Benchmarking energy efficiency in apparel production

Leading author Gherzi, editing Euratex, contributions from the full SESEC consortium

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1. About SESEC

Based on industry-driven ideas, SESEC is a cooperation project designed to support **Energy Efficiency** in the **European clothing** industry. Co-funded by the European Union through the IEE programme, SESEC develops and offers Energy Efficiency tools, information and training for companies to assess their consumption and implement corrective measures considering cost-effectiveness. Coordinated by EURATEX and run by a nine partners consortium, SESEC started in March 2012 and last thirty months. Periodic information on progresses and cooperation opportunities with organisation which are not member of the consortium are released through the SESEC website hosted in www.euratex.eu.

2. About this document

Released in March 2013, this document is an extract of a SESEC working document presenting the result of a benchmark exercise to **assess the average consumption of energy in producing specific garments.**

3. Important note

This document represents an intermediate step of the SESEC project activities, the following conclusions are provided for reference and **cannot be considered as final**.

4. Executive Summary

A benchmark is a point of reference by which something can be measured.

The whole SESEC project work aims at boosting energy efficiency in garment production, within this scope a critical point is how to define meaningful benchmarks to assess energy efficiency level of surveyed companies, the result is summarized in the table of page 10.

The most important issue is to find a manner to compare data.

Within SESEC a first database was set up by performing energy audits at the premises of 27 companies in 4 different EU countries (named country A, B, C and D) and which produce garments of 7 different segments. In total 32 complete sets of data were collected: 7 in country A, 8 in country B, 12 in country C and 5 in country D.

Since some companies produced more than one type of garment, eventually data for up to 42 relevant segments (type of garments) were collected and used for this first benchmark definition namely: 3 for T-shirts and related – knitted, 5 for shirts and blouses – woven, 10 for trousers and skirts – woven, 11 for suits and overall jackets – coats, 5 for pullovers – flat knitted, 4 for underwear and bras and 4 for technical products.

In the case of technical products it was judged unrealistic and unwise to define a first set of benchmarks. The main reason is that collected data in this segment are difficult to compare since within the segment of technical products a far too wide variety exits and products are of different sizes, types and complexity, a sub segmentation would be necessary for a fair comparison.

The data collected show that there are **no general obvious similarities** in the overall energy consumption of companies producing garments of the same product segment or companies producing in the same country. **Nevertheless these values serve as a first indicator for an energetic survey**.

The above statement is a clear sign that benchmarks have to be defined very carefully in order to offer a useful tool for the self - assessment being important for the further development of the project. A differentiation will be made for the seven product categories defined for the SESEC project.

Since the SESEC project work focused on garment units, this paper will concentrate on relevant key values of the main production processes and on generally valid additional issues as e.g. lighting. Additional information as efficiencies in steam- and compressed air generation or HVAC issues could serve as orientation, but have to be treated even more carefully.

5. How to define benchmarks

Basic point of interest is, how much energy is consumed per unit produced in a factory and how this value is compared to other companies, producing similar products.

From a first point of view this sounds quite easy but by analysing and comparing the values received in depth, a lot of questions arise: Is the quantity and type of processes applied the same, is the product produced the same, should other values be compared to visualize certain details and much more.

At specific project internal consultation session took place during a SESEC meeting (Bologna, March 2013) and by appraising both researchers' and industry perspectives the SESEC approach for benchmarks was agreed. Base for this discussion was the following table:

		Product segment						
Category	Parameter	T-shirts and related - knitted	Shirts and blouses - woven	Trousers and skirts (casual and denim) - woven	Suits & overall jackets - coats	Pullovers flat knitted	Underwear and bras	Technical products
Factory	units/production floor size [pcs / m^2]							
	units produced/employee [pcs/emp]							
	units produced/sewing machine [pcs/mc]							
	working minutes/employee [min/emp]							
	working minutes/unit produced [min/pcs]							
	Factory size category [small - medium - large]							
Energy	Energy consumed/unit produced [kWh/pcs]							
	Energy consumed/working minute [kWh/min]							
	Energy consumed/employee [kWh/emp]							
	Energy consumed/floor size [kWh/m^2]							
	Production energy consumed/unit produced [kWh/pcs]							
	Production energy consumed/working minute [kWh/min]							
	Production energy consumed/employee [kWh/emp]							
	Production energy consumed/floor size [kWh/m^2]							
	HVAC energy consumed/unit produced [kWh/pcs]							
	HVAC energy consumed/working minute [kWh/min]							
	HVAC energy consumed/employee [kWh/emp]							
	HVAC energy consumed/floor size [kWh/m^2]							
	Lighting energy consumed/unit produced [kWh/pcs]							
	Lighting energy consumed/working minute [kWh/min]							
	Lighting energy consumed/employee [kWh/emp]							
	Lighting energy consumed/floor size [kWh/m^2]							
	Operating fluids energy consumed/unit produced [kWh/pcs]							
	Operating fluids energy consumed/working minute [kWh/min]							
	Operating fluids energy consumed/employee [kWh/emp]							
	Operating fluids energy consumed/floor size [kWh/m^2]							
Other	Energy consumed / energy purchased [%]							
	Share of type of energy consumed [cake diagram with %]							

In general there are different possibilities to set a reference point to refer the benchmark values on which could be:

- Number of employees being in charge of a production unit
- Size of production surface (e.g. m^2)
- Production time needed (working minutes) which could be taken as working minutes per employee or as working minutes per number of units produced
- Number of production machines in operation (e.g. sewing machines)
- Category of production facility (e.g. small, medium, large, however small, medium and large have to be defined in detail)
- Number of units produced in a defined time frame (e.g. one month or one year)
- Type of processes taken into consideration for the comparison (e.g. knitting, spreading, cutting, sewing, welding, bonding, stitching, finishing, washing, ironing, packing, transport,…) which is very important for a fairly conducted benchmark measuring
- Complexity of final product (e.g. number of stitches necessary for one unit produced)

By choosing different base conditions in different production units, a comparison of values conducted becomes a very difficult process and complicates a fair assessment.

The fact, that not all assessed companies of the first group of companies audited supplied exactly the same quality of output data, the definition of benchmarks has to be carried out very carefully.

As already mentioned in the introduction, main differentiation of this first benchmark definition will be made between the seven chosen product segments. Further following guideline will be taken as reference:

Key values

Key vales are based on relevant main production steps

- Spreading
- Cutting
- Sewing
- Knitting (where applicable, what means for flat knitted pullovers)

Data will be based first on units produced, then on employees engaged, then (where possible) on working minutes spent, and at the end on floor size dimension occupied.

Then the energy consumed for lighting of the production facilities also will be taken into the category of key values

- Lighting energy per unit produced
- Lighting energy per working minute
- Lighting energy per employee
- Lighting energy per production floor size

Optional values

Operating fluids used as steam and compressed air include usually a big potential to save energy in production and distribution or allocation. Since often solutions in the production units are chosen individually it is not so easy to define general benchmarks to be achieved, however where possible values conducted could be taken as orientation support. Indicated values will be referred to units produced.

HVAC, Logistics

For HVAC and Logistics there is no intention so far to take conducted values as references for the SESEC project.

For HVAC there are different habits in different countries. Often we talk about individual solutions. There are companies with no air conditioning in the working area, others put a lot of attention to comfortable climate for employees. There are factories located in favourable climatic areas, where no heating is required, other setups could recover heat from finishing processes to condition the sewing area. Further it depends on the condition of buildings and production processes installed under one roof. Situation has to be analysed individually from unit to unit, therefore it is not possible to define a benchmark value which makes sense.

Also for logistics, solutions have to be rated individually. There are production units with transport services for their employees. With other companies responsibility to reach the work place is under the responsibility of their employees. Production units with long distances between the single production processes spend more energy for internal logistic needs than others. That is the main reason for not taking into consideration the collected values in a general way.

With all difficulties of fair comparison, nevertheless it could be interesting to bring the overall consumed energy in relation to the mill output in units, to the number of employees, to the working minutes spent or to the floor size occupied.

6. SESEC benchmark collection, first values

By screening the output data from the 27 conducted audits and by comparing the values of data sets from same product segments following benchmarks arise:

Benchmarks: Summary								
Segment		T-shirts and related - knitted	Shirts and blouses - woven	Trousers and skirts (casual and denim) - woven	Suits & overall jackets - coats	Pullovers flat knitted	Underwear and bras	Technical products
per unit	spreading							
	cutting							
	sewing							
	spreading/cutting/sewing	0.16	0.31	0.44	2.01	0.25	0.072	
	knitting					0.38		
	lighting	0.052	0.10	0.13	0.51	0.33	0.021	
	steam		0.063	0.55	7.84	0.78		
	compressed air		0.027	0.072	0.32	0.0134	0.0009	
	total energy	0.902	1.02	8.33	19.17	6.15	0.19	
per employee	spreading							
	cutting							
	sewing							
	spreading/cutting/sewing	635	492	588	860	174	2000	
	knitting					578		
	lighting	214	145	178	163	34.9	572	
	steam		89.2	739	3'362	1'178		
	compressed air		42.9	96.8	45.4	14.5	26.3	
	total energy	278	1'323	11'192	2'392	1'292	5'167	
per working minute	spreading							
	cutting							
	sewing							
	spreading/cutting/sewing		0.081	0.008	0.012	0.007	0.0131	
	knitting					0.02		
	lighting		0.017	0.0024	0.013	0.0031	0.0038	
	steam		0.010	0.010	0.093	0.077		
	compressed air		0.0072	0.0013	0.0027	0.0004	0.0002	
	total energy		0.015	0.15	0.164	0.175	0.034	
per floor size	spreading							
	cutting							
	sewing							
	spreading/cutting/sewing		56.25	180.13	42.39	10.47	61.59	
	knitting					27.8		
	lighting	22.78	17.04	26.58	8.31	3.88	17.63	
	steam							
	compressed air							
	total energy	392	134	268	225	77.5	159.2	

All values in kW/reference value

The benchmark values energy consumed per unit (market in red) usually are the most asked ones. With values indicated per single process, as e.g. cutting sewing, they start to

become important and useful for companies they want to compare their values with benchmarks.

Of course it would be possible to generate more data out of the completed questionnaires. In case of need for additional values, collected completed questionnaires could be further analysed in order to generate specific data.

Financial data for energy consumption have not been collected with the used questionnaire. An interesting benchmark however could be based on energy cost and related to turnover as e.g.

- Overall energy cost / turnover
- Electrical energy cost / turnover
- Thermal energy cost / turnover

These values also depend strongly on the share between thermal and electrical energy in use, the kind of energy carrier and local sales prices.

7. Energy consumption analysis

The energy consumption analysis bases on data collected at the occasion of the 27 energy audits collected between August 2012 and December 2012 which are described in the document **Energy data of clothing companies**[1]. Data of each company were harmonized and collected with the same questionnaires (despite of national/organizational methodologies). In March 2013 the generated database provides satisfactory results and is expected to be extended allowing further energy consumption analysis. This could also lead to modifications of the benchmarks so far identified.

[1] Document available on the SESEC website

8. Production variation over the year

The relevant time frame chosen for this first benchmark definition is one year. Seasonal variation with monthly collected energy data could lead to further knowledge. The available data source collected so far is not rich enough to define benchmarks on a monthly base.

9. Critical comments and probable room for improvement

An increasing number of data sets will allow to define more different key values which make sense to be compared and lead to further benchmarks.

Chosen benchmarks are not final values. They are based on data sets collected and maybe can be topped with progressing project activities. A periodical adaption will be necessary.

In order to define benchmarks also for technical products, it would be necessary to sub segment further this segment could be by application (e.g. work wear, protective wear,…) or by adding weight related benchmark values kW/kg of product produced.

10. Annexes

Benchmarks: T-shirts and related knitted				
Basic values				
Company		A5	C3	C11
Units produced		782'543	19'321	
Employees		192	200	
Working minutes				
Floor size m^2		1'800		
Energy values				
Spreading			527	
Cutting		64'780	6'275	
Sewing		57'195		
Spreading/cutting/sewing		121'975	6'802	0
Knitting				
Lighting		41'000	7'552	
Steam		9'087		
Compressed air			3'408	
Total energy consumed		705'433	55'581	
Key figures: benchmark indications				
per unit	spreading	0.0000	0.0273	
	cutting	0.0828	0.3248	
	sewing	0.0731	0.0000	
	spreading/cutting/sewing	**0.1559**	0.3521	
	knitting	0.0000	0.0000	
	lighting	**0.0524**	0.3909	
	steam	0.0116	0.0000	
	compressed air	0.0000	0.1764	
	total energy	**0.9015**	2.8767	
per employee	spreading	0.0000	2.6350	
	cutting	337.3958	31.3750	
	sewing	297.8906	0.0000	
	spreading/cutting/sewing	**635.2865**	34.0100	
	knitting	0.0000	0.0000	
	lighting	**213.5417**	37.7600	
	steam	47.3281	0.0000	
	compressed air	0.0000	17.0400	
	total energy	3674.1302	**277.9050**	
per working minute	spreading			
	cutting			
	sewing			
	spreading/cutting/sewing			
	knitting			
	lighting			
	steam			
	compressed air			
	total energy			
per floor size	spreading	0.0000		
	cutting	35.9889		
	sewing	31.7750		
	spreading/cutting/sewing	67.7639		
	knitting	0.0000		
	lighting	22.7778		
	steam	5.0483		
	compressed air	0.0000		
	total energy	391.9072		

Benchmark company

Benchmark value

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Benchmarks: Shirts & blouses woven

Basic values

Company	A4	A7	C4	D1	C12
Units produced		384'000	137'792	140'258	
Employees	13	240	200	99	
Working minutes	1'173'920	318'381		853'770	
Floor size m^2	128	2'100		475	

Energy values

Spreading			3'759		
Cutting	1'226	30'450	103'650	17'885	
Sewing	9'492	87'675	93'269	51'102	
Spreading/cutting/sewing	10'718	118'125	200'678	68'987	0
Knitting					
Lighting	2'181	105'420	58'322	14'402	
Steam			394'502	8'827	
Compressed air	1'683	10'290	24'306	6'155	
Total energy consumed	17'199	409'866	625'397	143'707	

Key figures: benchmark indications

per unit	spreading		0.0000	0.0273	0.0000	
	cutting		0.0793	0.7522	0.1275	
	sewing		0.2283	0.6769	0.3643	
	spreading/cutting/sewing		**0.3076**	1.4564	0.4919	
	knitting		0.0000	0.0000	0.0000	
	lighting		0.2745	0.4233	**0.1027**	
	steam		0.0000	2.8630	**0.0629**	
	compressed air		**0.0268**	0.1764	0.0439	
	total energy		1.0674	4.5387	**1.0246**	
per employee	spreading	0.0000	0.0000	18.7950	0.0000	
	cutting	94.3077	126.8750	518.2500	180.6566	
	sewing	730.1538	365.3125	466.3450	516.1818	
	spreading/cutting/sewing	824.4615	**492.1875**	1'003.3900	696.8384	
	knitting	0.0000	0.0000	0.0000	0.0000	
	lighting	167.7692	439.2500	291.6100	**145.4747**	
	steam	0.0000	0.0000	1'972.5100	**89.1616**	
	compressed air	129.4615	**42.8750**	121.5300	62.1717	
	total energy	**1'323.0000**	1'707.7750	3'126.9850	1'451.5859	
per working minute	spreading	0.0000	0.0000		0.0000	
	cutting	0.0010	0.0956		0.0209	
	sewing	0.0081	0.2754		0.0599	
	spreading/cutting/sewing	0.0091	0.3710		**0.0808**	
	knitting	0.0000	0.0000		0.0000	
	lighting	0.0019	0.3311		**0.0169**	
	steam	0.0000	0.0000		**0.0103**	
	compressed air	0.0014	0.0323		**0.0072**	
	total energy	**0.0147**	1.2873		0.1683	
per floor size	spreading	0.0000	0.0000		0.0000	
	cutting	9.5781	14.5000		37.6526	
	sewing	74.1563	41.7500		107.5832	
	spreading/cutting/sewing	83.7344	**56.2500**		145.2358	
	knitting	0.0000	0.0000		0.0000	
	lighting	**17.0391**	50.2000		30.3200	
	steam	0.0000	0.0000		18.5832	
	compressed air	13.1484	4.9000		12.9579	
	total energy	**134.3672**	195.1743		302.5411	

Benchmark company

Benchmark value

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Benchmarks: Trousers & skirts woven

Basic values

Company	A1	A4	B2	B3	B7	B8	C5	D3	C11	C12
Units produced	900'000		201'129	382'597	60'000	500'000	120'302	130'000		
Employees	670	30	129	300	10	21	200	198		
Working minutes	49'320'000	2'592'741						94'080		
Floor size m^2	670	238						850		

Energy values

Spreading							3'282			
Cutting	76'113	4'905		618'420		124'651	90'493	22'562		
Sewing	317'940	37'967	106'080	36'960	5'863		81'431	177'137		
Spreading/cutting/sewing	394'053	42'872	106'080	655'380	5'863	124'651	175'206	199'699	0	0
Knitting										
Lighting	119'250	6'327	56'188	156'856	2'550	5'706	50'919	43'068		
Steam	494'911		937'351	1'041'546			347'160	422'443		
Compressed air	64'873	6'732	64'896	43'560	523	2'733	21'221	24'332		
Total energy consumed	7'498'756	63'900	1'522'319	3'337'911	15'072	176'430	875'175	771'231		

Key figures: benchmark indications

per unit	spreading	0.0000		0.0000	0.0000	0.0000	0.0000	0.0273	0.0000		
	cutting	0.0846		0.0000	1.6164	0.0000	0.2493	0.7522	0.1736		
	sewing	0.3533		0.5274	0.0966	0.0977	0.0000	0.6769	1.3626		
	spreading/cutting/sewing	**0.4378**		0.5274	1.7130	0.0977	0.2493	1.4564	1.5361		
	knitting	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	lighting	**0.1325**		0.2794	0.4100	0.0425	0.0114	0.4233	0.3313		
	steam	**0.5499**		4.6604	2.7223	0.0000	0.0000	2.8857	3.2496		
	compressed air	**0.0721**		0.3227	0.1139	0.0087	0.0055	0.1764	0.1872		
	total energy	**8.3320**		7.5689	8.7244	0.2512	0.3529	7.2748	5.9325		
per employee	spreading	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	16.4100	0.0000		
	cutting	113.6015	163.5000	0.0000	2061.4000	0.0000	5935.7619	452.4650	113.9495		
	sewing	474.5373	1265.5667	822.3256	123.2000	586.3000	0.0000	407.1550	894.6313		
	spreading/cutting/sewing	**588.1388**	1429.0667	822.3256	2184.6000	586.3000	5935.7619	876.0300	1008.5808		
	knitting	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	lighting	**177.9851**	210.9000	435.5659	522.8533	255.0000	271.7143	254.5950	217.5152		
	steam	**738.6731**	0.0000	7266.2868	3471.8200	0.0000	0.0000	1735.8000	2133.5505		
	compressed air	**96.8254**	224.4000	503.0698	145.2000	52.3000	130.1429	106.1050	122.8889		
	total energy	**11192.1731**	2130.0000	11800.9225	11126.3700	1507.2000	8401.4286	4375.8750	3895.1061		
per working minute	spreading	0.0000	0.0000						0.0000		
	cutting	0.0015	0.0019						0.2398		
	sewing	0.0064	0.0146						1.8828		
	spreading/cutting/sewing	**0.0080**	0.0165						2.1227		
	knitting	0.0000	0.0000						0.0000		
	lighting	**0.0024**	0.0024						0.4578		
	steam	**0.0100**	0.0000						4.4903		
	compressed air	**0.0013**	0.0026						0.2586		
	total energy	**0.1520**	0.0246						8.1976		
per floor size	spreading	0.0000	0.0000						0.0000		
	cutting	113.6015	**20.6092**						26.5435		
	sewing	474.5373	**159.5252**						208.3965		
	spreading/cutting/sewing	588.1388	**180.1345**						234.9400		
	knitting	0.0000	0.0000						0.0000		
	lighting	177.9851	**26.5840**						50.6682		
	steam	738.6731	0.0000						496.9918		
	compressed air	96.8254	28.2857						**28.6259**		
	total energy	11192.1731	**268.4874**						907.3306		

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Benchmarks: Suits, overall jackets & coats

Basic values

Company	A4	A6	B1	B3	B4	C6	C8	D2	D3	D4	C10
Units produced		62'486	85'930	382'597		48'244	120'000	200'942	35'000	481'138	
Employees	54	154	220	300	20	200	280	418	198	1'000	
Working minutes	4'619'428	11'052'386						1'009'800	276'480	56'338'560	
Floor size m^2	396	3'240						4'200	600	10'800	

Energy values

Spreading						1'316	22'625				
Cutting	9'809	72'542		618'420	12'419	15'669	27'837	251'173	22'562	572'902	
Sewing	45'935	64'816	184'536	36'960	15'094		190'200	313'966	177'137	632'939	
Spreading/cutting/sewing	55'744	137'358	184'536	655'380	27'513	16'985	240'662	565'139	199'699	1'205'841	0
Knitting											
Lighting	9'372	148'590	104'839	156'856	3'256	20'420	61'055	34'885	43'068	774'045	
Steam			1'500'476	1'041'546			941'393	728'351	422'443	5'250'658	
Compressed air	13'464	44'704	158'400	43'560	908	8'510	46'281	4'802	24'332	152'638	
Total energy consumed	89'082	1'016'611	3'027'174	3'337'911	47'831	141'579	1'554'476	2'068'144	771'241	9'221'435	

Key figures: benchmark indications

per unit	spreading		0.0000	0.0000	0.0000		0.0273	0.1885	0.0000	0.0000	0.0000	
	cutting		1.1609	0.0000	1.6164		0.3248	0.2320	1.2500	0.6446	1.1907	
	sewing		1.0373	2.1475	0.0966		0.0000	1.5850	1.5625	5.0611	1.3155	
	spreading/cutting/sewing		2.1982	2.1475	1.7130		0.3521	**2.0055**	2.8124	5.7057	2.5062	
	knitting		0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	
	lighting		2.3780	1.2201	0.4100		0.4233	**0.5088**	0.1736	1.2305	1.6088	
	steam		0.0000	17.4616	2.7223		0.0000	**7.8449**	3.6247	12.0698	10.9130	
	compressed air		0.7154	1.8434	0.1139		0.1764	0.3857	0.0239	0.6952	**0.3172**	
	total energy		16.2694	35.2284	8.7244		2.9346	12.9540	10.2922	22.0355	**19.1659**	
per employee	spreading	0.0000	0.0000	0.0000	0.0000	0.0000	6.5800	80.8036	0.0000	0.0000	0.0000	
	cutting	181.6481	471.0519	0.0000	2061.4000	620.9500	78.3450	99.4179	600.8923	113.9495	572.9020	
	sewing	850.6481	420.8831	838.8000	123.2000	754.7000	0.0000	679.2857	751.1148	894.6313	632.9390	
	spreading/cutting/sewing	1032.2963	891.9351	838.8000	2184.6000	1375.6500	84.9250	**859.5071**	1352.0072	1008.5808	1205.8410	
	knitting	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
	lighting	173.5556	964.8701	476.5409	522.8533	**162.8000**	102.1000	218.0536	83.4569	217.5152	774.0450	
	steam	0.0000	0.0000	6820.3455	3471.8200	0.0000	0.0000	**3362.1179**	1742.4665	2133.5505	5250.6580	
	compressed air	249.3333	290.2857	720.0000	145.2000	**45.4000**	42.5500	165.2893	11.4880	122.8889	152.6380	
	total energy	1649.6667	6601.3701	13759.8818	11126.3700	**2391.5500**	707.8950	5551.7000	4947.7129	3895.1566	9221.4350	
per working minute	spreading	0.0000	0.0000						0.0000	0.0000	0.0000	
	cutting	0.0021	0.0066						0.2487	0.0816	0.0102	
	sewing	0.0099	0.0059						0.3109	0.6407	0.0112	
	spreading/cutting/sewing	0.0121	**0.0124**						0.5597	0.7223	0.0214	
	knitting	0.0000	0.0000						0.0000	0.0000	0.0000	
	lighting	0.0020	**0.0134**						0.0345	0.1558	0.0137	
	steam	0.0000	0.0000						0.7213	1.5279	**0.0932**	
	compressed air	0.0029	0.0040						0.0048	0.0880	**0.0027**	
	total energy	0.0193	0.0920						2.0481	2.7895	**0.1637**	
per floor size	spreading	0.0000	0.0000						0.0000	0.0000	0.0000	
	cutting	24.7702	**22.3895**						59.8031	37.6033	53.0465	
	sewing	115.9975	**20.0049**						74.7538	295.2283	58.6055	
	spreading/cutting/sewing	140.7677	**42.3944**						134.5569	332.8317	111.6519	
	knitting	0.0000	0.0000						0.0000	0.0000	0.0000	
	lighting	23.6667	45.8611						**8.3060**	71.7800	71.6708	
	steam	0.0000	0.0000						173.4169	704.0717	486.1720	
	compressed air	34.0000	13.7975						**1.1433**	40.5533	14.1331	
	total energy	**224.9545**	313.7688						492.4152	1285.4017	853.8366	

SESEC
Sustainable Energy Saving for the European Clothing Industry

Benchmarks: Pullovers, flat knitted

Basic values					
Company	A2	C7	D2	D5	C11
Units produced	747'506	16'388	92'518	81'645	
Employees	280	200	60	54	
Working minutes	26'236'349		1'254'600		
Floor size m^2	3'200		1'000	1'122	

Energy values					
Spreading					
Cutting		5'770	10'466	4'800	
Sewing	184'384			134'400	
Spreading/cutting/sewing	184'384	5'770	10'466	139'200	0
Knitting	547'334		34'886	31'200	
Lighting	407'688	6'987	3'876	26'880	
Steam	2'008'600			63'598	
Compressed air	10'000	2'891	660	12'960	
Total energy consumed	4'593'902	48'375	77'525	413'563	

Key figures: benchmark indications						
per unit	spreading	0.0000	0.0000	0.0000	0.0000	
	cutting	0.0000	0.3521	0.1131	0.0588	
	sewing	0.2467	0.0000	0.0000	1.6462	
	spreading/cutting/sewing	**0.2467**	0.3521	0.1131	1.7049	
	knitting	0.7322	0.0000	**0.3771**	0.3821	
	lighting	0.5454	0.4263	0.0419	**0.3292**	
	steam	2.6871	0.0000	0.0000	**0.7790**	
	compressed air	**0.0134**	0.1764	0.0071	0.1587	
	total energy	6.1456	2.9519	0.8379	5.0654	
per employee	spreading	0.0000	0.0000	0.0000	0.0000	
	cutting	0.0000	28.8500	174.4333	88.8889	
	sewing	658.5143	0.0000	0.0000	2488.8889	
	spreading/cutting/sewing	658.5143	28.8500	**174.4333**	2577.7778	
	knitting	1954.7643	0.0000	581.4333	**577.7778**	
	lighting	1456.0286	**34.9350**	64.6000	497.7778	
	steam	7173.5714	0.0000	0.0000	**1177.7407**	
	compressed air	35.7143	**14.4550**	11.0000	240.0000	
	total energy	16406.7929	241.8750	1292.0833	7658.5741	
per working minute	spreading	0.0000		0.0000		
	cutting	0.0000		0.0083		
	sewing	0.0070		0.0000		
	spreading/cutting/sewing	**0.0070**		0.0083		
	knitting	**0.0209**		0.0278		
	lighting	0.0155		**0.0031**		
	steam	**0.0766**		0.0000		
	compressed air	**0.0004**		0.0005		
	total energy	0.1751		0.0618		
per floor size	spreading	0.0000		0.0000	0.0000	
	cutting	0.0000		10.4660	**4.2781**	
	sewing	**57.6200**		0.0000	119.7861	
	spreading/cutting/sewing	57.6200		**10.4660**	124.0642	
	knitting	171.0419		34.8860	**27.8075**	
	lighting	127.4025		**3.8760**	23.9572	
	steam	627.6875		0.0000	**56.6827**	
	compressed air	3.1250		**0.6600**	11.5508	
	total energy	1435.5944		**77.5250**	368.5945	

Benchmark company

Benchmark value

SESEC
Sustainable Energy Saving for the European Clothing Industry

Benchmarks: Underwear & bras

Basic values

Company	A3	B5	B6	D5
Units produced	4'264'063	14'000'000	14'000'000	4'000'624
Employees	154	38	57	72
Working minutes	23'504'030			
Floor size m^2	5'000	3'100	3'300	470

Energy values

Spreading				
Cutting	106'825			4'800
Sewing	201'135			134'400
Spreading/cutting/sewing	307'960	0	0	139'200
Knitting		1'312'484		
Lighting	88'165	176'602	66'121	26'880
Steam			9'868'107	63'598
Compressed air	4'048	1'264'725	120'600	12'960
Total energy consumed	795'769	3'614'666	11'187'410	413'563

Key figures: benchmark indications

per unit	spreading	0.0000	0.0000	0.0000	0.0000
	cutting	0.0251	0.0000	0.0000	0.0012
	sewing	0.0472	0.0000	0.0000	0.0336
	spreading/cutting/sewing	**0.0722**	0.0000	0.0000	0.0348
	knitting	0.0000	0.0937	0.0000	0.0000
	lighting	**0.0207**	0.0126	0.0047	0.0067
	steam	0.0000	0.0000	0.7049	0.0159
	compressed air	**0.0009**	0.0903	0.0086	0.0032
	total energy	**0.1866**	0.2582	0.7991	0.1034
per employee	spreading	0.0000	0.0000	0.0000	0.0000
	cutting	693.6688	0.0000	0.0000	66.6667
	sewing	1306.0714	0.0000	0.0000	1866.6667
	spreading/cutting/sewing	**1999.7403**	0.0000	0.0000	1933.3333
	knitting	0.0000	34539.0526	0.0000	0.0000
	lighting	**572.5000**	4647.4211	1160.0175	373.3333
	steam	0.0000	0.0000	173124.6842	883.3056
	compressed air	**26.2857**	33282.2368	2115.7895	180.0000
	total energy	**5167.3312**	95122.7895	196270.3509	5743.9306
per working minute	spreading	0.0000			
	cutting	0.0045			
	sewing	0.0086			
	spreading/cutting/sewing	**0.0131**			
	knitting	0.0000			
	lighting	**0.0038**			
	steam	0.0000			
	compressed air	**0.0002**			
	total energy	**0.0339**			
per floor size	spreading	0.0000	0.0000	0.0000	0.0000
	cutting	21.3650	0.0000	0.0000	**10.2128**
	sewing	**40.2270**	0.0000	0.0000	285.9574
	spreading/cutting/sewing	**61.5920**	0.0000	0.0000	296.1702
	knitting	0.0000	423.3819	0.0000	0.0000
	lighting	**17.6330**	56.9684	20.0367	57.1915
	steam	0.0000	0.0000	2990.3355	135.3149
	compressed air	0.8096	407.9758	36.5455	27.5745
	total energy	**159.1538**	1166.0213	3390.1242	879.9213

Benchmark company

Benchmark value

SESEC
Sustainable Energy Saving for the European Clothing Industry

Benchmarks: Technical products

Basic values

Company	A4	C1	C9	D3
Units produced		53'096	6'920'000	20'000
Employees	24	110	131	198
Working minutes	1'148'533			
Floor size m^2	202	1'680	2'373	300

Energy values

Spreading			12'703	
Cutting	2'452	56'141	54'836	22'562
Sewing	18'984		63'699	177'137
Spreading/cutting/sewing	21'436	56'141	131'238	199'699
Knitting				
Lighting	3'714	20'714	56'626	43'068
Steam		234'087		24'332
Compressed air	3'366	23'898	83'683	422'443
Total energy consumed	34'078	552'712	409'081	771'241

Key figures: benchmark indications

per unit	spreading		0.0000	0.0018	0.0000
	cutting		1.0573	0.0079	1.1281
	sewing		0.0000	0.0092	8.8569
	spreading/cutting/sewing		1.0573	0.0190	9.9850
	knitting		0.0000	0.0000	0.0000
	lighting		0.3901	0.0082	2.1534
	steam		4.4088	0.0000	1.2166
	compressed air		0.4501	0.0121	21.1222
	total energy				
per employee	spreading	0.0000	0.0000	96.9695	0.0000
	cutting	102.1667	510.3727	418.5954	113.9495
	sewing	791.0000	0.0000	486.2519	894.6313
	spreading/cutting/sewing	893.1667	510.3727	1001.8168	1008.5808
	knitting	0.0000	0.0000	0.0000	0.0000
	lighting	154.7500	188.3091	432.2595	217.5152
	steam	0.0000	2128.0636	0.0000	122.8889
	compressed air	140.2500	217.2545	638.8015	2133.5505
	total energy	1419.9167	5024.6545	3122.7557	3895.1566
per working minute	spreading	0.0000			
	cutting	0.0021			
	sewing	0.0165			
	spreading/cutting/sewing	0.0187			
	knitting	0.0000			
	lighting	0.0032			
	steam	0.0000			
	compressed air	0.0029			
	total energy	0.0297			
per floor size	spreading	0.0000	0.0000	5.3531	0.0000
	cutting	12.1386	33.4173	23.1083	75.2067
	sewing	93.9802	0.0000	26.8432	590.4567
	spreading/cutting/sewing	106.1188	33.4173	55.3047	665.6633
	knitting	0.0000	0.0000	0.0000	0.0000
	lighting	18.3861	12.3298	23.8626	143.5600
	steam	0.0000	139.3375	0.0000	81.1067
	compressed air	16.6634	14.2250	35.2646	1408.1433
	total energy	168.7030	328.9952	172.3898	2570.8033