ENERGY MANAGEMENT STANDARDIZATION IN THE PRINTING INDUSTRY

Co-funded by the Intelligent Energy Europe Programme of the European Union

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INDEX

EXECUTIVE SUMMARY 5

INTRODUCTION 7

1 BACKGROND OF THE EUROPEAN PRINTING INDUSTRY 11

2 ENERGY DIAGNOSIS OF EUROPEAN PRINTING INDUSTRY 13
- 2.1 Consumption parameters and equipment 13
- 2.2 Energy management practice 14
- 2.3 Demands from the market 15
- 2.4 Barriers and obstacles 15
- 2.5 Baseline 15
- 2.6 Research approach in the sector diagnosis 17
- 2.7 Updating the baseline 18

3 ENERGY PERFORMANCE INDICATORS 21
- 3.1 The definition of an energy indicator in particular 22
- 3.2 Lessons learned from the use of the indicators in the companies 24
- 3.3 Research approach in the Parameterization phase 25

4 Energy Management System (EMS) 27
- 4.1 What is a management system? 27
- 4.2 The Energy Management System (ISO 50001) 28

5 ADAPTED ENERGY MANAGEMENT SYSTEM FOR THE PRINTING INDUSTRY (ENMS) 29
- 5.1 Adapted Energy Management System for the printing industry (EnMS) 33
- 5.2 A system for energy management 34
- 5.3 Definition of energy management 34
- 5.4 Important components of energy management 35
- 5.5 Control and corrective measures 36
- 5.6 Management involvement 36

6 SPECIFIC GUIDELINES 37
- 6.1 Green marketing, do good things and talk about them! 37
- 6.2 Environmental indicators: Carbon footprint is a step stone to environmental management 38
- 6.3 Quality Control 39
- 6.4 Overcoming financial barriers in energy efficiency projects 40

7 IMPLEMENTATION OF ADAPTED ENERGY MANAGEMENT SYSTEM (ENMS) IN PRACTICE 43
- 7.1 The EMSPI project 43

8 VALIDATION OF THE ENMS AND OTHER DEVELOPED MATERIALS
- 8.1 External quality peer-review on developed Diagnosis/Parameterisation (energy indicators) and Guidelines. 45
- 8.2 Validation of the EnMS and implementation 45
  - 8.2.1 The Target group: SMEs 45
  - 8.2.2 National organizations 48

9 CONCLUSIONS AND RECOMMENDATIONS 49

EXECUTIVE SUMMARY

This publication describes the purpose, and results of the EMSPI project, a project to create more energy efficiency in the printing industry. The EMSPI project is co-funded by the Intelligent Energy Europe Programme of the European Union.
This publication describes the method and tools which are developed and use at the implementation of an energy management system in 100 companies in the five participating companies. This publication will give you an overview and knowledge on energy management and efficiency.

The EMSPI project will achieve direct energy savings at least in 100 Printing Industry SMEs by developing and implementing an energy management system standard based on EN 16001 / ISO 50001, which will allow them to have continuous energy consumption savings in the medium and long term.
The specific objectives to be achieved are:

- To develop an adapted specific energy management standard according to the statements of ISO 50001 and EN 16001. A deep and detail energy diagnosis of SMEs printing industry will be developed;
- To develop sector-specific implementation guidelines including the exploitation of existing approaches and tools (Green Marketing Plan, Sector Carbon Footprint Calculation...), in order to create systematic and continuous energy savings in the medium and long term within a strategic and competitiveness oriented framework;
- To implement energy management standard at 100 SMEs by means of developed specific guidelines and tools for Printing Industry, which creates a systematic and continuous energy savings in the medium and long term; A ceiling of 25% to the 100 SMEs target is set to allow to participate for micro SMEs not able to implement the full standard,
- To enhance the awareness, capabilities and skills of SMEs managers and personnel (maintenance). Achieve a “critical mass” or multiplier effect at industry level in order to expand the developed set of tools and information and specific communication materials to all the stakeholders to all the European countries;
- To develop energy efficiency learning materials in order to spread specific knowledge about achieving energy consumption savings. It is expected to distribute these materials to all the European Printing associations and printing schools;
- To establish a corporate strategy based on sustainable environmental indicators which will improve the competitive advantage for SMEs in the printing industry

Initial phases
During the initial phases of the project, in the first phase, the project was focussed on analysis and assessment of the current situation in the printing industry in terms of Energy Management. According to Energy Management Systems’ standards (EN16001, ISO 50001), defining an energy baseline was the first step to take to implement such systems. Analysing energy sources, equipment and tools used in the printing industry would help to define the baseline. Data analysis were carried out and the energy baseline developed and ensured that the conclusions of the Energy Sector Diagnosis document were handed over and used in the following work packages. It resulted in the report Energy Diagnosis of the European Printing Industry.

Energy efficiency is a way of managing and restraining the growth in energy consumption. Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input.

In the next phase the central issue was the definition of the indicators. Energy Performance Indicators can help companies assess their energy performance. The research of the partners in the countries and the analyses and assessment of KPI in the industry let to defining the methods for definition, analysis, assessment and selection of the energy indicators for both internal use in the companies as well as for benchmarking. This information is defined in the report: Indicators Guide.

The next phase was focussing on development of Energy Management standards adapted to the printing industry. The so called EnMS is developed in a Basic and a Full version. Two versions of the Energy Management System are developed so that the Basic version fittest on the demands of smaller companies and the Full version on the demands of the mediate and lager companies within the graphic sector.
The EMS was developed, evaluated and adjusted with stakeholders like sector organisations and colleague energy specialists before testing it in practice. During the development the recruitment and selection of the participating SMEs started. Through workshops, personal visits, working together with sector organizations contact with the companies and the energy managers were made. The development is documented in: Energy baseline diagnosis; Adapted standard manual's requirement; the EMS Implementation manual, implementation spreadsheet; coaching material, training material for implementation of Energy Management system, all in a Basic and a Full Version and workshop material.
After the development of the EnMS the "Specific guidelines" were developed. The Guidelines aimed to promote and support entrepreneurs and energy managers in the SMEs to implement the system to increase energy efficiency in the printing industry. Several reports, technical articles and news items were developed published and were necessary evaluated.

Second Phase
During the second part of the EMSPI project, the energy management systems was implemented in 100 SMEs in the printing industries. The in the first part of the project developed tools and training materials (for energy managers at Printing SMEs) were put in practice. At the company level the partners contributed as a consultant in the participating companies by carrying out training workshops and supporting the companies with energy review, development and implementation of procedures as well as targets and action plans. Also the development of an Excel tool for analysis of energy use and consumptions targeted the companies in the printing industry took place during this phase and led to a Summary of Energy efficiency potential improvements. This phase resulted in several reports. Through the implementation in the 100 participating SMEs the goals of the project had to be fulfilled.

In the EMSPI project the achieved results are for the period 2013- 2017 are:
- Energy consumption reduction of 127,000 GJ (14% reduction in 2017 compared to 2013)
- Reduction of 13,300 ton of CO2 (14% reduction of emissions).
- Energy cost savings of 2,140,000 € (12% reduction of costs)

Awareness of at least 300 SMEs per country (total 1500) on energy efficiency and energy management is created. During the project the Project Validation, an evaluation took place. The developed material was evaluated through validation workshops with the stakeholders and validation activities in relation to the participating companies were carried out.

An approach and a system of energy management adjusted to the demands of the printing industry is developed and tested and the results were positive! The participating companies saved energy and money, reduced the CO2 emissions with a respectable amount. Everything is ready for you as an entrepreneur or energy manager in a company to start a energy efficiency project! It will bring you a lot of positive energy!

INTRODUCTION

In the last three years the EMSPI project has been carried out. This project aimed to promote actions for increase the energy efficiency at European small and medium sized enterprises (SMEs) of the Printing Industry by promoting the implementation of Energy Management System based on the global standard ISO 50001.

Why is energy efficiency important?
Reason number one is that it provides a lower energy bill for your company. When you use less energy, you also need to pay less or keep the bill the same as energy prices increase or your business has consumed more energy.

Reason number two to save energy: money is of course not the only reason to go down on energy consumption. Many individuals and businesses are saving energy because they want to contribute to a better environment. When energy is produced, substances that are harmful to the environment are released. Thus, when your company is saving energy, it helps you to improve a better environment. But not only the production of energy but also the consumption of energy is harmful to the environment. When your company or organization uses fossil energy, carbon dioxide (CO2) is released. Too much CO2 in the air leads to the global warming.

The third reason has to do with your stakeholders including your customers. They will increasingly expect you and your company or organization to work energy efficiently and your products are energy efficiently produced.
That's why a project like EMSPI is important. It give companies the opportunity to start an energy efficiency program for themselves. The information tailor-made to the printing and media industry is available on the website: www.emspi.eu.

Goals of the EMSPI project

The EMSPI project had different goals. The project had to achieve direct energy savings at least in 100 Printing Industry SMEs by developing and implementing an energy management system standard based on ISO 50001, which will allow them to have continuous energy consumption savings in the medium and long term.
The specific objectives to be achieved were:

- To develop an adapted specific energy management standard according to the statements of ISO 50001. A deep and detail energy diagnosis of SMEs printing industry will be developed;
- To develop sector-specific implementation guidelines including the exploitation of existing approaches and tools (Green Marketing Plan, Sector Carbon Footprint Calculation...), in order to create systematic and continuous energy savings in the medium and long term within a strategic and competitiveness oriented framework;
- To implement energy management standard at 100 SMEs by means of developed specific guidelines and tools for Printing Industry, which creates a systematic and continuous energy savings in the medium and long term; A ceiling of 25% to the 100 SMEs target is set to allow to participate for micro SMEs not able to implement the full standard,

The EMSPI project aims to promote actions for increase the energy efficiency at European small and medium size enterprises (SMEs) of the Printing Industry by promoting the implementation of Energy Management System based on the global standard ISO 50001.

- To enhance the awareness, capabilities and skills of SMEs managers and personnel (maintenance). Achieve a "critical mass" or multiplier effect at industry level in order to expand the developed set of tools and information and specific communication materials to all the stakeholders to all the European countries;
- To develop energy efficiency learning materials in order to spread specific knowledge about achieving energy consumption savings. It is expected to distribute these materials to all the European Printing associations and printing schools;
- To establish a corporate strategy based on sustainable environmental indicators which will improve the competitive advantage for SMEs in the printing industry.

Structure

The publication you are looking at is a representation of the results of the activities that took place within the EMSPI project. It contains more background information on the world behind the daily practice of energy efficiency in a company or organization.
The project had several parts. The most important part is the implementation of an simple or more complex energy management system in 100 participating companies. Al the other parts were focusing on building an to the printing industry adapted Energy Management System, the so called EnMS. These parts were focused on:

1. a diagnosis of energy within the printing industry,
2. Energy Performance Indicators (EPI) which can help companies to assess their energy performance,
3. the development of an Energy Management System,
4. validation of the results,
5. and communication/dissemination with the target groups: entrepreneurs and (energy) managers of companies (SMEs) in the sector and other stakeholders like sector organisations, educational institutes etc.

Part one, two and three have strong cohesion and influence each other. During these three phases of the EMSPI project, research has been conducted and the knowledge has been developed to eventually reach an adapted management system for the printing industry.

Approach

To reach the goals of the project as mentioned before the project had to collect data, analyze the data and create information which is needed to create the different tools needed such as:

- an adapted specific energy management standard according to the statements of ISO 50001,
- a deep and detail energy diagnosis of SMEs printing industry will be developed,
- To develop sector-specific implementation guidelines, tools and training material, including the exploitation of existing approaches and tools (Green Marketing Plan, Sector Carbon Footprint Calculation), in order to create systematic and continuous energy savings in the medium and long term within a strategic and competitiveness oriented framework.

So the work started with the Energy Sector Diagnosis: focusing on analysis and assessment of the current situation in the printing industry in terms of Energy Management. According to Energy Management Systems' standards, defining an energy baseline is the first step to take to implement such systems. Analyzing energy sources, equipment and tools used in the printing industry will help to define the baseline.

The gathered information was used in the Parameterization phase. Setting up of specific energy Printing Industry Indicators. All the information analyzed in the Sector diagnosis is used to establish energy use parameters in the printing industry by means of producing Energy Indicators. This Parameterization phase was an intermediate phase that will provide the technical base to implement energy management system under an adapted standard for the printing industry.

Printing Industry Adapted Energy Management Standard Development: Previously generated information of 5 participant EU countries regarding energy use and management, specific project materials (including procedures and registries) to implement the EMS has been developed. Standard materials are created using as benchmark ISO 50001 and will be used as guideline for Energy Management System adapted standard development.

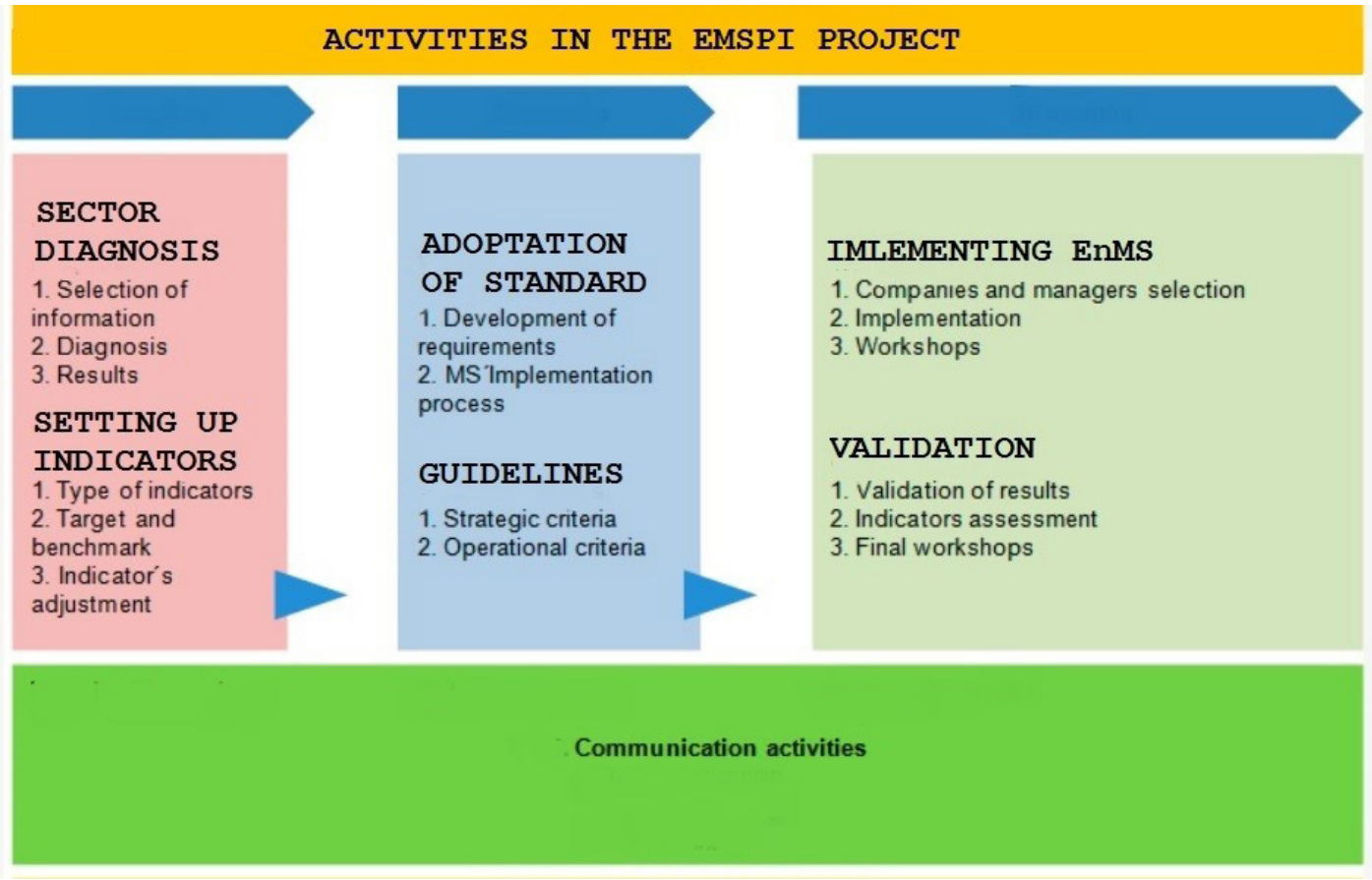

Figure 0: Activities in the EMSPI project

To support implementation and anchoring the system in the SMEs Specific Guidelines are developed. The standard materials and implementation process has been established in the previous phases but the development of this information tries to support the maximization of the benefits associated to the implementation of the Standard including strategic and operational criteria (green marketing techniques, KPI environmental indicators, quality control and analysis of ESCOs' involvement potential).

The Implementation of Adapted Energy Management Standard is a very important part of the project. An adapted Energy Management System for the printing industry had to be implemented in 100 SMEs with the help of consultants and the so called "Energy Managers" in the participating SMEs to enhance the awareness of industrial associations and SMEs in the European Printing Industry by introducing different materials, awareness tools, benchmark tools for assessment, and a EnMS Standard manual for the Printing Industry in EU.

During the project Project Validation was executed. Feedback loops with the target actors outside the consortium of partners is introduced to ensure an external quality review of the guidelines, manuals and spread sheet before their implementation. The EnMS standard developed is assessed in terms of adequacy to the actual reality of the European printing industry and on the other hand indicators were analyzed too, both General and Specific indicators developed in the Energy Sector Diagnosis and the Parameterization phase.

Consortium of partners in the project

The EMSPI-project was carried out in five countries: Czech Republic, Denmark, Germany, Spain and The Netherlands. The partners in the project in these countries were:

- Enviros, a consulting company providing assistance mainly in the field of energy, environmental and business consultancy in the Czech Republic;
- Grakom, the Graphic Association Denmark for Communication, Design & Mediaproduktion , Denmark;
- INNOWISE, a research & consultancy company with special expertise in innovation management, knowledge & technology transfer;
- Factor, an international climate change consultancy firm from Spain
- KVGO Dienstencentrum, a consultancy company, focussing on sustainability in the print media industry, related to the Royal Dutch Printers Association in The Netherlands.

The EMSPI project is co-funded by the Intelligent Energy Europe Programme of the European Union.

1 BACKGROUND OF THE EUROPEAN PRINTING INDUSTRY

The European printing industry (in 27 countries) counts more than 134.000 companies. Primarily this industry consists of small companies and between 70 % and 85 % of the companies in the industry have less than 10 employees. In terms of numbers of companies as well as the revenue, Germany has the largest printing industry in Europe. The four largest countries (i.e., France, Germany, Italy, and the U.K.) contribute about two-thirds of the printing revenue in Western Europe, with the remaining 12 countries sharing the other third. Given their share of revenue, Italy and Spain have a very large number of establishments.
It is a general trend that the number of printing companies is decreasing and particular in relation to traditional graphic production of printed matters. In recent years, the printing industry has been undergoing significant consolidation and the process is still ongoing. The number of companies is expected to decrease by 2%-5% per year. The innovative companies focusses, besides the traditional print, also on services with added value and activities on the field of new (electronic) media. Revenue will hold up somewhat better as the value per print item and revenues from value added services tend to rise.
Commercial printers account for the bulk of production, with more than half of that revenue. In-house printing sites and packaging printers add about 10% each to the total European revenue, while other types of establishments contribute significantly less.

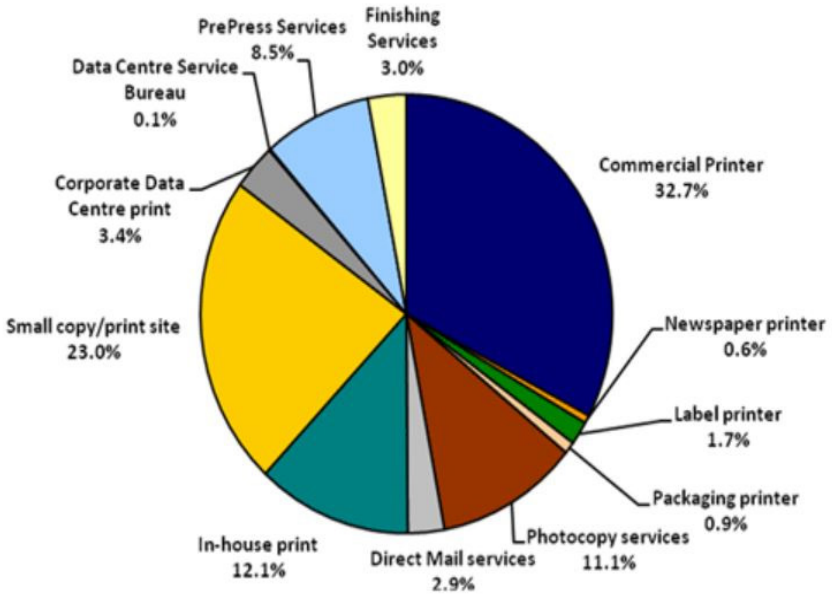

Figure 1: Sectors of the European Printing Industry

The European printing industry is very sizeable, but dominated by small companies. The competition through electronic channels is growing rapidly and that takes its toll. Advertising spending is moving to electronic media and printed documents are replaced by electronic ones. While the impact of the financial crisis in 2009 overstated that decline, the industry has to adjust the direction of development. Nevertheless, many companies thrive in a challenging business environment. With almost €106 billion in revenue, printing remains a sizeable industry. In fact, there are many niches that offer growth opportunities and those can be found in almost all the industry segments.

A wide range of products are produced in the printing industry. In addition to magazines, books, and newspapers, other examples of printed products include direct mail, labels, manuals, and marketing material. But also: memo pads, business order forms, checks, maps, T-shirts, and packaging. The industry also includes establishments that provide quick printing of documents for the consumer or support services, such as prepress, embossing, binding, finishing, and mailing.

In a constantly changing world of technological progress and consumer choice, the European printing industry is at the forefront of innovation aimed at meeting customer needs. This innovation requires the implementation of new measures that in most of the cases increase energy consumption. Printing companies are fully aware that an innovative product range is the best ally to ensuring the long-term competitiveness and adaptability of a whole sector to new market trends.

According with the report “Prospects for the EU printing sector to respond to its structural and technological challenges” the average size of the companies is still too small and divided. Most businesses are family-owned, have a weak financial structure, little structured strategic vision and a reluctance to invest in energy efficiency and innovation.

There is an on-going intense price war within the EU and a difficulty of building sustainable and qualitative differentiation. The printing industry is relatively disconnected from R&D which could jeopardize structural innovation.

With an increasing focus on global services as opposed to the product itself, environmental protection becomes a key differentiator. Even if significant divergence in terms of legal context persists within the EU member states, Europe remains a leader in environmental performance. This creates a new possibility: the relentless legislation imposed over the past few years - often presented as being responsible for endangering the competitiveness of the European printing industry - may in the future become one of its main assets.
The offset printing technique is still the dominating printing technique in Europe. Although the European printing industry widely differ in size and complexity, there are also common characteristics which seem to be the same for the printing industry in all the countries.

2 ENERGY DIAGNOSIS OF EUROPEAN PRINTING INDUSTRY

The first phase of the EMSPI project focusses on research in the industry in the different countries and evaluates the current status of energy consumption and energy management in the European printing industry. The overall objective of the Energy Diagnosis is to gather knowledge about all relevant aspects of Energy Management in the European printing industry and in the five partner countries. The research analysed the energy sources, consumption parameters and equipment in the industry and it showed the current management practice including the good and bad practice. Also the influences of legislation and the demands from the market as well as barriers and obstacles are described. More detailed information is available on the website: www.emspi.eu in the document: “Energy Diagnosis of European Printing Industry”.
Based on the energy diagnosis in the five countries in the EMSPI project it can be concluded that the companies in the European printing industry widely differ in size and complexity. However, there are also common characteristics which seem to be the same for the printing industry in all the partner countries.

1. The European printing industry primarily consists of small companies and between 70 % and 85 % of the companies in the industry have less than 10 employees. It is a general trend that the number of printing companies is decreasing and particular in relation to traditional graphic production of printed matter. The offset printing technique is still the dominating printing technique in Europe.
2. Consumption of energy
   The overall consumption of different energy sources in the printing industry seems to be quite uniform in most of the countries. Electricity as a source represents approximately 60 % of the total energy consumption, and the consumption of natural gas among 30-40 %.
   In the countries with district heating this energy source covers approximately 10 % of the total energy consumption.
   When comparing the energy consumption of the individual companies, there are major differences in the energy sources used in the companies. Except for the differences in the climate conditions and the availability of district heating as an energy source this might well be caused by differences in the printing technologies used in the companies.
   The companies with the printing technique heatset offset are normally using natural gas as an energy source in the drying process representing more than 40 % of the total energy consumption of the companies.

2.1 Consumption parameters and equipment

The distribution of the energy consumption for different kinds of equipment varies widely from coun-try to country and even more from company to company.

An analysis and assessment of the current situation in the printing industry will be made in terms of Energy Management Systems’ standards (EN16001, ISO 50001), defining an energy baseline is the first step to take to implement such systems. Analyzing energy sources, equipment and tools used in the printing indusry will help to define the baseline.

Below is listed the equipment, which in general represents more than 90 % of the total energy consumption in the printing companies in the partner countries of the EMSPI project.

- Production machines Up to 40 %
- General space heating Up to 31 %
- Drying Up to 23 %
- Ventilation Up to 15 %
- Lightning Up to 10 %
- Compressed air and vacuum Up to 8 %
- Office equipment Up to 7 %

The stated percentages are average consumptions on country level, and it should be taken into consideration that the distribution in the individual companies might deviate significant from these values due to differences in the climate conditions and in the type of production.

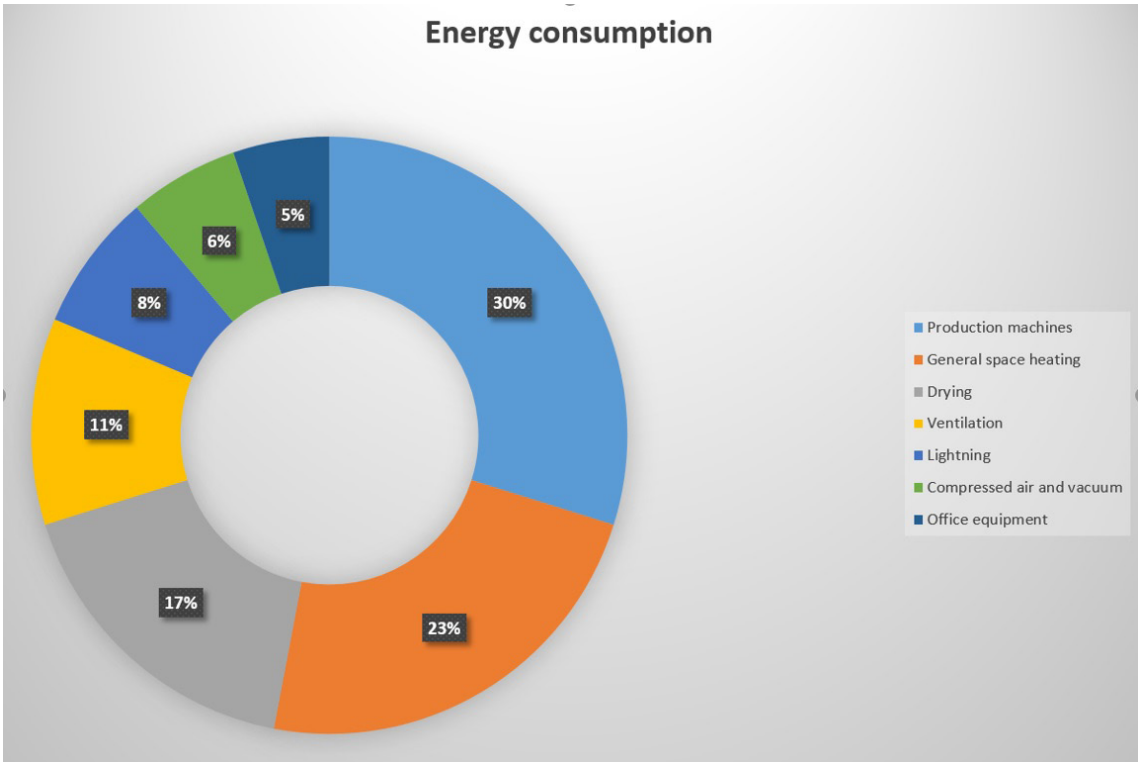

Figure 2: Energy consumption in the average printing company in Europe.

2.2 Energy management practice

The current energy management practice in the printing industry has been assessed in relation to eight selected performance parameters:

- Definition of responsibility
- Monitoring and benchmark
- Target and action plans
- Production and maintenance
- Legislation and guidelines
- Equipment and BAT
- Standards and certification
- Carbon footprint (Energy in life cycle).

A rating method has been developed in order to analyse and assess good and bad practice in the five partner countries on a scale from 1 to 4, where 4 represents best practice. The rating shows that the average company performance of all partner countries is low. In all partner countries, some companies are performing on level of best practice, but they only represent from 1 to 12 % of the total number of companies in the countries, resulting in a low average score.

Best practice for energy performance of products in a holistic approach has also been addressed in this research. This is relevant because ISO 50001 provides the opportunity for companies to include the energy consumption in the supply chain of the company in the scope of the energy management system. Since the indirect energy consumption represents approximately 80 % of the overall energy consumption in the life cycle of the printed product, it can be very relevant to include the indirect energy consumption and a holistic approach in the energy management activities of a printing company.

2.3 Demands from the market

It is a common trend that there are only limited requests from the market to the energy performance of the printing companies. However, some customers demand documentation for the energy performance in the life cycle of the printed product due to the fact that energy consumption has the most significant environmental impact in the life cycle of the printed product. The request for documentation of the energy performance from the market is more common when it comes to the carbon footprint of both the printed product and the printing company. An increased demand for carbon footprint calculations in the printing industry might be a potential driver for implementing energy management activities in the printing industry in general.

2.4 Barriers and obstacles

The research written down in the national energy diagnosis documents of the five countries clearly show that there are two overall barriers for energy management in the European printing industry.

- Structure of the printing industry
- Internal prioritization in the companies

The European printing industry primarily consists of small companies and 70-85% of the companies in the industry have less than 10 employees. In small companies almost all of the employees are multitasking and having tasks directly related to the production process as their primary tasks. The consequences are that it is a challenge to allocate resources related to the strategic activities in the companies.
Common for the printing industry in all the partner countries is the lack of internal prioritization in the companies. This barrier is not limited to the structural conditions in relation to small companies, but is a general barrier also for large companies. The key issue is that it is difficult for the management on the strategic level of the companies to assess the potentials for energy savings. The problem is closely linked to the ability to map, monitor, and analyse the energy consumption in the companies and the lack of adequate key performance indicators and benchmarking facilities. When the potential savings or costs are not clear for the top management it is likely that neither human nor financial resources will be allocated to energy management activities.
It is of significant importance to the success of the EMSPI project that the developed tools and guidelines are targeting small companies. Furthermore, particular focus should be on the definition of adequate key performance indicators and the opportunities for implementing these in a variety of different companies.

2.5 Baseline

It is essential for all improvement projects in an organization or a company that the current conditions are well known and that adequate indicators exist in order to monitor and control the process. Within the framework of ISO 50001 this is defined as the “Baseline”, a minimum or starting point used for comparisons.
Based on the information available from research it has been possible to identify two common indicators for all the countries, which forms the basis of the baseline of the EMSPI project:

- Energy consumption per produced paper (GJ/ton)
- Energy management practice (Score on scale 1-4. 4 is best practice)

The baseline of the five partner countries in the EMSPI project is shown in Figure 3 and 4.

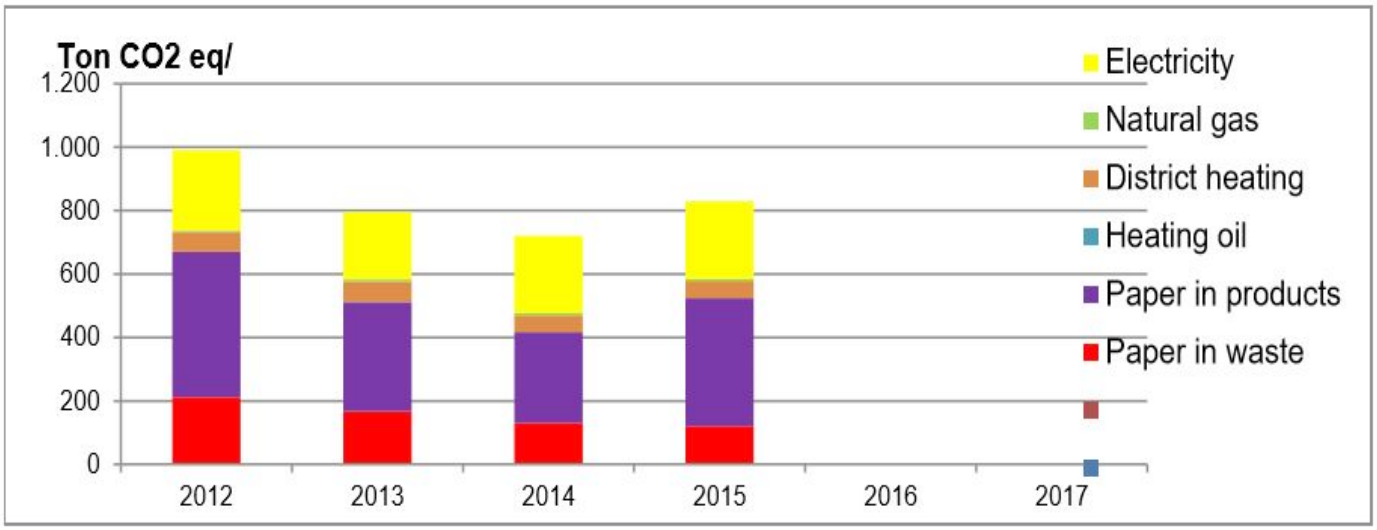

Figure 3: Baseline - Energy consumption per produced paper in the five partner countries.

The indicator for the energy consumption per produced paper is in average 3.1 GJ/ton for all the five partner countries. Figure 4 shows that there are significant differences in the indicator value from country to country and the standard deviations shown in Figure 3 uncover an even greater difference in the indicator values between companies within each country. This fact points out that the differences in indicator values in Figure 3 are not only caused by differences in the energy performance between the countries, but most likely also by the fundamental quality of the indicator.
The indicator "Energy consumption per produced paper (GJ/ton)" was the only common energy consumption indicator that could be defined based on the information, which has already been published in terms of previous European projects or other official sources. This indicator is used widely in the printing industry in Europe and may be the most relevant indicator in some contexts.

However, there are certain conditions that have an influence on the quality of this indicator:

- An indicator with the amount of produced paper in ton reflecting the size of the production may cause uncertainty in the indicator value. Since the thickness of the produced paper varies depending on e.g. product type and customer designs, it would make the indicator value stronger, if the indicator was based on data for the size of the production, which is independent of the thickness of the paper.
- An indicator based on the production output as "Produced Paper" may cause uncertainty in the indicator value. In this case the indicator value is based on: Produced paper = Consumed paper – Paper waste. Since energy is used for all the consumed paper in the production, it might influence the indicator value, if the paper waste, which to some degree reflects the quality performance, is subtracted. As an indicator reflecting the performance of the product it is however relevant to have the production output as a reference.
- When an indicator is based on summarized energy sources it makes the indicator less suitable, particular when the energy consumption for production and the energy consumption for heating and/or cooling of facilities are summarized.
- For the purpose of benchmarking it would be relevant to include conditions like printing techniques, product types, size of companies, and size of print jobs into consideration in order to make the indicator values more comparable.

The significant standard deviations in Figure 3 are very likely caused by differences in the conditions described above which in practical makes the baseline values in Figure 3 less suitable for the use as benchmarking in individual companies. Particularly the differences in printing techniques, product types, size of companies, and size of print jobs are considered to have a great impact on the baseline data (see 2.7 Updating the baseline).

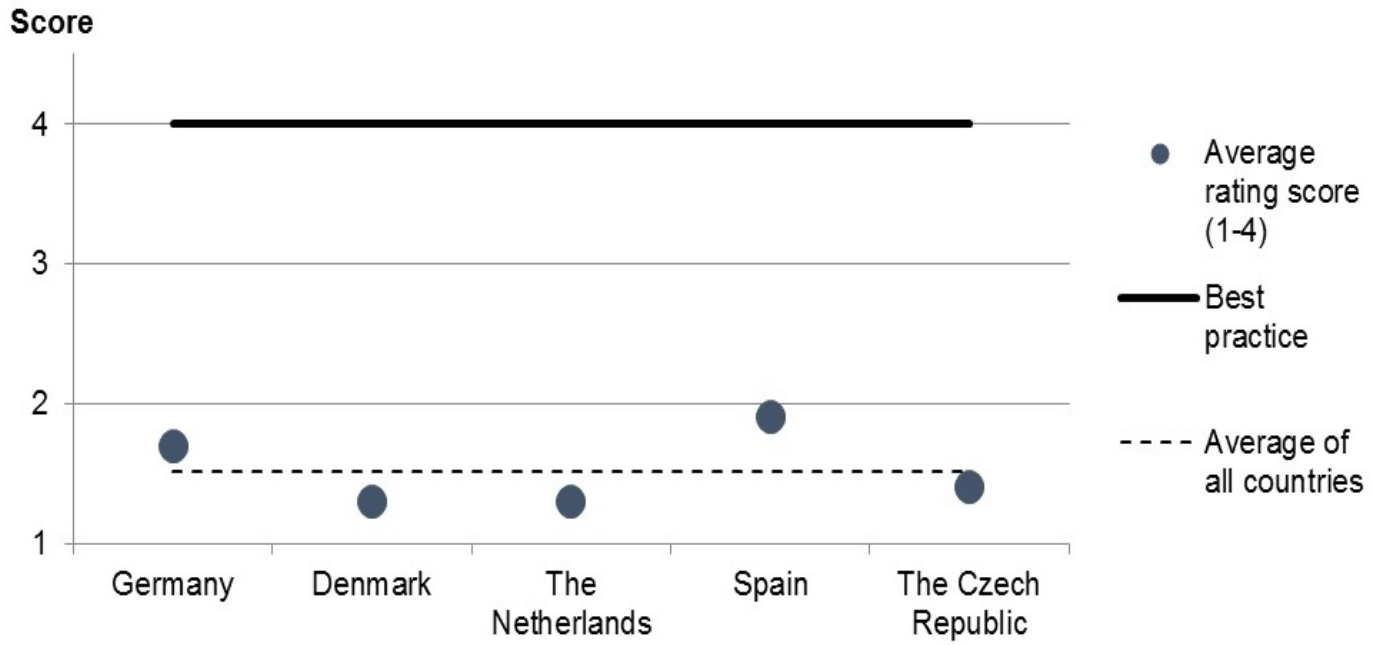

Figure 4 : Baseline - Energy management practice in the five partner countries on a scale from 1 to 4, where 4 represents best practice.

The indicator for the energy management practice for all the countries in the project is in average 1.5 on a scale from 1 to 4, where 4 represents best practice.
Figure 4 shows that there are significant potentials for improvements in energy management in the European printing industry.
The developed rating method and the indicator for energy management practice could be a relevant indicator for small companies (in the EMSPI project), which are implementing only some elements of energy management according to ISO 50001. The indicator might also be relevant in larger companies, because it might be difficult for some companies to document continual improvement activities by the use of consumption indicators, when the production volumes are going down, which is widely happening in the European printing industry.

2.6 Research approach in the sector diagnosis

The research in the first phase of the EMSPI project focused on analysis and assessment of the current situation in the printing industry in terms of Energy Management. The objectives with the diagnosis were:

- defining an energy baseline,
- analysing main energy sources,
- making an overview of barriers, obstacles and succesfactors,
- overview best practices,
- get an overview of the legislation concerning energy management and energy efficiency.

According to Energy Management Systems' standards (EN16001, ISO 50001), defining an energy baseline is the first step to take to implement such systems. Analysing energy sources, equipment and tools used in the printing industry will help to define the baseline. The partners in the five countries: Czech Republic, Denmark Germany, Spain and the Netherlands collected the necessary information through desk and field research. A survey was developed to obtain more direct information about the energy management practices. Input was obtained from about 10-20 companies per country. The different types of information that was gathered, were:

- data available from sources as professional associations en sector organizations,
- ISO 51001 implementation data from printing industry projects,
- data from Energy Efficiency audits in the sector,
- energy sources used in the sector (electricity, fuel, gas),
- energy use and consumption data and indicators,
- data about equipment specific printing machinery as well as regular industrial equipment.

Selection and collection of information needed to obtain an energy baseline of the printing industry in the five participating EU countries. The information was collected, analysed and published in national diagnosis documents and a European diagnosis document. This report describes the detailed conditions in each of the participating partner countries and summarizes the national trends into a common European Energy Diagnosis. Assessment of all the information has taken place to develop an energy baseline for the printing industry. It gives an overview of main energy issues and practises and must act as the base on which build up all the following phases of the project.
The result of the research is published in the European diagnosis document: "Energy Diagnosis of European Printing Industry" on the website as PDF document.

2.7 Updating the baseline

Based on data from the participating companies after the implementation of the adapted Energy Management System (EnMS) in a later phase in the EMSPI project the baseline as defined is updated and analysed. The baseline was defined as:

Energy consumption per produced paper (GJ/ton)

In Figure 4.1 the baseline is compared to the baseline of the participating companies before the EMSPI project started. Since the EMSPI project started in March 2014 the year 2013 is defined as the baseline year. The company data for the energy consumption in 2017 is estimated and based on the energy consumption in 2016 and the planned energy savings in the companies.

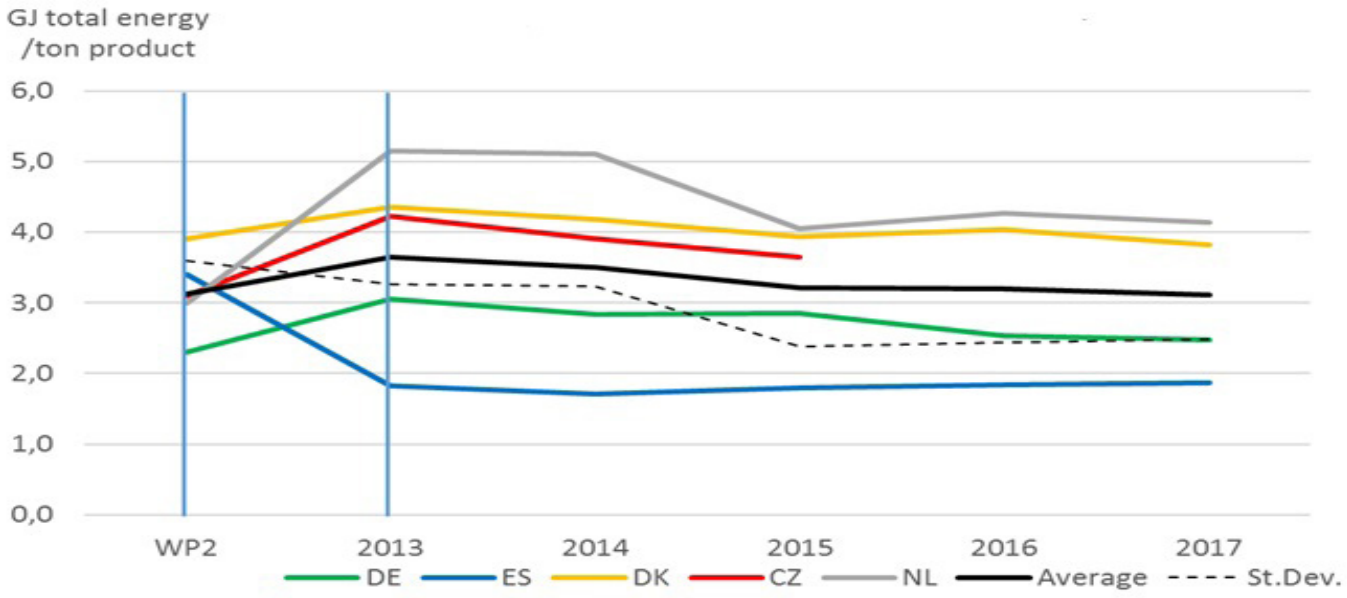

Figure 4.1: Baseline KPI-Energy per produced products (simple average)

Figure 4.1 shows that there is a significant difference between the baseline defined in the "Energy Diagnosis of European Printing Industry" and the baseline of the participating companies in 2013. This difference is most likely caused by a different mix in the type and size of companies included in the analysis of the baseline which emphasizes the importance of updating the baseline with data from the participating companies in the EMSPI project.

Since the suitability of the indicator and baseline defined in "Energy Diagnosis of European Printing Industry" was evaluated to be bad in the research of the energy indicators the alternative baseline from WP3 has been used for analysis:

Energy consumption per consumed paper (GJ/ton)

In Figure 4.2 the updated baseline is shown with data from the participating companies in the EMSPI project starting in year 2013.

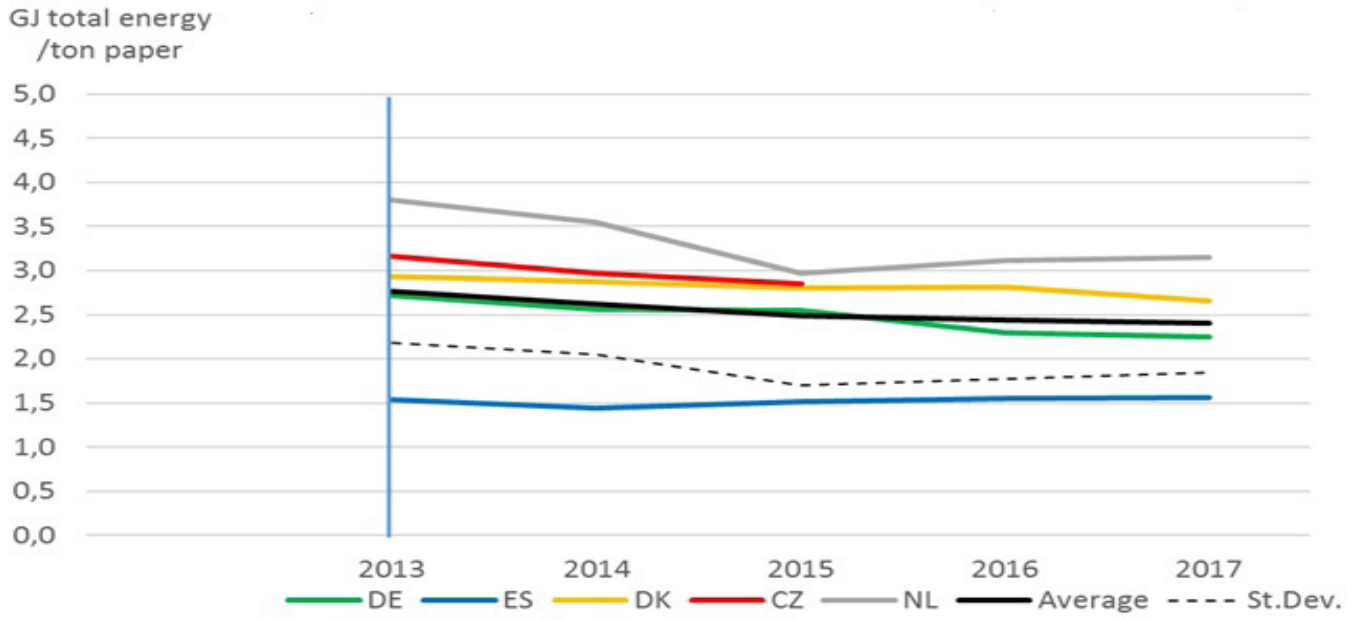

Figure 4.2:Baseline KPI-Energy per consumed paper (simple average)

Figure 4.2 shows that an indicator and baseline based on **consumed** paper as an alternative to **produced** paper results in more harmonious and stable data with a reduced standard deviation. This conclusion is in line with the evaluation of the indicators in WP3.

3 ENERGY PERFORMANCE INDICATORS

Energy Performance Indicators can help companies assess their energy performance. Furthermore, the research in the project includes as well a discussion of the European benchmarking indicators, which establishes the baseline for future comparisons between companies at the European level. Due to the actual lack of data on energy consumption in the printing industry, it is not viable at the moment to establish benchmarking values, but it is possible to determine the indicators that may be suitable for it. At the end of the EMSPI project, as the implementation of the Energy Management System in the printing companies was conducted, there was more information available to establish the European benchmark.

A significant identified barrier for the work with energy management in graphic companies is the lack of internal prioritization, which is closely connected to the companies' ability to monitor and analyse the energy consumption. In this context, energy indicators play an important role, since the precondition for a company to work with continuous improvements is that of the company being capable of monitoring the performance according to the principles for PDCA (Plan, DO, Check, Act) under the frame of a management standard such as ISO 50001. Therefore, the basis for working with definition of energy indicators should be that it is preferable for a company to have indicators that are not the most suitable than not to have indicators at all.

#	Indicator category	Indicator	Suitability as benchmarking indicator
3.9	Space cooling	$\frac{\sum_i^n ESEER_i [adim] \cdot Elect.cons._i [kWh]}{\sum_i^n Elect.cons._i [kWh]}$	Acceptable
3.13	Space cooling	$\frac{Electricy\ consumption\ [kWh]^{CDD}}{Cooled\ floor\ area\ [m^2]}$ CDD: Cooling Degree Day energy consumption.	Acceptable
3.15	Space cooling	$\frac{Electricy\ consumption\ [kWh]^{CDD}}{Cooled\ building\ volume\ [m^3]}$ CDD: Cooling Degree Day energy consumption.	Acceptable
5.1	Indirect energy consumption	$\frac{Carbon\ footprint\ [t\ CO_2e]}{Size\ of\ production\ *}$ * The size of the production can be measured in different ways as described in Table 2 in section D.2.	Useless (unless standardised calculation systems are used)
5.3	Indirect energy consumption	$\frac{Waste\ paper\ [ton]}{Consumed\ paper\ [ton]}$	Acceptable

Figure 5: Deming cycle Plan, Do, Check, Act

In this chapter an analysis and selection of energy performance indicators for the printing industry is described, as well as an outline of the proposed European benchmarking. This was the result of research in the project and the input to the actual implementation of the adapted Energy Management System (EnMS) in the SMEs.

The purpose of defining indicators is to efficiently monitor and manage a certain process with the intent of maintaining a specific level for the process or to change the process. For an indicator to be characterized as being suitable, it needs to weigh the following often conflicting demands:

- The indicator shall provide precise information about the performance.
- The indicator shall be based on data that is easily accessible.

All the information analysed in the previous phase (sector diagnosis) will be used to establish energy use parameters in the printing industry by means of producing Energy Indicators.

3.1 The definition of an energy indicator in particular

An Energy performance indicator (EPI) is a: *quantitative value or measure of energy performance, as defined by the organization. They could be expressed as a simple metric, ratio or a more complex model.*

According to the definition of ISO 50001, indicators can both be based on raw data of the energy consumption and also be key figures for the energy performance, where the energy consumption is normalised to a fixed reference to compensate for the variation in production and climate conditions. Since the production in the graphic industry often varies.

An indicator is a variable that provides information on the state or level of a parameter. As stated in the introduction, in this section, the different types of indicators which could be useful for the printing industry are defined. These indicators can be categorized as follows:

- Energy indicators for the production process
- Energy indicators for general space heating
- Energy indicators for general space cooling
- Energy costs indicators
- Indirect energy related indicators

A theoretical ideal energy indicator provides stable information about the energy performance of a specific process without the indicator being affected by other conditions than the actual process. However, such an indicator is hardly realistic in the real world, since the majority of indicators can be affected by external conditions and at times to such a degree that it makes the indicator unstable and unsuitable as management tool.

Results of the research in the Parameterization phase

After having analysed in the research within the EMSPI project, the suitability of different types of Energy Performance Indicators for the internal use of printing companies was mapped. The analysis focuses on determining which indicators may be useful for internal use and for the benchmarking between different companies.
When using indicators for internal use, the main purpose is to extract information which may help control and reduce the internal energy use. However, when the indicators are used for benchmarking, the purpose is to obtain a comprehensive and reliable image of the whole sector, obtaining information to compare the features of different companies and assessing the situation of the sector in general. Therefore, the indicators used for benchmarking need to assure comparability between different companies, without being too influenced by factors that may hinder it.
In fact, the tables as shown in the detailed report: “Indicators and Benchmarking of the European Printing Industry” include the information necessary to determine whether the indicators proposed may be suitable solely for internal use or both for internal use and benchmarking. While, in previous sections, an assessment of the indicators for internal use was performed, in this section, on the one hand, the results of that assessment are evaluated and the best indicators for internal use are included, because only those indicators that obtained a mark higher than “acceptable” in the suitability for internal use are displayed. On the other hand, the evaluation of the use of indicators for benchmarking is carried out as well, including the tables below the results obtained for every indicator which was deemed suitable as an internal indicator when its suitability for benchmarking is being considered.
The energy indicators in the report: “Indicators and Benchmarking of the European Printing Industry” are classified by the earlier mentioned categories. In each one of the tables the suitability of these indicators for internal use is included, as well as the conditions influencing the stability of the indicator for benchmarking purposes and the suitability of its use as a benchmarking indicator.
In the table below, a summary of the indicators that are considered to be the most suitable ones for the sectoral benchmarking is included.

#	Indicator category	Indicator	Suitability as benchmarking indicator
3.9	Space cooling	$\frac{\sum_i^n ESEER_i[adim] \cdot Elect.cons._i\,[kWh]}{\sum_i^n Elect.cons._i\,[kWh]}$	Acceptable
3.13	Space cooling	$\frac{Electricy\ consumption\ [kWh]^{CDD}}{Cooled\ floor\ area\ [m^2]}$ CDD: Cooling Degree Day energy consumption.	Acceptable
3.15	Space cooling	$\frac{Electricy\ consumption\ [kWh]^{CDD}}{Cooled\ building\ volume\ [m^3]}$ CDD: Cooling Degree Day energy consumption.	Acceptable
5.1	Indirect energy consumption	$\frac{Carbon\ footprint\ [t\ CO_2e]}{Size\ of\ production\ *}$ * The size of the production can be measured in different ways as described in Table 2 in section D.2.	Useless (unless standardised calculation systems are used)
5.3	Indirect energy consumption	$\frac{Waste\ paper\ [ton]}{Consumed\ paper\ [ton]}$	Acceptable

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3.9	Space cooling	$\frac{\sum_i^n ESEER_i[adim] \cdot Elect.cons._i\,[kWh]}{\sum_i^n Elect.cons._i\,[kWh]}$	Acceptable
3.13	Space cooling	$\frac{Electricy\ consumption\ [kWh]^{CDD}}{Cooled\ floor\ area\ [m^2]}$ CDD: Cooling Degree Day energy consumption.	Acceptable
3.15	Space cooling	$\frac{Electricy\ consumption\ [kWh]^{CDD}}{Cooled\ building\ volume\ [m^3]}$ CDD: Cooling Degree Day energy consumption.	Acceptable
5.1	Indirect energy consumption	$\frac{Carbon\ footprint\ [t\ CO_2e]}{Size\ of\ production\ *}$ * The size of the production can be measured in different ways as described in Table 2 in section D.2.	Useless (unless standardised calculation systems are used)
5.3	Indirect energy consumption	$\frac{Waste\ paper\ [ton]}{Consumed\ paper\ [ton]}$	Acceptable

Figure 6: Summary of potential benchmarking indicators

The results of the research are shown in the detailed report: “Indicators and Benchmarking of the European Printing Industry” (see the website www.emspi.eu for more detailed description of the indicators per category).

3.2 Lessons learned from the use of the indicators in the companies

According to the national stakeholders and SMEs, the defined parameters are very suitable for the sector. Furthermore, these parameters are also used in the ISO-accredited ClimateCalc calculation methodology (a well-known carbon footprint accounting system).
It was difficult to define the right specific energy indicators. Due to the lack of company data, the consortium made the right decision when taking into account kWh/ton consumed paper as a right indicator. Almost 100% of the companies have used that indicator as the most relevant for their reality, considering the availability of data.

However, other companies have considered the use of other relevant indicators such. The considered indicators are expected to stimulate SMEs much more than before, as they are specific for the printing sector. The indicators selected cover the different aspects and from the different points of view commonly applied for this type of industries.
The guide: Indicators and Benchmarking of the European Printing Industry (which is a document as a part of the adapted Energy Management System (EnMS)) is also considered well enough for its readers. In general, the targets and benchmark are considered adequate.

The adjusted suitability of the indicators was presented in the standard implementation guideline before the implementation. In order to elaborate a benchmark for all of the participating companies, the indicator considered as most suitable is the indicator presented below, as it is the most approachable for the majority of companies:

$$\frac{\text{Energy consumption [GJ]}}{\text{Consumend paper [ton]}}$$

Remarks:

- When energy sources for production and space heating are summarized the indicator can only be used with annual data.
- Benchmark might be possible between companies with the same climate conditions.
- The stability of the indicator decreases if the data for substrate is based on the amount of purchased substrate due to variations in stock.

In terms of indirect energy related indicators, the carbon footprint (t CO2 eq) has also been calculated for energy consumption, paper consumption and paper waste for all of the companies, as it has been automatized in the energy diagnosis tool. See example below for the results of the carbon footprint as presented in the tool:

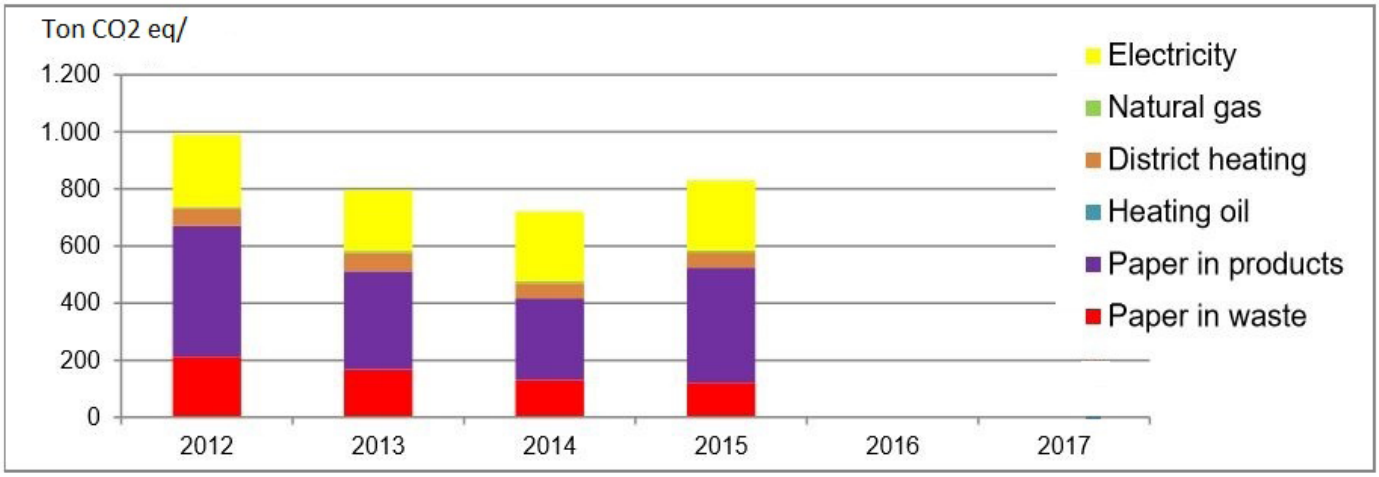


Figure 7: Results of the carbon footprint

For companies which have indicator data for the production with a high frequency on e.g. a monthly basis it is possible to make a dynamic analysis and baseline of the energy consumption by including the variations in the production in the analysis.

3.3 Research approach in the Parameterization phase

The information analysed in the previous phase Energy Sector Diagnosis is used to establish parameters in the European printing industry by means of producing Energy Indicators. This research was an intermediate phase that provided the technical base to develop energy management system specifically adapted to the printing industry. The information gathered in the evaluation of the different country reports together with the overall research was analysed. The differences in energy consumption per country and the differences in the printing industries (size, equipment, management systems, energy market availability of energy sources) were reviewed. Specific parameters in terms of energy consumption using the previously defined energy baseline for the printing industry were set up to obtain specific indicators for the printing industry. The final version is discussed with the stakeholders and their input is used. The results are published in the "Guide of General and Specific Indicators, Targets and Benchmark" which is published on the website.

4 ENERGY MANAGEMENT SYSTEM (EMS)

4.1 What is a management system?

A Management System is a set of coherent agreements (whether or not laid down in methods, procedures, work instructions, formats, etc.) to establish and subsequently implement policy and objectives. The starting point is to comply with laws and regulations and to achieve continuous improvement. The foundation of the management system is a good understanding of the risks and opportunities for improvement of activities, products or services. The choices are partly based on the ideas of potential stakeholders.

All management systems are built up following the known plan-do-check-act cycle (PDCA):

- Plan: Determining the policy based on identified opportunities and risks, setting goals and drawing up implementation plan.
- Do: Take organizational and technical measures to achieve goals.
- Check: Monitoring or objectives are achieved and risks are guaranteed and, where necessary, corrective measures taken.
- Act: Modifying the policy aimed at further improving performance. The start of a new cycle.

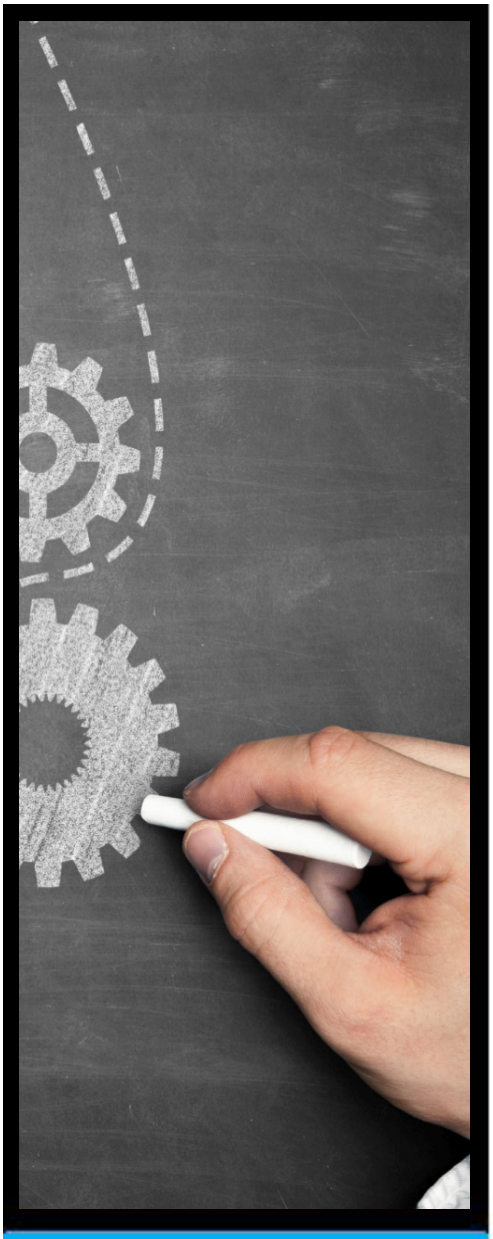
Advantages of a management system

A management system helps a company to formulate policies that systematically manage the risks (quality, environment, health & safety, energy) and improve the performance of the company. The use of a management system leads to:

- New insights into their own processes with ideas for improvement as a result;
- The right information to set priorities;
- Identification of risks and possibilities to control them;
- Better process control;
- Higher motivation of employees through direct involvement.

When a company systematically work in accordance with a management system there will be several advantages. The benefit can be paid out in several ways:

- Savings in the production process (for example, less waste and errors);
- Better market position;
- Good relationship with competent authority and with the environment;
- Better relationship with stakeholders of the company like customers or financiers;
- Lower insurance premiums.



Energy-saving: when it comes to energy saving, energy management is the process of monitoring, controlling, and conserving energy an organization. Typically this involves the following steps:

1. Metering your energy consumption and collecting the data.
2. Finding opportunities to save energy, and estimating how much energy each opportunity could save.
3. Taking action to target the opportunities to save.
4. Tracking your progress by analyzing your meter data to see how well your energy-saving efforts have worked. (And **then back to step 2, and the cycle continues...)**

4.2 The Energy Management System (ISO 50001)

ISO 50001 is the international standard for energy management systems. The norm focuses specifically on reducing the energy consumption of an organization or company. This is based on a detailed understanding of energy consumption and its use. Compared to the ISO 14001 standard, more stringent requirements are imposed on the depth of monitoring of use, identification of possible improvements and objectives to achieve this. Energy is one of the environmental aspects of the ISO 14001 standard, but it is the central subject in the ISO 50001. A clear difference to the ISO 14001 standard is that the ISO 50001 focuses only on the organization's own energy consumption and not on the energy consumption in the chain.

The basis for the energy management system is the plan-do-check-act cycle (PDCA). In addition to this implementation cycle, ISO 50001 also sets requirements for management system results:

- Focusing on the continuous improvement of energy performance.
- To ensure that all information and resources are present to achieve the goals.
- Complying with applicable legal requirements.

ISO 50001 standard

ISO 50001 is a tool for supporting companies in their energy management and in saving energy and costs. The standard provides guidelines for all kinds of organizations from small to large who want to systematically improve their energy performance. A new version of the ISO 50001 is under development. This version, like the ISO 14001: 2015, will be based on the so-called ISO High Level Structure (HLS).

5 ADAPTED ENERGY MANAGEMENT SYSTEM FOR THE PRINTING INDUSTRY (ENMS)

An adapted Energy Management System (ENMS) for the printing industry is developed and will be implemented in SMEs in the European Printing Industry. It is supported by introducing different materials, awareness tools, benchmark tools for assessment, and a EnMS Standard manual for the Printing Industry in EU.

Structure of the Energy Management System (Basic Vs Full model)

Like described avove the printing industry is characterized by the large number of small businesses. Not all of the companies can implement a full Energy Management System. Companies with less than 20 employees and which not have a Quality & Environment Management Systems already implemented, would be discouraged if they had to implement the specific energy management standard. It could be too costly for them and would perhaps discourage these companies to engage in implementing an Energy Management System (EnMS). That's why two versions of the Energy Management System are developed to fit on the demands of smaller and mediate and lager companies within the graphic sector.

The organizations interested in implementing an Energy Management System (EnMS) are able to choose one of the following options:

- "Basic": Designed as a first step in EnMS. For organizations that cannot meet all the requirements of the ISO 50001 standard.

- "Full": Leading to a complete implementation of the EnMS, assuming all the requirements of the ISO 50001 standard. For highly committed organizations.

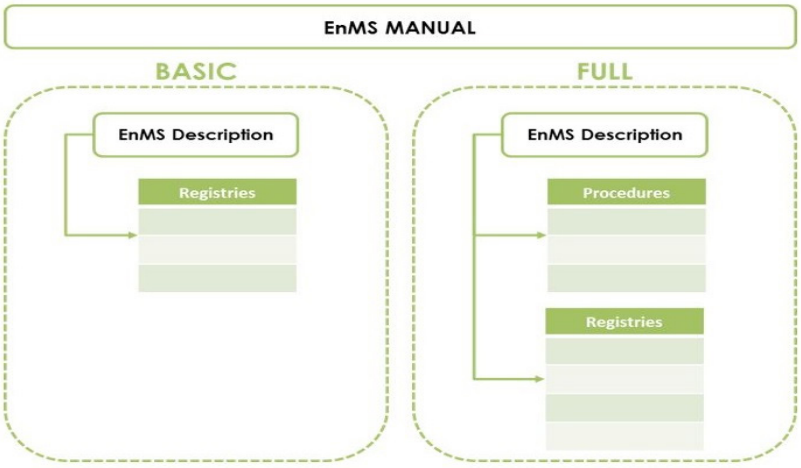


Figure 8: Basic- versus Full Energy Management System

Energy Management System Manual

The manual is a reference document, easy to read and easy to understand. The content of the manual covers all the subjects of the EnMS. The manual includes examples, comments, figures, links and references.

Gathered information regarding energy use and management, specific project materials to implement the Energy Management System will be developed. Standard materials will be created using as benchmark EN 16001 and ISO 50001 and will be used as guideline for Energy Management System adapted standard development.

Provides detailed information regarding the PDCA (PLAN-DO-CHECK-ACT) approach – also known as Deming Cycle – to achieve continuous improvement in energy performance.

"Basic" version: The basic implementation is specially focused in the "PLAN" and "DO" phases of the Deming Cycle, which include the energy planning, implementation and operation tasks. These tasks are summarized in sections 2 and 3 of the Basic Version of the EnMS Manual document.

"Full" version: The full implementation covers all four phases of the Deming Cycle. These phases are specified in sections 2, 3, 4 and 5 of the Full Version of the EnMS Manual document.

Procedures and registries

Procedures: Only available for the "Full" version. A procedure is used to describe in detail a specific and advanced task.

Registries: control documents for setting goals, writing record of implementations undertaken, and proposing improvements. Available in the basic version and the full version of the EnMS.

Figure 9: Registries of the Full version of the EnMS

The scope of each EnMS option is defined considering the selection of elements listed below.

EnMS element	Basic	Full	Description
4.1	**X**	**X**	System description of EnMS / handbook (shared with 4.5.4.1.)
4.3 g	**X**	**X**	How to determine Energy policy
4.3 h		**X**	The current Energy policy
4.4.1	**Check yearly a measure list**	**X**	How to do the Energy planning process

EnMS element	Basic	Full	Description
4.4.2	Add it to the measure list	X	Inventory of Legal and other requirements (last line)
4.4.3 a	X	X	Criteria and methodology for performing Energy review (4.4.3). 4.4.3a – Analyse energy use and consumption
4.4.3 b	X	X	Results of the Energy review and updates thereof (4.4.3).
4.4.3 c	X	X	Discovered opportunities for improving energy performance
4.4.4		X	Established Energy baselines for the own organization
4.4.5		X	Methodology for determining and updating Energy Performance Indicators (EnPIs) for the own organization
4.4.5		X	EnPIs reviewed and compared with energy baseline
4.4.6	X	X	Energy management action plan and keeping it updated
4.4.6		X	Current Energy objectives and targets
4.4.6		X	Detailed energy objectives and targets at relevant functions
4.5.2		X	List of competence, education, training, skills and experience
4.5.2		X	Trainings provided and other actions taken to meet the needs of competence
4.5.3	Simplified	X	The formal decision to communicate externally about an organization's energy policy, EnMS, energy performance
4.5.3		X	The standard methodology for external communication
4.5.4.1	X	X	System description of EnMS / handbook (shared with 4.1.)
4.5.4.2		X	Document controls of the EnMS documents
4.5.4.2		X	EnMS Documents with correct versions
4.5.5		X	Operational control
4.5.6		X	Results of the design activities
4.5.7		X	Document with internal energy purchasing specifications
4.6.1		X	Energy monitoring plan
4.6.1	Only purchase level	X	Results from monitoring and measurements of key characteristics

EnMS element	Basic	Full	Description
4.6.1		X	Records of calibration (and other means of establishing accuracy and repeatability) of equipment used for monitoring, and measuring key characteristics of its operation
4.6.1	X	X	Records of activities carried out when "significant deviations in energy performance" are encountered.
4.6.1		X	Review detailed measurements needs to achieve control
4.6.2		X	Results of the evaluations of compliance with, and changes in, legal and other requirements
4.6.3		X	Audit plans and schedules for Internal audits
4.6.3	**Checklist with annual saving possibilities**	X	Internal audit results
4.6.4		X	List of corrective and preventive actions
4.6.4		X	Reviewing the effectiveness of corrective and preventive action
4.7	**Checking yearly consumption and measure list**	X	Organization's EnMS (management review)

Figure 10: Register

EnMS Description

"Basic" version: The document is an editable template, therefore the company details can be added throughout the document.

Consists in a brief document containing all the information needed to handle the EnMS, except the registry forms, which are linked in the text.

"Full" version: The document is an editable template, therefore the company details can be added throughout the document.

Consists in a brief document containing most of the information needed to handle the EnMS. The text links to the procedures (to add detailed description when it is needed) and to the registry forms.

All the documents are downloadable as PDF at: www.emspi.eu

ClimateCalc

ClimateCalc, www.climatecalc.eu, is an eTool designed to provide exact information on the climate impact of the individual graphic product in a life cycle perspective. ClimateCalc calculates the climate impact of the specific printed matter as well as of the entire printing company. This tool measures the CO2 emission through all the steps in the production of the printed matter; from cutting down the tree to the delivery to the customer. To calculate the climate impact of a specific graphic product, data representing the specific raw materials must be included in the production of the printed matter together with data representing the graphic company producing the printed matter. ClimateCalc provides such a calculation basis. ClimateCalc is owned by graphic organizations in Europe. The members of International Association ClimateCalc are FEBELGRA (Belgium), UNIC (France), KVGO (the Netherlands), BPIF (Great Britain), NHO (Norway), APIGRAF (Portugal) and the Graphic Association Denmark, Grakom (Denmark) which participates in EMSPI project.

5.1 The full scope of energy management

Taking decisive actions in reducing the energy consumption in a company, is a task that maybe sounds easy, but is sometimes much more complex to bring it in to practise. Most of the entrepreneurs want to delegate the energy coordination task to an employee of his or her company, not even realizing if this employee has the right skills to do the job.

This strategy only works when the entrepreneur realizes that the start of the implementation of an energy management system actually starts at the management table. The coordinator should feel the support/back-up from his or her manager, to make the implementation a success. This is because it is always for a coordinator quite difficult to change the mind-set of his/her colleagues. This task is almost impossible, when the coordinator doesn't have a serious support at all.

This lack of serious management support seems to be the first main barrier for a company to be successful in reducing their energy consumption. The viewpoint of managers towards purchasing or waste management is on the other hand another matter. Costs in not-sustainable purchasing or waste management, one can easily translate this in money losses. Energy on the other hand is an invisible production resource. Most of the entrepreneurs are not easily willing to start with an energy action plan. In their opinion it costs valuable time and money and the results are unsure. Due to the results of the EMSPI project the sector starts to know better. Working on energy savings, is nowadays a more serious management issue.

After years of experience in the creative industry we can conclude that entrepreneurs who are willing to invest in their employees and business strategy, are more successful than others. These kind of companies are mostly the innovators or early adopter of the business, who find every time new opportunities to stabilize or even enlarge the capacity of their business, independent from the economic situation their sector is in. For these kind of entrepreneurs, it will also be easier to implement an energy management system, such as ISO 50001.

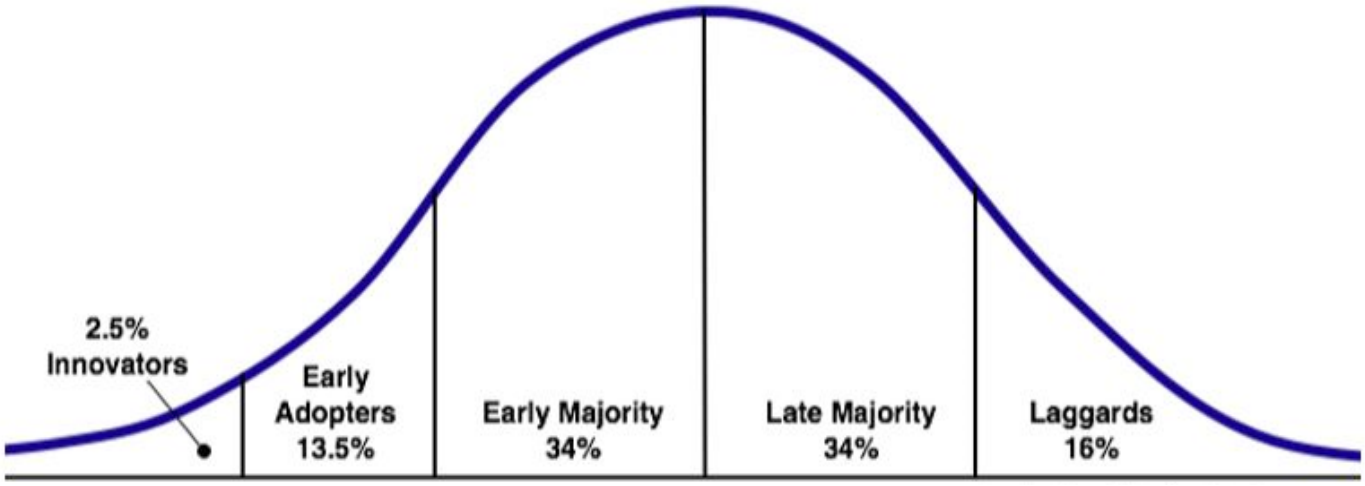


Figure 11: Gauss curve

They have a clear viewpoint what the (financial) benefits could be to work in a constructive way with complex technical energy matters. For them it is all about Business Risk Management (BRM) and Stakeholders Expectations Analyses (SEA). They have the idea that if they incorporate energy management into their own general business concept, they are capable of reacting in a more effective way towards the (future) customer's needs. Bottom line: Energy management is all about thriving your business well.

But we have to be realistic. Not all the entrepreneurs are innovators or early adopter. Most of the entrepreneurs belong to the majority of companies, who plan their own strategy on the behavior and choices of the early adopters in the business.

5.2 A system for energy management

An energy management system is designed for companies:

- that want to have insight into the energy consumption within the company;
- to monitor and reduce energy use;
- to establish compliance with the specifications themselves and make a statement about that;
- that wish to ensure that they comply with the energy policy set itself;
- compliant to demonstrate to third parties;

An energy management system ensures that a company pays proven and structural attention to energy management. The benefits of an energy management system are evident;

- Effective and efficient management of energy consumption;
- Quantify effort and results;
- Easy to demonstrate that the company meets certain requirements.

Energy management requires structural attention, and structural attention within an organization requires a management system:

'An energy management system includes organizational structure, agrees on roles and responsibilities, and procedures, processes and facilities to implement energy management'.

The development of the energy management system may differ from company to company, but the goal is always the same: continuous performance improvement in energy efficiency. Just like occupational health, environmental and quality management systems, an energy management requires continuous repetition of the cycle of "Plan, Do, Check, Act.

5.3 Definition of energy management

Energy management can be defined as follows: "Energy management is conducting a structural and economical way of organizational, technical and behavioral measures to minimize the use of energy, including the energy for the production and use of raw materials and consumables".

This definition shows that energy management and an energy management system have three angles:

1) The organization

Energy management is embedded in the management and organizational structure. The essential aspects are planning, monitoring, information management and defining responsibilities.
2) The technique

The approach to energy management is dependent on the process and operating conditions which are specific for each sector as well for the printing industry. Technical measures are always part of it, both within the (production) processes in information. On the website of the project you can find more detailed information on the technical aspects on energy within the printing industry.

3) The behavior

The approach to energy management takes into account the social aspects of business operations, such as management style, attitude and behavior of employees and the organization. The implementation of a system needs careful planning of the activities, taking the employees in account. The right information, in an understandable language at the right moment, is crucial for their support and motivation.

5.4 Important components of energy management

There are three main components of energy management. These components are:

- Energy policy statement,
- Planning,
- Implementation.

1. Energy policy statement

Your company should start there with the introduction of energy management where clear benefits are to be expected. You can, for example, in the first instance set up compliance with legal requirements, by addressing the causes of energy waste or focus on efficient use of energy.

As increasing experience of the company and its energy management begins to take shape, programs and techniques can be put in operation to further improve the energy performance. If the system grows into adulthood, environmental considerations, including energy issues, may be included in all business decisions.

To ensure success it is important that the executive level (management) of the company is committed to the improvement of energy management and to the development or implementation of an energy management system. The company-management can demonstrate this commitment by endorsing the policy statement and by providing sufficient employees and resources.

2. Planning

Planning consists of four closely interrelated elements. A good initial energy analysis, an **inventory of all energy aspects** is the starting point. The second element is i**dentifying legal and other requirements (the baseline)**, necessary to assess the current level of energy to the desired maximum level power consumption. Based on these two surveys **goals and targets** can be defined, which are then specified in more **concrete actions in an energy management program**.

The policy (containing the goals and targets of an organization), more specifically, must be based on knowledge of total energy consumption and how it is connected or can direct be attributed to activities, products or services of the organization.

The inventory of the energy aspects and its analysis is a continuous process in which the past, present and potential impacts (positive or negative) of the activities of a company on the power consumption can be established.

It is essential for a reliable analysis that employees who can influence the use of energy or bear responsibility for the use, are also involved in the making of the analysis. The analysis should heavily consider the consumption data in determining the priority of approach, in determining the environmental aspects and drafting of the energy management program.

3. Implementation

A company is constantly being confronted with changing requirements of stakeholders, with a dynamic business environment and with a self-imposed process of continuous improvement. This means that also the requirements of the commitment and the competences of the company and its employees constantly evolve. To achieve its energy objectives, the company should focus on her people, systems, strategy, resources and structure, and align them together.

Many companies can deploy their energy management stepwise. The implementation level should be consistent with the level of consciousness of the energy demand, energy aspects, expectations and benefits and availability of resources.

- Important aspects in implementation:
- Structure of the company and responsibility-level,
- Human, physical and financial resources,
- Training and awareness,
- Communications (internal and external),
- Documentation of the basic elements of the energy management system,
- Control of implementation activities.

5.5 Control and corrective measures

Measurement, monitoring and evaluation are the main components of the energy management system in order to achieve performance in accordance with the established energy management program. The results of the measurements of performance need to be evaluated at least once a year and will have to be assessed in relation to the control mechanisms and energy objectives and targets.

There should be a periodic evaluation of compliance relevant laws and regulations. The findings, conclusions and recommendations as a result from measuring, monitoring, audits and other reviews of the energy management system, should be documented. The necessary corrective and preventive measures must be identified and documented as well.

To improve the effectiveness of corrective measures and to ensure preventive measures, the management must ensure the implementation of these measures and that the execution will be monitored systematically.

5.6 Management involvement

The companies' management should assess periodically the energy management system to ensure its effectiveness and need to the ongoing capability.

An energy management system should be subject to continuous improvement to realize overall improvement in the energy performance. The subject and the scope of the assessment of the energy management system should be wide enough to address energy aspects of all activities and the products or services. Also the impact on the financial performance and possibly on the competitiveness of the company need to be included.

6 SPECIFIC GUIDELINES

Implementing an Energy Management System demands knowledge and skills on several issues. In this chapter we will give information to maximize the benefits associated to the implementation of the Standard, including strategic and operational criteria. Detailed information on topics such as Green marketing techniques, KPI environmental indicators, Quality control and analysis of ESCOs' involvement potential can be found on the website: www.emspi.eu, tab Progress and tab Deliverables.

6.1 Green marketing, do good things and talk about them!

Improved corporate reputation, enhanced customer connectivity/ reliability and increased revenue, are only a few of the potential effects going hand in hand with a profound green marketing strategy. That is why we will show you how to make use of the strategic value of the new energy management standard (EnMS) developed in the EMSPI project. Especially entrepreneurs in the printing industry have a lot of choices to make. The technology changes quickly and customers' requirements even faster. And: there is always the cost argument around. Energy efficiency and environmental awareness impose an increasing impact on consumer preferences. But being "green" and "energy-efficient" alone isn't enough anymore. Instead you really have to demonstrate your products added value to your customers. That's the point when a broad and solid green marketing strategy comes in place.

Green marketing is a concept that refers to the process of selling products and/or services based on their environmental benefits. In times of a progressing global warming and an increasing environmental awareness going alongside, promoting your products with sustainability and/or eco-friendliness can become a major advantage to you and your company in several ways.

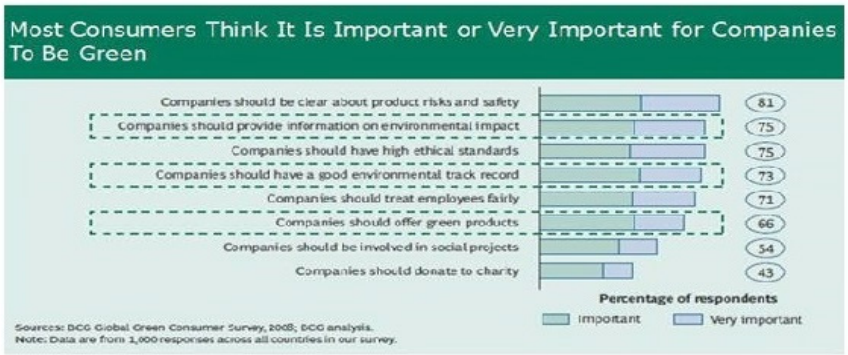
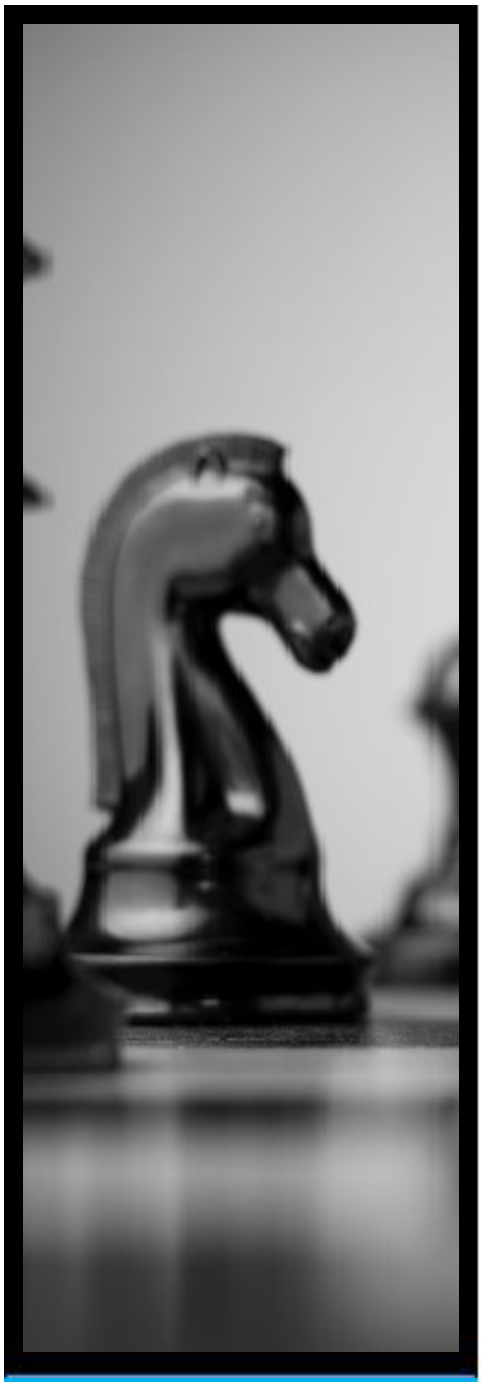


Figure 12: Customers opinion on Green

As a part of your green marketing activities you can show that you are going along with or even ahead of legal regulations and thereby promote the growths of your corporate reputation. Other way round, anticipating measures by greening your company might put you in advantage when it comes up to fulfil legal regulations. On top of that reducing the CO2 output and/or enhancing energy savings, often leads to the opportunity of availing yourself to subsidies or tax reliefs.



Information and tools to maximize the benefits associated tot the implementation of the Energy Standard including strategic and operational criteria (green marketing techniques, KPI environmental indicators, quality control and analysis of ESCOs'involvement potential) will be developed.

Furthermore by using green marketing you specifically highlight how your products' added value matches your customer's preferences. According to reliable surveys, consumers expect companies to be proactive when it comes to being "green". That's because, according to these surveys, consumers believe that companies have a greater impact on environmental developments than individuals and thereby a greater responsibility towards the environment. The second interesting finding of these surveys was the fact that most consumers are willing to pay more for green products, especially when they do believe that these products bear some added value (eco-friendly, healthier, safer etc.).

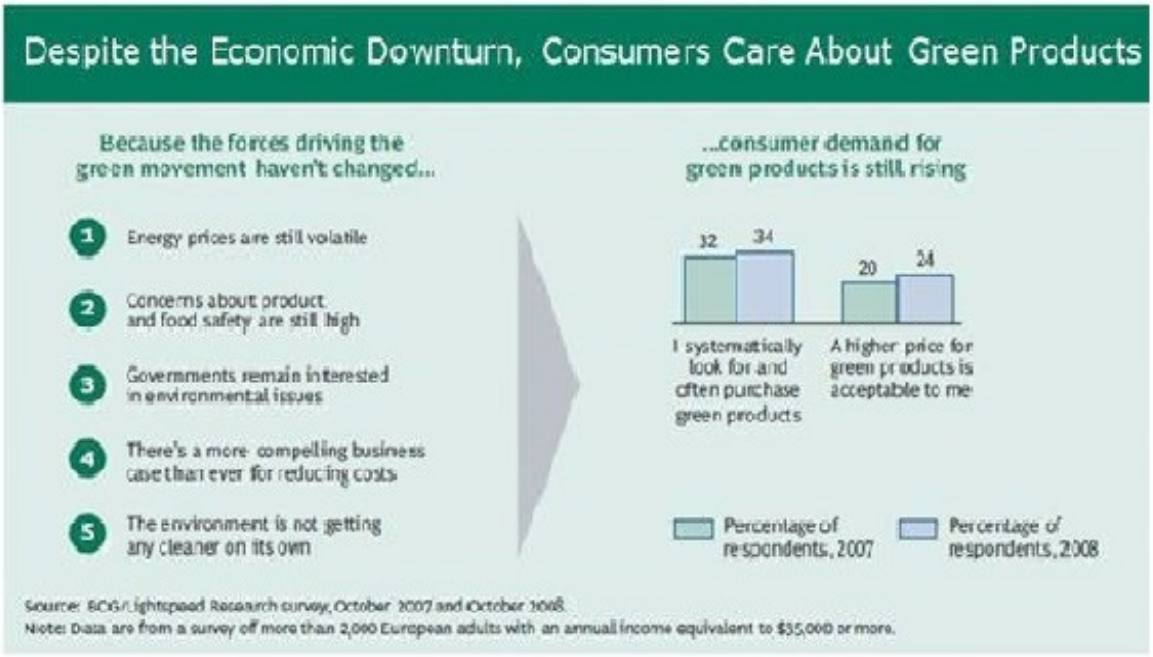


Figure 13: Demands of the customer to green products

Another advantage of your green marketing is the win-win situation for cost savings and environmental benefits, because the "greening" of your company will not only provide a positive effect on the environment, but also on your own expenditures and revenues. Through the implementation of an EnMS for example, you will increase your company's energy efficiency and thereby reduce your expenditures on energy. In the context of your Green Marketing campaign you should explain that part of these savings is passed down to the consumer.

Finally, the positive effect of being considered an eco-friendly company is not to be underestimated, when it comes to the recruiting of qualified employees, especially in times of an ongoing demographic change and the associated labour shortage, being green is a crucial advantage for your company to recruit skilled workforce. A more detailed report on Green Marketing can be found on the website.

6.2 Environmental indicators: Carbon footprint is a step stone to environmental management

The trend in modern management systems is moving towards more and more integrated systems, not limited to cover only one type of activity in the company like environmental issues or quality issues. This trend is first of all caused by demands from the market requiring the companies to document continual improvement in relation to e.g. health and safety, energy efficiency, CSR and various safety aspects. The road to integration has been paved by the alignment of the ISO management standards making it simpler for companies to handle multiple standards under the same management system.

A company which has implemented an energy management system according to ISO 50001 can use the existing structure of the management system to implement any other ISO management system. The simplest first step will be to extent the management activities to cover the environmental activities as described in ISO 14001 or EMAS. The energy management system of a printing company is often focusing only on the direct energy consumption in the company by managing the consumption of electricity and fuels for heating. However the energy management system can easily be extended to cover the most important environmental impacts of printing by focusing also on the indirect energy consumption.

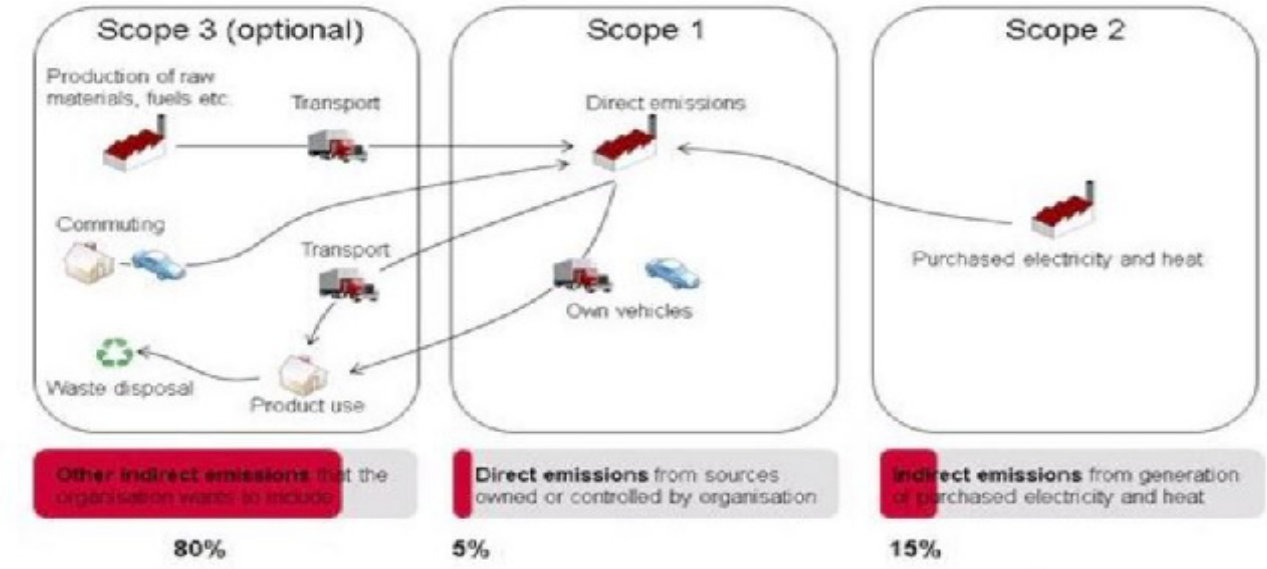


Figure 14: Distribution of the greenhouse gas emission of the lifecycle of a product

From an environmental perspective the indirect energy consumption is extremely relevant since the supply chain of the printing company is rather energy intensive and approximately 80% of the total energy consumed in the life cycle of the printed product is allocated to the manufacturing of the raw materials in the supply chain. From the perspective of a printing company this means that the raw material efficiency in the company is by far the most important environmental impact of the company. The energy intensity of the supply chain also means that carbon footprint is an excellent tool to manage the most important energy consumptions and environmental impacts in the supply chain due to the direct link between the energy consumption and the emission of greenhouse gases. This means that the most obvious way for a printing company to start working with some of the most important environmental indicators is to use indicators based on carbon footprint. The easiest way to calculate a carbon footprint of the company is to use one of the existing carbon calculators on the market but the company should be aware that there are major differences in the way the different carbon calculators are calculating and how much they cover in the calculations. This can be of significant importance if the company wishes to benchmark the performance or use the carbon footprint in the marketing of the company or the products. In these cases the company should use a carbon calculator based on international standards like www.climatecalc.eu.

In case the company wishes to work with carbon calculators which are not standardized, the company should be aware that the calculation boundaries and the reference data can have significant influence on the calculations and can make the comparison between companies and products impossible. The guideline explains in more details what the company must be aware of if it uses carbon calculators that are not standardized.

6.3 Quality Control

Energy efficiency is directly related to Productivity, defined as “the relationship between what is produced and the means employed, such as labour, materials, energy, etc.”. This is, obviously, directly linked with Economical Productivity, where production of a unit of goods is considered to be economically efficient when that unit of good is produced at the lowest possible cost. The relationship between quality and productivity is very direct. Hence the need for organizations to have effective methods of improvement, monitoring, evaluation and measurement strategies for continuous improvement and productivity.

Before the theories of Deming it was often thought that quality and productivity had a negative relationship to each other: increasing quality meant a productivity decrease. This reduction in productivity was argued as resulting from the time and resources devoted to conducting inspections that leads to a reduction of direct production efforts. Deming was responsible for proving a positive and direct relationship between quality and productivity, showing that increased quality reduces costs through reducing errors, faults and resolving customer complaints, among other issues. There thus exists a clear and direct link between Energy Efficiency and Quality.

Productivity with quality is a philosophy of work that involves discipline and perseverance to achieve better results and sustain them over time. Nowadays, a company isn´t productive and competitive if it doesn´t engage with quality, production, lower costs, schedules, standards, efficiency, innovation, new working methods, technology, and many other concepts that improve everyday productivity and competitiveness. It´s more and more important in the short and medium term. Therefore, in every organization, productivity, competitiveness and quality are three concepts and processes that go hand in hand, forming a trio of keys intimately tied to succeed in an environment marked by globalization and the fierce competition at all levels. According to the latest sector information, the product efficiency and turnover, raises with about 3% till 7% when the management decides to implement a quality management system. Introducing Lean manufacturing even enlarges this figures 3 times.

Quality of printing products could be defined as the fulfilment of requirements established by the customer, regarding image elements, colorimetry, texts, size, format, functionality, finishing, etc, with different relevance depending on the kind of printed product. Quality problems have a direct impact on productivity and energy costs when a full or partial production must be repeated, when printing machines must be stopped and started or when additional control process must be implemented.

Control of printing quality is a tool for increasing the energy efficiency of the printing SMEs, understood as the production of printed material versus energy consumed. This will be possible through the combination of validated printing processes, optimal machinery, well-maintained equipment and implementation of proper control processes. We can say that *"The better the technical processes, machinery status and control processes; the fewer mistakes and the better the Energy Efficiency"*

6.4 Overcoming financial barriers in energy efficiency projects

Why are so many energy efficiency projects not implemented even when it makes sense to do? ESCOs could be a useful way to boost energy efficiency projects. And savings should be monitored to assure that the projects are actually profitable.

The *"energy-efficiency gap"* has been discussed by researchers, engineers and economist among other professionals along the last thirty years: Why are so many energy-efficiency projects not implemented even when it makes sense to do it, based on the cost-benefit analysis? Dozens of papers have studied the problem and have also identified possible explanations for this energy-efficiency paradox. These barriers can be classified as market failures, behavioural effects and model defects, and there are also variations between different decision makers (users, home owners, business managers).

Nevertheless, this quideline is going to focus on the topics mentioned below, that surely could be included in the rationale of most of the companies that are considering an energy-efficiency project.

- Access to finance
- Energy-efficiency projects' ROI under company's "hurdle rate"
- High perceived risk due to limited expertise on energy-efficiency projects
- Lack of knowledge or misinformation

ESCO model as a solution to the energy-efficiency gap

Briefly, an Energy Services Company (ESCO) designs, builds, finances and maintains an energy-efficiency project. An ESCO assumes technical and economic risks, and links its profits to the savings generated by the project.

Contracting an ESCO is a useful way to overcome the barriers previously mentioned:

- The ESCO finances the energy-efficiency project, therefore the company's financial statements does not assume the investment,
- The ESCO invests in its core business and, probably, the opportunity interest rate used to analyze the investment is aligned with the energy-efficiency project's ROI,
- The ESCO is an expert in energy-efficiency projects and measures properly the risks of the investment,
- The ESCO is focused on giving advice to the company about the project in order to assure a win-win business relationship.

The need of Measurement and Verification (M&V)

Once an energy-efficiency project is conducted, either through an ESCO, using own funds or bank loans, the result in terms of savings should be monitored to assure that the project is actually profitable. There are internationally approved methodologies, such as IPMVP, that lead to calculate properly the savings.

A third party consultant is useful to develop the M&V (Management & Verification) plan and to mediate between the company and the ESCO in case of dispute.

Finally, if the energy-efficiency project is funded through a loan, a M&V plan could decrease the risk valuation and consequently, may facilitate the granting of the loan by the bank.

7 IMPLEMENTATION OF ADAPTED ENERGY MANAGEMENT SYSTEM (ENMS) IN PRACTICE

If you look at the implementation of the Energy Management System (EnMS), you can do this from different perspectives. One point of view is from the EMSPI project, have the objectives been met? On the other hand, from the stakeholders: participating companies and other stakeholders like national organizations. Below we discuss the different points of view.

7.1 The EMSPI project

The EMSPI project had clear goals regarding implementing the Energy Management System (EnMS). They were:

- 100 SMEs with a fulfilled energy management system according to EN 16001 and/or ISO 50001 and potentials on energy efficiency improvement.
- 40000 GJ, 880 ton CO2 and 915.000 € of potential savings during the project lifetime
- Awareness of 300 SMEs per country on energy efficiency and energy management and how to use tools and project materials within the industry in each country, through direct and indirect dissemination activities.

In the longer run, the project create a “critical mass” or multiplier effect at industry level in order to expand the developed set of tools and specific communication materials.

Activities in the implementation process

The implementation took place step-by-step by selecting the companies in each country. In all countries workshops were organized for the SMEs and sector organizations to build knowledge and create awareness within the industry. In some countries, such as The Netherlands the intrest in the workshops was very high and in other countries like Germany the attention was much lower. In that cases, the workshops were combined with a company visit. After the workshops and selection process of the company, the company committed itself to the project. After this formal statement the implementation of the EnMS started in the company. The companies’ energy manager was assisted by project-consultants. The managers were trained in two workshops. Coaching material for Energy Management implementation was developed and used. At least two company visits were executed. The necessary measurements and collecting of data at the start of the implementation was done. During several months or longer (if necessary) the EnMS was implemented. At the end, before the closure of the project, the end measurements and collecting of data in every company were made. By comparing the results of the first and last data we gathered the information of the improvements made in the EMSPI project. The implementation of the EnMS had has given the paricipating companies many advantages like: improvements, savings etc.

An adapted Energy Management System for the printing industry will be implemented in 100 SMEs with the help of consultants and the energy manager of each company to enhance the awareness of industrial associations and SMEs in the European Printing Industry.

ClimateCalc, the eTool designed to provide exact information on the climate impact of the individual graphic product in a life cycle perspective. The participating companies could use the eTool for free during the implementation phase in the project. During the measurements the data is collected en used to calculate the end results on CO2 reduction.

What were the results of the implementation within the project?

The adapted Energy Management System for the printing industry based on ISO 51001 has been implemented in 100 SMEs including execution of workshops etc.. 16 Companies have implemented the Basic version. They implement only the part of the standard (a ceiling of 25% to the 100 SMEs target is set to allow for these companies not able to implement the full standard to participate). 84 companies implemented the Full version of the EnMS with a fulfilled energy management system according to EN 16001 and/or ISO 50001.

In the EMSPI project the achieved results are for the period 2013- 2017 are:

- Energy consumption reduction of 127,000 GJ (14% reduction in 2017 compared to 2013)
- Reduction of 13,300 ton of CO2 (12% reduction of emissions).
- Energy cost savings of 2,140,000 € (12% reduction of costs)

Awareness of at least 300 SMEs per country (total 1500) on energy efficiency and energy management is created through direct (personal contact, workshop activities, information activities etc.) and indirect dissemination activities (newsletters, articles on websites in the press etc.). During the project all the researches, reports and other deliverables have been carried out/delivered and published on the project website: www.emspi.eu. There is an open access guaranteed during the next years to the website so al the material can be downloaded in PDF. Several parties have shown interest to continue the process of implementation in view of the encouraging results.

Experiences in developing the EnMS

After a period of 0,5 till 1 year enough relevant work experience was collected about the EnMS, to find relevant improvements. The translation of the quit technical orientated ISO 50001:2011 standard created some problems. The main question was to find the right balance between the ‘clean’ translation of the standard and the practical usefulness of the materials in the practice of the industry. Based on the wide experience of the researchers in the printing industry we were well known about the fact that blue print materials (i.e. the standard EnMS manual) should be practical, easy to understand and easy to implement. Otherwise the barrier to start with the implementation would be too high for entrepreneurs and their employees.

8 VALIDATION OF THE ENMS AND OTHER DEVELOPED MATERIALS

In the EMSPI project a specific phase is defined in order to validate the intermediate and final outputs, outcomes and impacts of the project. Feedback loops with the target actors outside the consortium were introduced to evaluate and strengthen the activities in the project to ensure an external quality review of the guidelines, manuals and spread sheet before their implementation.

8.1 External quality peer-review on developed Diagnosis/ Parameterisation (energy indicators) and Guidelines.

According to the national stakeholders and SMEs, the diagnosis of the situation regarding energy management and efficiency are very useful. The defined parameters are very suitable for the sector. Furthermore, these parameters are also used in the ISO-accredited ClimateCalc calculation methodology (a well-known carbon footprint accounting system).

Regarding the guidelines all in all the project output was rated rather positive. But there are still great potentials in the field of **Strategy and Green marketing**. Companies who focus on this field may create a huge and positive impact for themselves and face a bright future.

Almost all the entrepreneurs are at the moment positive about the content of the **Quality control** paper. They understand that one can define two kinds of quality control:

1. General quality management of the organization
2. Quality level of the produces physical product.

They realize that improving their quality, also means that they will produce according to the philosophy: “do everything one time right”. This saves costs, production time and energy.

Participating companies and stakeholders have acquired a higher amount of awareness in terms of **financial aspects and ESCO’s** during the process of implementation. That increase has to do with the ESCO guideline developed in the project.

8.2 Validation of the EnMS and implementation

8.2.1 The Target group: SMEs

During the implementation phase in the EMSPI project national differences in the awareness level of entrepreneurs and their requests how the Energy Management System (EnMS) should be implemented in their own company were indentified. All the implementations were supported with the knowledge of external project consultants. They could evaluate on the spot the implementation process in the company. The following differences were detected:

- Companies participated who were well known with the other ISO standards, i.e. ISO 9001, quality management and ISO 14001, environmental management. For these companies – especially the ones who implemented environmental management – the implementation of ISO 50001 was a logical next step;

Validation is the process that investigates whether the developed methods, materials and structures, etc., meet the expected standards of the target group, entrepreneurs and energy managers of SMEs and sector organizations.

- We located companies who were even actively stimulated by their most important stakeholders: their client, to start with sustainability improvement actions, i.e. ISO 50001;
- Companies participated located in countries where the government is stimulating SMEs to start with energy improvements, by changing their national law and/or intensifying their control programs;
- Some governments even provide tax deductions, when companies are doing well in energy management;
- And of course we have SMEs located in countries where there is no or almost no stimulus from the local governments or clients.

In any case the SMEs had to start with the implementation of the adapted EnMS. One can conclude that not in all cases the SMEs were all that successful in the implementation of EnMS. The EU had foreseen this situation by allowing the consortium to create two kinds of implementation programs:

1. The EnMS FULL version: the complete implementation of the ISO 50001 in at least 75 companies (and if possible 15 per country);
2. The EnMS BASIC version, a simplified version of the ISO 50001, were companies only have to search for their energy improvement measures and an Action Plan to implement them in the (near) future. 25% of the 100 participating companies could make use of this simplified ISO 50001-system.

As said before, after implementing several management systems, and after the discussions with the energy managers of the SMEs - FULL and BASIC – some improvements were found. One of the comments was the fact that the system could be more user friendly in order to be implemented by the companies by their own effort. The registries were separated excel documents developed as control documents for setting goals, writing records of implementations undertaken, and proposing improvements. Available in the basic version and the full version of the EnMS. The aim is to achieve a much efficient and sustainable format for measuring potential energy efficiency improvements and the follow up of energy efficiency and consumption performance. The EnMS adapted standard developed is therefore be assessed in terms of suitability to the actual reality of the printing industry. The main stakeholders are of course the SMEs. During the contacts with the SMEs during the workshops, company visits and the validation period (in the project a validation was foreseen) there was enough information collected to improve the EnMS adapted manual standard.

The **overall satisfaction of the participating companies** was mediate to high (differs per country and per item: Guidelines, implementation EnMS etc.). The focus on the evaluation was:

- the EMSPI blue print materials,
- the specific guidelines development,
- the implementation of EnMS.

The appreciation of the materials, tools, knowledge, implementation, assistance was different per country. In the project a scale of 1 to 5 was used. 1 means not satisfied at all and 5 means very satisfied. The scores varied mostly between 3 and 5. Detailed information on the results you can find on the website under: Validation.

Creation of awareness in the companies

To get a general overview of the awareness level of SMEs per country about the relationship between EnMS and other management topics (Guidelines), a self-Assessment tool (www.selfassesment.eu/emspi/) was created by Dienstencentrum with 15 general orientated questions about all the management issues of energy management. Find under here a screen shot:

Figure 15: Screen shot Self-assessment tool

The results of this tool provides a clear viewpoint on the level of integration of energy management in the present organisation level of the SMEs. The conclusions can be reached by analogise the results from the first stage (0-assessment or Baseline-assessment) with the final results of the last measurements. This internet application contains 15 specific multiple choice questions about EnMS and the other management topic. Due to the fact that all the questions are divided over the 5 topics, the tool will provide the respondent a specific figure per category and an over-all figure at the end of this assessment. The respondent also gets an general advise how to increase his/her score in the future.

Results of the awareness on energy efficiency and management

Results of the **Czech Republic** gives an increase of the energy management awareness within the group of SMEs: from 3.8 (BASELINE value) to 6.1 (FINAL measurement with an increase of more than 60%).

Results of **Denmark:** there has been a significant increase in the energy management activities in the companies as well as an increase in the awareness of the benefits of working with management systems at the strategic level of the companies. During the project period most of the companies has experienced that the energy efficiency activities can be the step stone for other strategic initiatives in relation to marketing, environmental and quality management.

In **Germany** the overall impact is very positive. It becomes clear by comparing the final score (average). It went up from 42 out of 100 to 64 out of 100. But nevertheless there are still plenty of hidden potentials in the companies. Especially in the categories “Strategy and Green Marketing” and “Awareness in Energy Management” a lot of work still has to be done.

Based on the collected results for **Spain** we can generate the following conclusions: An important increase in the results of the Self-Assessment has taken place in every aspect in Spain: (1) Energy Management, (2) Strategy and green marketing, (3) Environmental indicators, (4) Financial Aspects and (6) Quality control. The level of awareness has increased a total of 2.207 points based on data from the 2nd quarter. This increase reflects an average final score 22 points above data from the 2nd quarter of last year.

Results for **the Netherlands** we can generate the following conclusions: it shows a clear increase of the energy management awareness within the group of SMEs. The content and approach of the EMSPI project in The Netherlands created an increase in the awareness in energy management: from a 4.5 (BASELINE value) to a 7.1 (FINAL measurement with an increase of the awareness of 53%).

8.2.2 National organizations

In this target group different stakeholders were presented such as: national and international employers organizations, certifications bodies, industrial energy experts, universities, European graphic media network (EGIN).

The national stakeholders are mostly pleased with the final outcomes of the Energy Management System (Basic and Full Version). They propose to find new ways to digitalize the content in smarter applications, or make the system more user friendly. This will reduce the amount of work and increase the understanding of the system by SMEs. Another advise it to simplify the content even more, to make ISO 50001 or a simplified version of it. For that purpose, the basic version of the system was developed, specially focused in the “PLAN” and “DO” phases of the Deming Cycle, which include the energy planning, implementation and operation tasks. The development of a basic system targeted the small companies or companies with few resources for energy management is very good.

The full system seems to be comprehensive for most companies. The creation of a basic system is emphasized as a positive initiative. Another remark from stakeholders is that the EnMS seem to be very comprehensive, but It could probably be difficult for companies to use the materials without the help of external consultants. It would be useful to include examples and guiding text in the materials. However, for stakeholders it seems like that the materials covers all aspects of the energy management system, or even more than required. In most of the aspects of the Energy Management System, feedback from stakeholders varies depending on the nationality of the SMEs, mainly as a result of the previous knowledge on Energy Management, but a generalized feedback is that the system should be even more practical and user friendly in order to be implemented by the companies on their own. Also the wish seemed to exist to achieve a much efficient and sustainable format of the registries for measuring potential energy efficiency improvements and the follow up of energy efficiency and consumption performance. As the registries are the main documents to be managed and updated by the participating companies during the entire process, a new layout for its completion is presented, which makes it more simple as all the registries are managed in the same document.

9 CONCLUSIONS AND RECOMMENDATIONS

Energy management and energy efficiency are important issues for the printing industry and the SMEs in Europe. On the one hand to meet the environmental objectives as formulated at international, European and national level, on the other hand to reduce energy costs, to ensure a green image of the company and industry and to contribute socially to the preservation of our environment.

The EMSPI project shows that energy management pays off with the help of the adaptation of an Energy Management System (EnMS). The 100 companies that have participated in the project have a short term benefit and are looking forward to long-term benefits. Also at sector level nationally as well as internationally, work with energy management in a structured way can bring good results and help achieve goals. Using a managements system like the EnMS is:

- good of your organization: using a Management System ensures you so have a quality-based approach to your entire business operation. As ISO states: “For business, (ISO) standards are strategic tools that reduce costs by minimizing waste and errors and increasing productivity.” The standard tells you “WHAT” is important. Your organization needs to determine “HOW” best to implement the standard requirements for your company. This can be relatively simple for a smaller, or start-up operation, but complex for a multi-site, international corporation. Lean tools and techniques as developed in the EMSPI project can help the company implement systems/processes as efficiently as possible.
- an entry to new markets. Many European firms will not do business with a company (as their supplier) unless you have an ISO certification. With this certification, you can also gain access to additional customers. It can be a marketing tool even for customers that do not require a certification from their suppliers. Certifications are not always necessary. Having an EMS is also valuable. A company with an EMS proves that the company is an efficiency driven organization, self-disciplining, continually improving, driving down costs, etc. When push comes to shove, that may be a deciding factor in their purchasing decision.

As a company working on a project as the introduction of an EnMS can provide more involvement and motivation from the employees. Ideas of the work floor often proves valuable in contributing to savings. Having and working on a common goal helps companies make them open for change, which is one of the building blocks of innovation.

Lessons learned during the EMSPI project are the fact that per country the government rules are different and that in one country there can be a great interest in companies, while in another country it can take a lot of effort to interest SMEs. The connection with the industry, sector organizations and SMEs is of great importance. Direct communication in the language of the SMEs is necessary. One should bear in mind that if companies give a slight response to the topic of energy efficiency, considerable time and effort is needed to distribute the information that convinces companies that they will benefit from energy efficiency. Energy efficiency is a hidden topic in business management.

The work within the EMSPI project has led to the successful implementation of energy management systems in 100 printing companies in five countries (Denmark, Germany, Netherlands, Czech Republic and Spain).

Also training of the energy managers of the companies and consulting on the background available has proved very successful. Commitment and motivation are important key words. The project shows that an organization always requires a number of drivers and that the management of the organization must take the lead.
The developed material, training material, the material of the EnMS had to be practical and adjusted to the sector and to the needs of the SMEs in the sector will successful implementation be possible. During the project the contact with the SMEs and other stakeholders was very valuable. Materials were adjusted to meet the standards of the companies and the sector.

Not all the recommendations could be followed in this project. For example, the recommendation to digitalize the content of the EnMS in smarter applications could not be achieved within this project. This could be a challenge for the future.

The EMSPI project proved that SMEs can implement an Energy Management System in a calculable timespan with the help of an adapted EMS (the EnMS), training and support of consultants. The implementation brought significant savings, in some areas more than expected. SMEs enjoy great benefits when they start with energy efficiency. So go to the website, download the material needed to get started and get started! Visit www.emspi.eu.

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