

Do voluntary agreements deliver? Experiences from Denmark and expectations for Sweden

Agneta Persson
ÅF-Process AB
Box 8133, SE-104 20 Stockholm, SWEDEN
agneta.persson@afconsult.com

Erik Gudbjerg
LokalEnergi A/S
Skanderborgvej 180, DK-8260 Viby J, Denmark
eg@lokalenergi.dk

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Abstract

Voluntary agreements and other industrial energy efficiency schemes building on energy management systems have been implemented and used in several European countries during the last decade. The aim of these agreements and schemes is to encourage industry to implement energy management systems and thereby identify and carry out measures to reduce energy consumption. In return for participating in the schemes and implementing energy management systems the industry is “rewarded” with energy tax remedies.

Will these kind of agreements deliver energy efficiency and reduced energy consumption? This paper focuses on experiences from voluntary agreements and implementation of energy management systems carried out in real life in Denmark and Sweden. The paper describes the structure of the agreements and expected outcome versus real results so far. The paper also deals with costs associated with joining a voluntary agreement (for the individual company) and which categories of industry these kinds of agreements mainly attract. Furthermore the paper will show main success criteria (real or perceived by industry) in order to deliver energy efficiency and reduced energy consumption by voluntary agreements. The paper will also show that important indirect effects (such as better product quality, increased production capacity, increased employee engagement) have been achieved by the involved industries.

Introduction

The energy consumption in the industrial sector corresponds to approximately 30 percent of the total energy consumption in Europe. The corresponding numbers in Denmark and Sweden are approximately 20 percent and 40 percent of the total energy consumption. Measures have to be taken to bring energy consumption down and reduce CO₂ emissions.

The policy instrument voluntary agreements (VA) is used in an increasing number of countries aiming at increased energy efficiency, reduced energy consumption and reduced CO₂ emissions. The question whether voluntary agreements can deliver energy efficiency has been discussed by several kinds of actors, e.g. policy makers, industry and lobby organisations, and this paper is arguing that voluntary agreements do deliver energy-efficiency. Two countries using these kind of agreements, Denmark and Sweden, have experiences exceeding ten years respectively recently launched a voluntary agreement programme.

DENMARK

In 1990 the Danish Parliament passed legislation, setting a target for reduction of the CO₂ emissions, stating that total national emissions should be reduced by 20 percent in relation to 1988 emission levels. In 1992 CO₂ taxes were introduced on all energy sources in Denmark. This tax package aimed at a 3.9 percent reduction in CO₂ over a period from 1995 to 2005, simultaneously improving industrial energy efficiency. An evaluation carried out in 1999 (by the Danish Energy Authority) indicates that the objective will be met. However, the energy taxes would put Danish energy-inten-

sive industry in a vulnerable position as the industry would lose competitive power if they were to pay the full CO₂ tax. In order to make the industry more interested in improving energy efficiency and to give the energy-intensive companies a helping hand a system of voluntary agreements was introduced by the government. If an industry enters the voluntary agreements scheme it could obtain a CO₂-tax rebate. The conditions the company has to fulfil on their part of the agreement are:

- The company should be on the “process list”, which is a list of energy-intensive production branches prepared by the Danish Energy Authority.
- And/or the company’s energy-tax load should exceed 4 percent of the company value added (based on the year previous to signing the agreement).

One of the drivers to bring companies to sign voluntary agreements was a foreseen energy-cost increase with 16 percent in 2005 due to the new energy taxes for the companies.

The development towards decreased energy consumption in Denmark is a result of determined efforts and actions. The Danish authorities have by 2003 succeeded in reducing total energy consumption with 3.5 percent compared to 1988, in the same period the GDP has increased with 50 percent. This means that the energy intensity measured in MJ/Euro, of GDP has decreased with 34 percent, corresponding to 1.9 percent per year.

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The Swedish application of voluntary agreements started almost a decade later than the Danish. The Swedish preparations started already in the middle of the 1990s, but the legislation was passed only in December 2004, and the programme started in January 2005. The Swedish industrial voluntary agreements are called Programme for Energy Efficiency (Program F r Energieffektivisering), PFE, and aim at energy efficiency, reduced energy consumption and reduced CO₂ emissions. The programme is coupled to the EU energy-tax harmonisation. Participating in the voluntary agreement scheme enables electricity tax deduction for the energy-intensive industry in return for energy-efficiency measures and implementation of an energy-management system. Agreements apply for five years, and the conditions Swedish companies have to fulfil to be eligible for voluntary agreements are:

- The company must be defined as energy intensive, meaning either the company’s energy costs have to exceed 3 percent of the company overall production value, or the company’s total energy, CO₂, and SO_x taxes have to exceed 0.5 percent of the company’s value added.
- Tax deduction can only be obtained on process-related electricity.

The national Swedish energy policy is like the Danish aiming at realising the significant industrial energy-efficiency potential. Several policy measures need to be implemented

and used to see this potential realised, among which voluntary agreements is one.

Description of Danish and Swedish voluntary agreements

The purpose of introducing voluntary agreements was in both Denmark and Sweden to reduce the increment in energy consumption and to realise existing energy saving potentials in the industry sector. A key element in both the Danish and Swedish voluntary agreement programmes is the energy management system.

DENMARK

In spite of the success of previous energy efficiency efforts the Danish Energy Authority’s current plan on energy savings shows that there are still major possibilities to make the Danish industry more energy efficient. The Danish Energy Authority has estimated the total energy-saving potential of electricity, oil and district heating¹ to be 25 percent of current consumption from 2005 and 15 years onward (estimation from 2002), see Table 1 below. The total annual energy consumption is 59 TWh whereof 19 TWh electricity in Danish industry. The new Danish goal for annual energy savings through voluntary agreements (from 2006) is 280 GWh, half of the savings estimated to come from electricity and the other half from other energy sources.

The Danish Energy Authority has implemented several different policy measures to make industry invest in energy-efficiency and energy conservation actions. The most effective ones used by the Danish Energy Authority have been:

- Voluntary agreements
- Subsidies
- Information activities

As mentioned earlier energy-intensive industries and/or companies fulfilling the requirement of energy-related taxes exceeding 4 percent can sign agreements on energy efficiency with the Danish Energy Authority to receive a CO₂ tax relief. A corner stone of the agreement is that the companies implement a certified energy management system. Subsidies and information activities have been used to stimulate more companies taking part in the agreement programme. Lack of information is the main reason why some companies still have not joined the programme.

By the end of 2002, more than 400 Danish companies had signed voluntary agreements and implemented energy management systems. These 400 companies represent approximately 60 percent of the total energy consumption in trade and industry in Denmark.

There are two ways of signing an agreement in Denmark, on an individual basis or as a member of a group with uniform processes, products and energy consumption patterns. In the case of a group agreement the Danish Energy Authority enters an agreement with a group of companies or a whole industrial sector. A group agreement includes guide-

1. In Denmark primary focus on energy efficiency and energy savings has been on electricity, oil and district heating. The natural gas grid is new, and the Danish focus regarding natural gas has been on increased use rather than energy efficiency.

Table 1. Industrial energy-saving potential in Denmark from 2005 and 15 years onward (Estimation of energy-efficiency potential expressed without regard to conversion losses). Source: Danish Energy Authority, 2002.

| End use | Current consumption | | | Societal energy-efficiency potential [how calculated: interest rate, life time, energy prices?] | | | |
|------------------------|---------------------|-------------|------------------|---|-------|-------------|------------------|
| | Oil | Electricity | District heating | Potential | Oil | Electricity | District heating |
| | GWh | GWh | GWh | % | GWh | GWh | GWh |
| Boiler and net losses | 2 830 | 0 | 0 | 40 | 1 132 | 0 | 0 |
| Heating/Boiling | 59 230 | 590 | 350 | 25 | 1 480 | 150 | 90 |
| Drying | 3 890 | 200 | 200 | 25 | 970 | 50 | 50 |
| Vaporisation | 1 130 | 0 | 90 | 40 | 450 | 0 | 35 |
| Distillation | 900 | 0 | 0 | 30 | 270 | 0 | 0 |
| Sintering | 3 710 | 6 | 0 | 20 | 740 | 1 | 0 |
| Melting/foundry | 620 | 880 | 0 | 20 | 125 | 180 | 0 |
| Other heating > 150 °C | 2 020 | 260 | 570 | 20 | 405 | 50 | 115 |
| Process, total | 25 760 | 1 930 | 1 200 | 24 | 6 180 | 463 | 287 |
| Lighting | 0 | 4 290 | 0 | 20 | 0 | 860 | 0 |
| Pumping | 0 | 1 470 | 0 | 35 | 0 | 515 | 0 |
| Fridge/freezer | 0 | 2 140 | 0 | 40 | 0 | 860 | 0 |
| Ventilation and fans | 0 | 2 970 | 0 | 40 | 0 | 1 190 | 0 |
| Compressed air | 0 | 1 270 | 0 | 35 | 0 | 445 | 0 |
| Other el. Motors | 0 | 3 300 | 0 | 15 | 0 | 495 | 0 |
| Computers/ appliances | 0 | 795 | 0 | 25 | 0 | 200 | 0 |
| Other el. end use | 0 | 115 | 0 | 10 | 0 | 12 | 0 |
| Secondary energy | | 16 350 | | 28 | | 4 580 | |
| Space heating | 4 620 | 670 | 7 070 | 25 | 1 155 | 170 | 1 770 |
| Total | 32 040 | 18 950 | 8 270 | | 8 390 | 5 380 | 2 420 |
| Overall sum | | 59 270 | | 25 | | 14 900 | |

Table 2. Danish industry energy and CO₂ tax levels.**TAX LEVELS**

| | Heavy Process | | Light Process | | Space Heating | |
|--|----------------|-------------------|----------------|-------------------|----------------|-------------------|
| | With Agreement | Without Agreement | With Agreement | Without Agreement | With Agreement | Without Agreement |
| Energy Tax (The full tax is 6.8 euro/GJ) | 0% | 0% | 0% | 0% | 78% | 100% |
| CO ₂ -Tax (The full tax is 13.4 euro/ton CO ₂) | 3% | 25% | 68% | 90% | 78% | 100% |

lines for the mandatory requirements companies have to fulfil. One third of the participating Danish companies have signed group agreements, among which the greenhouse sector, the potato flour sector and the condensed milk sector. Also, a number of local dialogue networks involving companies working with EMS have been established across the country. Within these networks the companies can learn from each other's experiences.

Table 2 below shows the tax level for Danish energy-intensive industries before and after entering the voluntary agreements. The tax level is given as a percentage of the full tax level that equals [2005] 13.4 Euro/ton CO₂. Note the different tax levels depend on the type of activity ("Heavy process" or "Light process", or "Space Heating").

Heavy processes are defined as specific energy-intensive processes, such as melting, boiling and distillation. Light processes include energy consumption that is neither heavy nor space heating. When one energy source is used for more than one process category, e.g. space heating as well as heavy

process, the differentiation in tax level is based on consumption per type of activity. Energy or CO₂ taxes on space heating are not valid if bio fuels and renewable energy are applied.

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The Swedish Voluntary agreement programme allows only for individual agreements, and only for energy intensive industry. A necessary requisite for Swedish agreements is a certified energy management system.

The National Energy Agency has estimated the number of eligible companies to be between 1 150 and 1 300 (approximately 25 percent of companies with more than 200 employees). The annual electricity consumption in these companies is approximately 42 TWh (corresponding to 75 percent of the total industry electricity consumption or 29 percent of the national electricity consumption, 2003). So far some ten agreements have been signed between the National Energy Agency and individual companies.

Eligible tax reduction is approximately 55 Euro/MWh on process-related electricity consumption.

The agreement

Both the Danish and Swedish voluntary agreement schemes include the following four key elements:

- *An energy management system* must be implemented in both countries. In Sweden industry also has to meet certain requirements beyond the energy management system, such as energy-efficient purchasing and energy-efficient designing.

- *Energy-saving measures* comprise well-defined energy-saving options. Companies, which enter into agreements on heavy process, must implement all energy-efficiency measures pertaining to the heavy process with repayment terms of less than four years in Denmark, respectively less than three years in Sweden.

In Denmark non-energy intensive companies can sign agreements too if their energy-related tax load exceed 4 percent. These companies must implement all energy-efficiency measures with repayment terms not exceeding six years.

- *Special studies* which cannot be accomplished by energy inspection, e.g., such as particularly complicated measures which cannot be thoroughly analysed within the timeframe established for compilation of an agreement. In the event that these studies reveal energy-saving measures which have repayment terms of up to four and six years, for heavy and light processes respectively, these measures are to be implemented within a year of submission of the results in Denmark.

- In both Denmark and Sweden *Energy management* comprises guidelines for companies how to ensure that savings achieved in daily operations can be maintained, that intervention takes place in cases of ineffective operations, and that new possibilities for efficiency are evaluated as a natural aspect of daily operations. As a part of energy management, guidelines are laid out for the organization of efficiency activities, energy control, energy-effective purchasing, training and motivation of staff.

The Danish voluntary agreements are on a three year basis with a yearly assessment of the company efforts. The Swedish agreements are on a five year basis, with two points of company effort assessments. The first assessment occasion

occurs after the second year of the agreement and the second evaluation occurs after the fifth and final year of the agreement.

Danish and Swedish EMS

From the start of the Danish voluntary agreement programme until 2001 companies planning to adopt energy management systems (EMS) could receive subsidies in the implementation phase. In addition, specific energy saving projects in individual industries were subsidised. Good examples are considered very important in the promotion of energy management systems. At present more than 20 EMS demonstration projects have been completed in Denmark. These experiences have been used in the development of a number of guidelines and practical and operative tools, which facilitate the implementation and operation of energy management systems in other companies.

Both the Danish and the Swedish standards for energy management systems (DS 2403 and SS 627750) define the constitution of the EMS to be included in a voluntary agreement. The energy management system should enable the organization to continually improve its energy efficiency and to achieve maximum energy savings. The guidelines prescribe regular review of the system to identify new opportunities for improvement and implement new energy conserving measures. The parts of the organization which are covered by the energy management system should be clearly identified.

The energy management system consists of:

- Company's energy policy
- Planning process
- Implementation and operation
- Checking and corrective action
- Management and review

The company's energy policy is the main driver in implementing and improving the organization's energy management system. The policy reflects the commitment of top management with respect to energy so that the organization is able to maintain and enhance its efforts continually to achieve a more energy-efficient operation and more energy conservation. The policy shall define and set clear targets for the company and should be communicated to all employees and the public.

Table 3. Elements of Danish and Swedish voluntary agreements.

| | Denmark | Sweden |
|--|--|---------------------------------|
| Eligible participants | Energy intensive industry and non-energy intensive industry e-tax > 4% | Energy intensive industry |
| Length of agreement | 3 years | 5 years |
| Company assessment | Yearly | Year 2 and year 5 |
| Tax reduction | See Table 2 | 55 Euro/MWh process-related el. |
| Payback investments | 4/6 years* | 3 years |
| Energy Management System | Yes | Yes |
| Requirements on Energy-efficient purchasing and planning | - | Yes |
| Special studies | Yes | - |

* Energy-intensive industry 4 years payback time, non-energy intensive industry 6 years payback time.

The planning process includes an energy audit that maps and evaluates all significant energy consumption elements. On the basis of this process a first assessment of possible areas for energy-saving measures are carried out, and decisions are taken on which saving and/or energy-efficiency measures should be analysed in depth. The energy audit should be regularly updated. An important issue is defining targets for energy efficiency and to consider use of best available technology, when purchasing new equipment (called energy-conscious (or energy-efficient) purchasing). Furthermore the management system also comprises an education and information plan on energy related issues for the employees. The energy management system as a whole must be described so that it is accessible and understandable to all relevant persons.

The checking and correction action part of the EMS requires that the organization shall establish and maintain documented procedures to monitor significant energy consumption elements and all activities that may have a significant impact on energy consumption. This means that the energy consumption should be assessed and evaluated at a frequency which allows relevant key indicators to be obtained (e.g. kWh per kg molten forgings or kWh per production value). Key indicators should be used as control tools and ensure intervention in the event of failures and out of control energy consumption.

Company management are requested to review the energy management system regularly to ensure its continuing suitability. The management review shall address the possible need for changes to policy, targets, action programmes and other elements of the energy management system, in the light of the commitment to continual improvement.

The above mentioned are only a brief description of the energy management system, in addition, a number of measures are introduced in order to monitor and verify the energy management process.

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Danish experiences have shown that many companies can reduce their energy consumption, and thereby energy costs, considerably merely by implementing an energy management system, even without concrete saving measures or investments. The savings achieved this way is due to the increased attention and focus energy consumption is given

through the systematic approach of EMS. Typically, a company implementing an energy management system can expect to reduce its energy consumption by at least 5 to 10 percent during the first years after implementation (AKF, 2002). Many companies achieve an even larger energy reduction. Therefore energy management systems has become an essential part of the Danish voluntary agreement system on energy efficiency. Some concrete examples on energy savings achieved with to energy management systems are shown in Table 4 below (Danish Energy Authority).

The Danish energy management system concept was developed in the 1990s by the Danish Energy Authority in close cooperation with industrial organisations. The Danish Standard for Energy Management (DS 2403), under which companies can be given certification, was introduced in 2001.

The Danish standard for EMS has been designed to be applicable to all types and sizes of companies, irrespective of diverse geographical, cultural and social conditions. It provides a framework within which individual companies tailor their own energy management systems. The Danish EMS's structure and terminology are parallel to that of the standards for environmental management system, ISO 14001, and for quality management system, ISO 9001. The main difference is that the standard for EMS focuses particularly on energy issues.

Companies who have already implemented an environmental management system can use the standard for energy management system to strengthen the energy aspect of their environmental management system. The EMS has been integrated into other management systems in many Danish companies. It is used more often in conjunction with environmental management systems than with quality management systems.

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Both the Swedish voluntary agreement programme and the Swedish energy management system standard (SS 627750) are to a large extent influenced by the Danish programme and standards. However, influences and experiences from other national voluntary agreement schemes can also be seen in the Swedish programme, and naturally adoption to Swedish conditions have been made.

Table 4. Concrete examples on energy savings achieved through implementing energy management systems.
(Source: Danish Energy Authority, 2002.)

| ENERGY SAVINGS FROM ENERGY MANAGEMENT | | | | | | |
|--|-----------------------------|-----------------------------|--------------------|---------------------------|--------------|--|
| Results from demonstration projects on energy management in companies without an agreement on energy efficiency with the Danish Energy Authority. Some of them also focused on water consumption. | | | | | | |
| Company | Products | Annual energy costs* | | Savings in percent | | |
| | | 1000 euro | Electricity | Heat | Water | |
| MAN B&W Diesel A/S, Alpha Diesel | Propulsion plants for ships | 1,200 | 6 | 18 | 21 | |
| De danske Spritfabrikker A/S | Wine and spirit | 700 | 5 | 29 | 25 | |
| Ø-Pølser A/S | Sausages | 300 | 9 | 11 | 33 | |
| Bundy A/S | Fluid carrying systems | 100 | 14 | 12 | - | |
| Karl Molin Stålkonstruktioner A/S | Steel constructions | 50 | 23 | 39 | - | |

*Including water costs

The Swedish energy management system standard has been developed by the National Energy Agency and the Swedish Standards Institute in close cooperation with industry. The structure and terminology of the Swedish energy management system standard are, like the Danish, parallel to the structure and terminology of the standards on environmental management systems (ISO 14001) and quality management system (ISO 9001). Companies already having implemented environmental and/or quality management systems can rather easily integrate the energy management system as a module to the existing management system.

Evaluation of the Danish voluntary agreement scheme and energy management system

The Danish voluntary agreement programme has been in place long enough to be evaluated while the Swedish programme has just been launched. Thus this chapter deals only with the outcomes of the Danish programme.

Evaluation of the Danish energy-tax system has shown that it has been possible to establish an energy-tax system resulting in a decrease in CO₂-emissions, without causing a decrease in the competitiveness of trade, industry and services. The voluntary agreement system has been a very important element in improving energy efficiency in Danish companies where taxes as a policy instrument would not have been a realistic instrument (Danish Energy Authority, 2004).

In the case of companies having signed voluntary agreements, several evaluation studies estimate achieved improvements of approximately 2.7 percent of the yearly consumption of total energy consumption of involved companies. This corresponds to yearly energy savings of 0.1 TWh (electricity, oil and district heating). General energy-efficiency measures, special audits and energy management systems are estimated to contribute approximately by one third of this reduction each. An estimate on the impact of Danish energy policy measures carried out by the Danish Energy Authority is shown in Table 5. The estimated savings given for voluntary agreements in Table 5 includes EMS. It is also presumed that a continuation of the volun-

tary agreement system until the end of 2005, relative to a situation without these agreements, can lead to a decrease in CO₂-emissions corresponding to 6% of total emissions in industry and trade. Of this reduction the major part is due to energy management systems. However, maintaining the positive effects of energy management systems will require that companies give higher priority to the managerial part of the system and not only focus on energy accounting.

In December 2002 the Danish voluntary agreement system was evaluated on behalf of the Danish Energy Authority the evaluation findings were:

- That 50 percent of the companies involved in a voluntary agreement, described the energy savings as considerable (savings exceeding 20 percent).
- The energy management system was assessed positively and being an advantage to the company. Some companies have introduced it in establishments in other countries too.
- The requirements from the voluntary agreements on energy efficient planning have resulted in concrete savings.
- 19 out of 20 interviewed companies say the special investigations have lead to concrete measures having improved energy efficiency.

Costs associated with joining a voluntary agreement

Danish experiences have shown that it may cost the individual company 10 000-15 000 Euro to implement and certify an energy management system. The costs depend on how complex the plant is. Some companies have argued that it is too costly to carry out energy audits and to have the audits verified.

Which categories of industry are attracted?

Several industry categories have been attracted by the Danish voluntary agreement programme. Among these the most common are found in food industry (meat, potato flour, and dairy products), breweries, chemical industries, gardeneries,

Table 5. Evaluation of impact of Danish energy policy measures during the period 1990 to 2003. (Source: Danish Energy Authority, 2004).

| Measure | Total [GWh] | Electricity [GWh] | Other [GWh] |
|---|-------------|-------------------|-------------|
| Building codes | 225 | 0 | 225 |
| Energy labelling of buildings | 42 | 0 | 42 |
| Energy labelling of appliances | 3 | 3 | 0 |
| Standby Action Plan | 60 | 60 | 0 |
| Electricity Saving Trust | 83 | 83 | 0 |
| DSM by electricity grid companies | 125 | 125 | 0 |
| DSM by gas companies | 56 | 0 | 56 |
| DSM – District heating | 56 | 0 | 56 |
| Voluntary Agreement Scheme – industry | 112 | 56 | 56 |
| Promoting condensing gas boilers | 12 | 0 | 12 |
| Agreement glazing and windows | 108 | 0 | 108 |
| Transport | ? | | |
| Total | 880 | 326 | 553 |
| Total primary (electricity multiplied by 2.5) | 2 200 | 815 | 553 |

animal food industry and pulp and paper industries. In Sweden the most common industries to be attracted by the voluntary agreement programme are foreseen to be pulp and paper industry, mineral and mining industry and chemical industry.

Important indirect effects

The main driver to enter the programme is receiving the CO₂-tax rebate. However, participating industries have also benefited from indirect effects such as better product quality, increased production capacity and increased employee engagement. Most industries participating in the Danish voluntary agreement programme have found the agreement delivering important positive side effects (Danish Energy Authority).

Often these benefits have a more significant economical impact to the individual company than the tax rebate. One such example is Århus Olie A/S, a company producing oils for the food industry. When upgrading the production process, the 15 existing production lines were replaced by two new larger lines. Energy analysis carried out after replacement showed that production was possible with a major decrease in the number of pumps compared to the old manufacturing process. Moreover an electricity saving potential of 50 percent was realised. The electricity savings correspond to a yearly cost saving of 110 000 Euro (1.2 M DKK), with an investment pay back time of less than a year.

Conclusions

To reach a sustainable society energy consumption has to be turned down and CO₂ emissions reduced substantially. There is no single measure leading to fulfilment of this goal, instead a multitude of actions delivering energy efficiency must be taken. Based on experiences from the more than ten year running Danish programme voluntary agreements appear to be of significance to reach sustainability. Voluntary agreements have shown to deliver energy efficiency in both theory and practice.

To realise these efficiency gains industrial voluntary agreements should build on a proper energy management system, including:

- Company energy policy
- Planning process
- Implementation and operation
- Monitoring and corrective actions, and
- Management and review

Equally important are actual energy-efficiency measures taken, both general and based on special studies.

The main driver for individual companies to enter a voluntary agreement has shown to be the tax rebates. However, once having entered the scheme other benefits, such as better product quality and increased employee engagement, have often shown to be more economically significant to the company than the tax rebate. Furthermore evaluation of the Danish voluntary agreement programme shows a high de-

gree of individual company satisfaction. However, consideration should be given to possibilities to reduce the administrative costs of entering into a voluntary agreement, without this causing reduced efforts to save energy.

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