

Energy Management and Benchmarking in Small and Medium Enterprises

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ABSTRACT

It is well known that many companies are reluctant to focus on energy management or to invest in energy efficiency measures. Nevertheless, there are many good examples that prove that the right approach to enhance energy efficiency can very well be combined with the priorities of companies. Especially small and medium enterprises (SMEs) can benefit from an international facilitated approach because normally they have a lack of resources and time to look for these best practices which are relevant for their sector.

In a pilot project 65 SMEs from 11 European countries of the food & drink industries successfully tested a package of interactive instruments which offers this approach. The package consists amongst others of a user-friendly web based E-learning scheme for implementing energy management and benchmarking. Several practical tools to support the cycle of continuous improvement of energy efficiency in the company have been tested such as checklists, sector specific measure lists, templates for auditing and energy conservation plans.

An important feature and trigger for companies is the possibility for SMEs to benchmark anonymously their energy situation against others of the same sector. SMEs can participate in a unique web based benchmarking system to interactively benchmark in a way which fully guarantees confidentiality and safety. Follow up activities for a further international outreach to expand the number of participating SMEs of various sectors have been started.

Introduction

Implementing “traditional” technological solutions can decrease energy consumption, but successful implementation of energy efficiency in SMEs however does require a mix of technological and non-technological approaches (Intersee, 1998) and (Helgerud and Mydske, 1999).

In all the energy management activities that are carried out by public or private organizations, either at the level of associations, municipal, regional or national level, the requirements for target setting, monitoring of performance and results are becoming increasingly important. The classic “If you can’t measure it – don’t do it” is a management saying with a lot of sense. Energy monitoring and benchmarking are in fact critical success factors to all other activities that are related to energy efficiency measures. SMEs in particular are reluctant to focus on energy management or to invest in energy efficiency measures. In this respect in SMEs there are still many opportunities for improvement and there are many good examples that prove that the right approach to invest in energy efficiency can very well be combined with the priorities of companies like cost effectiveness and product quality.

Today, although SMEs are responsible for a large part of the globally energy use, most information and tools relevant to realize energy-efficiency in SMEs, are scattered. Fewer resources are needed when all relevant information and tools that have shown good practice are available for immediate use. If on top the benefits for the individual SME are directly visible

then implementation of energy management systems in SMEs and thus the allocation of resources to improve energy performance will be assured.

Therefore the project “Benchmarking and Energy Management Schemes in SMEs”(BESS) was started in January 2005 focusing especially on SMEs so they can benefit from a European facilitated approach and minimize the resources and time to look for these best practices which are relevant for their sector. Though the BESS project aims at all industrial sectors the food and drink industry was chosen for the pilot phase. This leading industrial sector consists mainly of SMEs. This sector has a very positive and pro-active attitude towards improving environmental issues and is well organized on the international level. Their European Confederation of Food and Drink Industries of the EU (CIAA) has cooperated with the BESS project from the very beginning.

An important trigger for companies to assess energy efficiency improvement possibilities is the availability to compare their own energy efficiency with as many similar companies from the sector as possible. It is important however to overcome the barriers experienced in previous benchmarking schemes (EBPI 2003). BESS, described in this paper shows that this is possible.

Goals, Activities and the Organization of the Project

The primary project objective was to develop and promote the widespread application of benchmarking and energy management in order to improve energy efficiency in industrial SMEs, with particular focus on the food and drink industry. Participants from 11 European countries a broad base for the project and insure access to specific knowledge of energy management issues.

A further objective is the development of a sustainable approach to the application of innovative solutions, thereby insuring the continued relevance of energy efficiency and energy management to SMEs. This, with a view to the improved competitiveness of European industry on the world market, by way of reduced production costs, reduced energy intensity and a measurable contribution to Kyoto commitments.

To achieve the project objectives the project focused on the development of an interactive tool promoting a systematic and persistent approach to energy management and benchmarking.

The tool consists of an energy management implementation model and standards for adoption of energy management measures covering a selection of appropriate measures, implementation and day-to-day management, an E-learning scheme and a monitoring and benchmarking system for the food & drink industry.

The project was carried out by a European consortium of energy agencies/institutions in cooperation with national and international SMEs and sector associations and others. It contained a pre-study to choose the best practices in energy management and benchmarking and the development the interrelated package of pilot tools. In 11 pilot countries the tools were tested in 60 SMEs including a comparative analysis of energy monitoring and anonymous benchmarking and a targeted dissemination of results with support from the food & drink associations.

In every participating country the consortium established a National Pilot Co-ordination Group which consists of the national representative from the consortium, a national industrial association from the selected sector, representatives from the participating companies and a consultant (if needed). Each pilot is acting as data collection point and as testing environment.

The Tools Developed in the Project

Preparations for developing the tools resulted in a report on a pre-study on the definition of the main challenges and the roll out of best practices” and in detailed reports on Energy management, Benchmarking, web based E-learning and on the concept of the interrelated package of instruments for the pilot. The interrelation and the summing up of the instruments can be found in figure 1 and table 1.

Figure 1. The Interrelation of the Package of BESS Tools and Instruments

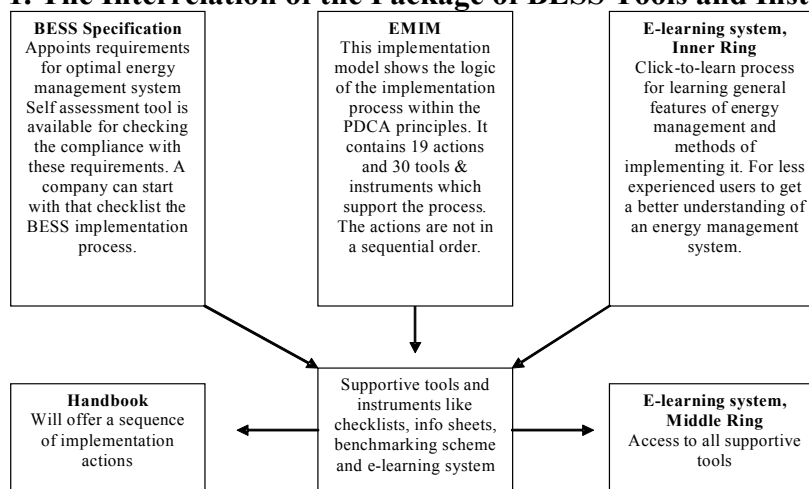


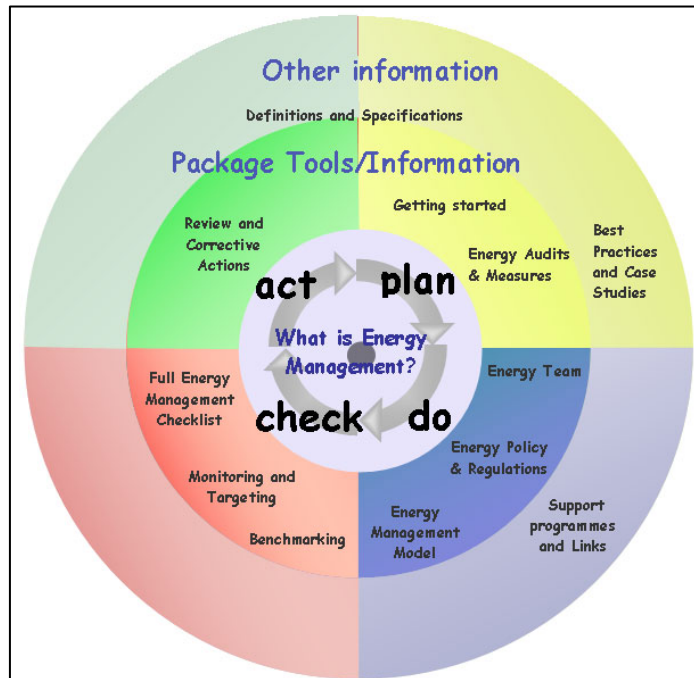
Table 1. Overview of BESS Tools

nr	Tool		Tool
0	EMIM	16	Introduction to energy management implementation plan
1	Business Case (including sector fact sheets) – Meat processing, Bakeries, Dairies	17	Energy Management Checklist
2	Self assessment checklist	18	Set of indicators with M&T (explanation)
3	Commitment – example declaration of management	19	Benchmarking scheme incl. data collection templates
4	Energy audit sample + description procedures	20	Benchmarking scheme - final version
5	Energy audit data collection sheet	21	Sector specific measures lists for new sectors
6	Horizontal measure list	22	E-learning system phase 1 (bulls eye + part middle ring)
7	Sector specific measure lists	23	E-learning system phase 2 (inner ring)
8	Links to existing national measure lists	24	E-learning system phase 3 (middle ring + outer ring)
9	Info sheet legislative & regulative framework	25	Energy management handbook draft
10	Template for elaborating action plan (ECP)	26	Energy management handbook final
11	TRA matrix: roles, responsibilities, authority	26	National programs & international projects
12	Template for organizing energy management team (incl. Energy coordinator)	28	Ready to hand guidelines for policy makers
13	Examples of energy policies	29	Set of definitions
14	Best practices and case studies	30	Specification, definitions and linking lists)
15	Description of good housekeeping measures	31	Review and corrective Actions

The Project Website and the E-Learning Scheme

The project multi lingual website has been launched on www.bess-project.info. It contains general information about the project including downloads (e.g. project reports), news and “links” section, the E-learning scheme and a link to the interactive benchmarking scheme. Consortium members and some stakeholders are facilitated by a consortium area, an interface to an E-learning scheme from which all tools are available to the SMEs participating in the project.

Figure 2. The BESS E-Learning “Dartboard” Navigation Structure



This interface which has been developed looks like a dartboard (based on the SenterNovem interactive E-learning system for implementation of energy management for Dutch LTA companies). In the dartboard structure the BESS E-learning scheme contains the following features which are accessible via a multi-language navigation structure:

- Informative text (“bull’s eye”) – a section containing general and some detailed information on energy management and its implementation.
- An easy-to-follow, step-by-step approach for learning about the general features of energy management and methods of implementing it (PLAN DO CHECK ACT buttons of the inner ring). The features and information contained in the informative text section are also available within this section. It is structured along the lines of the EMIM.
- Tools and other information (outer rings) – this section contains interactive tools and other informative texts for those users that have decided on implementing energy management systems and need additional tools and information (i.e. measure lists, information of energy audit procedures, checklists, best practices, etc.)

- Links to sites for additional information (outer rings) – this section contains links to other web sites that contain additional information (i.e. Legislation and supporting program)

Implementing Energy Management

The implementation of an EM system ensures that a company continually passes through the cycle of making energy policy, planning energy efficiency actions, implementing those and checking the results, on the basis of which new policy is made.

Within the BESS approach it starts with the preparation of business case, execution of self-assessment and project implementation plan). It continues with energy policy definition and setting up the team and appointing the coordinator (energy manager). The energy audit is executed together with definition of legislative framework.

Based on findings from previous phases, an action plan is prepared, defining roles and responsibilities. There are tools for energy accounting, measures lists and other tools, an action plan is to be implemented in the next stage, together with procedures for operation and maintenance (e.g. from measure lists).

A set of indicators (e.g. specific energy consumption: SEC) and benchmarking has to be developed to monitor the process and performance. Finally, the energy management is checked through a set of questions in the Energy Management Checklist. Based on regular review, modifications are to be explored and performed.

In the table below the major actions within the BESS energy management implementation model (EMIM) are listed. Each action is subordinated to one of the nine main energy management implementation steps. Though there is no fixed schedule the numbers 1 to 9 describe a possible time sequence for implementing energy management for the first time.

Table 2. Summary of the BESS Energy Management Implementation Model (EMIM)

	PLAN	PLAN	DO	DO	CHECK	ACT
START	A. UNDERSTAND	B. PLAN	C. COMMIT	D. IMPLEMENT	E. EVALUATE	F. REVIEW
Business Case	Energy Audit	Energy Action Plan	Energy Coordinator	Implement the Action Plan	Indicators	Revision
1	4	5	2	6	7	9
Pre-Self assessment	Analysis tools	Roles & responsibilities	Energy team	Operation and maintenance	Monitoring & targeting	Improve
1	4	1+5	2	6	7	9
EM Implementation Plan	Legislative & Regulatory Framework		Energy policy		Benchmarking	
1	4		3		8	
Definitions Specifications					Energy Manag. Checklist	

A - F represent the (yearly) cycle of continuous improvement after implementation.

To create a common understanding a set of definitions for basic terms of energy management within BESS and the BESS Energy Management Specification have been elaborated. The requirements of the specification are based on the ISO 14001 environmental management standard (Plan - Do - Check - Act). Companies can decide which requirements to include in their energy management system according to their needs and characteristics.

The requirements consist of all items which are necessary to comply with when a company wishes to have a good quality energy management system and of some additional desirable requirements for a full (certifiable) system. The BESS Specification is harmonized with the existing European national standards and specifications on energy management. Currently a European CEN standard on energy management is under development (CEN/CLC TF189, 2007).

The BESS Linking List is a tool which shows how the BESS energy management (EM) specification matches with existing ISO management standards and the HACCP specification (Hazard Analysis and Critical Control Points), which is applicable to the food and drink industry.

The ambition to check & improve the quality level of the energy management system at regular intervals is an essential part of the system itself and is facilitated by an excel based BESS Energy Management Checklist. The 26 question checklist with 2 priority levels is based on an existing energy management checklist and is used by more than 1000 SMEs in the Netherlands.

A company starting to implement energy management has several BESS “getting started” tools available. Filling out the business case and the pre-self assessment checklist (a 7 key question version of the BESS EM Checklist) are the first tasks, which result in an overview of essential basic company data and indicators and identification of other influences defining the company decisions. These can be used to present the top management the importance of energy management. To facilitate elaborating this business case, sector fact sheets are included.

A template of company commitment is used to facilitate getting company commitment to implement the energy policy which is essential for long term success. The highest level of the organization (for example, a board member or the managing director), who’s signature on the company commitment will demonstrate the importance of the program. Support of highest level personnel will assist the managers who will be actively involved in implementing the strategy.

The description of the roles and responsibilities and the template for organizing an energy management team shows the first steps of how to organize the staff who will work on the energy management. The TRA matrix is a list of tasks, responsibilities and authority to clearly identify which individuals in the organization are directly and indirectly involved with energy. The template deals amongst others with the key functions and selection of an energy coordinator and the energy management implementation team.

The introduction to a energy management implementation project plan aims at facilitating the documentation of the implementation activities of a company which is in fact a separate project during the steps taken to implement the energy management system in the company. It documents the planning and the consequences of all activities mentioned in the Energy Management Implementation Model and thereby shows the way for a successful planning and running of the energy management implementation process.

After the stage of getting started relevant key questions for companies which want to implemented an energy management system are: “What is the organization’s position on energy management?” and “what is the relationship between energy management and daily operations?”

A clear vision defined in an energy policy statement signed by management supplies the proper framework for energy management. BESS provides an introduction to this aspect and an example of an (internal) energy management policy declaration of the company. One of the elements is that the organization satisfies all relevant laws, regulations and other subscribed requirements. Therefore BESS provides an Explanatory note on Legislation and Regulations.

Another important activity of the energy management cycle is to execute/update an energy audit. The energy audit description and the energy audit data collection sheet facilitate the company which starts with auditing activities. The description explains the work to be done,

different types of audits and the expected results. The audit assesses the total energy consumption of the company, determines the specific energy consumptions in relation with appropriate parameters and identifies the energy conservation potential and the energy saving opportunities. It helps management to realize the importance of energy, to detail the energy policy and to set performance objectives and targets.

Other tools to support the conduction of an energy audit have been developed like a description of good housekeeping measures which require no or very low cost investments and measure lists which can be separated into two distinct categories: horizontal measure lists and industry-specific measure lists (in the pilot lists for dairy industry, for bakeries and for meat processing). These measure lists support decisions on implementing energy efficiency measures and on feasibility studies within the framework of an energy action plan. Measure lists offer the company descriptions and impacts on energy consumption of potential measures.

The results of the audit and the analysis of energy saving options have to be documented. The Energy Action Plan documents the commitment of the company to carry out current and future actions (for the duration of the plan e.g. the coming 4 or more years) for further steps to implement energy management and actions to be taken to increase energy efficiency of the company. The excel based template includes also an example table of content of an energy action plan and an Energy savings register. Thereby an overview is created of the current status of the planning and the implementation of the actions (measures and feasibility studies) so far.

After the PLAN and DO parts of the “Deming cycle” (continuous quality improvement model) follow the Check and ACT parts. Monitoring and Targeting (M&T) is an essential part of the company’s energy management system (the Check within the PDCA cycle). Besides regularly checking the actual level of implementation of the energy management information handling techniques can be used to manage the energy usage effectively within the company. BESS gives a description of these techniques of which benchmarking is an example facilitated by the project in particular. M&T should be developed in accordance with the organization’s existing production and financial management and information systems.

An Energy management system in place needs regular review to ensure the system is functioning properly and on a continuous basis. Possible improvements can be identified during these reviews with strong ambition to prepare a set of corrective activities in next steps of energy management cycle. BESS provides information how these Review and Corrective Actions should be carried out. The Review should assess the results of any audits or surveys conducted since the last Management Review and the current status of any recommendations, the key factors that influence energy consumption, the adequacy of resources for the continued operation of energy management, current and proposed regulatory compliance in relation to energy management etc.

To ensure that recommendations are taken into account, the Management Review must be documented and the energy team must agree follow-up actions and designate persons responsible for implementing the actions.

Benchmarking

Energy benchmarking focuses on a comparative analysis of energy use per unit of physical production, otherwise known as energy intensity or specific energy consumption. This energy intensity can then be compared to the "best practice". Examples of performance

indicators for monitoring and benchmarking on different levels are indicated in the table 3. In the pilot-phase of BESS-project the consortium focused on benchmarking at level 1.

Table 3. Different Levels of Energy Benchmarking

Level	Indicator	Unit
Level 1: Company	Total energy consumption/ton produced	kJ/ton
	Total electricity consumption/ton produced	kWh/ton
	Quality level on Energy Management Checklist	%
Level 2: Process/product	Process related energy/quantity produced	kJ/quantity
	Non-product depending energy use/square meter heated	kJ/m ²
Level 3: Equipment	Electricity for compressed air applications/ton produced	kWh/ton
	Energy for steam production/ton steam produced	kJ/ton

There also exist other institutions that offer energy benchmarking (Energetics/En Vita and Solomon Associates). One-2-Five® Energy of Energetics is a software package that helps the clients to assess their energy management practices, benchmark it against best practice, and develop a program for continuous improvement. Another is Solomon Associates who are offering benchmarking to hydrocarbon industries (refineries and chemical plants). Their benchmarking tools cover many areas of production, including energy, which is the largest expense at many of these plants. Solomon promotes its benchmarking tool as a source of information and as an incentive for process improvements. These supporting tools are mostly used by larger companies to exercise benchmarking. In the late nineties Energy benchmarking for energy intensive industries has also been taken up by governments to realize voluntary agreements with industry to improve their energy efficiency. The Dutch and Flanders Benchmarking covenants are examples these policy instruments (Energy Efficiency Benchmarking covenants in the Netherlands and Belgium).

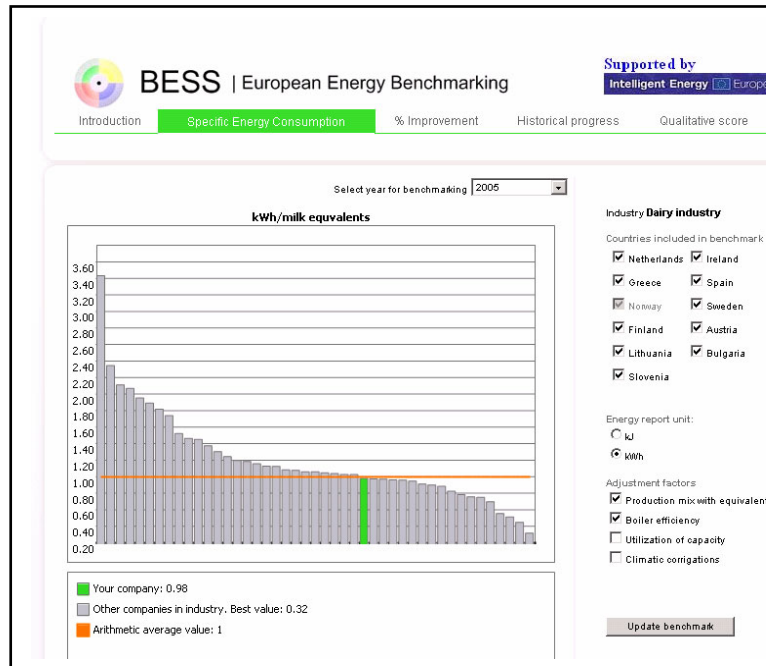
The BESS pilot web-based benchmark application however makes it possible to benchmark energy performance (specific energy consumption and the quality of the energy management system) against other (European) smaller and medium sized companies within the same industry sector/benchmark-class. The application is flexible regard establishment of new benchmark-classes and new indicators. This setup is done in the administration module by configuring benchmark-classes and how the indicators are calculated. The application has options for adjustment regard external factors like climate (heating), capacity utilization, production mix and boiler efficiency. The users of the international web benchmarking have the possibility to choose, whether or not to use adjustment factors.

In order to be able to do these adjustments, some additional data has to be reported. These data are optional, the companies do not have to report them, but it would be of great interest if as many as possible could report also these data, since the benchmarking will gain a lot in quality by that. A description of the adjustment factors can be downloaded from the BESS website. For the pilot companies a detailed description of the adjustment factors is available.

There are a number of different diagrams (see figure 3) showing the pilot company marked as green compared to the rest in the group marked in gray. This picture is an example of how it is presented on the web site (*Specific energy consumption for all companies in the selected industry sector, one diagram for each year*). On the right hand side there is a filter that sets different parameters to how each report is calculated. The filter is also present on each report and the parameter values selected by the user will be remembered when navigating to a new report. The filter contains 3 sets of parameters: Countries included in benchmark, Energy report unit, Adjustment factors.

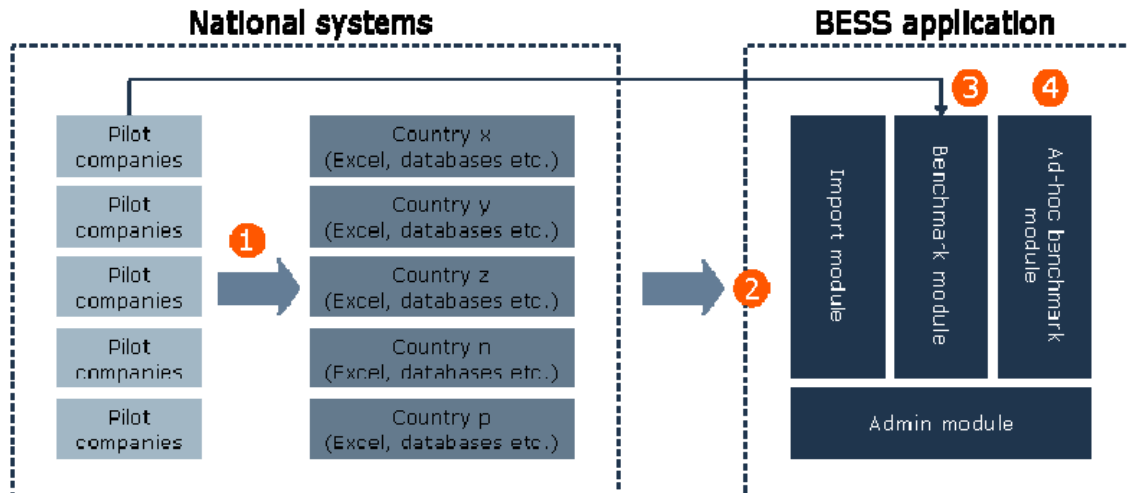
The web application is described in a document which can be accessed via the E-learning scheme by pilot companies and in a public version which can be downloaded from the BESS website. The first feed back from the pilot companies about the benchmarking modules is positive (user-friendly application with good presentation of the results).

Figure 3. Example of a BESS Benchmark Results (SEC of Dairy Companies)



The web-application system within the BESS project builds upon the Norwegian benchmarking system. The system has strong links to the E-learning module, and the benchmarking data-input was one of the E-learning activities during the pilot phase. It is designed to enable yearly benchmarking of energy data in Europe based on national data gathered by national systems. After the pilot companies have reported energy and production data to their national administrators, the data have been imported to the international benchmarking solution. Now the pilot companies are able to compare themselves with other European companies in the BESS benchmarking web site. The (pilot) company has to report its energy use once a year. For the pilot phase data from the last three years had to be reported. The illustration (figure 4) describes how pilot companies, national systems (for energy reporting) and the BESS web application interact.

Figure 4. Information Flow within the BESS Benchmarking System



1. Pilot companies report energy data into national systems
2. National systems quality assures registered data, and distributes it to BESS
3. Registered companies access BESS-application by their unique code and benchmark their own energy use with other companies
4. Non-registered users can anonymous use an ad-hoc benchmark module

The access to the BESS benchmarking application has several provisions to ensure access to correct data and to safeguard confidentiality of the data provided by the pilot companies. The pilot companies got the benchmarking data collection sheet from their national administrators, in which necessary information on energy and production figures is asked. The file also includes definitions and the classification of products. The list of products that has to be reported is designed for each industry sector. As far as possible, the products are defined by use of European standards like PRODCOM list¹, but some modifications have to be done. Even if the PRODCOM list consists of more than 5000 different products our pilot companies have products in their assortment that not are on the list. To specify products that not are on the list we have extend the code by letters. As an example we use the code 15.51.52.AA to specify sour milk products.

Via the E-learning scheme (dartboard in the project website) the users can get actual access to data entry sheets, additional information on adjustment factors and the actual web application itself. An important element in the benchmarking procedure is that the data submitted by the “registered” pilot companies are first validated and made anonymous by a unique code by the “national administrators” within the consortium before they are put by the international administrator (NEPAS)² in the system. While BESS registered project (pilot) companies can retrieve on-line their individualized benchmark results automatically and in a confidential way other companies and interested parties can take part in the BESS benchmarking as a temporary guest and look to the results of the benchmarking so far via the so called ad-hoc benchmarking module.

¹ List of PRODCOM products of the European COMMunity

² The BESS-partner, New Energy Performance AS (NEPAS), act as international administrator in the BESS-project.

The Pilot Results of BESS

The most crucial phase of the project was the actual participation of a limited number of SMEs in each of the 11 countries of the consortium members to test and to benefit from the tools developed in the project in a pilot situation. Most pilot companies which participated in the pilot are from the sectors chosen for benchmarking i.e. bakeries, dairies and meat processing companies. The pilot program plan contained several steps to be taken by the pilot SMEs to implement elements of the BESS “Energy Management Implementation Model”.

The national pilots had a certain freedom to deviate from the agreed sequence and to pay more or less time to the different steps taking the local circumstances into account though some steps were critical for the feed back on the tools.

The pilot has been finished in the spring 2007 with:

- energy management checks and benchmarking including 2006 figures
- the reporting/evaluation in order to adjust the tools and the publication of the handbook
- national and international dissemination activities and the formulation of guidelines and recommendations

Discussion & Conclusions

More than 50 companies in the food and drink industry, their associations and national governments gave feedback on tools developed within the BESS project with some significant results. The evaluated tools aimed to improve energy efficiency in SME companies by Benchmarking, Energy Management combined with E-learning indeed proved to be effective. Use of the tools results in energy savings and potential for profit growth: The BESS pilot company and country reports indicate that an increase of the profit from 3 up to 10% is feasible!

The lessons learned during this pilot project are of benefit for future projects in which companies are involved for testing tools that are not part of their core business.

Where associations were involved they were very helpful, even essential in communication with the candidate companies. Some countries organized, together with the associations, large scale meetings for the SMEs. In other countries companies have been contacted direct without involvement of associations. All methods worked well. Personal contact between the initiator/facilitator of energy efficiency activities and the companies remains the backbone of a (pilot) project, which in principle relies on information supplied by computer and the Internet. Especially at the introduction of the (BESS) tools, personal contact between the company, consultant and the National Pilot Coordinator is essential.

An important success factor for projects inside companies is commitment of the highest manager. Ideally during the first stage of the implementation, the energy representative and a higher manager should both be involved. Lack of time and insufficient human resources seem to be the toughest barriers for implementing energy management. Most of the pilot companies see external consultancy as a necessity for implementation. The consultants assisted the companies in understanding the concepts of energy management, performed energy audits and helped drawing up energy conservation plans.

Benchmarking is the main trigger for many companies to consider their energy management. We must exploit this knowledge in the reach out and the possible ex-BESS project by using this sequence: create awareness and interest via Benchmarking and then start

implementing energy management by the Plan Do Check Act cycle via E-learning. The pilot companies are predominantly positive about continuation of the benchmarking and E-learning scheme. The methodologies and tools that are embedded in the BESS Benchmarking scheme will also have a positive impact on the work that is necessary to follow up and monitor the implementation progress of new directives of the European Union.

Participating European member states want to give the BESS project a follow up on a national or European level. Follow up activities to expand the number of participating SMEs of various sectors is currently being discussed with other interested parties. The co-operation and interlinking with existing other complementary European and non-European initiatives and projects will create additional synergy and support. In this respect it has to be mentioned that in the follow up more attention has to be paid to show the business opportunities to the companies from the very beginning. The approach of the Canadian “Conference Board” explained in the article “Navigating Energy management: a Roadmap for Business” is an inspiring example (Bennet and Whiting 2005).

The project has shown that benchmarking across Europe is possible and that a group of interested parties can collaborate to achieve this. The project has developed a range of tools that are designed to encourage and facilitate pan-European energy benchmarking across a range of industry sectors and which should lead to improved energy efficiency, improved competitiveness and reduced environmental impact.

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