

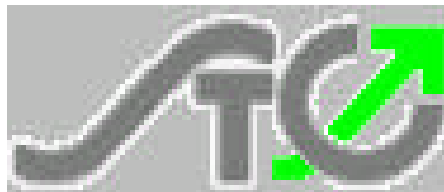


EMAS

Guidebook

Integrating Energy- and Environmental Management

Developed with support from the Norwegian Pollution Control Authority (SFT) and the SAVE-programme
Prepared by Oestfold Research Foundation and Institute for Energy Technology



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PREFACE

In collaboration with partners from Finland, Sweden, Denmark, England and Austria, Institute for Energy Technology - IFE initiated a SAVE-project aiming to increase the focus on energy management related to EMAS registration.

The EMAS Scheme (EU's Eco-Management and Audit Scheme) for the voluntary introduction of environmental management and auditing into industrial companies was included the Norwegian Pollution Control Act in 1996

This part of the SAVE-project is based on the experiences of member states with environmental analyses, and in particular the challenges in connection with getting companies to place a satisfactory emphasis on energy as an environmental factor. An important aim of the project is to develop an EMAS-adapted guidebook on energy management, targeting companies working for EMAS registration.

The Østfold Research Foundation (STØ) has produced this guidebook in collaboration with IFE. The author of the handbook is Audun Amundsen (STØ), with the assistance of Hans Jacob Mydske (IFE) and Thomas Seyffarth (IFE). The English version of the guidebook is a slightly abbreviated version of the Norwegian original. The guidebook is furthermore meant to be translated from the English version into any other language.

The project is financed 40% by the EU-Commission. The Norwegian Pollution Control Authority provides the project with financial support on the part of Norway.

READERS GUIDANCE

This guidebook aims at different target groups that in some way are involved with EMAS. The need for information and guidance varies, and this guidebook describes methodologies and activities which can contribute to integrate energy as an important element in EMAS.

Section 1-2 are general introductions to environmental management, EMAS and ISO 14001. This information may be new to some readers, whils others find it useful as repetition and to freshen up some main points.

Section 3 deals with energy management as such, focusing on the relationships between environmental- and energy management.

Section 4 deals systematically with all relevant articles in the EMAS-regulation, interpreting these with regard to energy. The objective is to give the companies specific and practical advice on how to proceed with EMAS, thus ensuring appropriate emphasis on energy

Section 5 describes 4 specific cases from EMAS companies where energy has been handled explicitly to ensure appropriate focus on this topic.

SUMMARY

What is energy management

Energy Management in practical terms means placing a focus on energy as a cost factor in a company. Energy management implies influencing the consumer's behaviour in terms of energy, the promotion of an economical energy operation and disclosing possibilities for energy saving. Furthermore, energy management is important in ensuring a company's energy supply, in the form of correct amount, quality and price.

A key task in connection with energy management is the establishment of routines ensuring a continuous improvement with regard to the optimisation of energy costs. This takes place through the use of a management system involving designated individuals in the organisation. These are made responsible for carrying out different tasks within registration and data processing, the development of key figures, information, etc. The latter is implemented through a plan based on the energy policy and the objectives established for the operation.

Quality and Efficiency in Environmental Management

Quality and not least efficiency in the introduction and maintenance of an energy management system are connected to one word: *integration*.

The different divisions for energy and the environment within a company illustrate this. It is easy to lose hold of a comprehensive perspective, and increase the danger of sub-optimisation. Figure 1 shows the connections between relevant areas that modern companies want to address.

Sustainable Development

Agenda 21 is on its way into the Member States of Europe and companies must, sooner or later, address this reality.

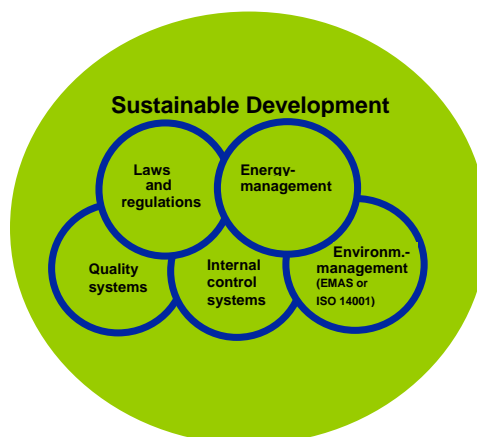


Figure 1 The figure illustrates integration of elements in a sustainable management system in a company

Quality Systems based on the ISO 9000 series.

Many companies are certified and have thus established a system. The introduction of energy management and/or EMAS can successfully be implemented in connection with this. If a documentation system for quality exists, this can be expanded to an "Energy - Environment and Quality System".

Internal Control Systems

Many companies have an internal control system that not only addresses the working environment, but also includes emergency systems, control systems for entrenched oil tankers, etc. Internal control systems are required by law only in Norway, but many European companies have corresponding systems.

In order to prevent duplication, and sub-optimisation, the company should consider whether it is expedient to integrate this into the environmental management system.

The environmental management system, whether in relation to EMAS, ISO 14001 or other national standards, should always be made a part of energy management.

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1. INTRODUCTION

The objective of this handbook is to provide guidelines for companies aiming to introduce energy management parallel to the environmental management system EMAS, or for companies that already have environmental management and want a greater focus on improved energy efficiency.

*Energy Management*¹ is a management system which is utilised to achieve specific objectives within trade and industry. What can be achieved?

- cost efficient energy use in the company
- reduced emissions of air pollutants
- less need for the development of new energy forms on a site

Companies which reduce their consumption of electricity produced from hydro-power or other renewable energy sources, will also contribute to reducing air pollutant emissions, as the energy saved can be used instead of fossil fuel in other areas.

Energy management is more relevant to industries where the energy costs comprise a larger share of overall costs. Table 1 shows examples of typical figures.

Table 1 Energy Cost in Relation to Overall Costs

Industry	Energy Cost in relation to overall costs
Bakeries	2-5 %
Meat Processing Industry	3-9 %
Dairy Industry	4 %
Timber and Saw mill Industry	4 %
Laundries and dry-cleaners	9 %
Grain-drying Industry	10 %
Foundry Industry	10 %
Pulp and paper Industry	13 %
Fish Meal Industry	25 %

¹ Energy Management; see chapter 3

2. ENVIRONMENTAL MANAGEMENT

Regulations and standards

An English standard for environmental management (BS 7750) has existed since 1993 and was the forerunner to the EU Regulation on environmental management (EMAS). An EU Regulation is designed for the situation in Europe. In order to address international conditions, the ISO 14001 on environmental management has been developed. There are Norwegian companies certified in accordance with the ISO 14001 standard, even though many more are registered according to EMAS. There are no regulations or standards for energy management.

What is EMAS

EMAS is a regulation for the voluntary participation of industrial operations towards an environmental management and environmental audit scheme in the EU. It was introduced into Norwegian legislation on April 10, 1995, as a regulation in "The Pollution Control Act". EMAS is an abbreviation which stands for "Environmental Management and Audit Scheme".

The Regulation is made up of 21 articles and five annexes. A brief explanation of the most important articles and annexes pertaining to energy management follows:

- Article 1:** General on environmental management, the environmental audit scheme and objectives of these.
- Article 2:** Definitions of terms and expressions used in the regulations.
- Article 3:** Procedure for fulfilling the certification requirements for an EMAS review.
- Article 4:** Audit and validation.
- Article 5:** Environmental Statement for each industrial sector taking part in the scheme.

- Annex 1:** Environmental policies, environmental programmes and environmental management systems requirements.
- Annex 2:** Requirements in connection with environmental audits.
- Annex 3:** Requirements for accreditation of environmental inspectors and their obligations.

To Whom Does EMAS Apply

EMAS applies to industrial operations, but an expansion is planned which will also include commercial firms, service industries and local and state government administration.

What are the intentions behind EMAS

The intention is first and foremost to prevent or reduce pollution or unnecessary use of energy and material resources by addressing the process-sources causing the problems. "Purification Plant Solutions" designed to separate pollutants into several fractions seldom solves the problem and should thus be replaced by reducing pollutants from the source. This can be achieved either through product change, the use of cleaner technology or "smarter" processing solutions.

The industry itself is held responsible for the effects of its activities and products on the environment and should therefore for its own benefit, work systematically towards the improvement of its processes and products.

This responsibility can be attained by developing and implementing an environmental policy, environmental objectives and environmental programmes as part of an efficient system for environmental management. The environmental policy, which in addition to being in accordance with all relevant regulatory environmental stipulations, shall include a commitment to a continuous improvement in environmental performance.

In order to achieve EMAS-registration, the company must publish and send out periodic environmental statements with information to the general public on the actual environmental status of the operation. The environmental policy shall also be reported, as well as the environmental programme, environmental objectives and environmental management system. Employers are to be made aware of their own role with regard to preventive environmental measures, and to be given the necessary training.

EMAS is divided up into 21 articles whereof the first 5 are about requirements to the operation. These will be focused upon in the remaining parts of the handbook. Article 1 is about environmental management and the environmental audit scheme. Its objectives include the following:

".....The objective of the scheme is to promote a continuous improvement in environmental performance..... "

What this implies is that environmental issues can not be solved once and for all through a single all-out effort, but rather must be solved through a systematic and ongoing strategy.

The Main elements of EMAS

For an industrial site to be registered as part of the scheme, the enterprise must:

- approve an environmental policy for the company
- carry out an environmental review
- lay down objectives for a lasting improvement of environmental performance
- introduce an environmental programme for the industrial site
- establish an environmental management system
- implement or have implemented, environmental audits
- publish a separate environmental statement

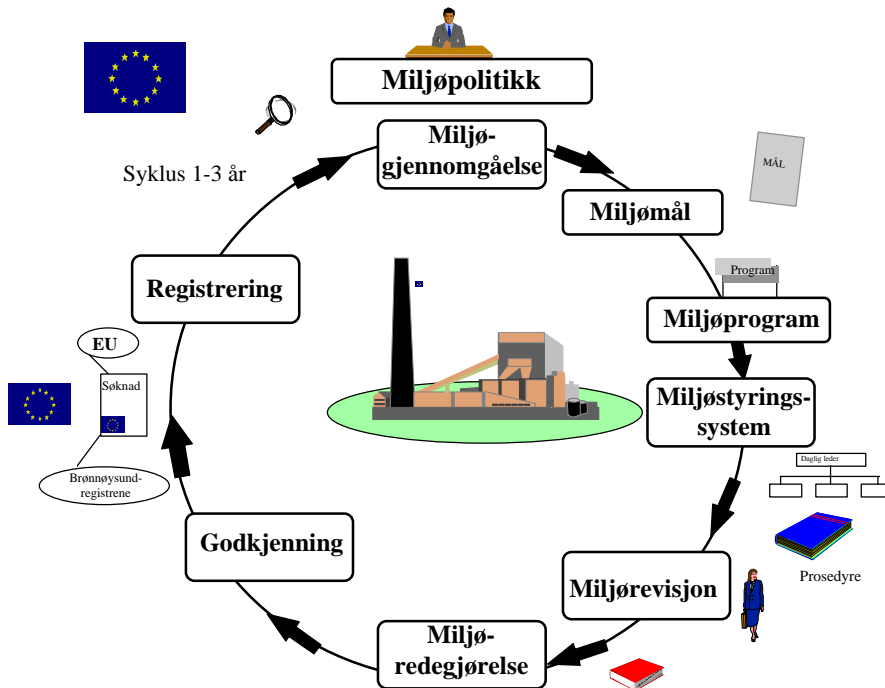


Figure 2 The Main Elements in EMAS (9)

The phases in a systematic EMAS process and their order, are shown in figure 2. All of these phases are also relevant to energy management, with the exception of the registration procedure. There is no reason why energy management or environmental management can not function well, even though the enterprise is not EMAS-registered. However, one hereby loses a marketing effect and access to an external control system, which can contribute to keeping the system dynamic and up to date.

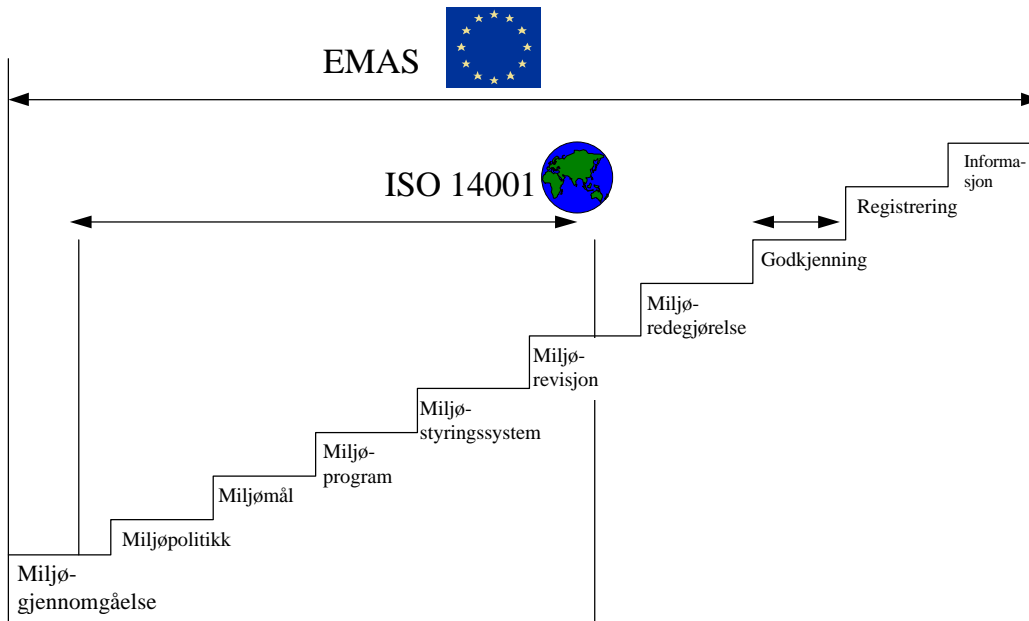


Figure3 The Figure illustrates the connection between ISO 14001 and EMAS

ISO 14001 and EMAS

Figure 3 shows the connection between ISO 14001 and EMAS, and as is clear EMAS is more comprehensive. When EMAS has been introduced, ISO 14001 certification can be realised through small initiatives.

A "certification" in correlation with ISO 14001 comes instead of EMAS "approval".

Some important differences between the two systems are that EMAS expresses a more strenuous requirement for continuous improvement, and that publication of an environmental statement creates a commitment to such activity.

Why Environmental Management

What are the most important motivating forces behind the introduction of environmental management? Experience tells us that one may benefit in one or more of the following ways:

1. Cost reductions
2. Reduced pollutant and waste emissions
3. A competitive advantage in the export market
4. A competitive advantage in the domestic market

A survey has been carried out in 22 Nordic companies in order to ascertain the cause for their introducing environmental management or other forms of environmentally friendly production. The survey took place in November 1997 (22). The responses shown in table 2 indicate that two answers stood out as being the most significant;

A " Meeting future market demands" (54%) and
B " Economic savings, profitability "(48%)

Table 2 Motivating forces behind introducing environmental management

Most important reason	Degree of importance (%)
Meeting future market demands	54
Economic savings, profitability	48
Requirements by law	38
Current market demands	38
Contribution to sustainable development	29
Other reasons	29
Useful tool for developing the organisation	25
Useful for ensuring worker involvement	23

3. ENERGY MANAGEMENT

What is Energy Management

”A tool which results in continuous improvements with regard to energy management, energy efficiency and choice of energy sources.”

Energy management is, like other management systems, system oriented - or, it represents a procedure or routine that will create results. The results are measures. The practical contents of the terms in “energy management” will be discussed in chapter 4 of this handbook. Examples are found in chapter 5.

Particularly important, the ABC’s of energy management

What is particularly important in the introduction of energy management will vary according to the starting point of the industry and company. Some companies have worked with energy economising and through this already have a higher level of expertise and greater interest in area of energy. The manager of a small fish processing company in *Engelsviken* puts it like this; *”we used to pay the electricity bill as a necessary evil. Now we look forward to receiving it, because it is exciting to see how small it is.”*

But what are the ABC’s of energy management? The main components are as follows:

- A. Energy Policy
- B. Energy Analysis
- C. Energy Objectives
- D. Energy Programme
- E. Training
- F. Energy Administration
- G. Energy Audit
- H. Annual Report

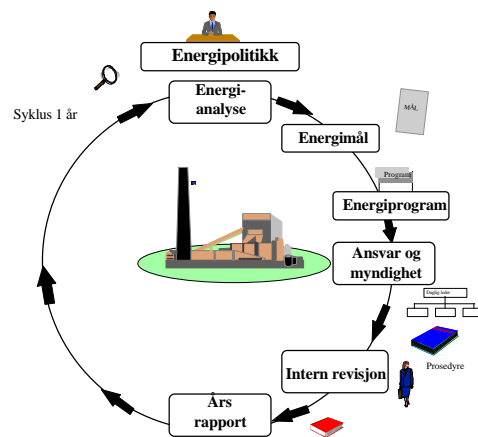


Figure 4 The Main Components of Energy Management

The aim of energy management is ongoing improvement, which hereby ensures that the components of the energy management system do not become static. In order to avoid this, they can be placed in a time cycle, as EMAS places its components in a time cycle. The individual elements of energy management are compared with the elements in EMAS in table 3 and in figure 4.

Table 3 Energy management in comparison with the EMAS requirements

Energy Management	EMAS requirements	Suitable for integration
Energy Policy Use the company's strategy, combine this with energy and think long term. Policy discussed and approved by the board.	Environmental Policy Specific requirements	yes
Establish Energy Management 1. Create an energy policy 2. Form energy related goals 3. Energy monitoring is introduced 4. Charting of approximate energy and water consumption. 5. Estimate of savings potential	Environmental Review Specific energy relevant requirements: 1. Evaluation of environmental consequences of energy use. 2. Energy management, efficiency and choice of energy source.	yes
Main Analysis (phase 2) 1. Create detailed mass and energy balances to determine the savings potentials. 2. Through voluntary brainstorming, an energy-economising measures list is identified. Detailing: basis for resolution.		No, not in accordance with regulation.
Energy Objectives Set up objectives which are 1. realiseable(within the scope of available resources.) 2. comprehensible(to those involved) 3.actual cost calculable (deadline)	Environmental Objectives Set up objectives which are 1. realiseable(within the scope of available resources) 2. comprehensible(to those involved) 3. actual cost calculable(deadline)	yes
Energy Programme Identify concrete improvement measures.	Environmental Programme Set up one list with concrete improvement measures.	yes
Training Carry out training programmes at all levels of the company.	Training Analyse needs and carry out training either internally or externally.	yes
Energy Management: Make instructions for: Who is responsible for what when (e.g.):Who reads the meters? Who works out the key energy figures?	Environmental Management System; Create and implement procedures for: Who does what when, who is responsible for what and which authority?	yes
Energy Audit 1. Test established standards against what has taken place 2. Write a review report.	Environmental Audit 1. Test established objectives against what has taken place 2. Publish an environmental statement	yes
Continuous Improvements Revise the policy and re-start from the top of the column. Adjust this according to the company's EMAS cycle.	Continuous Improvements Re-start from the top of the column. Use the company's new strategy, the environmental statement and revise the policy. Use maximum three-year cycles.	yes

Energy Management and EMAS – advantages and disadvantages

Companies that want to introduce EMAS have a lot to gain by focusing on energy and environment simultaneously, in the creation of an integrated energy and environmental management system.

The following are some of the *advantages* of integrating energy management and environmental management:

- avoid parallel management systems for environment and energy
- less paper work
- easier maintenance

The following are some of the *disadvantages*:

- large overly complex system
- not suited to the organisation and the current responsibilities
- advisors will seldom have expertise on both energy and the environment. Use of two different advisors can be expensive.

Profitability with Energy Management

A number of profitable improvement measures can be found, so that it often proves to be a profitable investment to introduce energy and environmental management. In energy intensive industries, such as the food industry, metal industry and laundries experience has shown that large savings are realised (3,18,22).

A survey done in 1995, carried out in 67 Norwegian companies that have implemented “Cleaner Production Assessment”, shows that including the energy element in this process results in good profitability.

Table 4 shows the results of the survey (18). Some companies had used external energy expertise in the implementation of the Cleaner Production Assessment and some had not. In those cases where energy expertise was brought in, the table shows that the number of energy measures out of the aggregate number of improvement measures increased from 29% to 66%.

Table 4 Results of 67 technical environmental analyses with regard to extra energy expertise in the implementation of 26 cases.

Category	Technical environmental analysis with increased focus on energy	Technical environmental analysis without special focus on energy
Number of companies in the survey group	26	41
Finance:		
The company's investment (1000 ECU)	530	250
Pay-back time without interest (yr.)	2.1	2.7
Energy:		
Reduction in energy consumption (MWh/yr.)	9.003	1.334
Energy related measures in % of total number of measures (%)	66	29
Cleaner production:		
Source measures in % of total number of measures (%)	63	78

(1) Based on an average energy price of ECU/MWh for all sectors.

(2) Pay-back less than six years

Carried out in Norway from 1993 – 95 (18). A greater number of energy measures were anticipated, but it was surprising that the difference was so great.

4. ENERGY MANAGEMENT IN EMAS

Procedure

The following ABC outlines a common procedure:

- develop a policy
- carry out a detailed environmental evaluation, and set up concrete objectives for changes.
- develop an environmental program and stipulate specific improvement measures
- implement the measures
- evaluate the results based on the initial objectives

Policy or Review First

In terms of experience, many industrial companies have limited expertise with regard to efficient energy use, and this will in turn pose problems if one starts directly with the formation of policy.

An alternative course of action can thus be to start by implementing an environmental review. The purpose is to build up the company's energy expertise by way of this process. It will subsequently be easier to develop policy, once the introductory environmental review has been carried out.

Companies with sufficient energy expertise should however start by forming a policy.

Environmental Policy

(EMAS Regulation Art. 3a)

Companies which have a quality system can integrate environmental and energy policy with the existing quality policy. The advantage then becomes one joint policy, instead of three separate ones. It can also prove easier to maintain an overview of an integrated energy, environment and quality system. Energy consumption and energy management are important quality factors for a company's operations. Some companies also choose to integrate the health, environment and security system (HES) in the quality and environmental control system. This must be evaluated in each individual case, independent of organisational situation and level of expertise.

To take part in the EMAS scheme, the company must in accordance with article 3a:

".....adopt a company environmental policy, in accordance with the relevant environmental requirements...the reasonable continuous improvement of environmental performance, with a view to reducing environmental impacts to levels not exceeding those corresponding to economically viable application of best available technology....."

Article 3a also says that environmental policy is to be in accordance with the requirements in annex 1:

- *the environmental management policy is to be adopted by the company's highest level of management, and shall be communicated to the company's personnel and be made publicly available. (annex 1A item 2)*
- *the environmental management policy is to address energy management, savings and choice (annex 1C item. 2).*

The example of an environmental policy with energy fully integrated, is from Østfold Eggcentral in Rakkestad (25). The policy was approved at a board meeting on December 17, 1997 and is displayed in figure 5.

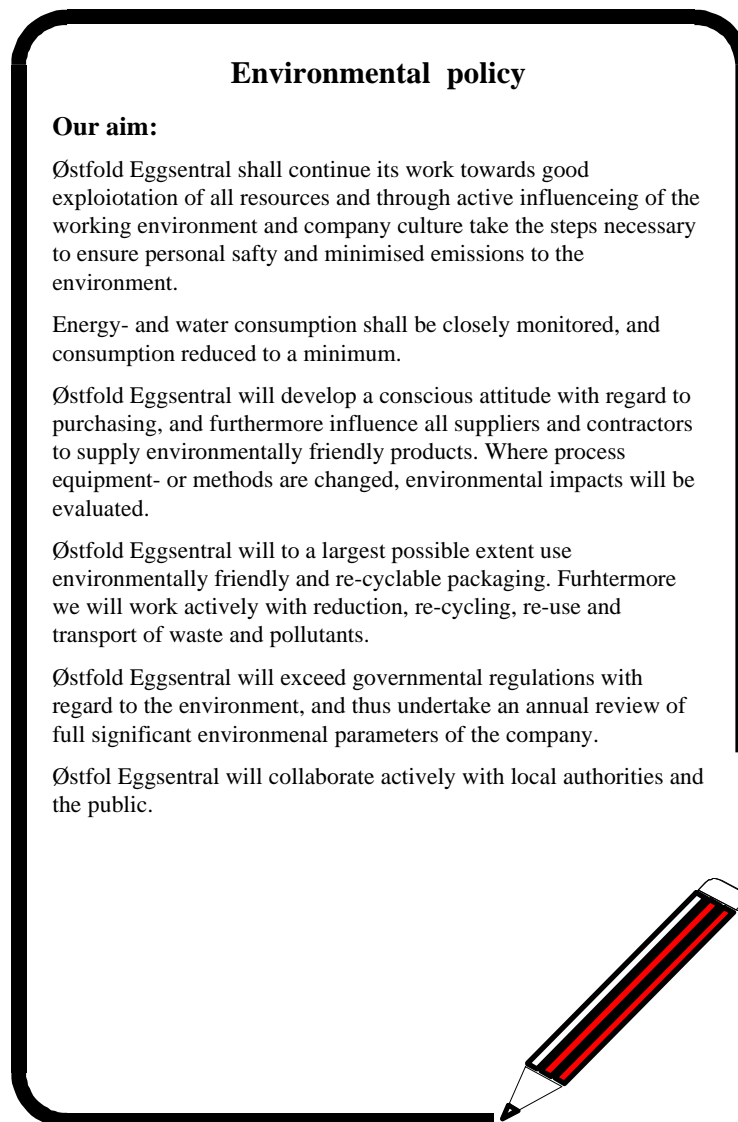


Figure 5 Environmental Policy from Østfold Eggcentral

Environmental Statement

(EMAS Regulation Art. 3b)

Many companies are so insufficiently staffed that they need consultants to assist them in undertaking an environmental review. Both energy- and environmental expertise will be needed here. If it is difficult to find a person or consulting company with expertise within both areas, one should consider involving two individuals or consulting companies that can work together.

In the EMAS Regulation, article 2, “environmental review” is defined as follows:

“environmental review”: an initial comprehensive analysis of the environmental issues, impact and performance related to the activities at a site.”

Further, article 3b says:

“conduct an environmental review of the site on the aspects referred to in Annex 1C”

Annex 1, part C stipulates, through 12 parts, each of these aspects. We have here shown them in terms of what is most relevant in an energy context, and the annex mentions in particular that the company must carry out the following:

1. *Evaluation, control and reduction of the impact of the activity concerned on the various sectors of the environment.*
2. *Energy management, savings and choice.*
3. *Raw materials’ management, savings, choice and transportation; water management and savings.*
4. *Waste avoidance, recycling, reuse, transportation and disposal.*
-
6. *Selection of new production processes and changes to production processes.*
-
11. *Staff information and training on environmental issues.*
12. *External information on environmental issues.*

Some terms/definitions

In annex 1C item 2 we find the terms *“Energy management, savings and choice”*. In Chapter 3 on Energy Management, there is a reasonably thorough discussion concerning what these and some other recurring terms represent. See also figure 4 in Chapter 3.

Energy Accounts

To be in a position to continue working with energy management, the company must set up energy accounts which are again based on the company’s energy monitoring system, if such a system exists. The energy accounts will be one part of the total environmental accounting system to an EMAS review, and in the following we will look more closely at such an environmental accounting system.

Environmental Accounting

The format of an environmental accounting system is crucial to an environmental review. All significant consumption of energy/raw materials/water and additives are to be recorded and quantified here. The principle behind an environmental accounting system is shown in figure 6.

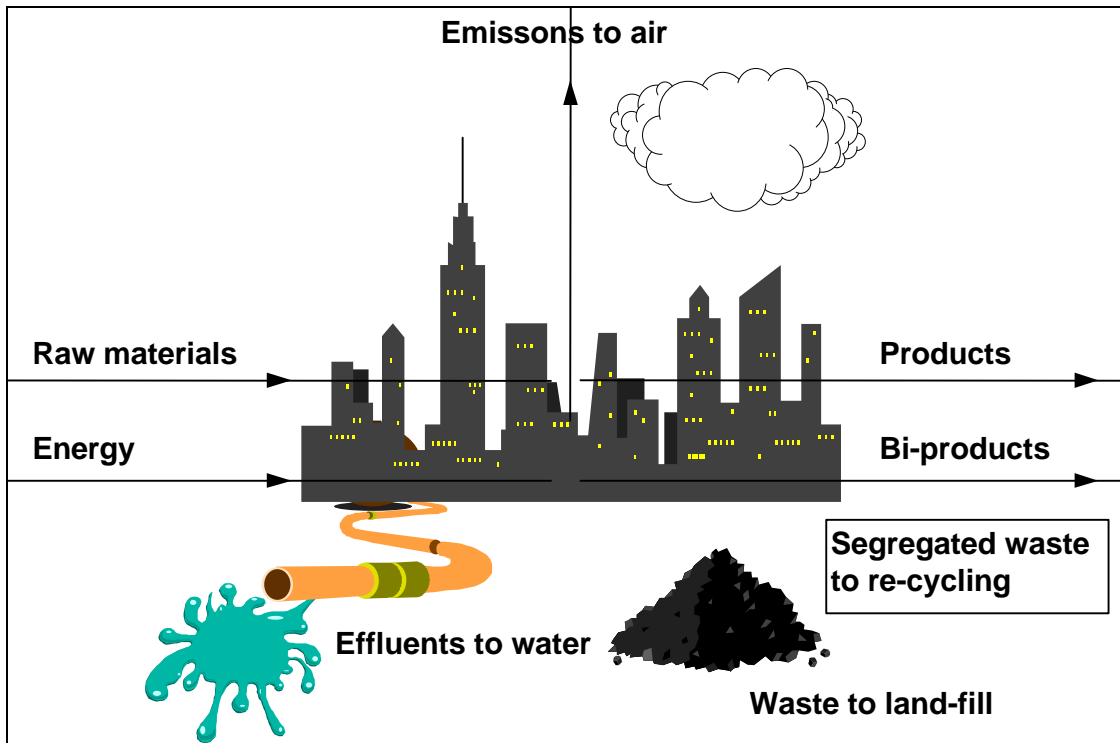


Figure 6 The figure shows the principle behind an environmental accounting system (mass- and energy balance)

How detailed should such a balance be? Large currents, expensive currents or poisonous currents are three factors which can be used as criteria.

An environmental accounting system for the company “Food Industry Ltd.” is shown in figure 7. In annex there is a schedule proposal which is suitable for the setting up of the primary data in an environmental accounting system.

On the basis of the figures from the environmental accounts, the company should be able to quantify its material flow, its energy consumption in various manufacturing processes, as well as different air and water emissions. This account will be an important starting point for the company, when it subsequently moves on to developing specific measures.

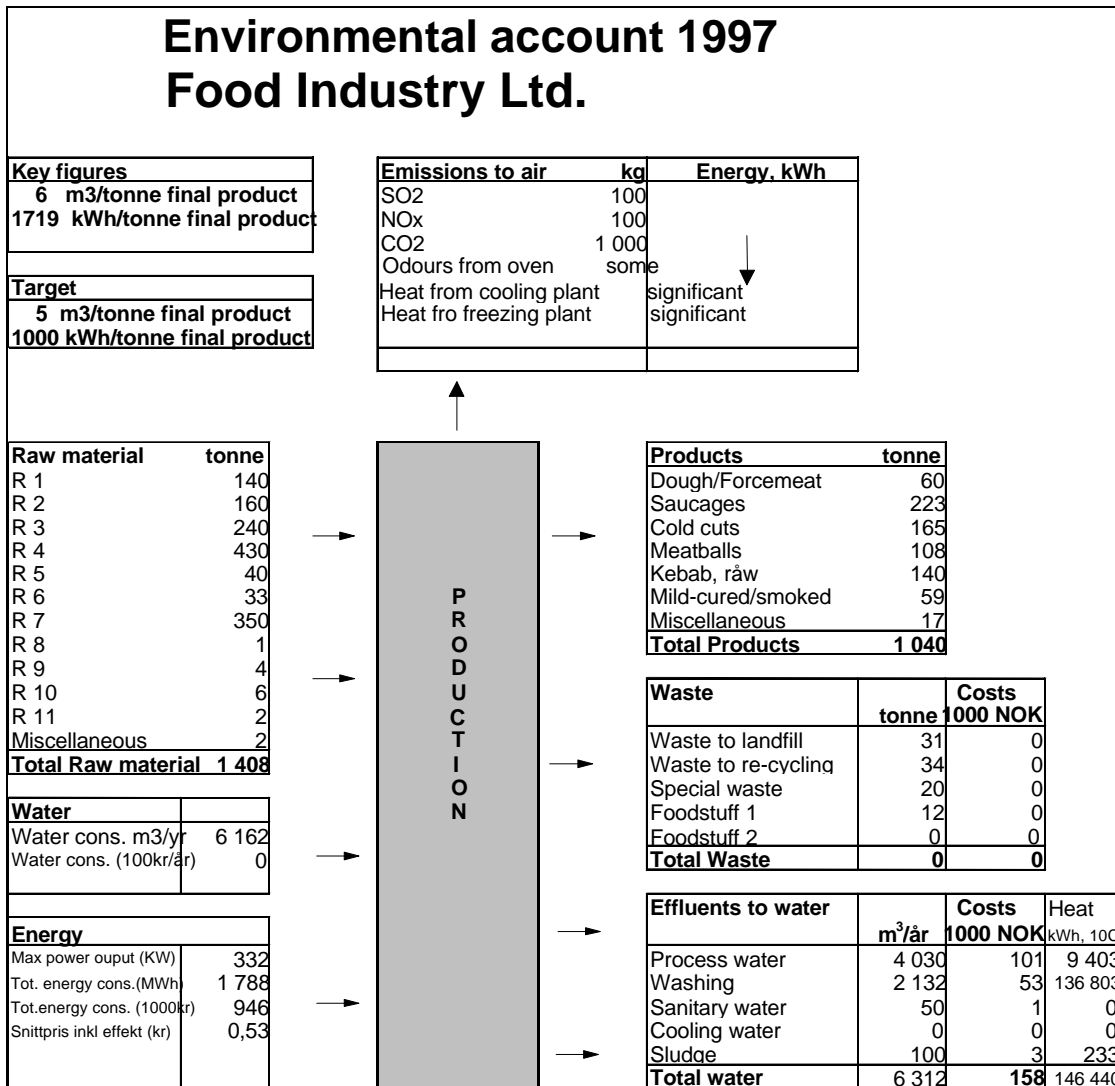


Figure 7 Environmental Accounting System for "Food Industry Ltd."

Energy and Environmental Analysis

In an energy and environmental analysis, the objective is to identify possible measures, calculate the effects on the environment and the energy saving potential, calculate potential, profitability and evaluate how the measures can contribute to fulfilling the approved objectives.

If the company does not possess the necessary expertise to carry out this work, it can be expedient to acquire assistance from external sources for the areas in question.

Detailed mass- and energy balances can be used as a basis for brain storming sessions on improvement measures. Some good techniques can be found in references (2) and (17). An important task for the project manager during this phase, is to arrange the brainstorming sessions and record proposals. The proposals are then subjected to a technical and financial analysis, and a list of the measures arranged by priority is

submitted. Often, the most important criteria will be economic profitability, and the measures are then ranked by priority in three groups; see table 5.

Table 5 Technical and economic proposals for prioritised energy saving measures.

Priority	Pay-Back Time (yr=X)	Implementation
A	$X < 1$	Immediate implementation
B	$1 \leq X \leq 5$	Put into the environmental programme
C	$X > 5$	Wait until a later date

Examples of a list of measures from an energy and environmental analysis are shown in table 6. The table is a summary of relevant improvement measures. Investments, energy, water, and costs savings, pay-back time and environmental benefits are given in the table. Annex 3 details an example of such calculations.

Table 6 List of possible measures from Grimstad Konsevesfabrikk AS

Measure	Priority	Savings					Environmental benefits
		Energy	Water	Money	Investment	Pay-back	
		tWh/yr.	m ³ /yr.	NOK/yr. (1000)	NOK (1000)	yr.	
Re-use of cooling water	B		2 115	12.3	50	4.1	Reduced water consumption
Automatic sorting of raw materials (1)	B			1 000	1200	1.2	Less raw material refuse
Modification of autoclave	B	31	1 750	19	50	2.7	Reduced energy and water consumption
Reuse of condensation water from boiler (1)	B	62	390	19.1	50	3	Reduced energy consumption
Regulation of water supply	A		470	2.7	0	-	Reduced water consumption
Training of operational staff	A	108	2 720	46	0	-	Saved energy and water. Reduced effluents of organic materials.
Energy Management	A	216	5 440	91	25	0.3	Saved energy and water
Concentration of organic material from waste water.	C			1.3	100	9.7	Sold as pig fodder. Less transport, reduced BOD emissions; 1000 tonne/yr.
Separation of water and organic materials.				?	?	-	Bi-product of former waste. Reduced organic material effluents.
Total		417	12880	1200	1475	1.2	

(1) Applies to all lines of production at the site.

Environmental Objectives

(EMAS Regulation Art. 3e)

In the EMAS Regulation article 2, “environmental objective” is defined as follows:

”the detailed objectives, in terms of environmental performance, which a company has set itself.”

Further, article 3e states:

”...to set objectives at the highest appropriate management level, aimed at the continuous improvement of the environmental performance in the light of the findings of the audit and appropriately revise the environmental programme to enable the set objectives to be achieved at the site;”

How to Set Energy Objectives

It is important that objectives are set which are in correlation with the energy and environmental policy, if one is to follow EMAS and the usual method for target management. Good objectives should be:

- comprehensible
- possible to accomplish
- actual cost calculable

How does one quantify comprehensible, possible to accomplish and actual cost calculable objectives? It depends upon the conditions at each company and also the profitability requirements which has stipulated by the company. There are however, two helpful tools available:

A. The Environmental Review

The documentation from the introductory environmental review should give an answer as to energy economising potential. Profitable measures and the energy economising potential should be described here. The quantifying of objectives depends upon how much potential has already been acquired at the point in time when the objectives are established. “Immediate Measures” or the most profitable and easiest to carry out, have in many cases already been implemented.

B. Comparison.

Separate key energy figures, expressed as kWh/kg finished product, make possible comparison, or “benchmarking” oneself from year to year. It also makes possible a comparison with other companies. Reference is made here to the Norwegian “Industrial Energy Efficiency Network” Annual Report where such comparable figures are given for a number of industries (26). Systematic key energy figures from the energy monitoring system will enable the company to set the proper objectives. See also chapter 5, where examples are given of key figures for the meat industry.

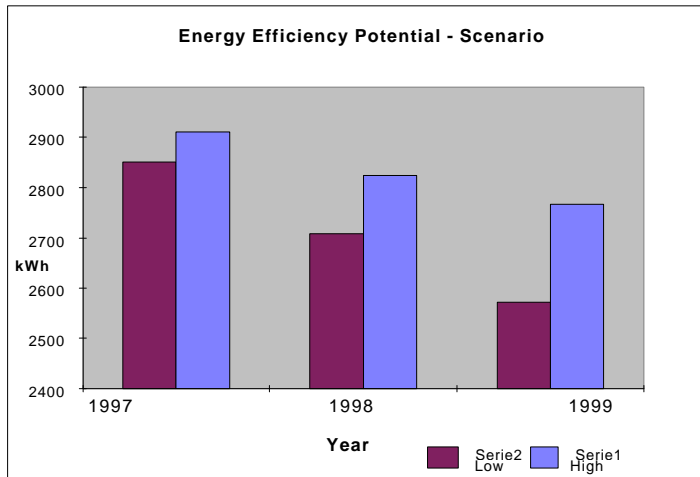


Figure 8 Simple outline of high and low energy efficiency ambition.

The first energy units are, as a rule, the simplest and most profitable to acquire. In the long run, it becomes more difficult and less profitable. The result of two alternative objectives for energy reduction are shown in figure 8. Such a presentation can be suitable for the discussion of a relevant energy economising prognosis within the company. In figure 9, objectives are given for the company “Food Industry Ltd.”

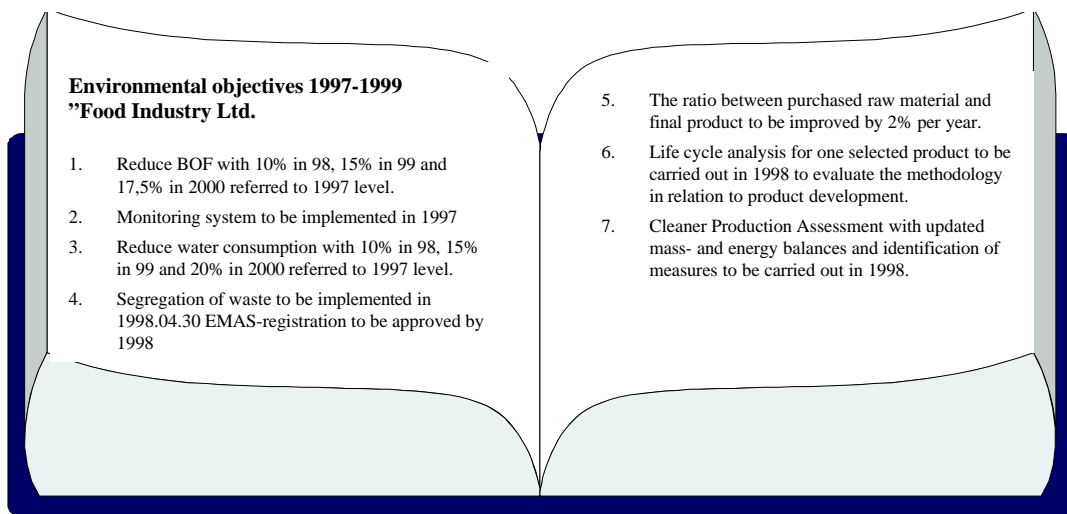


Figure 9 Examples of environmental objectives

The Environmental Programme

(EMAS Regulation Art. 3c)

In the EMAS Regulation article 2, “environmental programme” is defined as follows:

”a description of the company’s specific objectives and activities to ensure a greater protection of the environment at a given site, including a description of the measures taken or envisaged to achieve such objectives and where appropriate the deadlines set for implementation of such measures;”

Further, article 3c states:

” introduce, in the light of the results of that review, an environmental programme for the site and an environmental management system applicable to all activities at the site...”

Once the reduction objectives have been established, an environmental programme can be developed. The measures in the programme are to be in accordance with the policy and the established objectives.

How to Determine Measures

The list of measures which was created during the Environmental Review is a good basis for setting up a specific environmental programme, and those measures understood to be most profitable are further detailed here. On the Internet there is also a database containing implemented energy and environmental projects, with good examples of measures lists. The Internet Address is listed in reference (23). If there is not sufficient information available, a detailed energy economising analysis should be procured or, a technical environmental analysis carried out, by a group of persons with a wide energy expertise. Assessment of possible problem sources, brainstorming sessions and the involvement of company staff are ways in which such an analysis should take place. As mentioned in the introduction to the handbook, it can be extremely profitable to integrate energy expertise into such a process of analysis. For those unfamiliar with the process in question, it is describe in detail in reference (17). An example of an environmental programme is shown in table 7.

How to Describe a Measure

The individual elements or improvement measures in the environmental programme are to be lucid and comprehensible. In order to make the programme as concise as possible, descriptions and calculations can appear as enclosures or annexes. This is not an EMAS stipulation, but can nonetheless prove expedient. Persons in the organisation are responsible for the implementation of the individual measures. Nonetheless, deadlines must be set for implementation. The necessary resources in the form of economic funds and time resources of the persons in question are submitted.

Training

EMAS clearly stipulates that the individual expertise needed in an operation in order to make the right environmental and energy decisions in connection with the work tasks of each employee is to be outlined. A training programme must therefore be developed and carried out along with profitable, single measures. The implementation of a training programme can be brought in as a measure in the environmental programme. The contents of the training programme and the correct implementation of this must be planned and documented in order to satisfy the EMAS- requirements.

Table 7 Environmental Programme 1998-2000 "Food Industry Ltd."

Category	Measure	Environmental -Partial Objective	Date month	Investment NOK	Respons. sign
Product change	Life Cycle Assessment	Recyclable packaging	Dec. 98	100	AA
Source Measure	New Beet Boiler	Energy + less peeling waste	July 98	2047	HH
	Process change cabbage line	Energy + work atmosphere	July 98	870	IJ
	Pasteurise, reuse of warm water	Reduced water use +energy	July 99	100	FC
	Lid, Brine System	Better work atmosphere	Jan. 00	75	MC
	Reuse of cold water	Reduced water consumption	Feb. 99	60	TT
	Solar energy for heating of water	Saved el. energy (oil)	Mar. 98	150	aa
	Insulation, pipe prod. premises	Saved el.energy (oil)	Apr.99	25	yy
	Inst. of elec. boiler	Reduced emissions CO ₂ ,Sot,NO _x	May 99	1300	mm
Operational Routines	Level 2 of cleaning system, new routines	Less BOD in drains	May 98	0	nn
	Washing Routines	Water + Chemicals	May 98	10	nn
	Energy and environmental follow-up system	10% energy + 10% BOD	June 98	25	mm
Measures for working environment and cleaner production	New ventilation system discussed	Reduced draft	Dec. 99	900	nb
	Consequences Clarified	Better work atmosphere	Feb. 98		
	New shackle mounter	Noise reduction	May 99	50	nb
	New pallet loaders	Prevention of lifting injuries	June 98	200	nb
Bi-Products	Waste as animal fodder	1000 tonnes/yr. peelings	Jan. 97	0	uy
	Fodder/Fodder production	Further refinement of BOD and peelings	Feb. 00		jkh
	Improved filter process	Organic materials in drain	Nov. 99	100	lkjh
Training	Environmental rate		Jan. 99	0	uy
	Energy rate		Feb. 99	0	jkh
TOTAL				6012	Technical Director

k NOK = 1000

Calculated total profitability, pay-back time without interest: 2.5 years. Deviations from the budget are to be recorded for actual cost calculation.

Environmental Management System

(EMAS Regulation art. 3c)

In the EMAS Regulation article 2, the “environmental management system” is defined as follows:

“that part of the overall management system which includes the organisational structure, responsibilities, practices, procedures, processes and resources for determining and implementing the environmental policy;”

In this context we will thus view an *environmental management system* as a general management system and focus in particular on factors relevant to energy.

Further, Article 3c states:

“introduce, in light of the results of that review, an environmental programme for the site and an environmental management system applicable to all activities at the site...”

Management Systems and EMAS

An important part of a management system is the definition of responsibility and authority for individuals as part of the organisation. In order for persons in the organisation to be given the chance to do their best towards ensuring that the energy and environmental management system will function, an important condition is that they know what is expected of them and at which point in time. The separate phases of EMAS as described in figure 2 depend upon the clear definition of the responsibilities and authority of persons in the organisation. EMAS requires that such organisational factors are documented, but not necessarily with procedures. The various responsibilities and areas of authority related to the main components in an energy management system, in correlation with EMAS must be discussed internally and a decision made in connection with this.

Large companies with environment-related job instructions can merge these with factors connected to EMAS and environmental management. Companies with simpler organisational structures can create a table whereby responsibility and authority are related to EMAS and energy management. An example from “Company Ltd.” is shown in figure 10.

General Manager	Director of Production	Operational Manager	Director of Environment and Quality
Surveillance on the basis of the reports that the administration system works.	Acquire production data for finished products	Optimised energy production	Ensure EMAS approval
Obtaining funds for implementation of energy and environmental programme	Reporting responsibility Indicator of: - production figures - energy consumption /kg - water consumption /kg - bio-products (NoFe):	- Waste: - special waste - paper & plastic - iron - Measure energy consumption per time unit. - Purification system/emissions - Water	Update environmental programme Report to General Manager Environmental Review Ensure that the environmental management is working

Figure 10 Responsibility and authority at “Company Ltd.”

SPECIAL FACTORS

According to EMAS:

- staff is to be aware of the possible environmental effects of their work and of violations in procedure.
- measures are to be passed to prevent unintentional emissions of waste or energy.

An example here would be a boiler house manager, who is to ensure that entrenched oil tankers are controlled and inspected for leaks, as SFT stipulates in its regulation. Such factors must be documented by inclusion in the environmental programme and later be followed up with documentation of the inspection after it has been carried out.

Energy Monitoring System (EMS)

An energy monitoring system is a valuable tool for energy efficiency in the home. EMS in the home is shown on the annual energy calculation. For a household this is sufficient, but for a company with large energy expenses, it can prove lucrative to measure consumption on a regular basis.

An EMS is made up of the following main elements:

- A. Measure the energy consumption; energy consumption is to be measured continually and on a regular basis.
- B. Find key figures. The energy consumption is combined with other measurement data. Key figures are calculated.
- C. Implement measures if necessary. Inform of the figures found through B. The key figures should be addressed in the appropriate organisational forums, so that corrective measures may be carried out in the event of deviance.

In a discussion about the degree of automation of EMS in a meat production plant in Indre Østfold the manager stated the following;

"The automated retrieval of raw data on energy consumption and production figures makes sense, but when the key figures are to be calculated, one should use one's head."

This is an important point. Further, the key figures must be made available to everyone who can influence them at regular intervals. Action is taken upon deviance, or if the figures show an undesired trend. The energy calculation will in such cases not be of an unexpected volume.

Examples of the practical creation of EMS are shown in annex 3.

Energy and Environmental Key Figures

Østfold Eggsentral focuses on energy and water in its environmental review. A focus is placed on environmental key figures. Examples are given in table 8.

Table 8 Environmental Key Figures at Østfold Eggsentral

Consumption of:	1993	1996
Water (l/kg final product)	13.3	9.8
Energy (kWh/kg final product)	1.2	0.5

Which figures should be measured and calculated in an energy monitoring system (EMS) It is difficult to choose. Table 9 shows the relevant figures for "Company Ltd.". The situation describes a relatively common situation in industry. The company is doing well and has a good product. Production increases during the three year period, as does the energy consumption. Since the energy price fluctuates, it can be difficult to establish that there are serious problems at "Company Ltd." on the basis of the figures mentioned.

If on the other hand, the key figure for kWh/kg final product is calculated, we see that this first drops to 7.1 and subsequently increases to 10. At EMS we should operate with ratios which;

- are independent of fluctuations in energy price
- are independent of production volume
- describe the development in the company from day to day or week to week (independent of the measurement interval)
- are applicable to inter-organisational comparison

Comparisons, or "benchmarking" must involve the necessary expertise on the industry in question.

Example of Benchmarking for the Meat Processing Industry

The meat processing industry has since 1992 been a member of *The Industrial Energy Efficiency Network* which is an industry-managed energy efficiency programme, financed by the public authorities. On the basis of the reported energy and production figures from 21 meat processing companies each year from 1993 to 1996, a development in specific energy use is presented in figure 11. The energy consumption divided by the total amount butchered and manufactured, shows an increasing trend in the period. If one takes into consideration the boiler efficiency, there is instead a slight decrease in specific energy consumption (-0.7% per year). There has been a strong increase in oil consumption, particularly from 1995 to 1996.

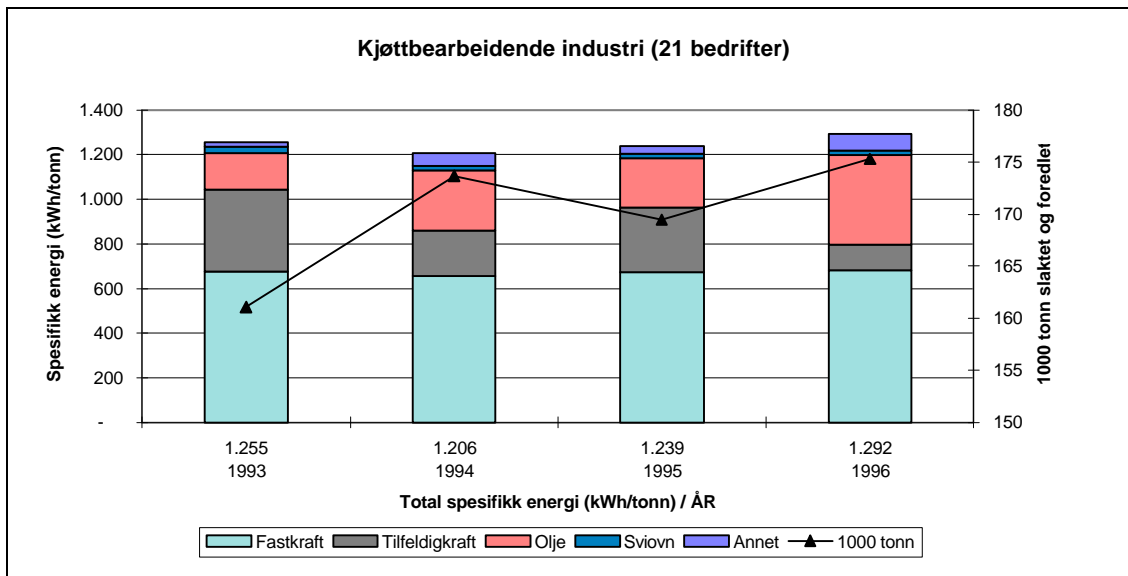


Figure 11 Development in specific energy consumption for the meat processing industry

For the meat processing industry, a method of calculation has also been developed which takes into consideration the various product combinations of different companies, in addition to using net energy. With this method, the development in specific energy is constant for the last 3 years, while there was a reduction in specific energy from 1993 to 1994

Table 9 Relevant energy and production figures from "Company Ltd." in the period 1995 to 1997

Company Ltd.	1995	1996	1997
Energy Consumption (kWh)	1 900 000	2 500 000	4 100 000
Production (tonnes)	200 000	350 000	410 000
Energy consumption/production	9.5	7.1	10.0
Energy price (NOK/MWh)	100	250	130
Energy Costs (NOK/tonne)	0.95	1.79	1.30
Energy Costs (NOK)	190 000	625 000	533 000

Environmental Audit

(EMAS Regulation Art. 3d)

An environmental audit is a method used to find out if the established policy, objectives, environmental programme and organisation are working as intended. The primary intentions of both energy and environmental management are tested; are lasting improvements achieved in the most expedient fashion? The results of the audit are used to develop corrective measures, policy adjustment, objectives and a new programme.

In the EMAS Regulation article 2, “environmental audit” is defined as follows:

“a management tool comprising a systematic, documented, periodic and objective evaluation of the performance of the organisation, management system and processes designed to protect the environment with the aim of:

- I) *facilitating management control of practices which may have impact on the environment*
- II) *assessing compliance with company environmental policies”*

Further, Article 3d states:

“to carry out or cause to be carried out, in accordance with Article 4, environmental audits at the sites concerned;”

In article 4 item 1 "Auditing and validation" it is stated that:

“The internal environmental audit of a site may be conducted by either auditors belonging to the company or external persons...”

Energy factors to be evaluated are, as mentioned above, discussed in annex 1, part C:

In Annex 1B item 6, audits are addressed as follows:

“...Management, implementation and review of a systematic and periodical programme concerning:

a) whether or not environmental management activities conform to the environmental programme and are implemented effectively.

b) the effectiveness of the environmental management system in fulfilling the company’s environmental policy...”

Audits occur with a frequency varying from one to three years, depending on whether the company’s impact on the environment is large or small.

Implementation of an Environmental Audit

Energy management, energy economising and choice of energy in particular are to be evaluated during an environmental audit, according to the requirements of EMAS. The audit shall test whether the existing policy and objectives lead to:

- lasting improvements
- effective energy management
- energy economising
- choice of energy

EMAS also stipulates that there shall be:

- a periodic internal audit, carried out by the company's own staff or hired consultants. Companies which have quality systems will often put this together with the management review as described in ISO 9000. Annual internal audits are otherwise the recommended minimum.
- a periodic external control/audit. The interval varies from one to three years, dependant upon the company's complexity and impact on the environment. This is determined by an external auditor.

An audit is always concluded with a written report which is to provide the basis for further work.

Environmental Statement

(EMAS Regulation Art. 3f)

In article 5, an *Environmental statement* is described as follows:

"An environmental statement shall include, in particular, the following:

- *an assessment of all the significant environmental issues*
- *a summary of the figures on pollutant emissions, and waste generation*
- *a presentation of the environmental policy and environmental programme*
- *a presentation of the environmental management system*
- *the deadline set for submission of the next statement*

There are also EMAS requirements that the statement is to be presented in a concise and comprehensible fashion. The Environmental Representative at Gilde Fellesslakteriet says the following:

"Our environmental statement is so simple and easy to read that even neighbour Hansen on the corner takes an interest in it."

There are also requirements for the quantification of pollutant emissions.

Summary of Quantification of Pollutant Emissions

The EMAS stipulates emission figures for oil, wood or chip combustion. Table 10 can be used to determine emission from light fuel.

Table 10 Specific emission for combustion of light fuel.

Emissions of end-user	g/MJ
CO ₂	81
SO ₂	0.2
NO _x	0.15
HC	0.01
CO	0.01
Particles	0.02

Source: Inventory Tool.

In Østfold Eggsetral's environmental statement, one finds emissions as a result of an oil consumption of 140000 litres in 1996. The emission is shown in figure 12. (CO₂ emission is at 401.000 kg and therefore exceeds the scale)

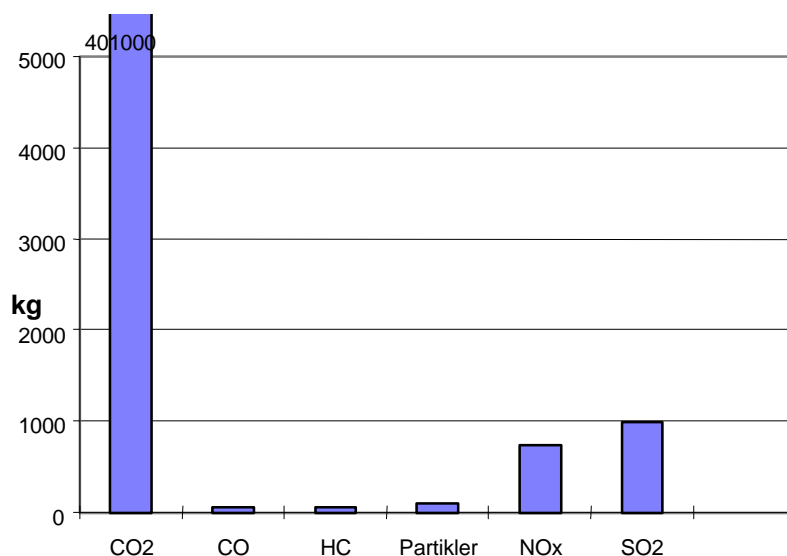


Figure 12 Emission from an oil-fired boiler with an annual consumption of 140,000 litres in 1996

The environmental account, or mass and energy balance, can be advantageously presented in the environmental statement. To satisfy the requirement for a simple presentation, there is a lot to be learned from Gilde Fellesslakteriet's solution. This is shown in figure 13.

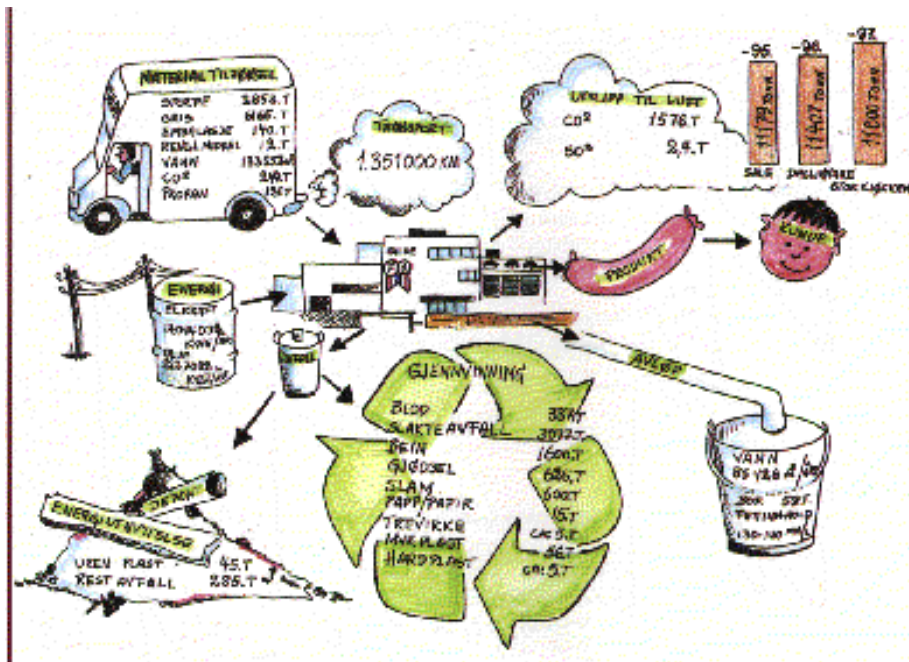


Figure 13 Mass and energy balance for Gilde Fellesslakteriet, Sarpsborg (24)

Validation and Registration

(EMAS Regulation Art. 3g,h)

The list of companies registered under the EMAS scheme is available in "Official Journal of the European Communities". Energy Management will not appear here under a separate category. In the case of Norway, one can find a list of all Norwegian companies which are registered in accordance with EMAS and certified in accordance with ISO 14001 on NHO's Internet home page http://www.nho.no/2a5e_15a.htm. On the same page there is also a list of approved environmental inspectors. These can be contracted when the company is ready for validation/certification. As an advisor/consultant in the development of the EMAS system there are other consultants to which the company should apply. The European Commission also has its own EMAS home page on the Internet. The address is <http://www.emas.lu>

5. Examples

This chapter presents four companies in the Norwegian meat processing industry that have implemented Energy Management related to their EMAS registration process. The companies have worked with a different intensity and at a different time-span during their EMAS registration process. The companies have therefore achieved different results. The companies' ambitions and requirements differs corresponding to the share of energy costs in the total cost picture.

Østfold Eggsentral, Rakkestad

- The company is affiliated to the Norwegian egg producers' co-operative society «PRIOR» and is the largest Norwegian chicken- and turkey slaughterhouse.
- Number of employees at the company is 138, and capital turnover for 1996 was 42,9 mill. ECU.
- Production volume in 1996:
 - 8367 tonnes chicken
 - 2449 tonnes turkey
- Energy carriers are oil, electricity and heat pumps, totally 20,9 TJ/year.
- The company was EMAS registered in December 1997. The Director of Quality Assurance is responsible for the companies' environmental control and EMAS registration.

Energy- and environmental policy

The annual report for 1996 introduced the companies' environmental policy and consequences for the external surroundings. This represented a milestone because the external surroundings never have been in focus in the annual report and on the annual meeting. The environmental policy is shown in figure 5

Energy management - routines

Energy management was inducted as an internal quality system during the EMAS registration process, and are summarised in the following:

- A. *Systems for monitoring and targeting* were implemented. The company has implemented a databased monitoring system which is logging water- and energy consumption for each production department.
- B. *Calculation of key statistics.* The logged data material is compared with the production parameters and key statistic is calculated for energy consumption and other relevant parameters, as shown in table 8

C. *Corrective efforts.* Key statistics and consumption figures are treated frequently within the management team. Corrective measures are effectuated if any major discrepancies are detected.

Key statistics are treated on a weekly basis. To make this work clearly defined duties are anchored in the organisation. This apportionment of liability is clearly defined in documents within the quality system.

Energy management - projects

Energy management is defined within the Environmental management system and is related to the initial environmental review and the environmental programme.

A technical environmental audit is scheduled as a project with a procedural co-operation with external expertise every third year. The objective of this project is to identify new measures, determine new targets and to suggest actions that will enter into the environmental programme. Through this work the company have to do the following :

- A. *Audit of mass and energy flow.* Every second year there is an audit of the most important mass and energy flows. This audit will set the priorities for further actions. The company register their mapping percentage as a measure to see how much of the energy consumption is monitorde in detail. Existing Mass and energy balance for “Østfold Eggsentral” is shown in figure 14.
- B. *Profitable energy conservation- and environmental efforts is generated* through brainstorming sessions. The suggested actions will be evaluated, and finally entered into the environmental programme.

Table 11 Percentage of monitored mass- and energy flow at Østfold Eggsentral 1996.

Flow	Percentage Monitored
Water	90 %
Thermal energy	60 %
Electrical energy	50 %

Reported energy and environmental key indicators

The company decided to work with the key indicators shown in figure 14. Specific energy consumption is an important indicator within a company with an energy intensive production. The monitoring percentage showed in table 11, describes how much of the total consumption is measured or studied in a proper way. A mapping percent at 100 can be inappropriate expensive to obtain. Some energy flows, e.g. hot water consumption at the loo, is so little that it is not suitable to measure.

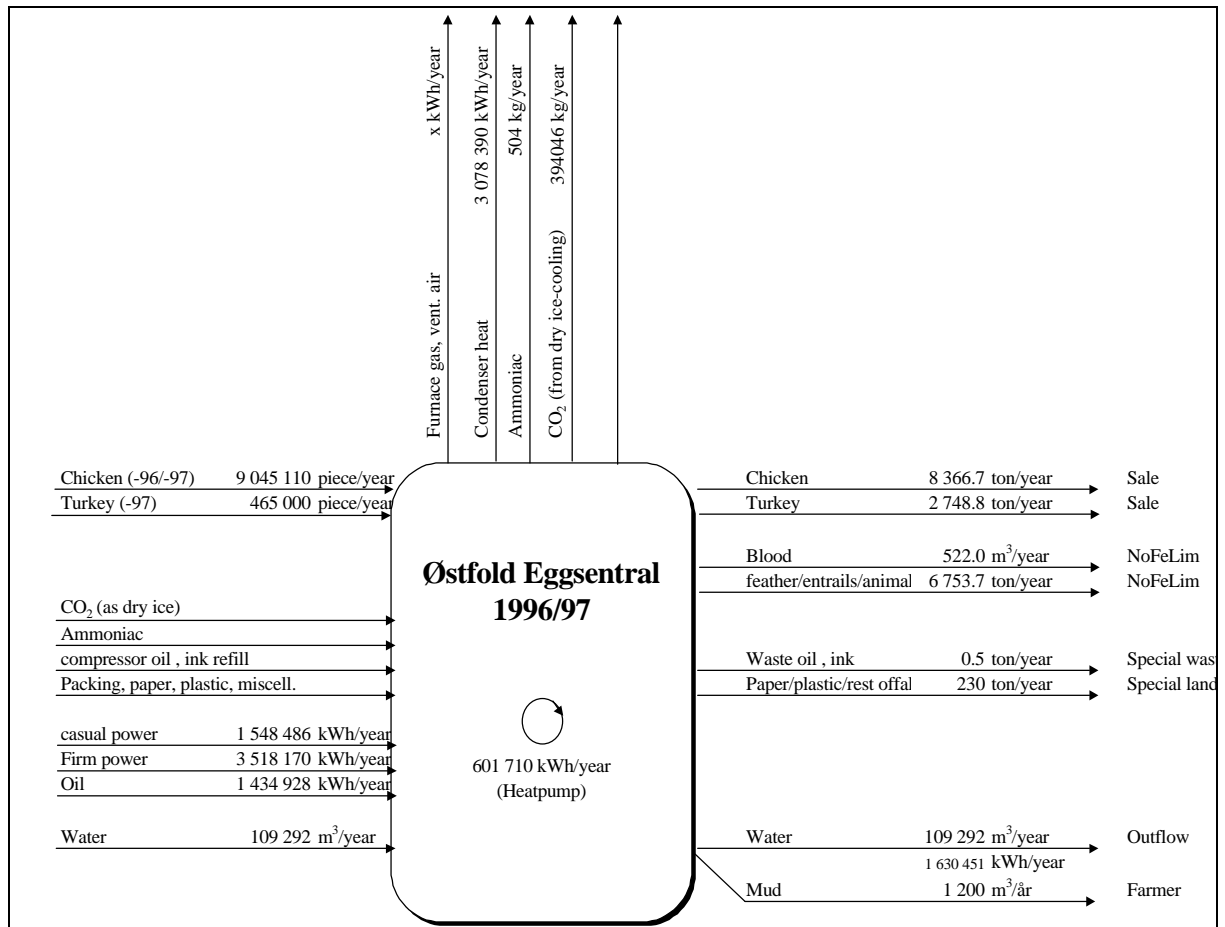


Figure 14 Mass- and energy balance for Østfold Eggsentral

Economical, environmental and energy savings:

Have the companies' efforts within energy and environmental savings been profitable?

- The heat pump installation is paid off and the saving is about 200.000 NOK each year (energy price 0,3NOK/kWh).
- The company has reduced their specific energy consumption from 1,2 to 0,5 kWh/kg final products. Because of less frozen product and less refinement in the production, the energy savings are difficult to estimate. However, if todays production had followed the older routines from 1993, the energy costs would be 1 mill. NOK higher.
- The company have reduced their specific water consumption from 13 to 9,8 l/kg finished product. This represents a saving of 0,5 mill. NOK each year.

For a detailed information about the efforts within the company, please refer to the environmental statement (25) and summary on Internett (23).

Gilde Fellesslakteriet, Sarpsborg

About the company

The company is processing Norwegian meat products with the trademark «Gilde» and «Goman». Norwegian farmers own the company and the number of employees is 350. The production includes transport of animals, slaughtering, refining and sale. The capital turnover for 1996 was 0,2 billions ECU. The production was 4600 tonne meat products. Energy carrier is oil and el., totally 65,9 TJ/year. The company got their EMAS certificate in November 1997.

Energy- and environmental policy:

The leadership for the slaughters co-operative society profiled the company as a “green company” and already in 1994 they announced that:

“Gilde Fellesslakteri shall run the production without inflecting the environment such as peoples, animals and nature.”

This announcement represented a milestone since the external surroundings never have been in focus by the leadership of the company.

Environmental control and energy management

Energy management was inducted as an internal quality system during the EMAS registration process, and are summarised in the following:

- A. *Systems for monitoring and targeting* were implemented. The company has implemented a databased monitoring system which is logging water- and energy consumption for each production department.
- B. *Calculation of key statistics*. The logged data material is compared with the production parameters and key statistic is calculated for energy consumption and other relevant parameters.
- C. *Corrective efforts*. Key statistics and consumption figures are treated frequently within the management team. Corrective measures are effectuated if any major discrepancies are detected.

«Gilde Fellesslakteriet» repeat in their environmental statement that energy- and water consumption constitutes an important environmental effect. Figure 15 shows some of the company's environmental statement.

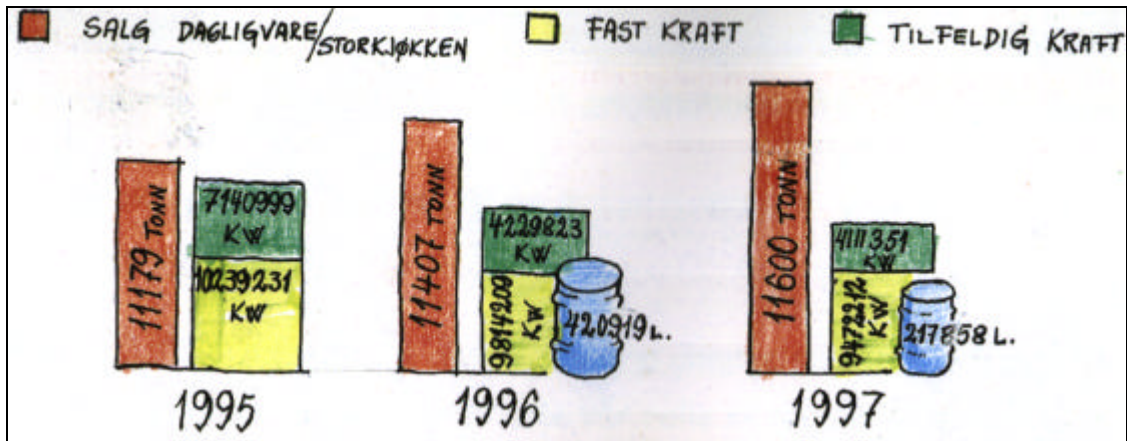


Figure 15 The figure illustrates the relation between sales volume and electricity consumption at Gilde Felleslakteriet (24)

The period for introduction of energy management and EMAS registration was in 1996 and 1997, but the company started with an energy audit and Cleaner Production Assessment already in 1993-94. The company's EMAS registration was accepted in November 1997, see figure 16.

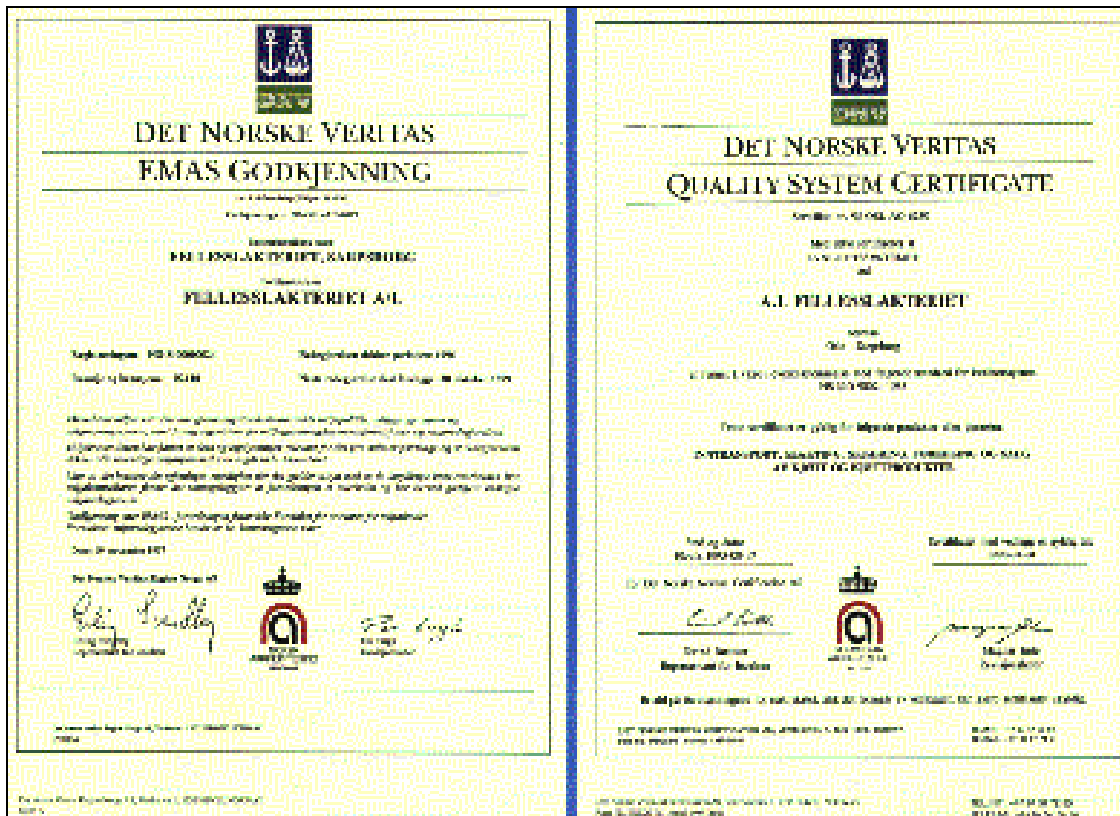


Figure 16: EMAS and quality certificate for "Gilde Felleslakteriet" is showed side by side to illustrate that they are integrated in the company.

Results

The company has through several energy efficiency measures obtained considerable operational savings every year. Measures that has been accomplished are:

- recycling of thermal energy from air compressors to heating up water
- use of compressed air from the compressors to run processing equipment
- increased power efficiency on the direct-fired boilers because of calcium cleaning of the consumption water
- energy saving light-bulbs are installed
- optimised control on the air compressors
- installation of electricity- and oil direct-fired boilers with high power efficiency
- installation of heat exchangers on the consumption water

«Gilde Fellesslakteriet» has reduced their water consumption as showed in table 12. Even though the production has increased in the same period, the decreasing of water consumption is considerable, from 14,5 to 10 litre water per kg final product. In economic terms these results represent a saving of 0,7 mill. NOK every year.

Table 12 Water consumption at «Gilde Fellesslakteriet»

Key indicators (water)	1995	1996	1997
Production (ton)	11 179	11 407	11 600
Water consumption (m ³)	163 000	133 000	116 000
Specific water consumption (l/kg final product)	14,5	11,7	10,0

Planned measures

- investigate possibilities for regain condenser heat from refrigerating systems
- investigate possibilities for utilising heat from the scorching-oven for space heating

Grimstad Konserverfabrikk, Grimstad

“Grimstad Konservesfabrik” (GK) is owned by *Gartnerhallen* and the number of employees is 40. The capital turnover for 1996 was 8,5 mill. ECU. The company preserves fruit and vegetables. Energy carriers are oil and electricity.

Energy- and environmental policy

The company has made an environmental policy that is integrated in their quality policy. The quality policy is showed in figure 17.

The company’s environmental- and quality policy

External demand

GK shall be open for the customers, local governments and the society’s demand within quality, health, environmental and safety questions. With the aid of GK’s quality- and environmental management system shall we secure continuous improvements to obtain top quality and environmentally friendly products.

Personnel

The employees shall have a good know-how and expertise about their functions and a spirit and enthusiasm that will secure right procedures, quality and working environment.

Business

The companies system for supply of raw material and purchasing of packaging and other input factors, shall secure that the products are in accordance with GK’s environmental- and quality requirements. Developments of the suppliers is important.

Technique

GK regards pollution as resources on the wrong path. Problems concerning pollution shall be solved with reduction of sources as for instance closing processing plants, recycling energy and re-use. We shall lay in the front edge concerning demand and specifications and be in the front lead to use environmentally friendly technique. We shall use production methods and equipment, which utilise raw materials and energy resources effectively and with the right quality. We shall use products and packaging, which from life cycle observation shall lead to good quality and keep pollution at a minimum. That means we must have a pro-active management concerning new production methods and the composition of manufactured products.

Environmental- and quality system

GKs environmental- and quality system shall be based on EMAS and ISO 9001.

Information

We shall aim at an open contact with our employees, local governments, mass media and with public authorities.

Figure 17 Environmental- and quality policy at Grimstad Konservesfabrik

Energy management

Energy management was inducted as an internal quality system during the EMAS registration process, and are summarised in the following:

- A. *Systems for monitoring and targeting* were implemented. The company has implemented a databased monitoring system which is logging water- and energy consumption for each production department.
- B. *Calculation of key statistics*. The logged data material is compared with the production parameters and key statistic is calculated for energy consumption and other relevant parameters.
- C. *Corrective efforts*. Key statistics and consumption figures are treated frequently within the management team. Corrective measures are effectuated if any major discrepancies are detected.

Table 13 Environmental key statistics at GK for 1994

Water (l/kg final product)	28
Energy (kWh/kg final product)	1,1

Results

Results from GK concerning energy- and environmental efforts is showed in table 6. The table shows that it is possible to save 1,2 mill. NOK. With an investment of 1, 5 mill. NOK.

Kjøttcentralen, Oslo

About the company

The company is a relative small factory. They buy meat that has already been slaughtered and then refine it further and sell it to a commercial kitchen. Number of employees at the company is 20, and the capital turnover for 1996 was 3 mill. ECU. Energy carrier is only electricity. The company is aiming at EMAS registration in 1998-99.

Energy efficiency audit as a part of the environmental review

Since the company had relative small environmental problems, it became natural to put focus on energy conservation. An environmental account was established at the same model as showed in figure 7. Likewise a collation of key statistics as showed in figure 18. The resulting potential, which appeared from this figure, motivated the company to put focus on energy management.

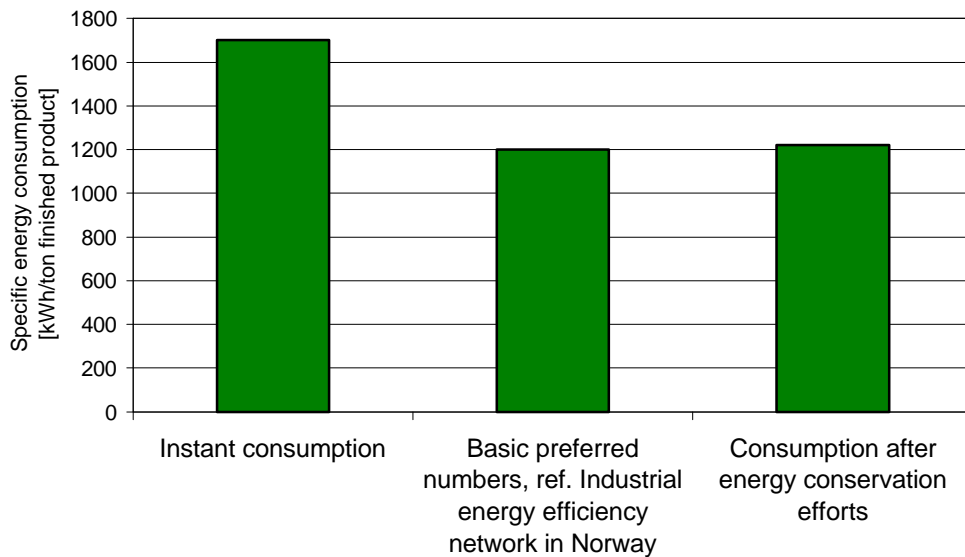


Figure 18 the potential for energy conservation for Kjøttcentralen

Energy management

Energy management was inducted as an internal quality system during the EMAS registration process, and are summarised in the following:

- A. *Systems for monitoring and targeting* were implemented. The company has implemented a databased monitoring system which is logging water- and energy consumption for each production department.

- B. *Calculation of key statistics.* The logged data material is compared with the production parameters and key statistic is calculated for energy consumption and other relevant parameters.
- C. *Corrective efforts.* Key statistics and consumption figures are treated frequently within the management team. Corrective measures are effectuated if any major discrepancies are detected.

What has been achieved

In the preliminary phase of EMAS registration, the company discovered that they had both cooled- and heated a room *at the same time*.

The measures in table 14 show a good profitability with an average payback time of 1,8 years.

Table 14 A list of measures at Kjøttcentralen

Measure	Energy savings (kWh)	Savings (NOK)	Investments (NOK)
1. Energy monitoring systems	88 500	28 143	
2. Regulation of heater cable	10 000	3 180	6 500
3. Reduction of condense pressure	25 000	7 950	4 000
4. Recycling of condense heat	80 000	25 440	141 450
5. Adjustment of electricity preheating	140 000	44 520	
6. Recycling of condense heat to vent.	130 000	41 340	180 000
7. Optimising of air flow rate	11 200	3 562	7 000
8. Free cooling of m engine room			
9. Curtain cold store			
10. Regulation of the lighting			
11. Time regulation of air flow rate			
12. Merger of measure equipment		38 112	13 000
SUM	484 700	192 247	351 950

6. ANNEXES

Annex 1 Outline for environmental account, mass- and energy balance

Annex 2 Prognosis modell, printout

Annex 3 Energy- and water monitoring suystem

Annex 4 Profitablility calculations

Annex 5 References

Annex 1: Outline for environmental account, mass- and energy balance

The following (Annexes 1-4) outline fragments from a computerized model for environmental accounting, or a mass- and energy balance sheet. (Only Norwegian language)

BEDRIFT RÅVARER

Nr Råvare	Råvarepris kr/tonn	1998		1999		jan.99		feb.99	
		tonn	1000 kr	tonn	1000 kr	tonn	1000 kr	tonn	1000 kr
1 Råvare 1			0	0	0		0		0
2 Råvare 2			0	0	0		0		0
3 Råvare 3			0	0	0		0		0
4 Råvare 4			0	0	0		0		0
5 Råvare 5			0	0	0		0		0

Energiforbruk

Nr Energiforbruk	1997		1998		jan.98		feb.98		mar.97	
	1000 kr	kWh	1000 kr	kWh	1000 kr	kWh	1000 kr	kWh	1000 kr	kWh
1 El - lys/varme			0	0						
2 El - prod.			0	0						
3 Olje			0	0						
4 Bioenergi			0	0						
5 Energikilde 5			0	0						
6 Energikilde 6			0	0						

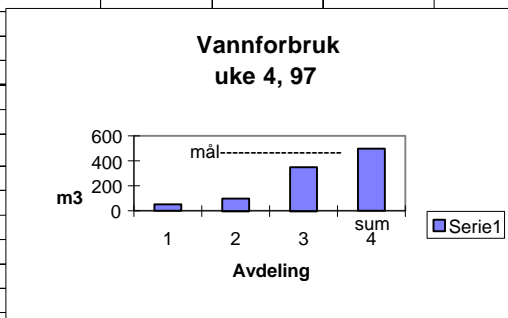
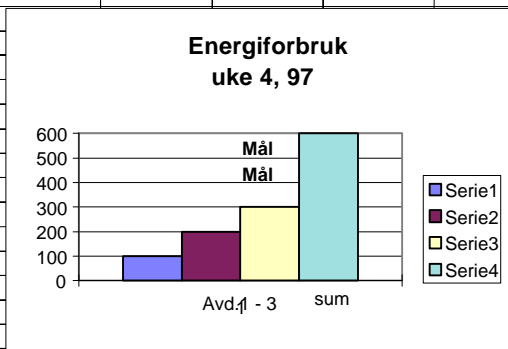
Mengde	1998			1999			jan	feb
	kWh	temp, °C	m ³ /år	temp, °C	m ³ /år	m ³ /år	m ³ /år	
Prosessvann	0				0			
Vaskevann	0				0			
Sanitær	0				0			
Kjølevann	0				0			
Annet vann	0				0			
SUM vann	0		0		0	0	0	

Annex 2 Prognosis modell, printout

Prognosemodell:		Enøk A/S Bedrift		
Modellen brukes slik; du kan endre forutsetningene som er angitt med fet skrift, resultatet regnes ut automatisk				
Forutsetninger				
Forbruk ved eksisterende produksjonsmåte siste år:				
Elektrokjel	(1000 kWh=1MWh)			1584 MWh
Fastkraft				3518 MWh
Oljekjel	(10 kWh pr l olje)			1435 MWh
Sum				6537 MWh
Energipris elektrokjel				0,4 kr/kWh
Energipris fastkraft				0,4 kr/kWh
Effektkostnad siste år				100000 kr/år
Oljepris				4 kr/l
Gj.snittlig energipris i kWh/år				0,43 kr/kWh
Forventet prisstigning pr år				5 %
Eksempel 1				
År	enøk prognose			totalforbruk pr år etter endr
	%	MWh	kr/år	MWh
1998	5	327	147032	6210
1999	5	311	146665	5900
2000	5	295	146298	5605
total		932	439995	
Eksempel 2				
År	enøk prognose			totalforbruk pr år etter endr
	%	MWh	kr/år	MWh
1998	3	196	88219	6341
1999	3	190	89851	6151
2000	2	123	61009	6028
total		509	239080	
Modellen kan kjøpes for kr 400 hos Stiftelsen Østfold forskning.				

Annex 3 Energy- and water monitoring system

Eksempel på rapportering fra energi- og miljøovervåkingsystem					
UKE 3 97					
avd 1	avd 2	avd 3	sum	snittverdi 96	
energi	kwh				
100	200	300	600	?	
energi/produksjon					
vann	m3				
50	100	350	500	?	
produkt	tonn				
15	10	8	7	?	
avfall	tonn				
5	2	1	60	?	
snitt 96 pr. uke					
avd 1	avd 2	avd 3	total		
energi	kwh				
90	260	400	750	?	
energi pr. produksjon	kWh/tonn				
6	26	1	1	?	
vann	m3				
60	120	470	650	?	
vann pr. produksjon	m3/tonn				
4	12	52	81	?	
produkt	tonn				
14	10	9	8	?	
avfall	tonn				
4	1	1	6	?	
avfall pr. produksjon,	tonn				
snitt 96 pr. uke					
avd 1	avd 2	avd 3	sum		
energi	kwh				
90	250	400	740		
vann	m3				
60	120	450	630		
produkt	tonn				
14	9	7	6		
avfall	tonn				
5	2	1	8		



Annex 4 Profitability calculations

Lønnsomhetsberegning, miljøtiltak ved A/S Industri, revidert juli 1997										prisstigning forutsatt i % p/ år: = 2,5			
tiltak nr	navn	investering	spart 1. år	spart 2. år	spart 3. år	spart 4. år	spart 5. år	spart 6. år	spart 7. år	spart 8. år	spart 9. år	spart 10. år	Akkumulert
		kr	kr	kr	kr	kr	kr	kr	kr	kr	kr	kr	cash-flow
1	isolere damp	-25000	8000	8200	8405	8615	8831	9051	9278	9509	9747	9991	64627
2	2 trinn VP	-500000	177000	181425	185961	190610	195375	200259	205266	210397	215657	221049	1482999
3	effektstyring	-100000	45000	46125	47278	48460	49672	50913	52186	53491	54828	56199	404152
4	vannf.renseri	-10000	43000	44075	45177	46306	47464	48651	49867	51113	52391	53701	471745
5	Energi-oppfølging	-200000	160000	164000	168100	172303	176610	181025	185551	190190	194944	199818	1592541

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