made concept was to be followed and therefore the scope for bargaining was wider. The most important themes in the negotiations between the DDB and the DEA were the question of reporting to the DEA, grants for energy-saving investments, the energy analysis and verification of it, see also below on Consensus and Controversies.

The procedures related to knowledge gathering deviated from the procedures employed in relation to individual agreements. To reduce costs, it was decided to make an energy analysis covering the whole sector,³ instead of carrying out costly energy audits at each individual plant. With the sectoral approach emphasis is placed on the most energy-intensive production processes and on energy-saving potentials which are common for several plants in the milk condensing sector instead of a minute examination of the potentials of each individual plant. Thus the notion *all* profitable energy-saving projects are reinterpreted and changed to *the most important* profitable energy-saving projects.

The possibility of reserving funds and including the question of investment grants in the agreements was an important issue in the negotiations between the DDB and the DEA. The DDB was eager to get the DEA to promise that subsidies would be granted to the investment projects in the agreement, but the DEA would not depart from the normal procedure where energy-saving investments having a payback period between three and six years can be given grants. Thus, the room for negotiation was restricted in terms of which offers the DEA could give.

According to the guidelines for the energy management, procedures for the procurement of energy-efficient production equipment and procedures for energy-efficient design must be formulated. However, the DEA has chosen not to insist that the milk condensing sector follow the guidelines strictly, as the DEA considered the implementation of the production

integrated energy-accounting system to be more important than the procedures. Thus, whereas the DDB has formulated recommendations regarding procurement, no recommendation has been formulated regarding energy-efficient design, and the individual plants are not obliged to make their own individual procedures. In this case, the DEA chose to give the plants some room for interpretation when implementing the energy management.

To sum up, the room for interpretation is limited in the Danish AS, but in the case of the milk condensing sector the negotiation strategy and the uncertainty about the specific requirements gave room for interpretation and some give-and-take bargaining.

Consensus and Controversies

The question of whether verification of the energy analysis was needed or not seems to be a dominant theme in the negotiations, even if it is of minor importance for the content of the agreement. The DEA argued that according to the legislation a verification was obligatory as the consultant must be independent of any particular interests his customer might have if a verification is to be superfluous. The consultant is employed in a subsidiary company of the DDB, and the relation was therefore considered to be too close. The question was discussed between the managers of the DEA and the DDB. The final decision was that a verification of the energy analysis of the sector was required. It is considered by the sector that the verification produced no new information and thus did not influence the content of the agreement, but in the DEA the verification is believed to have had a preventive effect.

In the discussion of sectoral approaches, the question of burden-sharing is often given much attention. In the case of the milk condensing sector, the burden to share was a number of energy-saving projects to carry out. This interpretation of how the problem of burden-sharing was solved in the internal negotiations varies.

According to Milky, the projects in the action plan are standard projects that the consultant had to »sell« to the plants in a »reverse auction« in order to please the DEA. The DEA, however, did not show any interest in how the projects were distributed among the plants. The management at Milky states that most plants were reluctant to commit themselves to the projects as they

were not convinced that the projects would fit the particular production technology used at their plant. The projects were eventually distributed among the plants, but Milky states that more time was needed if a proper distribution was to be made. Due to the lack of time, the allocation of projects was somewhat arbitrary.

According to the DDB, however, the distribution of obligations did not cause any major problems. In support of this argument, in Krarup et al. (1997) two other plants in the sector stated that the action plan with the specific obligations corresponded to their own suggestions and that they were under no pressure to accept them. Actually, the DDB finds the payback period criterion very fair and easy to work with. According to the DDB controversies over the burden-sharing can be avoided when this objective criterion is used to determine the obligations of each plant.

Exchange of Knowledge

At meetings between the DDB and representatives from the plants, the question of confidentiality and competition was discussed both in relation to the energy analysis and in relation to the reporting. Concerning the exchange of knowledge in making the energy analysis, the plants considered that the transfer of knowledge caused by the consultant was not a serious problem in relation to the competition among the plants because such transfer goes on all the time as the plants use the same suppliers. The plants, the consultant and the DEA all consider that the energy analysis has contributed to the diffusion of knowledge within the sector and that due to his long experience in the sector, the consultant has been able to suggest energy-efficiency improvements unknown to the plants. This is contrary to the general consideration about the plants having more specific knowledge about their processes leaving the consultant without any possibility to bring about new knowledge. Due to these circumstances, the DEA estimates that the energy analysis at the sectoral level has provided just as much information as would individual audits.

In relation to the reporting, the DEA insisted that proper documentation for the observance of the agreement at the plant level was required. The DDB and the DEA agreed that the DDB should collect data and coordinate the reporting to the DEA. As a condition for accepting this, the plants demanded that the confidential information concerning the plants and their

production should not be accessible for the other plants participating in sectoral agreements. This was accepted by the DDB and the DEA. Thus, as practical solutions were available, the concern for confidentiality and competitiveness among the plants yielded in favour of the need to stick together.

Actors and their Relations

The agreement between the milk condensing sector and the DEA involved quite frequent communication between the representative from the DDB and the consultant on the one side and the representatives from the DEA on the other side. Although there were controversies between the parties, the interaction between the two parties was generally positive and they appear to have been negotiating on equal terms. The representative from the DDB speaks the language of bureaucrats and thus functions as an intermediary between the government agency and the industrialist at the plants. To the DDB it was crucial that individual plants did not engage in bilateral discussions with the DEA. However, the DDB had to accept that direct contact between the DEA and the plants will occur in the cases when the action plan is not followed by the plants and the tax reimbursement subsequently is cancelled. In these cases the conflict will be solved between the DEA and the plant without involvement from the DDB.

When negotiations began, the plants were already cooperating with each other and the DDB in relation to energy regulation and other issues in order to secure the most favourable conditions possible for the sector. This cooperation continued during the negotiation phase. The consultant and the representative from the DDB put pressure on the plants to commit themselves to investments, development projects and energy management at a level acceptable to the DEA and thus tried to make the demands of the DEA meet the offer of the plants. The DEA and the plants have only interacted directly on very few occasions, i.e. when the DEA visited a plant, and when, due to the delays, a couple of plants made inquiries about the possibility of entering an individual agreement. Both the plants,⁴ the DDB and the DEA perceive this as an advantage.

4.2.3 Implementation

In this section the implementation of the VA for the sector and in more

detail the implementation at a specific milk condensing plant is described and analysed. As in the previous sections we will also supplement the results from our case study with information from other studies of the sectoral agreement with the milk condensing sector.

New Practices in Relation to Information and Knowledge Gathering

The DDB takes care of the correspondence with the DEA concerning the development projects. For instance, they take care of the applications for investment grants. A consultant carried out the energy audit and he participates in the implementation of development projects. Due to a big work load for the consultant, the projects were started later than planned, as DDB did not want to use another consultant lacking the specific knowledge about the sector. The idea is that experience derived from these development projects should be spread within the sector. Thus, to some extent *new practices in relation to information and knowledge gathering*, or put more moderately *strengthening the existing exchange of knowledge*, was the purpose of the development projects.

The DDB is going to continue its activities in relation to energy management if the plants ask for it. Thus, the relations between the plants and the DDB have evolved during the course of the agreement, as the DDB has taken on new tasks and the *strengthening of the existing exchange of knowledge* mentioned in relation to the development projects can also be observed in the field of energy management.

Each plant reports annually about the implemented projects and documentation of these and about the implementation of energy management to the DDB which aggregates the data and sends it to the DEA. The reporting to the DEA does not seem to have posed important problems and the DDB finds that a yearly evaluation is suitable. In order to keep confidentiality the individual contributions are not available for the remaining participating plants. The DDB has had a few comments and corrections to the plants' contributions, but Milky has not had any particular problems with the reporting. On the other hand, Milky does not see any benefits from the reporting, as the reporting does not lead to the provision of new information and is not used as an internal management. Milky also doubts that the DEA actually reads the reports and fears that the DEA will

make trouble once they realise how many deviations there have been from the original plans.

New Practices Regarding Performance

The overall target for the milk condensing sector is a 4% reduction of the specific energy consumption during the three years, the agreement lasted. The target is set by the DDB and it will not be regarded as a breach of the agreement if the sector does not reach the target. The overall target is not transferred into individual targets for the plants, even though some plants have set their own targets. Milky has not set individual targets. The plant characterises the targets at the sectoral level as a piece of »armchair work«, and claims that it is impossible to assess whether the quantitative target has been reached in a fair way. Nonetheless, the plant doubts that the target has been reached and wonders what the DEA is going to do about it.

According to both DEA and DDB, implementing the energy-saving projects has not posed important problems. Rebuilding and changes in production have caused delays and adjustments in relation to the original description of some projects. According to the DDB, the DEA has shown flexibility in the cases where the plants are part of a group and therefore need longer time for approval of investments. Some of the potential projects are implemented and according to the DDB new projects have been defined (Krarup et al. 1997; Ingerslev et al. 1998).

According to the agreement, our case plant should carry out two investment projects. A third project is included as a so-called potential project and can replace one of the two obligatory projects, if it turns out to be more convenient. None of the projects in the agreement have been implemented as described. Instead of implementing the projects listed in the agreement, Milky has carried out a number of what they call »energy-management projects« – i.e. projects that have been discussed in the energy-management group and figure on a list of energy-saving projects – the »apple polisher list« – which the plant makes in order to be able to document their efforts, should the DEA require it. Thus, the projects are energy related, but they are carried out as part of the regular maintenance and improvement of the production facilities, not as part of the agreement.

New Practices Regarding Organisation

The DDB plays a minor role in the energy management as it is considered to be a task for the individual companies. However, the DDB has arranged education for leaders and all employees. The participants afterwards asked

for more specific information about their own plant, and our case plant disagreed with timing. The employees were disappointed when they got back from the course, because the plant was not ready to implement their new ideas.

Concerning organisational changes as result of the energy management, all plants have appointed an energy manager to be responsible for energy matters, and organisational systems are implemented. However, the importance within the company and workload vary considerably among the companies (Krarup et al. 1997; Ingerslev et al. 1998).

In our case plant the most important organisational change is the setting-up of an energy group in the company. The group consists of the plant manager, the production manager, two engineers and the chief accountant and have met 7-9 times during the three years with an agreement. The guidelines concerning energy management are considered relevant by the plant, as they sum up the most important topics that should be on the agenda when the plant's energy-management group meet.

However, our case plant is not impressed with the overall concept of procurement procedures. In this company, the energy consumption and fuel mix related to different technologies has been an important part of the assessment of investment projects for years – at least in relation to the core production processes. If anything has changed, it is in relation to the secondary energy consumption where the company can apply for subsidies, if they follow the procurement standards for service equipment like, e.g., pumps.

According to the plant manager, introducing a more formal energy-management system has been the most positive experience related to the agreement, even though it has taken a long time to implement the system. For instance, making courses for the staff will be useful only now when the company is ready to follow up afterwards.

Understanding of the Agreement

In the DEA it is the impression that the DDB understands the VA and the subsidies attainable as a whole, and that especially the subsidies are important to the sector. The DEA interprets VA as an element in itself and not as a part of the subsidies. Thus, it seems that some room for interpretation exists in the understanding of the VA.

The understanding of the agreement from the DDB's point of view is that DEA is especially interested in implementing the investment projects, but the interviewee also states that both DEA and DDB have given the development projects high priority. It is also the opinion of the DDB that energy issues receive more attention in the individual plants due to the agreement.

The case plant has had no direct contact with the DEA in relation to the agreement and the plant's overall judgement of the DEA and the VA is not flattering. Instead of regarding the DEA's acceptance of the changes of the projects as a sign of flexibility, our case plant sees it as a sign of negligence. The plant does not think that the targets (see above) can be reached through the implementation of small projects. According to the plant, the targets can only be reached through abandoning old inefficient plants, optimization of existing plants and building of new large plants.

Also influencing the plant's view on the VA is the fact that the agreement is understood as an integrated part of the CO₂ package. When asked about e.g. negotiations, cost, advantages and disadvantages of the agreement, the interviewed persons very often refer to issues that are not, in a strict sense, part of the agreement scheme, like e.g. subsidies, the distinction between heavy processes and light processes and the cost of meters.

Relation to Other Policies

The very close relation to the CO₂ tax is influencing the implementation of the VA. The division between heavy and light processes seems to have posed problems for the plants as it is often unclear how the energy consumption should be divided into light and heavy processes. The division influences the tax payment of the plants. The taxation authorities have rejected the first account for the division into light and heavy processes made by our case plant, but the plant has appealed the decision. The conflict between the plant and the taxation authorities has not been settled. The DEA is not directly involved in this as the tax payment regards the taxation authorities.⁵ But the plant is disappointed with the DEA because the DEA did not support the plant in the conflict with the tax authorities, and this disappointment is reflected in the expectations regarding the agreement.

The subsidies are also very important to the plants in the milk condensing sector. Subsidies were available before the agreement was

signed, but the plants did not exploit the possibilities. The DDB estimates that the process of making an agreement has made the plants more aware of the possibilities and better prepared to make the applications.

New Practices Regarding Relations

During the course of the agreement as a whole, the DDB is considered to play an important role as an intermediary between the bureaucratic approach in the DEA and the practical approach in the companies. The DDB considers that the cooperation with the DEA has worked very well, although it has been difficult to get things clear about the commitment of the agreement for the sector and the companies. In contrast, our case plant doubts that the DEA does any monitoring at all. It is their impression that when the DEA has not sanctioned any of the deviations from the original action plan it is due to the fact that the DEA does not actually follow the implementation very closely. Also, Milky is disappointed that the DEA did not stand on Milky's side when Milky was in conflict with the tax authorities concerning the division in heavy and light processes.

4.3 Testing of Hypotheses for Voluntary Agreements

In the following, a set of hypotheses regarding the VA level are tested. The hypotheses are formulated by Kræmer and Hansen (1999).

- *Firms have a lot of room for interpretation within the different VAs*

In theory, there is practically no room for interpretation in the VAs as the guidelines for energy audit, verification and energy management are quite detailed. Furthermore, the qualitative targets set in the agreements place emphasis on activities rather than effects and leave only little freedom for the plant to choose the means. Some interpretation is possible in relation to the profitability of specific investment projects in spite of the general payback period rule. Energy management is also practised in different ways at the different plants. One paper mill has a lot of activity and tries to integrate energy management in other management systems, whereas the other mill perceives the energy management being sometimes in conflict

with the production management. The milk condensing plants have more room for interpretation than the plants with an individual agreement.

- *Authorities seldom use sanctions if the firms do not keep a VA*

Sanctions have not been applied in relation to our cases. None of the plants have fully complied with their agreement, but the DEA does not perceive the delays and alterations as the kind of non-fulfilment that can lead to sanctions. In the event of delays, changes in the preconditions or emergence of new knowledge, the paper mills have been expecting and have met flexibility on the part of the DEA. However, this does not mean that the mills are scamped with the fulfilment of the agreements. Both mills are eager to avoid conflicts and keep good relations with the DEA. When a firm wants to give up one obligation, it must offer to do something else in return. In a controversy with one of the paper mills, the DEA has threatened to use sanctions and cancel the agreement, but as a compromise the mill accepted the DEA's demands, and the demands were inserted in the agreement. The milk condensing plant's understanding of the DEA's sanctioning policy is somewhat different from that of the paper mills. At Milky, the lack of sanctions is interpreted as a result of scamped administration and not as a sign of flexibility. Milky fears sanctions in case the DEA notices that some projects have undergone some serious changes.

- *In the short run the VA does not improve the level of energy efficiency considerably above the non-intervention level, but in the long run new procedures and a higher level of information regarding energy efficiency will lead to considerable energy savings*

It is hard to estimate the long-term effects of the agreements at this point. Therefore, our evaluation is based on the expectations of interviewees and the activities carried out until now. In the short run the agreement's impact on the level of energy efficiency has been more important at Paper Mill West and Milky than at Paper Mill East, where all the large investment projects would have been carried out without an agreement. The effects derived from the audit and the energy management (higher level of information and new procedures) cannot be determined in any certain way. At Paper Mill West the audit led to the implementation of a project which concerns the supply-side and thus is not included in the agreement.

All three plants state that they intend to continue the energy management after the expiration of the agreement, and the paper mills expect to improve their energy-accounting systems during the coming years. They also expect the improved energy accounting to facilitate the work with energy efficiency. This could indicate that long-term effects can be expected. On the other hand, the paper mills point to the fact that the continuous attention and pressure from the DEA can be necessary to keep their attention on the energy issue when other issues require a lot of attention. Thus, the long-term effect may depend on continuous dialogue between the DEA and the plants.

- *Firms get more information through VA networks on energy efficiency from other firms in or outside the industrial sector, which reduces the transaction cost of energy-saving projects*

On the basis of the case study in the paper industry, we can only find weak support for the hypothesis. We have no records of the paper mills getting access to information through networks established due to the agreements. However, the consultant initiated Paper Mill West's discussions with a former sister firm during the energy audit. Whether the discussions led to any results is unclear. Also, Paper Mill West plans to participate in a network of plants with an energy agreement organised by its consultant. Paper Mill East is involved in several formal network activities touching on energy efficiency and energy management. Some of the networks have been established after the AS, but without direct relation to the agreements. In spite of the activities, the most important source of information on energy efficiency in the production processes for Paper Mill East is internal staff (and former employees) and their supplier.

In the milk condensing sector the situation is somewhat different. Although the plants insisted on confidentiality in relation to the reporting to the DEA, some exchange of knowledge has been facilitated by the agreement, e.g. in relation to the sectoral energy analysis, the energy-management courses and the development projects. This indicates that the sectoral approach has advantages over the individual agreements regarding the establishment of information networks.

- *Authorities get a deeper knowledge of the specific production processes through VA (VA decreases the asymmetric information problem)*

The DEA does get a deeper knowledge about the specific production processes through the energy audit and the reporting related to the VA, but the DEA does not make use of this knowledge neither to make estimates of the energy-saving potential at the aggregate level nor in relation to the negotiation, where, at least hypothetically, the information about the potentials of one firm, could be used to put pressure on another firm with similar production processes.

Endnotes

1. Small adjustments concerning the deadline for reporting to the DEA and verification requirements in relation to special investigations can be made.
2. After the agreement was signed, the Taxation Authorities established an interpretation of the rules defining most of the electricity consumption in the milk condensing sector as light processes. Prior to this formal interpretation the milk condensing plants believed that these processes were to be defined as heavy processes. The Danish Dairy Board estimates that the established interpretation can cost the milk condensing plants almost 3 million i in increased tax payments.
3. The energy analysis consists of three parts. The first part, phase 1, contains general information about the plants in the sector, the products of the sector, the production processes and their energy consumption.

Phase 2 uncovers the existing documents concerning data on individual energy audits and analyses of production processes. It should reveal the need for further analyses in relation to the action plan for the sector. It was concluded that condensation and drying are the two processes requiring the largest consumption of energy and appeared to constitute the most important potential for energy savings. The need for an analysis of the potential for process integration was discussed and finally considered irrelevant. In the phase 2 report, the DDB and the consultant estimated that the existing material was sufficient to proceed to Phase 3, the formulation of an action plan for the whole sector.

In the phase 3 report, a proposal for the action plan which is the basis for the agreement is put forward. The proposal contains possible energy-saving investments of two kinds: general investments which are expected to be implemented by all plants if it is not already implemented, and second, specific investments planned to be implemented by a specific plant.

4. Our case plant and two other plants involved in a previous studies (see Krarup et al. 1997; Ingerslev et al. 1998).
5. Concerning the division into light and heavy processes, the DEA is only occupied with the conditions for entering an agreement: heavy process or fulfilling the criteria for energy intensiveness for the company.

5 The Energy-Conservation Projects

In the study of the implementation of the VAs in two paper mills and in the milk condensing sector, we have examined three energy-conservation projects (ECPs) in more detail. The plants' work with the ECPs is a part of the implementation of the agreements. At Paper Mill West we will look into the implementation of a project concerning the sectioning of the compressed air system and at Paper Mill East we have chosen to study the implementation of a large investment in the optimization of a paper machine in more detail. The last ECP studied here is a waste heat recovery project carried out at Milky. Applying a simplified version of the approach applied when studying the AS and the VA levels, we will look at the decision to carry out the project, the negotiation over the way to do it, the implementation of the ECP and the effects. At the end of this chapter, in section 5.4, we will test a set of hypotheses regarding the implementation of ECPs.

5.1 ECP at Paper Mill West: Sectioning of Compressed Air System

At the time of our visit at the plant, only one ECP had been carried out due to the agreement at Paper Mill West. Before it was decided to enter into an agreement and carry out an energy audit, the technical staff at Paper Mill West had noticed the inefficiency of the compressed air system. The compressed air system served two paper machines and the workshops. When only one paper machine was in use, air kept seeping out at the other machine. The very visible waste bothered the energy manager, but due to a relatively long payback period and low interest in pure energy investments,

nothing happened.

When the consultant came to carry out the energy audit, the idea of sectioning the compressed air system surfaced again, but the consultant estimated that the payback period would exceed four years. The energy manager was eager to have the project included in the agreement, as this would guarantee the realisation of the project. He looked over the consultant's estimate and considered that it was possible to carry out the project at a lower cost than first estimated. The revised estimate had a payback period of 3.5 years.

With the new and lower payback period, the project was included in the audit report finished in April 1997, the report was verified in October 1997. Immediately after the verification, the agreement was made. The project was included in the agreement and the deadline for the realisation was set to July 1, 1998.

Three months after the conclusion of the agreement, the energy manager left the firm and was replaced by the current energy manager. The new energy manager did not give the project much attention before March 1998, when the mechanical engineer made a revised project plan. The new plan was more advanced and more expensive than the original plan. The plan was discussed by the mechanical engineer, the energy manager, the chief engineer and the master electrician, who meet every day. Two suppliers were asked to forward their quotations, the quality of the two solutions were discussed and a choice was made. The energy manager made an application for the investment to the top management in Germany who must approve of all investments exceeding 3,333 i . The application was refused due to the payback period of 8.5 years. There was, however, a miscalculation, as the larger reduction in the energy consumption derived from the more expensive solution was not included in the calculations. After the refusal, a new project plan, closer to the original project, was written and a new application was made. This time permission was given. The firm also applied for an investment grant from the DEA, but got a refusal because of some deviations from the standards.

When the deadline for the project and the first progress report, July 1, draws near, the energy manager had to push a bit to get the project implemented. The project could only be implemented during a weekend stop. It was carried out by external tradesmen.

In the policy-making and implementation process related to the ECP at Paper Mill West the negotiations were internal and involved technical staff and top management, with the consultant playing a special part, as he made the estimate of the payback period that put the project into the agreement. The technical staff members were committed to the project even though it was not very popular with the top management: First, an energy manager insisted on getting the project into the agreement and then the mechanical engineer tried to get a technically more sophisticated solution through in spite of a long payback period.

Effects

The project has not had any implications for the organisation. The project changes little in terms of energy practices as it is fully automatic. When the machines are shut down for repairs, the compressed air supply is automatically shut down, too. It can only be opened manually. This causes a little inconvenience, but is basically a matter of the staff getting used to the new routine. The project turned out to be more expensive than estimated. Energy savings have been realised, but no precise measurements of this effect have yet been available.

The Relation Between the ECP and the VA

The sectioning of the compressed air system is not a very important ECP in terms of energy savings, but it is visible. The inclusion of the project in the agreement is important, because the top management is committed due to the agreement. In the implementation, the fixed deadline and the reporting requirements provide the necessary external pressure for the project to be carried out in a plant where many other issues are given high priority. In this particular case, the technical staff used the agreement to realise their ideas in spite of a sceptical top management.

5.2 ECP at Paper Mill East: Optimization of Paper Machine

The ECP at Paper Mill East is a large investment project and the decision to implement the project is part of the mill's overall strategy. The board of

directors has decided that Paper Mill East shall aim at increasing the production capacity from around 200,000 tons/year to 250,000 tons/year by 2000. The managing director¹ was not satisfied with the performance of the old supplier and decided to change to a new supplier, with whom he had good relations. In 1996, the managing director asked the new supplier, who has a service department capable of making analyses of total production machineries, to analyse the plant with the purpose of making suggestions as to how to increase production capacity. Before the energy audit in relation to the agreement was commenced, the supplier delivered a report suggesting how a production capacity of 250,000 tons can be obtained by an optimization of the paper machines in three steps. The ECP is the second step, increasing the speed to 850 m/hour and the efficiency from 86% to 94%.

Concurrently with this process, Paper Mill East decided to start an energy audit in view of entering into an agreement. In December 1996, when the main parts of the energy audit were ready, the mill manager at Paper Mill East sent a letter of intent to the DEA. Due to changes in the guidelines taking effect in January 1997, the audit had to be revised before the verification.

The report from the new supplier was discussed between staff from production, maintenance and design at Paper Mill East and representatives from the supplier. The final specification was ready in March 1997 and the investment was approved by the managing director in spring 1997. In order to have the project included in the agreement and at the same time obtain an investment grant from the DEA, the energy manager and consultant made estimations of the energy savings. In May 1997, Paper Mill East applied for an investment grant from the DEA, and it was granted May 21. It was important for Paper Mill East to get a rapid response, as the project could only be implemented during a general stop at the plant, and the DEA proved to be ready to meet Paper Mill East's wishes.

The project was implemented in August 1997, immediately after the agreement was signed. The implementation took a couple of weeks. The work was carried out by mill staff and the supplier, and no other suppliers were asked to submit tenders. Before the implementation, the project was discussed with the staff and the safety representatives, even if the project does not affect neither the organisation nor the internal procedures. An

external consultant was hired to make estimations of the noise level. The plant has an environmental permit which allows 45 dB on existing production facilities whereas new facilities must have a noise level below 40 dB. The solution was to add some silencers to the project.

Effects

No measurements of the effect on the energy consumption have been made. The increased speed has been obtained, whereas the efficiency still is below the target of 94% due to numerous breakings of the web. This probably means that the effect in terms of energy efficiency is below the estimates.

The Relation Between the ECP and the VA

The main purpose of the project is to increase production capacity, not to improve energy efficiency. Nonetheless, the project will have an important impact on the specific energy consumption (see section 3.1.2). The project has been reinterpreted to fit into the agreement and, perhaps just as important, to the subsidy scheme.

5.3 ECP at Milky: Waste Heat Recovery

The ECP at our case plant concerns the use of waste gas from the industrial CHP plant. The plant decided to establish a CHP plant in December 1994 and already during the design phase the idea of making use of the waste heat was discussed. Originally, the plan was to install a steam injector as part of the CHP project, as this had been done with success in another plant. However, after further calculations it was clear that a steam injector was not needed in Milky, due to the stable steam consumption. At this point, the plant had already been granted a subsidy for the CHP plant including the steam injector. Part of this subsidy would be annulled if the injector was not installed.

As the plant was still interested in using the waste heat, they asked for permission to use the granted subsidy to install a heat exchanger instead. The DEA accepted this proposal. Thus, when the CHP plant was constructed in June 1996, a heat exchanger was installed in the chimney in view of making waste heat recovery possible at a later stage.

When the agreement was made, a large waste heat recovery project was included. The plant was interested in the project, but the exact formulation was made by the consultant. After the agreement was signed, the plant found out that the project was not as profitable as first estimated. Thus, the original version of the project was not implemented. Instead, other possibilities for waste heat recovery – of a smaller scale – were examined. The waste heat recovery project consists of five or six different subprojects formulated and planned in the energy group, and a consulting engineer did some drawings at the end of 1996.

The implementation of the project began in autumn 1997 and lasted for 8-10 months. The work was carried out by internal and external craftsmen when it was possible to intervene without disturbing the production. Now the offices, the changing rooms, the staff facilities, the weigh-in area, the processed cheese department and the vegetable oil used in the process are heated with waste heat.

Effects

The projects have had no effect on the organisation or the working routines. The effects in terms of improved energy efficiency are not as substantial as in the original project. The annual realised energy saving is approximately 650 MWh. The impact on the CO₂ emissions is a reduction of the emissions by approximately 135 tons per year.

Relation Between the ECP and VA

The project in the agreement was of a much larger scale than the project actually realised. According to the plant manager the realised project would have been carried out without an agreement, and he states that without the tax on heating more waste heat recovery projects would have been profitable and would have been carried out. Other ECPs, e.g. two projects concerning condensers which have both been granted subsidies, have been carried out due to the agreement, even though they are not explicitly mentioned in the agreement.

5.4 Testing Hypotheses for ECPs

Below we will test a number of hypotheses concerning the implementation of ECPs. The hypotheses are presented in Kræmer and Hansen (1999).

- *Energy-conservation projects are more often a minor appendix to the everyday life of the firms, therefore they will often be related to other issues, which the firm finds more important, e.g. environmental considerations*

The three ECPs chosen in this study are very dissimilar and our study is inconclusive regarding this hypothesis. Two projects are rather small and have little importance for the everyday life of the firm. The implementation of these projects was not related to environmental considerations or advantages in the production. They are »pure« energy-efficiency projects, and one of them was primarily carried out due to the energy managers commitment to the project. The third ECP is a large investment included in the firm's long-term strategy. The driving force in the implementation of this project has been the positive effect on the production capacity.

- *Most energy-conservation projects are implemented by a top-down approach from management*

This is certainly the case in Paper Mill East and Milky, but less so in Paper Mill West. The most important projects at Paper Mill East are related to the decision of the board of directors to increase production capacity. The projects at Paper Mill West have to a greater extent been formulated by the technical staff and the consultant. At both Paper Mill West and Paper Mill East (at least as regards the special investigations and the »pure« energy projects) the energy manager is responsible for the punctual implementation of the ECPs, but other staff members are also consulted (e.g. the working environment committee, the maintenance staff etc.). When the top management is involved in the implementation, it is to approve of the decisions/ suggestions of the technical staff. Thus, our study is inconclusive regarding this hypothesis.

- *Energy-conservation projects are often rather technical, and therefore involve the technical staff rather than ordinary employees*

In all three cases we have found support for this hypothesis, as the technical staff has dominated the process of implementing the ECPs. Other

employees have not been involved in neither the design nor the implementation of the ECPs. However, management has been involved in the investment decisions.

- *Energy-conservation projects do not relate to the PR strategy of the firm*
The findings from the case studies support this hypothesis. None of the ECPs (neither the three cases, nor the other ECPs) relate to the PR strategy of the firms, although the mill manager at Paper Mill East states that the agreement has given the firm good publicity. While neither Paper Mill West nor Milky include environmental issues in their PR strategy, the environmental profile of Paper Mill East is relatively high. Paper Mill East only uses waste paper and the firm's efforts to limit environmental problems related to the production are mentioned in the PR publication.

Endnote

1. That is, the manager of the paper division in the group.

6 Assessment of Country Study

In this chapter we will assess the country study from two different angles. In section 6.1, we will make an assessment of the implementation and impact of agreements based on the case studies. In section 6.2, we will broaden the scope and address the question of the efficiency of the AS in general and in relation to the particular cases in a discussion with a set of assessment criteria presented by Russell and Powell (1999) as our point of departure. Finally, in section 6.3 we will conclude with a brief discussion of the latest revision of the Danish agreement scheme.

6.1 Assessment of Case Studies

In this section we will sum up the reporting from the paper industry and the milk condensing sector in a discussion of the impact of the VAs and the chosen ECPs. In the discussion we will concentrate on three themes: The technical and organisational changes caused by the agreement, the relation to supporting initiatives, and the fulfilment of the VAs' own targets.

6.1.1 Technical and Organisational Changes – Effects on Energy Practice

Generally speaking, the Danish AS combines specific projects leading to short-term technical changes with energy management leading to long-term organisational and technical changes. Table 6.1 shows the technical and organisational changes in our three case plants.

Table 6.1 Technical and organisational changes in the three case plants

	Already established	Planned
Technical change	Investment projects (3-4 each plant) Special investigations (both paper mills) New knowledge about energy efficiency (especially Paper Mill West and Milky)	Following up on special investigations (limited number in the paper mills) Production integrated monitoring and management system (both paper mills) More measurements, meters etc. (all)
Organisational change	Energy manager appointed (all) Energy group established (all) Procedures for energy-efficient design (all) Energy-efficiency targets (Milky only at sectoral level) Energy-efficiency network (all, branch specific: Milky) Using energy management to identify new projects (Milky)	Involving staff more by demonstrating how each employee can affect energy consumption in his work ¹ (all) Following up on targets (paper mills) Improving energy-management system (all)

11. To do this, the production integrated monitoring and management system will be needed in the paper mills.

At Paper Mill East, most investment projects would have been carried out without an agreement, whereas at least half of the projects would not have been carried out without an agreement at Paper Mill West. At Paper Mill West the audit also led to the identification and implementation of projects not included in the agreement. Most of the special investigations would not have been carried out without an agreement, at least not in any formal way. At Milky the investment projects have not been carried out as planned, but they have been modified or replaced by other projects and the plant has made an »apple polisher's list« to document other energy-efficiency improving investments.

The energy management has not been fully implemented yet. All three plants state that they intend to continue the energy management after the expiration of the agreement and both paper mills plan to incorporate energy consumption in a production integrated monitoring and management system. However, the plants are not equally prepared to cope with the

challenges. At Paper Mill East the energy management will be integrated in the environmental management and is thus likely to continue after the expiration of the agreement. At Paper Mill West the energy management is more loosely coupled to the existing management structures and thus more likely to wither away after the expiration of the agreement. At Milky the energy management seems to be the most successful part of the agreement and well integrated in the management practices.

To sum up, at Paper Mill West the agreement has been important in terms of immediate technical changes and improved knowledge about energy efficiency, whereas the long-term effects on energy practice that are expected to rise from the energy-management activities may fail to appear if the pressure from the DEA decrease. At Paper Mill East, the technical changes (as compared with the base-line scenario) are small, but Paper Mill East has the organisational resources needed to carry out the planned activities in the future. At Milky the technical changes in terms of investment projects are not a direct result of the agreement, but the agreement has led to improved knowledge and awareness of energy efficiency, and new investment projects have been defined in the energy-management group.

A general observation concerning technical changes can be made from the case studies: the major investments that can reduce energy consumption and CO₂ emissions substantially are not carried out due to the agreements, but due to the overall strategy of the companies. These investments concern the replacement or improvement of larger parts of the production equipment, e.g. a drying tower at Milky or the optimisation of PMs increasing the production capacity and reducing the no-load loss. On the other hand, the agreements seem to affect the decisions concerning the replacement of ventilators, pumps, electric motors etc. These investments are often »pure« energy-efficiency projects which are less essential to the plants and therefore an agreement can make a difference in relation to these projects.

6.1.2 **Relation to Supporting Initiatives**

There are four supporting initiatives having an impact on the VAs. The first initiative is the CO₂ tax. The importance of this tax is crucial, because the increased tax and the possibility of obtaining a tax rebate are the main

reason why the three plants chose to enter an agreement. The CO₂ tax and the problems concerning the distinction between heavy and light processes in the milk condensing sector have had a negative impact on Milky's perception of the agreement.

The second initiative is the SO₂ tax. This initiative has not been mentioned as an important factor by the interviewees, but for one of the paper mills the SO₂ tax amounts to almost as much as the tax rebate. The fact that the plants cannot obtain rebates in relation to this tax means that it will affect the profitability of energy-efficiency improvements and especially of the profitability of conversion from, e.g. coal to energy sources with low sulphur and CO₂ content.

The third initiative is the investment grants and subsidies for energy audits. In an evaluation of the subsidy scheme, it was found that only 14% of the projects receiving investment grants are »free riders«, i.e., projects that would have been carried out anyway and at the same time (Johannsen and Togeby 1999). Our case study in the paper industry runs counter this conclusion. According to the case study in this sector, the subsidies do not affect investment decisions. However, it is the impression from the interviews that the subsidies do have a positive impact on the mills' opinion on the scheme. Thus, it can reduce hostility against the whole scheme. In the milk condensing sector the possibility of obtaining subsidies has had an impact on the design of new projects and due to this possibility the plants pay more attention to energy-saving projects (Krarup et al. 1997).

The fourth supporting initiative is a number of informative measures, like, e.g. brochures enumerating the benefits of implementing energy management and giving instructions on how to do it, free measurements of the electricity consumption in pumps, ventilators etc., network activities etc. Most of these measures were in place before the introduction of agreements and the plants' use of these offers varies. Paper Mill West participates in a network for plants with an agreement supported by the DEA, whereas Paper Mill East's and Milky's participation in networks is not related to such initiatives. Only one of the plants, Paper Mill West, has used the brochures on energy management and only to a minor extent.

6.1.3 Fulfilment of Agreements' Own Target

As the implementation process is not over yet, it cannot be finally determin-

ed whether the agreements have fulfilled their own targets. Furthermore, the targets in the Danish agreements are diverse and qualitative: they concern both specific investments, special investigations and energy management.

As for the specific investments, most are carried out according to the plan in the two paper mills, whereas all Milky's projects have been modified. The actual outcome of the investment projects has not been measured. The special investigations have been carried out according to plan, and have in some cases led to the implementation of ECPs. The replacement of one project in Paper Mill East's agreement with another project will not reduce the CO₂ effect of the agreement immediately, rather the new project will lead to a considerably larger reduction. However, in this case a »pure« energy project, which is traditionally hard to adopt, is replaced by a »production capacity« project which would have been carried out anyway. As most of the other projects would also have been carried out without an agreement, Paper Mill East's agreement comes very close to the base line scenario in terms of the realisation of specific investment projects.

Regarding the energy management, the paper mills report to the DEA and Milky reports to the DDB as prescribed in the agreement. The implementation has not been completed, but all three plants work to improve the systems as to make energy management a real management tool, even after the expiration of the agreement. The plants' problems with energy-efficient design procedures and their considerations about the quantitative targets set in the energy management indicate that in spite of modest results so far, they take the energy management seriously.

The two cases show that even in this very structured AS full compliance with the rules does not necessarily lead to results much beyond base line. However, at Paper Mill West the complex procedures taking the mill through an energy audit and the implementation of energy management have proved to be relevant, as the mill actually took a step forward in both knowledge about and organisation of energy efficiency as a result of the agreement. In the milk condensing sector the existing network has been reinforced and new knowledge has been provided through the energy analysis, and at plant level the implementation of energy management at Milky has been a success. To the DEA, getting such a process started is an implicit target (cf. chapter 2).

6.2 Assessment of Agreement Scheme Based on Russell and Powell Criteria

Comparisons between different policy instruments have long been a central part of socioeconomic research. Economic incentives, or so-called market-based instruments, e.g. a CO₂ tax or tradable permits, are often (at least by economists) expected to be superior to other policy instruments. New analyses of advantages and disadvantages with policy instruments have called this superiority into question; it is sometimes a big challenge for the regulator to obtain the necessary information about the damage cost and abatement cost of firms. Furthermore, the assumption that control and sanctioning can be carried out without costs is often far from reality. Also, taxes can have major undesirable redistributive effects. All in all, in practice, market-based instruments are not necessarily as superior a policy instrument as often suggested.

To give a more nuanced judgment of the advantages and drawbacks of the Danish AS, we will now evaluate the scheme in relation to five criteria. These criteria have been suggested by Russell and Powell (1999) as themes of discussion of practical considerations of instruments in environmental policy. Generally speaking, the perspective of the discussion is the regulator's perspective.

6.2.1 Static Concerns

The first theme for discussion is the static efficiency of the scheme, i.e. the short term cost-impact relation. One of the specialities in the Danish scheme – the link between the VAs and the CO₂ tax – has been studied in a purely theoretic model in Chidiak et al. (1999). According to this theoretic study, a scheme like the Danish could be *more cost-efficient* for society than a pure tax, when firms are heterogeneous and the regulator is concerned with the costs imposed on firms by regulation.

Turning to the findings in the case studies, the main question under the heading static concerns is whether the environmental target is reached with least cost, i.e. the sum of investment costs, information and search costs (energy audit, special investigations, verification) and administrative costs. Two issues of relevance to the static efficiency will be discussed below: (a) is the scheme designed to catch the cheapest savings first (b) is the overall

cost reasonable, compared with the savings?

As for (a) the scheme is designed to make it possible to carry out the most profitable investments first. The same payback criterion is used in all firms, i.e. a firm with many profitable projects has to realize relatively large savings, a firm without any profitable savings now and in the future (as long as the perspective of the audit) is loaded neither with investment projects nor special investigations. Thus, in principle, the Danish scheme is far from »the nightmare of efficiency«: the general percentage rollback.

Our cases show that this possibility is real, but as often underlined the consultant is very much dependent on the employees in the firms. The biggest savings in our three plants were not found in the audit, but were known by the firm. At the end of the day, whether an obligation for a firm to carry out many projects and special investigations is due to a big potential of profitable investments, or other reasons, e.g. an interested staff or a coincidence, is hard to say. Our cases tell us both; the consultant is not blind and will find something. However, cooperation with internal staff is a precondition to include large savings projects in the agreements.

As for (b), a major problem in the Danish scheme is the search costs, i.e. the energy audit, the verification and the special investigations. On the average, the audit and the verification costs amounts to 17,000-33,000 i¹ (Finansministeriet et al. 1999). For our case plants the costs were 20,400 i (Paper Mill West), 54,700 i (Paper Mill East) and 53,000 i for the milk condensing sector as a whole.

Considering only projects carried out because of the audit these search costs are (too) high. At Paper Mill East (with the highest cost) only two projects, corresponding to a CO₂ reduction of approximately 450 ton/year, do not stem from the report from the supplier, cf. section 4.1.1. In contrast, according to the estimates, the projects in the agreement which stem from the supplier's report will lead to CO₂ reductions of 10,000-20,000 ton/year. At Paper Mill West the projects in the agreement that are identified by the consultant will lead to an estimated CO₂ reduction of approximately 300 ton/year. Adding to this are reductions obtained through the special investigations.

For the plants in the milk condensing sector the search cost (energy audit and verification) has been much lower. The estimated effect of the investments projects in the milk condensing sector as a whole is a reduction

of CO₂ of approximately 12,200 ton/year covering both the plants' own suggestions and the consultant's ideas. Adding to this figure is the development projects and potential projects which according to the estimates will lead to further reductions of approximately 18,000 ton CO₂/year. However, the latter estimate is probably far too optimistic.

In a firm perspective the socioeconomic cost calculation is changed due to subsidies for the search costs (the audit) as well as the investments. E.g. Paper Mill East has received more than 500,000 i in investment grants for two years, 400,000 i in tax rebate over three years and subsidies for both energy audit and verification. Paper Mill West, has received much less than Paper Mill East. The tax rebate amounts to approximately 60,000 i a year and the investment grants to about 105,000 i over two years. The milk condensing sector as a whole has received approximately 600,000 i in tax rebate over the years 1996-1998.²

All in all: The Danish scheme is designed to catch the cheapest energy-efficiency investments first, but it is not as efficient as it looks at first glance. The search costs are too high, and they are remarkably higher for the individual agreements than for the sectoral agreement. As for other more pragmatic static concerns like monitoring and control we can give the Danish scheme fairly high marks. Another advantage in the Danish scheme is that there are no free-riding problems, as the tax rebate and the obligations are individual for both the individual and the sectoral agreements.

6.2.2 **Dynamic Considerations**

The two basic questions in relation to dynamic considerations are 1) whether the policy instrument is flexible over time and 2) whether the policy instrument stimulates the development of new energy-efficient technology.

As for the flexibility over time, the formal design of the Danish agreement scheme can be perceived as rather inflexible, as the obligations (including investments) for the whole period of validity are specified in detail when the agreement is signed. However, the period of validity is limited to a maximum of three years, and when conditions are changed, the obligations can be renegotiated.

The Danish scheme has been changed three times since the scheme

started in an agreement-like scheme in 1993, i.e. it has demonstrated flexibility. Until now, the changes have mainly consisted of more strict guidelines and better monitoring efforts. However, the scheme has also increasingly put emphasis on energy-efficient core production processes as the potential for large savings in the service equipment has, to a large extent, been exploited. Now, as a result of the evaluations of the scheme showing decreasing outcome from the energy audits concentrating on the static energy efficiency, the DEA is investigating possibilities of increasing emphasis on the dynamic energy efficiency by replacing the audit with R&D activities.

It is a weakness in the Danish AS in general that the scheme does not stimulate communication and diffusion of knowledge between firms, because most agreements are individual and the consultants' ability to secure the diffusion of knowledge is limited. The theoretic work in Chidiak et al. (1999) indicates that involvement in the scheme of a strong industrial association reduces search costs, as it centralises information gathering and communication. In the milk condensing sector, the consultant and the sector organisation have been working actively to motivate the firms, and the sector energy analysis for the milk condensing sector has been discussed among the firms with the intention of lowering the search costs. The two firms with individual agreements have had remarkably higher search costs, than the firms in the milk condensing sector.

The special investigations in the individual agreements and the development projects in the milk condensing sector are, potentially, fit to stimulate the development and diffusion of new energy-efficient technology. The special investigations sometimes lead to the implementation of investment projects, but the projects rarely involve development of new technology, and the results are not communicated to other firms.³ In the milk condensing sector, the development projects are designed to be of relevance to more than one firm in the sector. The consultant participates in the implementation of the development projects, and branch organisation diffuses the results by distributing reports and organising meetings concerning the projects.

Another dynamic element in the agreements is the energy management. Several elements in the guidelines could stimulate the development and diffusion of energy-efficient technology: Education of staff, the institution

of an energy group willing and able to follow up on new ideas, procedures involving dialogue on energy efficiency with suppliers etc. However, from our case studies we can conclude that these elements can be difficult to implement and, even if the firms are motivated, it is not done over night. The two evaluations of the scheme (Krarup et al. 1997; Buhl Pedersen et al. 1998) point to the fact that very few firms have energy-management systems that comply fully with the guidelines. This is confirmed in this study, but it is also evident from the case studies that the firms are working seriously to improve their energy-management systems.

6.2.3 Institutional Demands on the Regulator and Regulated

The Danish agreement scheme is not simple to administer (ref. chapter 2), but the regulator, the Danish Energy Agency, has set up two offices to deal with the energy efficiency and agreements in agriculture, trade and industry. It can be said that this is costly, but the offices operate the scheme as it was intended.

Administering the scheme requires detailed knowledge about the individual firms. The DEA has not got the necessary technical competence to retrieve and verify this information. Therefore, the scheme is built on self-reporting before and after the agreements enter into force with external verification of audits and some special investigations.

The firms use consultants to carry out the energy audits,⁴ and the consultants often assist the firms in formulating the energy-management plan, applications for investment grants, progress reports and reports concerning the result of special investigations. It seems that the consultants, who in principle should contribute with technical knowledge, sometimes take care of the paperwork instead. As it was said by an interviewee: »The consultant speaks the language of the administration, and he knows how things should be formulated to satisfy the DEA«.

When the consultant takes over communication with the DEA and the formulation of reports, the agreements require less internal expertise and management involvement, and the institutional demands on the firms are lower. But when the firms choose the easy way out of the institutional demands, some of the ideas behind the scheme suffer. A chief of section in the DEA explains: »We never believed that the DEA could really negotiate with the firms on equal terms. Instead, we have chosen to put the firms

through a process, where they have to work with energy issues. By doing so we hope to influence the internal power relations in the firms by strengthening the staff working with energy issues«. Thus, the institutional demand on the firms is an important part of the design.

Generally, the firms understand the intentions of the scheme and, with support from the consultant, they are able to perform the necessary activities to conclude an agreement. However, the process has involved less give-and-take negotiations than the DEA expected. From the case studies there are some indications that the firms do not know how to handle flexibility and that, to some degree, they prefer the reduced uncertainty related to fixed rules.

To sum up, the institutional demands in the AS are relatively high, but in the DEA the necessary human resources are available for the administration of the scheme. The firms use the consultants to lower the institutional demands, but this may reduce the »soft« effects of the agreements. However, the procedures are generally followed, the investments carried out and the reports written, but some of the more dynamic elements may take up more room in the paper than it does in the firm's everyday life.

6.2.4 **Political Considerations**

The reasons for the choice of agreements as a policy instrument towards the energy-intensive industry are very similar to those found in other countries (see Hansen and Larsen 1999). What is different from most countries is the link to a CO₂ tax. The agreement scheme was introduced to limit the unwanted consequences for the *distribution* between trade and industry, and perhaps more importantly, for the *competitiveness* of a few very energy-intensive and well-known firms caused by the essential choice of a tax as policy instrument. The fact that industry had recommended agreements like the Dutch LTA instead of taxes, made the use of the term »agreement« politically opportune in spite of the schemes' similarities with the exemption scheme in place 1993-1996, a scheme which was not called an agreement.

Taking political considerations into account, the advantage of the Danish AS as a policy instrument is that it creates a lot of activity related to a problem at the political agenda, with few distributional consequences and with some effect. As the VAs in the Danish scheme last for maximum three

years, it does not constrain Parliament's possibilities of choosing other policy instruments later if deemed necessary. However, the political value of the AS cannot be evaluated without considering the whole CO₂ package, as the efficiency of the scheme may depend on taxes creating the economic incentive to enter into an agreement. Passing the taxes through Parliament will usually be the politically difficult part.

6.2.5 Risk

The risk criterion seems relevant when considering, e.g. product or process prohibitions or prescriptions. Here the government ought to know the outcome of such a strong interference in the consumers' and firms' possibility to choose. Also for taxes there is a risk that the possibility of substitution in production or consumption is different from the expected, i.e. the outcome of the tax is unexpected (high or low).

As for the AS here analysed, there is an outcome risk.⁵ That is, a VA is (probably) not the right policy instrument when the environmental problem in question has to be solved fast. But increased energy efficiency and reduced CO₂ emission are long-run problems where a learning process might be relevant for all parties involved; government as well as industry. And as previously mentioned the Danish VAs only last for three years, i.e. there is a built-in mechanism for revision, i.e., from a risk perspective and for long-run »not very toxic« environmental problems, the AS has its advantages.⁶

6.3 The Future Danish Agreements

In the assessment above we found many advantages (e.g. environmental effectiveness and prevention of free riding), but also some weaknesses in the Danish AS: The search costs are high (mainly due to the energy audit), the scheme is fairly static due to the emphasis on specific investment projects instead of development and diffusion of new technology, the firms rely on the consultants to handle the comprehensive paper work, the slow implementation of the energy management is not sanctioned and the transparency is low. However, being aware of these weaknesses, the DEA has suggested a major revision of the scheme which was passed through

Parliament in December 1999 (Lov nr. 1107 af 29. December 1999). The revised scheme entered into force by January 2000 (Energistyrelsen 2000a).

In the new scheme, the energy audit is no longer obligatory. Instead of implementing investment projects identified in the audit report, the firms are expected to identify the profitable projects themselves through special investigations related to the core energy-consuming processes and the full implementation of an advanced energy-management system. The definition of profitable investment projects has not changed, all projects with a payback period of less than four years must be carried out. Thus, in the new scheme emphasis is put on energy management as a tool to build internal competences to deal with energy efficiency instead of relying on external consultancy (Energistyrelsen 2000a and 2000b).

The implementation of the energy-management system will be verified once, not by the DEA, but – in line with EMAS and ISO – by an independent verification agent. The direct interaction between the DEA and the individual firms will be limited to the negotiation phase, when the firms' obligations are laid down. The basis for these negotiations is a proposal made by the firm specifying the firm's energy policy and targets and how the firm intends to reach these targets (Energistyrelsen 2000a and 2000b).

The firms must still self-report once a year, but the DEA will no longer check the data thoroughly. Instead of the routinely formal check of progress reports, detailed random checks of the firm's energy-management systems and compliance with the agreement will be made by independent verification agents (Energistyrelsen 2000b). The obligations and benefits related to the agreements are still individual, but the revised scheme is designed to make it more advantageous to enter collective agreements (Lovforslag nr. 51 af 27. October 1999).

The transparency problem has not been solved yet, but the DEA is examining different ways to enhance transparency and give the public access to more information on the agreements, the firms' compliance and the impact on energy efficiency. By providing more information, possibly by issuing a yearly progress report, the DEA hopes to draw attention to the agreements and promote increased involvement from the part of industry and the industrial organisations.

To sum up with some preliminary reflections about the new scheme: Whereas the findings in this study indicate that the 1996/1997 scheme had

its most important impact on the rearguard, the new scheme promises to offer more challenges for the vanguard due to the emphasis on continuous improvement of the energy management and special investigations.

An important advantage of the new scheme is that the (external) search costs for the firms are lower. However, the firms' internal search costs and administrative costs may increase. The new scheme requires increased management involvement and in-house man power which may be difficult to accept (and afford) for some (in particular small) firms.

With the new monitoring procedures the DEA keeps the firms at arm's length as the control of the firms' compliance is put in the hands of independent verification agents. Therefore, the administrative burden of the DEA and the risk of agency capture are diminished in comparison with the 1996/97 scheme studied in this report. However, as we discussed previously, the lack of a credible feedback from the DEA may influence some firms' perception of the scheme in a negative way and the arm's length principle and the lack of specific projects in the agreements may also increase the asymmetric information between the DEA and the firms.

All in all, the new scheme represents a serious attempt to overcome some of the most important weaknesses in the scheme studied in this report, i.e., the lack of innovation and knowledge diffusion, the high search costs for industry and administrative costs for the DEA. A drawback of the new scheme is that it may be more difficult to monitor the implementation.

Endnotes

1. 130,000-250,000 DKK, 100 i = 750 DKK.
2. We lack data concerning the investment grants for the milk condensing sector.
3. Due to formal barriers such as confidentiality, but also because nothing in the agreements secure the establishment of networks between neither the firms in a sector nor the consultants advising these firms.
4. The firms are not obliged to use a consultant for the audit, but almost all firms do.
5. First, the audit report may not reveal any energy-saving potentials with the required payback period, and second, the actual outcome may be lower than estimated. For firms risk is involved in that they commit themselves to projects that may prove to be less profitable than

estimated.

6. See also section 6.2.2 on Dynamic Considerations.

Appendix 1

Contents of the VAIE Project

The VAIE project has been organised in different tasks, which followed quite different approaches to the analysis of voluntary agreements, ref. the web-site of the project: www.akf.dk/vaie

Task A: »Theoretic model and meta-analysis« followed an approach from economics and here three theoretic models on voluntary agreements are presented. The models are confronted with a meta-analysis based on existing investigations of agreements. The goal is to point to central actors in the policy-making and implementation processes, and to discuss ways of distributing knowledge and information among the actors. Given the simplifying assumptions, the analysis derives the welfare implications of agreements.

Ref.: Chidiak, M.; M. Glachant and L.G. Hansen (1999): Theoretical Perspectives on the Efficiency of Voluntary Approaches to Promote Energy Efficiency. CERNA, Paris.

Task B: »Framework for country studies« describes the methodological framework for the country studies undertaken.

Ref.: Kræmer, T.P. and K. Hansen (1999): Voluntary Agreements – Implementation and Efficiency. Framework for the Country Studies. AKF Forlaget, Copenhagen.

Task C: »Country case studies«. The five country studies in Denmark, France, Germany, the Netherlands, and Sweden are based on case studies of agreement schemes and voluntary agreements. The objective is primarily

to identify impact mechanisms at firm level in relation to the implementation process of agreement schemes respectively the voluntary agreement.

Ref: Chidiak, M. (2000): Voluntary Agreements – Implementation and Efficiency. The French Country Study. Case studies in the sectors of packaging glass and aluminium. CERNA, Paris.

Johannsen, K.S. and A. Larsen (2000): Voluntary Agreements – Implementation and Efficiency. The Danish Country Study. Case Studies in the Sectors of Paper and Milk Condensing. AKF Forlaget, Copenhagen.

Kågström, J.; P. Helby and K. Åstrand (2000): Voluntary Agreements – Implementation and Efficiency. Swedish country study report. Covering the EKO-Energi programme. With case studies in pulp and paper and heavy vehicle manufacturing. JOULE contract no. JOS3 CT 970021. Lund University, Environmental & Energy Systems Studies, Lund.

Ramesohl, S. and K. Kristof (2000): Voluntary Agreements – Implementation and Efficiency. The German Country Study. Case studies in the sectors of cement and glass. Wuppertal Institute for Climate, Environment, Energy, Germany.

Rietbergen, M. G.; M. Breukels and K. Blok (1999): Voluntary Agreements – Implementation and Efficiency. The Netherlands' Country Study. Case studies in the sectors of paper and glass manufacturing. NW&S Report No. 99073, Utrecht University, Utrecht.

Task D: »Actual outcome – the nonintervention case«. Three methods: monitoring of the historical development, the actual change in energy-efficiency investment behaviour and simulation of energy-efficiency investment behaviour are described. The methods are used on data mainly from the Netherlands and the actual outcome of voluntary agreements is assessed.

Ref : Rietbergen, M. G. and K. Blok (1999): The Environmental Performance of Voluntary Agreements on Industrial Energy Efficiency Improvement. NW&S Report No. 99068, Utrecht University, Utrecht.

Task E: »Voluntary Agreements in an EU perspective«. The other tasks in the project, especially the country studies and task A, are discussed in task E from an EU perspective, focussing on the question of implementing agreement schemes at the EU level.

Ref.: Helby, Peter (2000): Voluntary Agreements – Implementation and Efficiency. European relevance of case study results. Reflections on transferability to voluntary agreement schemes at the European level. JOULE contract no. JOS3 CT 970021. Lund University, Section for Environmental and Energy Systems, Lund.

Tasks F & G: »Conclusions and policy recommendation« summarizes the findings in the project and gives policy recommendation concerning voluntary agreements.

Ref.: Krarup, S. and S. Ramesohl (2000): Voluntary Agreements in Energy Policy – Implementation and Efficiency. The Final Report from the project Voluntary Agreement – Implementation and Efficiency (VAIE), AKF Forlaget, Copenhagen.

Appendix 2

List of Acronyms

AS	Agreement Scheme
CD	Centre Democrats
CHP	Combined Heat and Power
DDB	Danish Dairy Board
DEA	Danish Energy Agency
DI	Confederation of Danish Industries
DSM	Demand-Side Management
ECP	Energy-Conservation Project
FAO	Food and Agriculture Organisation of the United Nations
IEA	International Energy Agency
PM	Paper Machine
R&D	Research and Development
SME	Small and medium-sized enterprises
VA	Voluntary agreement
VAIE	Voluntary Agreements – Implementation and Efficiency

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