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**BESS - Benchmarking and Energy management Schemes in SMEs**

**Description of the  
BESS Web based monitoring and benchmarking**

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## BESS - Web based monitoring & benchmarking

A web-based tool for international benchmarking of key indicators for selected sectors within the European food and drink industry is developed. The tool which is currently tested by pilot companies from the dairy, bakery and meat industries within the BESS project builds upon the Norwegian benchmarking system. The benchmarking tool has strong links to the e-learning module, and the benchmarking data-input will be one e-learning activity during the pilot phase.

Energy Benchmarking is a tool which comprises the collection, analysis and reporting of data to provide an industrial company with a context for assessing its energy efficiency in comparison to others in the same sector. It provides data on how energy is currently used within a particular industrial sector, process or building type.

In addition to technical factors, benchmarking can be applied to energy management to evaluate how far a company has progressed in its efforts compared to other companies in their own sector and in different countries and an "ideal" energy management approach.

Energy Benchmarking has some features of energy monitoring because periodical benchmarking enables a company to follow its performance over time and, depending on the design of the benchmarking scheme (if also system specifications have been benchmarked), take informed corrective action. Energy benchmarking and monitoring allows your company to identify deficiencies and adopt better practices.

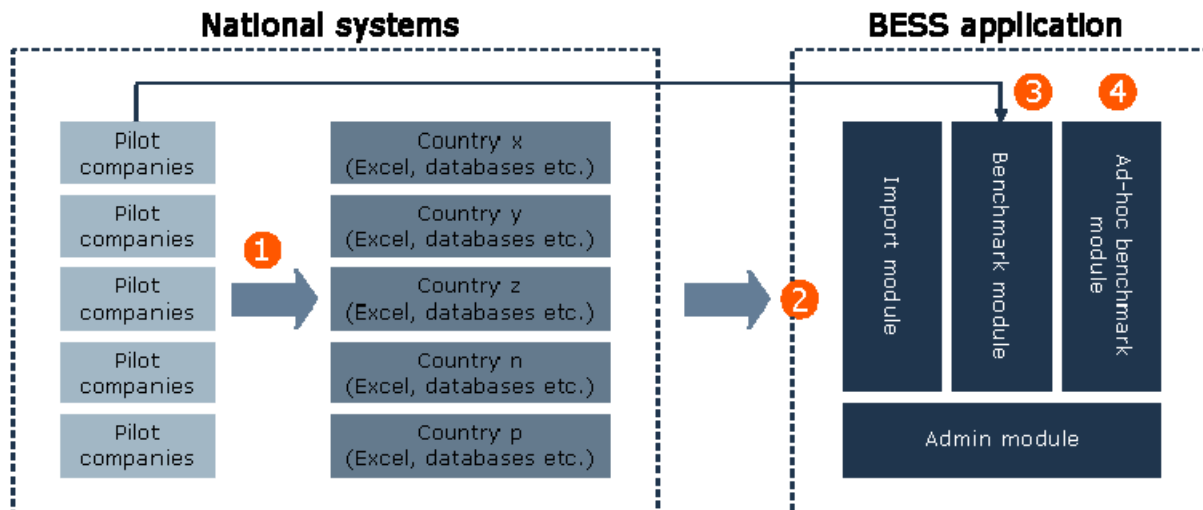
Energy benchmarking focuses on a comparative analysis of energy use per unit of physical production, otherwise known as energy intensity or specific energy consumption (SEC). This energy intensity can then be compared to the "best practice". Examples of performance indicators for monitoring and benchmarking on different levels are indicated in the table 1. In the pilot-phase of BESS-project we will start focusing on benchmarking at level 1.

*Table 1 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 metre heated	kJ/m <sup>2</sup>
Level 3: Equipment	Electricity for compressed air applications/ton produced	kJ/ton
	Energy for steam production/ton steam produced	kJ/kJ

The BESS pilot web-based benchmark application makes it possible to benchmark energy performance against other European pilot companies. In the first phase you will find data for participating pilot companies within the food and drink sector (dairies, meat industry and bakeries). The application is flexible regard establishment of new benchmark-classes and new indicators. The application has options for adjustment regard external factors like climate (heating and cooling), capacity utilization, production mix and boiler efficiency.

The web-application system is designed to enable yearly benchmarking of energy data in Europe based on national data gathered by national systems. The illustration below describes how pilot companies, national systems (for energy reporting) and the BESS web application will interact.



1. Pilot companies reports energy data in to national systems
2. National systems quality assures registered data and distributes it to BESS
3. Pilot companies access BESS-application and benchmark their own energy use with other companies in the same industry (BESS registered companies)
4. Non-registered users can 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 to be provided by the pilot companies.

## Input

The pilot companies will get an Excel sheet from their national administrators, were one A4 page contains all the energy and production figures they have to report. The file also includes definitions of the energy carriers used and the classification of products.

The pilot company will have to report their energy use once a year. The energy use shall be reported in to a report schema (excel sheet) distributed by the national administrator (by e-mail or downloaded from the e-learning module). When the schema is filled out it must be returned to the national administrator. The energy input data of the scheme is presented in table 2 and it is common for all industry sectors.

Into the same scheme, the pilot companies also have to report their production the last two years. 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 international standards like the PRODCOM list, but some modifications has do be done. As an example the production to be reported by the pilots in the dairy industry is presented in Table 4 and 5.

The application has options for four different kinds of adjustment; boiler efficiency, climate, production utilization and production mix. The users of the international web benchmarking have the possibility to choose, whether or not to use adjustment factors. A description of the methodology for the different adjustments is available at the web site.

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 such data, since the benchmarking will gain a lot in quality especially when those data represent substantial influences. The optional data to report are presented in table 6 For the pilot companies a detailed description of the adjustment factors is available.

*Table 2 Energy input*

ENERGY	Unit	2004	Boiler eff. (%)	2005	Boiler eff. (%)	Extra information
Electricity (firm power)						(Line 1 and 2 are total elec.-used)
Electricity used by el.boiler						
Light fuel oil						
Middle distillates						
Heavy fuel oils						
Natural gas						
LPG (Propane, butane)						
Coal						
Bio energy						
District heat etc.						
Other energy						Specify:

*Table 3 Definitions of energy sources*

<b>Energy source</b>	<b>Definitions</b>	<b>PRODCOM</b>
Electricity (firm power)	Electricity not used for heat/steam production in electricity boilers	40.11.00.00
Electricity used by el.boiler	Electricity used for heat/steam production in electricity boilers	40.11.60.00
Light fuel oil	Fuel oil with density 0.84 kg/litre	23.20.15.00
Middle distillates	Fuel oil with density 0.88 kg/litre	23.20.16.00
Heavy fuel oils	Fuel oil with density 0.98 kg/litre	23.20.17.00
Natural gas	Natural gas, liquefied or in gaseous state	40.22.10.00
LPG (Propane, butane)	Propane and butane, liquefied	23.20.20.00
Coal	Hard coal + Lignite	10.10.00.00.+ 10.20.00.00
Bio energy	Wood, saw dust, bark, straw etc	20.10.40.00
Heat	Steam and hot water supply services	40.30.10.00
Other energy	Energy not defined elsewhere (should be specified)	
Boiler efficiency	Average annual boiler efficiency (%)	

*Table 4 Input of production figures for the dairy industry*

<b>PRODUCTION</b>	<b>Unit</b>	<b>2004</b>	<b>2005</b>
Processed milk	litre		
Sweet milk products	litre		
Sour milk products	litre		
Cup products	litre		
Hard cheese	kg		
Brown cheese	kg		
Other cheeses	kg		
Casein	kg		
Dried products	kg		
Butter /butter oil	kg		
Preserves	kg		
Supplemental milk delivered	litre		
Juice	litre		

*Table 5 Definition of dairy products*

PRODCOM	PRODUCTION	Unit	Definition
01.21.2 + 01.22.2	Processed milk	litre	Raw milk from bovine cattle, sheep and goats
15.51.10.00	Sweet milk products	litre	Processed liquid milk and cream, not concentrated
15.51.52.AA	Sour milk products	litre	Yoghurt and other fermented or acidified milk or cream (if in cups, reported as "cup products" instead of as "sour milk")
15.51.52.BB	Cup products	litre	Products delivered in cups (should not be included elsewhere!)
15.51.40.50	Hard cheese	kg	Hard cheese, matured
15.51.40.30	Brown cheese	kg	Brown whey cheese
15.51.40.00	Other cheeses	kg	Other cheese than matured hard cheese and brown cheese
15.51.53.00	Casein	kg	Casein
15.51.20.00	Dried products	kg	Dried milk, whey etc, delivered as powder
15.51.30.00	Butter /butter oil	kg	Butter and dairy spreads
15.51.51.00	Preserves	kg	Milk and cream, concentrated, other than in solid forms
15.51.00.SS	Supplemental milk delivered	litre	Milk delivered to other dairies without other processing than chilling
15.32.00.00	Juice	litre	Fruit and vegetable juices

*Table 6 Optional input needed in order to adjust for differences*

Other information	Unit	2004	2005
Capacity utilization	%		
Basic energy consumption	%		
Heating degree days			
Heating dependent share	%		

The heating degree-days of a year are obtained by subtracting the average temperature of a day by the “base temperature” and accumulate this for all the days during the year. In this project we use 18°C as the “base temperature”. Cooling degree-days can be calculated in a similar way, but there is no officially designed base temperature and CDD are not implemented within the BESS-application.

Specific energy consumption often increases when the production capacity isn’t fully used because of basic energy consumption are being spread over less units of production than at full production rate. The objective to adjust for reduced production capacity utilization is to separate the effect of a production rate change from other variables and energy efficiency changes. Adjustment should only be used for external factors (beyond the influence of the company itself).

When adjusting for capacity utilization, the basic energy consumption is reduced in the case of lower production utilization to match the share of basic energy consumption at full capacity utilization. If e.g. the basic energy consumption at full capacity utilization is 30%, it might increase to 35% at the level of 80% production utilization. The basic energy consumption then represents a too large part of the total energy consumption that ought to be reduced to the same level as in the case of full production capacity utilization.

Production capacity utilization may be defined as the production capacity the plant is designed for, at normal working hours. A practical way of calculating the production capacity utilization may be the actual raw material input divided by the designed input. For dairies this would then be treated raw milk, for bakeries consumption of flour and for the meat processing industry the received tons of meat.

A way of calculating the non-production dependent share is to plot the energy consumption against productions using data that have been collected at regular intervals (daily, weekly, monthly...). Most processes will exhibit a pattern through which a straight line (best fit line) can be drawn. This line indicates the relationship between energy consumption and its driver (in this case, production). The intercept with the y-axis shows the non-production dependent energy use in absolute figures.

## Output

When the pilot companies have reported energy and production data to their national administrators, and all the data have been imported to the international benchmarking solution, the pilot companies will be able to compare themselves with other European companies in the BESS benchmarking web site.

There are a number of different diagrams showing the pilot company marked as green compared to the rest in the group marked in gray. The following diagrams are presented at the web site:

- Specific energy consumption for all companies in the selected industry sector (one diagram for each year) – see figure 1.
- Development in specific energy consumption (% change since last year, one diagram for each year) – see figure 2.
- Average for the industry sector and the company during all reported years. See figure 3.
- Quantitative benchmarking based on the BESS energy management checklist in the e-learning part. See figure 4.

All diagrams may be shown with different filters, where the company can select which countries to compare with, the energy unit to be displayed, and which adjustment factors to use. By ticking each box, different diagrams will be presented. The following options exist:

- Countries
- Energy units
- Use net energy (with reported boiler efficiencies)
- Adjust for differences in product mix
- Adjust for differences production utilization
- Adjust for differences in climate

The benchmarking results can be influenced by specific production procedures, the type of companies and other circumstances differing from country to country. Companies taking part in the benchmarking are in the optimum position to interpret their results best and to identify key opportunities to improve their own energy efficiency.

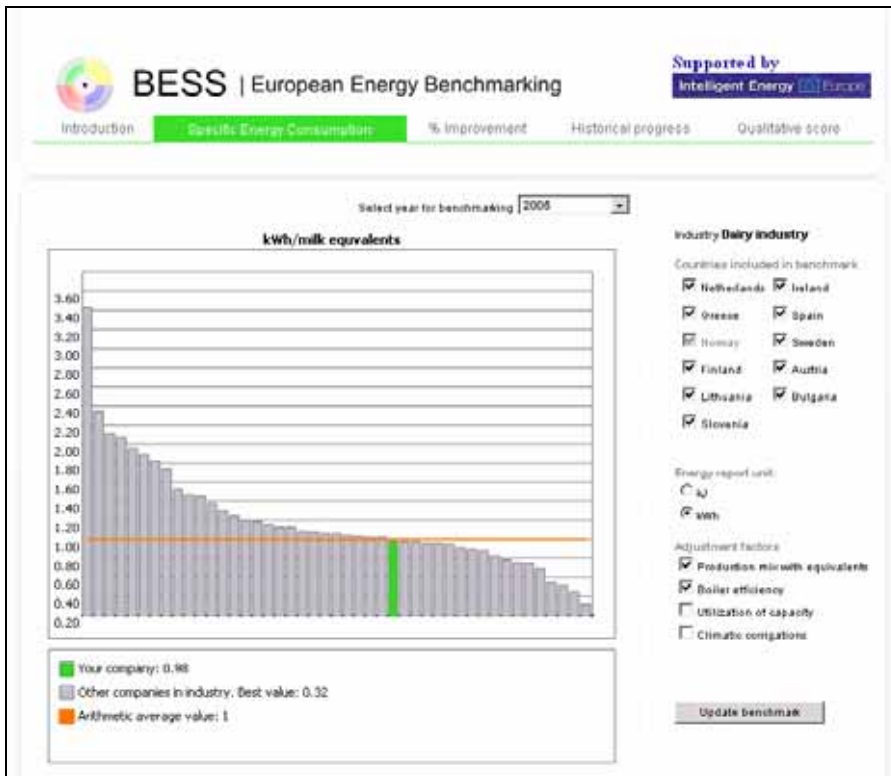


Figure 1: Specific energy consumption for all companies in the selected industry sector (one diagram for each year).

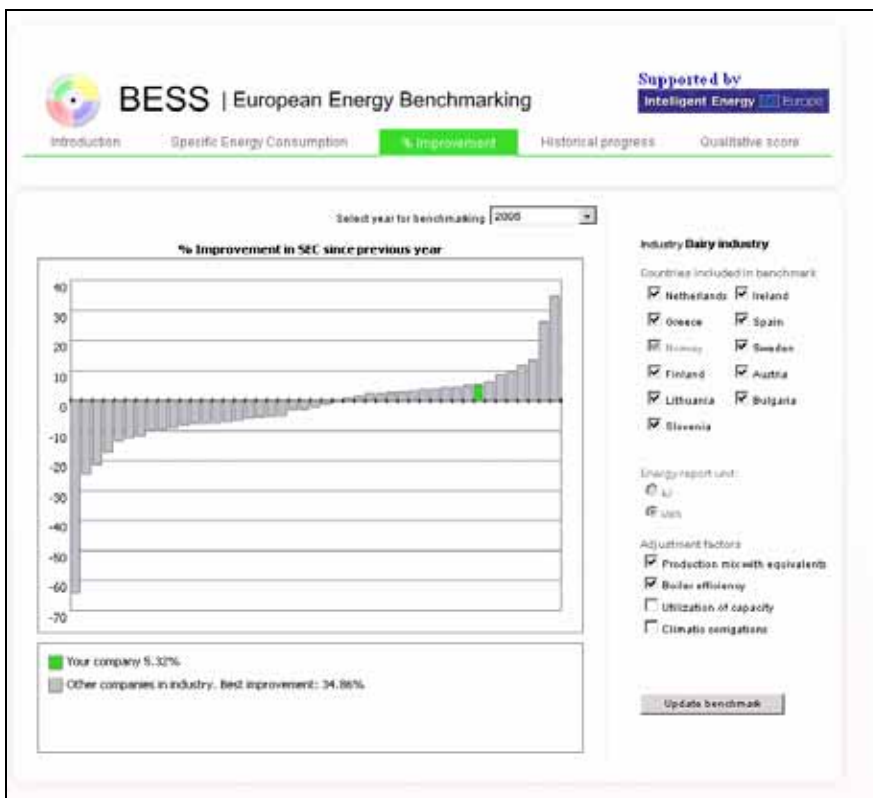


Figure 2: Development in specific energy consumption (% change since last year, one diagram for each year).

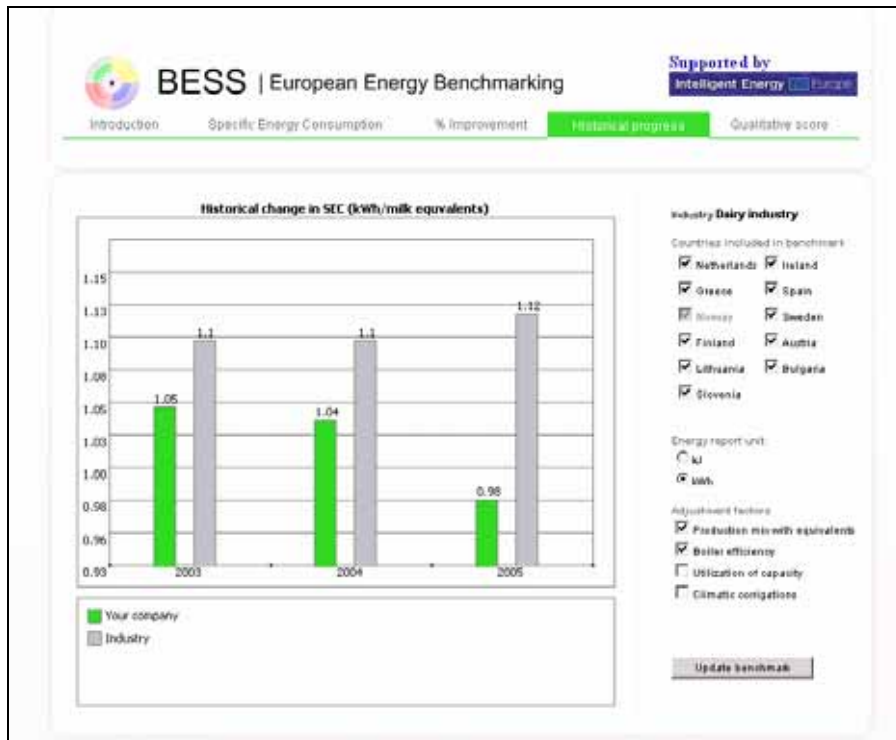


Figure 3: Average for the industry sector and the company during all reported years.

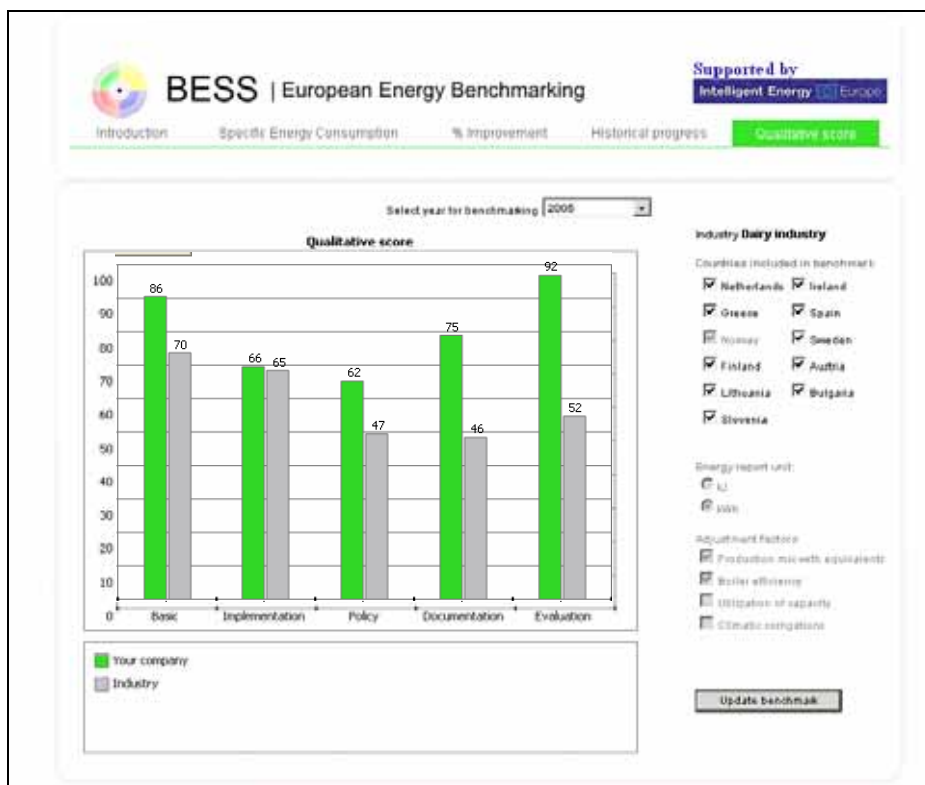


Figure 4: Quantitative benchmarking based on the BESS energy management checklist in the e-learning part.

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