



EU-MERCI

EU coordinated **ME**thods and procedures based on **R**eal **C**ases for the effective implementation of policies and measures supporting energy efficiency in the Industry

HORIZON 2020 Project Nr. 693845

Analysis of the industrial sectors in the European Union

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1 Food and beverage sector in EU-28

The food and beverage sector (NACE C10 and C11)¹ in the EU consists of 280,000 enterprises, where over 4.3 million people are employed and have contributed to over 1,000 billion \in in turnover and over 200 billion \in in value added for 2012. More than half of the companies are SMEs. The main parameters for statistical analysis of the sector are reported in the below table.

Description	NACE (Group)	Number of enterprises [n]	No, of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of food products	C10	264,699	4,096,033	914,000	170,000	837,000
Processing and preserving of meat and production of meat products	C10.1	39,012	936,213	216,977	30,688	205,325
Processing and preserving of fish. crustaceans and molluscs	C10.2	3,570	109,487	24,672	3,988	22,873
Processing and preserving of fruit and vegetables	C10.3	10,500	257,525	64,119	12,912	59,384
Manufacture of vegetable and animal oils and fats	C10.4	8,100	60,359	55,509	3,917	45,673
Manufacture of dairy products	C10.5	11,998	354,079	140,000	20,000	130,000
Manufacture of grain mill products.	C10.6	6,000	105,852	45,718	7,167	42,186

Table 1: Food and Beverage sector in EU-28 statistics data.

¹ To the same group belongs also C12 division (Manufacture of tobacco products), but its final energy consumption is not relevant (1% of the total final energy consumption of cumulated C10, C11 and C12), so it will not be considered for the scopes of this study.

D4.2 - Picture of efficiency projects implemented by the Industry sector-by-sector and process-by-process

starches and starch products						
Manufacture of bakery and farinaceous products	C10.7	155,219	1,530,972	114,523	39,524	108,199
Manufacture of other food products	C10.8	25,100	599,926	171,869	42,505	155,170
Manufacture of prepared animal feeds	C10.9	5,100	122,339	77,500	9,530	66,000
Manufacture of beverages	C11	23,956	384,849	148,000	36,700	140,855
Distilling, rectifying and blending of spirits	C11.01	5,077	39,432	23,845	7,087	23,005
Manufacture of wine from grape	C11.02	11,039	95,707	29,797	6,328	29,637
Manufacture of cider and other fruit wines	C11.03	619	4,307	1,835	369	1,738
Manufacture of other non- distilled fermented beverages	C11.04	175	585	143	27	433
Manufacture of beer	C11.05	3,050	108,371	43,620	11,955	40,394
Manufacture of malt	C11.06	146	3,586	3,944	533	3,733
Manufacture of soft drinks; production of mineral waters and other bottled waters	C11.07	3,851	134,829	44,010	10,375	41,914

The final energy consumption share of Food and Beverage industry is 85-90% of Food sector (C10) and 10-15% for Beverage sector (C11).

2 Pulp, paper and print sector in EU-28

The pulp and paper industry (NACE C17 and C18) provides around 179,000 jobs in the EU and 1.5 million in the value chain. It has a turnover of 79 billion euros and adds 16.5 billion Eurors to the EU GDP. It is strong in export markets, with an export rate of 21% of its production.93% of total Pulp and Paper production is fabricated by the members of CEPI, the Confederation of European Paper Industries.

The EU Pulp production accounts for about 24% of the world pulp production. According to CEPI information, the share of Pulp production among the Member States is strongly unbalanced, with Sweden and Finland accounting for around 60% of the total production and around 91% of the total production of 2015 split among 8 countries (Sweden, Finland, Portugal, Germany, France, Spain, Austria and Poland).



World Total Pulp¹ Production by Region in 2014

CEPI Total Pulp¹ Production by Country in 2015



Figure 2: CEPI total pulp production by MS in EU-28.

Regarding paper and board production, the EU accounts for about 26% of the total production, with 8 MS (Germany, Finland, Sweden, Italy, France, Spain, Austria and Poland) accounting for 83% of the European production, with a more balanced distribution among them:



Paper & Board Production by Region in 2014

Figure 3: World paper and board production by region.



90.9 Million Tonnes

Figure 4: CEPI Paper and board production by MS in EU-28.

According to Eurostat the main parameters to be used for the analysis of the sector are:

Description	NACE (Div)	NACE (Group)	Number of enterprises [n]	No, of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of paper and paper products	C17	-	19,394	588,500	176,977	41,564	168,216
Manufacture of pulp, paper and paperboard	-	C17.1	2,137	169,818	82,042	16,899	78,783
Manufacture of articles of paper and paperboard	-	C17.2	17,257	418,682	94,935	24,664	89,433
Printing and reproduction of recorded media	C18	-	109,101	628,786	74,347	27,678	72,974
Printing and service activities related to printing	-	C18.1	104,117	610,612	71,101	26,689	69,946
Reproduction of recorded	-	C18.2	4,984	18,174	3,246	989	3,028

Table 2: Pulp and Paper sector in EU-28 statistics data.

media

The majority (90-98%) of the final energy consumption lies with the manufacture of paper and paper products (NACE C17), while only 2-10% is attributed to printing and reproduction of recorded media.

This is mainly due to the fact that the upstream pulp processes and paper and paperboard fabrication is much more energy intensive than printing and reproduction of recorded media. THe Sector C17 can be furtherly split into:

- C17.1: 73% of total energy consumption for the sector
- C17.2: 27% of total energy consumption for the sector.

This report focusses on sector C17 and especially C17.1.

3 Petroleum refineries sector in EU-28

The petroleum refineries sector (NACE C19) contributed to 0.8% of the EU's GDP in 2011, where the most important groups are manufacture of coke oven products (NACE C19.1) and refined petroleum products (NACE C19.2). The main parameters for statistical analysis are reported in the below table.

Description	NACE (Group)	Number of enterprises [n]	No, of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of coke and refined petroleum products	C19	412	36,641	118,891	2,822	96,743
Manufacture of coke oven products	C19.1	41	5,127	2,835	294	2,121
Manufacture of refined petroleum products	C19.2	371	31,514	116,056	2,528	94,621

Table 3: Petroleum	refineries sec	tor in EU-28	statistics data.
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Both subsectors are energy intensive, with C19.2 consuming 92% of the total sector final energy and C19.1 only 8%. The sector has over 400 enterprises in the EU generating nearly 97 billion € of revenues. Refined petroleum products (C19.2) are the largest subsector, accounting for nearly 98% of total sector revenues. Up to 80% of EU refining capacity is shared among 9 countries (Germany, Italy, UK, France, Spain, the Netherlands, Greece, Belgium and Sweden).



Figure 5: Petroleum refineries distribution in EU-28.

The coking subsector (C19.1) is heavily concentrated in Poland, which accounted for more than two thirds of the total EU value added and close to three fifths of the workforce (in 2010 it contributed 68.4% of EU-27 value added in this subsector and 59.9% of the workforce).

4 Chemical sector in EU-28

The chemicals and pharmaceutical sector contributed to 5% of the EU's GDP in 2011. The most influencial groups in terms of production value are Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms (NACE C20.1) and Manufacture of pharmaceutical preparations (NACE C21.2), which accounted for 70% of total production value. The main statistics parameter to be considered for the sector analysis are reported in the below table.

Description	NACE	Number of	No, of persons	Turnover	Value added	Production
	(Group)	enterprises	employed	[mil €]	[mil €]	value
		[n]	[n]	L - J		[mil €]
Manufacture of	C20	28,306	1,096,562	552,704	106,210	486,986
chemicals and						
chemical						
products						
Manufacture of	C20.1	8,886	549,289	348,952	61,631	313,064
basic chemicals.						
fertilisers and						
nitrogen						
nlastics and						
synthetic						
rubber in						
primary forms						
Manufacture of	C20.2	623	25.977	15.077	3.002	11.470
pesticides and	020.2	023	23,377	10,077	5,002	11,170
other						
agrochemical						
products						
Manufacture of	C20.3	4,100	133,767	40,817	10,501	35,993
paints.						
varnishes and						
similar coatings.						
printing ink and						
mastics						
Manufacture of	C20.4	8,283	199,056	61,394	14,232	54,531
soap and						
detergents.						
cleaning and						
preparations						
perfumes and						
toilet						
preparations						

Table 4: Chemical and pharmaceutical sectors in EU-28 statistics data.

Manufacture of	C20.5	6,104	164,880	78,465	16,843	64,463
other chemical						
products						
Manufacture of	C20.6	310	23,593	8,000	N/A	7,464
man-made						
fibres						
Manufacture of	C21	4,072	479,333	227,879	83,808	206,066
basic						
pharmaceutical						
products and						
pharmaceutical						
preparations						
Manufacture of	C21.1	900	49,577	29,795	11,150	28,810
basic						
pharmaceutical						
products						
Manufacture of	C21.2	3,172	429,756	198,084	72,658	177,256
pharmaceutical						
preparations						
			1			

In 2012 the sector counted over 28,000 enterprises in the EU generating 552 billion € of revenues (519 billion in 2015, representing about 14.7% of global revenues for the sector). Over 65% of organisations in the chemicals sector are microenterprises, but the 35% of large entreprises contribute 65% of value added. Something similar happens in pharmaceutical, where 70% of organisations are SMEs; however large enterprises contribute 78% of value added. About Energy consumption, the share among the different subsectors is:

- Petrochemicals (C20.1): 47% (Energy intensive);
- Basic inorganic (C20.1; C20.5): 25% (Energy intensive);
- Polymers (C20.1; C20.6): 12% (Non-energy intensive)
- Specialty chemicals (C20.2; C20.3): 8% (Non-energy intensive);
- Consumer chemicals (C20.4): 2% (Non-energy intensive);
- Pharmaceutical products (C21): 6% (Non-energy intensive).

This report focusses on the Chemical sector (C20) and on its most energy intensive subsectors. The Chemical sector presents a high variety of processes and products (Figure 8)

Sales 2015 (€519 billion)



Figure 6: EU chemical sales by product (2015).

The two largest chemical producers in the EU are Germany and France, followed by Italy and the United Kingdom. These four MS together accounted for 61.4% of sales in 2015, valued at 318.9 billion €. The share rises to 84% when including the Netherlands, Spain and Belgium. The remaining 21 EU member states accounted for 16% of EU chemicals sales in 2015, valued at 82.8 billion €. Austria and Poland are the two largest contributors in this last group.



Figure 7: Chemicals production share in EU-28.

5 Non-metallic minerals sector in EU-28

Non-metallic mineral products (NACE C23) comprise of the production of cement, ceramics, glass and lime. These manufacturing sectors are characterised by the transformation of naturally occurring minerals such as limestone, silica and clays through an energy-intensive process. The end products range from bricks and tiles to glass and tableware. The most important subsectors are:

- Manufacture of glass and glass products (C23.1);
- Manufacture of ceramics and ceramic products (C23.2, C23.3, C23.4, C23.7, C23.9);
- Manufacture of cement (C23.5 and C23.6);
- Manufacture of lime (C23.5 and C23.6).

The non-metallic minerals sector contributed to 1.5% of the EU's GDP in 2011. The general statistic parameters for sector analysis are:

Description	NACE (Group/Class)	Number of enterprises	No, of persons employed	Turnover [mil €]	Value added [mil €]	Production value
		[11]	[n]			
Manufacture of other non- metallic products	C23	97,975	1,259,267	207,520	61,002	193,297
Manufacture of glass and glass products	C23.1	15,711	305,862	45,000	15,000	42,424
Manufacture of refractory products	C23.2	860	30,932	5,899	1,640	5,268
Manufacture of clay building materials	C23.3	3,627	114,974	17,073	5,624	16,196
Manufacture of other porcelain and ceramic products	C23.4	13,288	97,819	8,822	3,314	7,679
Manufacture of cement. lime and	C23.5	1,100	62,680	19,982	6,639	19,520

Table 5: Non-metallic minerals sector in EU-28 statistics data.

plaster						
Manufacture of articles of	C23.6	23,500	385,483	69,810	17,520	65,239
concrete.						
cement and						
plaster						
Cutting.	C23.7	35,910	164,203	13,800	5,000	12,959
shaping and						
finishing of						
stone						
Manufacture	C23.9	3,979	97,314	27,134	6,265	24,011
of abrasive						
products and						
non-metallic						
mineral						
products						
n.e.c.						

The share of energy consumption for the different subsectors is:

- Manufacture of glass and glass products (C23.1): 17%;
- Manufacture of ceramics and ceramic products (C23.2, C23.3, C23.4, C23.7, C23.9): 19%;
- Manufacture of cement (C23.5 and C23.6): 58%;
- Manufacture of lime (C23.5 and C23.6): 6%.

Cement and lime production (C23.5, C23.6) are the largest industries, accounting for nearly 45% of total sector revenues. Glass manufacture (C23.1) is the next largest contributor, with turnover accounting for over 20% of the non-metallic sector. SMEs as a group dominate the sector in terms of number of enterprises (99% of the EU-27's sectoral total) and persons employed (64% of the EU-27's sectoral total) in 2010. The remaining enterprises (1%) are considered large and accounted for 47% of the value added and 36% of the sector's workforce.

5.1 Glass sector

The EU is the world's biggest producer of glass with a market share of around one third of total world production. Germany remains the EU's biggest producer with about one fifth of the volume, closely followed by France, Spain, Italy and the UK. The glass industries comprise five sectors covering different glass products, applications and markets. They are represented at EU level by specific associations:

- container glass (60-70% of output in tonnage terms but about 54% in terms of value);
- flat glass (about 25-30% in both tonnage and value);

- glass fibers (about 2% of total tonnage production but with very high value);
- domestic glass (about 2% of total tonnage production);
- special glass (about 1% of total tonnage production).

Container glass, with its 160 manufacturing plants distributed all over the EU, is an important contributor to the EU economy and provides direct employment to about 50,000 people, while creating many job opportunities along the total supply chain.



Figure 8: Container glass plants in EU-28.

The EU association for container glass is FEVE. The flat glass sector is the second largest sector of the European glass industries. Flat glass is mainly used in buildings and automotive industries, but later also solar-energy application and urban and domestic furniture and home decoration applications have been developed.

Flat glass is manufactured in the EU by 7 companies operating some 50 float plants. Float plants are the biggest glass manufacturing sites with production capacities of up to 850 tonnes of melted glass per day. The sector directly employs approximately 15,000 people in glass making and many more in downstream treatments (automotive glass processing, glazing, etc.).



Figure 9: Flat glass production plants in EU-28 (Float lines).

The EU association for flat glass production is Glass for Europe. Production of glass fibers (continuous filament glass fibre - CFCG) is one of the smallest sectors of the glass industry in terms of tonnage (2%) although the products have a relatively high value to mass ratio.

Continuous filament glass fibre is mainly used to produce composite materials. The sector covers applications ranging from the automotive and transportation sector (such as aircrafts) to wind energy, agriculture, construction, communication, electrical and electronic as well as sport and leisure. Approximately 5,000 people are directly employed by the European glass fibre manufacturers. The EU association of glass fibre producers is Glass Fibre Europe.



Figure 10: Glass fiber producers in EU-28.

Domestic glass sector comprises the manufacturing of glass tableware, cookware and decorative items such as drinking glasses, bowls, plates, cookware, vases and ornaments. Domestic glass is manufactured by more than 300 facilities, mainly SMEs, which are spread throughout Europe.

Special glasses have a high added-value linked to their intense technological content. This sector regroups a large range of products such as lighting glass, glass tubes, laboratory glassware, glass ceramics, heat-resistant glass, optical and ophthalmic glass, extra thin glass for the electronics industry (e.g. LCD panels, photovoltaics) and radiation protection glasses. These last subsectors, however, are less significant in terms of energy intensity.

5.2 Ceramics sector

The EU ceramics industry (NACE23) is a world leader in producing uniquely designed high quality ceramic products such as tiles, bricks, sanitary ware, or vitreous clay pipes. Most manufacturers (about 80%) are innovative small and medium-sized enterprises (SMEs). The ceramics industry represents an annual turnover of around 28 billion €, accounting for approximately 25% of the global production and over 200,000 direct jobs in the EU. The EU ceramic industry is export-oriented with 30% of its production sold outside the EU market. Ceramics products can be divided into 4 categories:

- Construction and housing: it comprises bricks and roof tiles, wall and floor tiles, clay drainage pipes, sanitary-ware and expanded clay;
- Consumer goods: it comprises tableware, ornamental-ware and household appliances;
- Industrial applications such as abrasives, refractories and porcelain enamel;
- High tech and innovation goods in the fields of Electronics, Healthcare, Security, Transport and Renewable Energies.



PRODUCTION VALUE (2015)

Figure 11: Production value share of different ceramics products.

The Ceramics industry is energy intensive, with around 30% of the production costs related to energy. The EU has 1,091 installations producing ceramics, with 80% of energy consumption associated with the production of bricks, wall, floor and roof tiles. Six MS share 80% of total EU production (Germany, France, Italy, UK, Portugal and Poland), even if the production declined over the years, starting from 2008. The demand for those products is influenced by new builds and renovation: however, recent declines have been due to significant competition from low cost imported products and a reliance on raw materials from outside markets (such as China) where costs are rising.

5.3 Cement sector

The EU cement production accounts for about 5.5% of the global production of cement (CEMBUREAU + rest of Europe):



Figure 12: World cement production by region.

In 2006, 267.5 million tonnes of cement, with a value of 19 billion €, were produced in the EU by 356 installations. The EU cement industry in 2006 represented 10.5% of total world production. This decreased to 5.6% of world production in 2011 (195.5 Mt) however. Large cement plants produce some 4,000 tonnes of cement per day. The production process is highly energy-intensive, with energy costs representing up to 40% of total product cost. The main aspects to take into consideration about cement industry are:

- The costs of road transportation are very high, making it worthless to haul cement for more than 200-300 km; however, with the modern vessels, it is possible to carry cement with cargo-ships over longer distances for a lower unit price;
- The regional demand of cement is proportional to the density of population and the disposable income;
- The production of cement is carried out in large plants, whose capacity is not easily modifiable after building;
- The regional demand is very volatile, making it necessary to be able to transport it to the neighbouring regions via road hauling or by ship.

The geographical distribution of production (according to 2012 production data reported in U.S. Geological Survey, Minerals Yearbook) is reported in the Figure below:



Cement Production in EU-28

Figure 13: Cement production in EU-28 (data from 2012).

As we can see, there are 10 MSs (Germany, Italy, Spain, France, Poland, Greece, Romania, UK, Portugal and Belgium) sharing more than 80% of the total production. The others account from 0% to 2% of the total production each. Considering also historical data (from 2008 to 2012), it emerges that 3 MSs (Italy, Germany and Spain) share from 40% to 50% of the production each year.

5.4 Lime sector

Lime is used for various applications in different fields.



Figure 14: Overview of customer markets and functionality of lime products.

In 2006, the EU-25 lime production accounted for 16.3% of global lime production. Historically, today's important lime assets were owned by large industrial conglomerates. During the last three decades, many conglomerates divested from these assets, leading to the formation of larger groups of smaller companies that have lime production as their core business. The five biggest companies own around 40% of all installations in the EU. The majority of the other installations are SMEs, often single plant, family-owned enterprises, typically with lower production capacity. Lime is produced in most of the EU countries, except the Netherlands and Luxembourg. According to EuLA reports, the largest producers are Germany, France, Italy, Spain, Poland, Belgium and UK.

6 Iron&Steel sector in EU-28

The EU is the world's second largest steel producer (NACE C24.1 C24.3. C24.5) after China, accounting for 10% of global crude steel production, represented by the EUROFER association.

The distribution of production in MS is not balanced: 9 of them (Germany, Italy, France, Spain, United Kingdom, Poland, Belgium, Austria and the Netherlands) share 82% of the total EU-28 production of 2015, with Germany responsible for about 25.7% of it:



SHARE PER COUNTRY (2015)

Figure 15: Iron and Steel production share in EU-28.

The sector consists of 4 main groups, with production of basic iron and steel and of ferro-alloys (generally indicated as "non-alloy") being the most significant sector.



CRUDE STEEL PRODUCTION BY QUALITY

Figure 16: Crude steel production by quality in EU-28.

The process sharing of the production is around 60% in favour of electrical processes, while 40% is represented by other processes:



CRUDE STEEL PRODUCTION BY PROCESS

Figure 17: Crude steel production by process in EU-28.

The key economic indicators for the iron and steel sector to be used for sector analysis are:

Description	NACE (Group)	NACE (Class)	No. of enterprises [n]	No. of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of basic iron and steel and of ferro- alloys	C24.1		2,394	312,590	140,665	18,023	138,011
Manufacture of basic iron and steel and of ferro- alloys	-	C24,10	2,394	312,590	140,665	18,023	138,011
Manufacture of tubes. pipes. hollow profiles and related fittings. of	C24.2		2,019	114,968	32,320	6,821	31,005

Table 6: Iron and Steel sector in EU-28 statistics data.

steel							
Manufacture of tubes. pipes. hollow profiles and related fittings. of steel	-	C24,20	2,019	114,968	32,320	6,821	31,005
Manufacture of other products of first processing of steel	C24.3		2,926	69,827	21,544	3,877	20,603
Cold drawing of bars	-	C24,31	260	6,328	1,929	360	1,898
Cold rolling of narrow strips	-	C24,32	205	12,609	5,185	810	4,965
Cold forming or folding	-	C24,33	1,861	29,295	7,248	1,452	6,973
Cold drawing of wire	-	C24,34	600	21,595	7,182	1,254	6,768
Casting of metals	C24.5		1,961	123,113	18,924	5,680	18,567
Casting of iron	-	C24,51	1,467	93,399	14,747	4,249	14,431
Casting of steel	-	C24,52	494	29,714	4,177	1,431	4,136

The Energy consumption in Iron&Steel sector comes mostly from subsectors C24.1 (73% of total final energy consumption of sector C24) and C24.2 (24% of total energy consumption of sector C24), while C24.3 is considered non-energy intensive and C24.5 accounts for 2% of total final energy demand.

7 Other metals sector in EU-28

The Non-ferrous metals (NFM) sector (NACE C24.4 and C24.5) is composed by the upstream base metal production (aluminium, copper, lead, zinc and tin) and precious metals production and the secondary processing and fabrication activities of light metals and other non-ferrous metals. They are used in many different sectors, especially automotive, aerospace, mechanical engineering, electronics, medical devices and construction. This is due to their thermal, electrical, magnetic and isolating characteristics and their recyclability and low specific weight. The main products are reported in the Figure below:



Figure 18: Non-ferrous metals use in EU-28.

The NFM sector had an annual turnover of over 118 billion € in 2012. The largest economic contributions are delivered by 2 classes: Aluminium production (NACE C24.42) and copper production (NACE C24.44), contributing to approximately 70% and 64% of annual turnover and value added of NFM sector respectively in 2012. The production of NFM is highly energy-intensive; a reduction of energy consumption is given by the re-use of materials through recycling. The main statistics parameter for Non-ferrous metals industry are reported in the below table:

Description	NACE (Group)	NACE (Class)	Number of enterprises [n]	No, of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value
Manufactur e of basic precious and other non- ferrous metals	C24.4	-	3,600	199,617	118,271	15,000	168,216
Precious metal production	-	C24.41	738	8,762	11,045	960	10,590

Table 7: Non-ferrou	s metals s	sectors in	EU-28	statistics	data.
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Aluminium production	-	C24.42	1,510	97,598	40,222	6,019	38,632
Lead. zinc and tin production	-	C24.43	243	15,559	8,016	1,346	7,750
Copper production	-	C24.44	368	33,676	42,114	3,560	38,682
Other non- ferrous metal production	-	C24.45	713	13,337	8,381	1,444	7,805
Processing of nuclear fuel	-	C24.46	N/A	N/A	N/A	N/A	N/A
Casting of metals	C24.5	-	6,200	250,568	38,965	11,341	38,446
Casting of light metals	-	C24.53	2,038	82,644	12,841	3,951	12,731
Casting of non-ferrous	-	C24.54	1,672	28,368	6,176	1,396	6,095

8 Machinery sector in EU-28

The machinery sector is split among 4 NACE divisions:

- C25 (Manufacture of fabricated metal products, except machinery and equipment);
- C26 (Manufacture of computer, electronic and optical products);
- C27 (Manufacture of electrical equipment);
- C28 (Manufacture of machinery and equipment not elsewhere classified).

The machinery sector group has over 560,000 enterprises and over 6.9 million persons employed and contributed to a turnover of over 1,600 billion in revenue in 2012. The largest division is manufacture of machinery and equipment (C28) with 40% of the sector's turnover and persons employed. Most of the companies are SMEs, of which the majority are family owned or employing less than 50 people. The main parameters for statistical analysis of the sector are reported in the below table:

Description	NACE	Number of	No, of persons	Turnover	Value added	Production
	(Group)	enterprises	employed	[mil €]	[mil €]	value
		[n]	[n]			[mil €]
Manufacture	C25	382,611	3,561,858	468,042	159,211	448,141
of fabricated						
metal						
products.						
except						
machinery and						
equipment						
Manufacture	C25.1	117,645	1,016,128	119,486	38,052	114,868
of structural						
metal products						
Manufacture	C25.2	5,454	131,101	20,381	6,146	18,662
of tanks.						
reservoirs and						
containers of						
metal						
Manufacture	C25.3	946	27,522	8,157	2,070	7,290
of steam						
generators.						
except central						
heating hot						
water boilers						
Manufacture	C25.4	1,184	59,719	13,657	5,007	13,555
of weapons						
and						

Table 8: Machinery sector in EU-28 statistics data.

ammunition						
Forging. pressing. stamping and roll-forming of metal; powder metallurgy	C25.5	14,300	296,324	57,567	15,939	55,898
Treatment and coating of metals; machining	C25.6	140,889	1,010,834	106,109	43,495	104,282
Manufacture of cutlery. tools and general hardware	C25.7	52,000	409,979	50,685	20,702	47,986
Manufacture of other fabricated metal products	C25.9	50,193	610,251	92,000	27,800	85,600
Manufacture of computer. electronic and optical products	C26	41,473	1,013,222	252,280	70,252	219,405
Manufacture of electronic components and boards	C26.1	9,986	261,388	58,734	16,437	51,846
Manufacture of computers and peripheral equipment	C26.2	6,200	71,252	22,800	5,867	20,020
Manufacture of communicatio n equipment	C26.3	6,310	153,201	54,740	8,558	38,556
Manufacture of consumer electronics	C26.4	2,681	47,609	24,380	3,583	22,513
Manufacture of instruments and appliances for measuring. testing and navigation;	C26.5	11,300	381,237	70,000	28,000	66,000

watches and						
CIOCKS						
Manufacture of irradiation. electromedical and electrotherape utic equipment	C26.6	2,039	52,437	12,291	4,047	11,623
Manufacture of optical instruments and photographic equipment	C26.7	2,503	44,763	9,005	3,690	8,582
Manufacture of magnetic and optical media	C26.8	454	1,335	330	70	265
Manufacture of electrical equipment	C27	50,347	1,391,070	289,795	83,748	264,224
Manufacture of electric motors. generators. transformers and electricity distribution and control apparatus	C27.1	22,900	642,421	130,000	40,927	121,045
Manufacture of batteries and accumulators	C27.2	500	28,195	9,000	1,532	7,423
Manufacture of wiring and wiring devices	C27.3	4,370	199,630	48,673	11,936	46,078
Manufacture of electric lighting equipment	C27.4	7,545	137,701	27,726	8,526	23,974
Manufacture of domestic appliances	C27.5	3,632	202,274	43,703	10,750	36,617
Manufacture	C27.9	11,400	180,849	30,693	10,077	29,087

of other						
electrical						
equipment						
			2 0 0 7 0 7 0 0	624.440	100.670	504.000
Manufacture	C28	92,930	2,868,762	631,419	190,673	581,862
of machinery						
and						
equipment						
(not elsewhere						
classified)						
Manufacture	C28.1	11,734	849,422	207,000	62,000	180,000
of general-						
purpose						
machinery						
Manufactura	C28 2	26 500	010.260	184.000	F C 700	170.000
of other	C28.2	30,500	919,360	184,000	50,700	170,000
orother						
general-						
purpose						
machinery						
Manufacture	C28.3	7,307	171,126	43,419	9,973	38,862
of agricultural						
and forestry						
machinery						
Manufactura	C28 4	9 5 7 2	225 249	40.000	12.000	40.000
of motal	020.4	0,372	223,240	40,000	13,000	40,000
forming						
mashinamyand						
machine tools						
machine tools						
Manufacture	C28.9	28,817	703,606	157,000	49,000	153,000
of other						
special-						
purpose						
machinery						
1	1					

The energy consumption share of the different sectors is:

- Manufacture of fabricated metal products, except machinery and equipment (C25): 40-60%;
- Manufacture of computer, electronic and optical products (C26): 5-15%;
- Manufacture of electrical equipment (C27): 15-20%;
- Manufacture of machinery and equipment n.e.c (C28): 20-35%.

The share is however difficult to split accurately, due to the lack of disaggregated data in EUROSTAT and to the large differences among MS.

9 Energy Statistics in EU-28 – fuel and energy prices for industrial customers

For Natural Gas, Coal, Fuel Oil and Electricity, there are plenty of datasets about energy carrier prices that can be used for KPIs. For the other carriers (however less spread), a single evaluation has been performed when needed, by integrating the data with single countries statistics. A recap of the adopted fuel prices used in EU-MERCI database KPIs calculation is reported in the table below (ref. Deliverable D3.2 – Appendix 1):

Energy Carrier	Price [€/toe]	Source
WASTE	0.0	Assumed to be zero
Waste (non-renewable)	0.0	Assumed to be zero
Municipal waste (non-renewable)	0.0	Assumed to be zero
Industrial wastes	0.0	Assumed to be zero
Renewable Energy Source (RES)	0.0	Assumed to be zero
Hydro power	0.0	Assumed to be zero
Wind power	0.0	Assumed to be zero
Solar thermal	0.0	Assumed to be zero
Solar photovoltaic	0.0	Assumed to be zero
Tide, Wave and Ocean	0.0	Assumed to be zero
Geothermal Energy	0.0	Assumed to be zero
Solid biofuels (excluding charcoal)	276	ProPellets
Biogas	0.0	Assumed to be zero
Municipal waste (renewable)	0.0	Assumed to be zero
Charcoal	0.0	Assumed to be zero
Liquid biofuels	0.0	Assumed to be zero
Biogasoline	0.0	Assumed to be zero
Biodiesels	698	European Biomass Industry
		Association
Other liquid biofuels	0.0	Assumed to be zero
Bio jet kerosene	0.0	Assumed to be zero
GAS	389	EUROSTAT
Natural gas	389	EUROSTAT
OIL	661	Statistics Austria
Liquefied petroleum gas (LPG)	924	myLpg.eu
Gasoline (without bio components)	1,714	IEA
Gas/diesel oil (without bio components)	1,389	IEA
Fuel oil	334	IEA
Petroleum coke	401	Met Coke Consultants
Hard coal	99	Elaboration from BP

Table 9: Energy carriers' prices for industrial customers.

		Statistical Review of World
		Energy
Coking Coal	176	Steelonthenet.com-
		Elaboration on IEA data
ELECTRICITY	1,089	EUROSTAT
Waste heat	0.0	Assumed to be zero
N/A	0.0	N/A
ELT - End of Life Tyres	0.0	Assumed to be zero
RDS (Refuse-derived fuel)	0.0	Assumed to be zero
Solvents	0.0	Assumed to be zero
Fossil dh	0.0	Assumed to be zero
Biomass dh	0.0	Assumed to be zero

Some energy carriers have been assumed at zero costs, because they are either classified as Renewable Energy sources or coming from different types of wastes.

For other carriers it has been possible to find an average European value from different sources (e.g. Eurostat, IEA, BP Statistical Review of World Energy), while for others it has been necessary to use national data.

10 Energy Statistics in EU-28 – CO₂ emission factors from different energy carriers

For the analysis of data and the calculation of KPIs, some statistics about energy carrier CO_2 emission factors are necessary. All the factors available in literature have been converted into tonnes CO_2 /toe. A recap of the adopted emission factors used in EU-MERCI database KPIs calculation is reported in the table below:

Energy Carrier	CO ₂ emissions	Source
	[tonnes CO ₂ /toe]	
WASTE	0	Considered at 0 emissions
Waste (non-renewable)	3,84	Covenant of Mayors –
		assumed equal to municipal
		waste
Municipal waste (non-renewable)	3,84	Covenant of Mayors
Industrial wastes	3,06	DEFRA Greenhouse gas reporting
Renewable Energy Source (RES)	0,00	Considered at 0 emissions
Hydro power	0,00	Considered at 0 emissions
Wind power	0,00	Considered at 0 emissions
Solar thermal	0,00	Considered at 0 emissions
Solar photovoltaic	0,00	Considered at 0 emissions
Tide, Wave and Ocean	0,00	Considered at 0 emissions
Geothermal Energy	0,00	Considered at 0 emissions
Solid biofuels (excluding charcoal)	0,00	Considered at 0 emissions
Biogas	0,00	Considered at 0 emissions
Municipal waste (renewable)	0,00	Considered at 0 emissions
Charcoal	0,00	Considered at 0 emissions
Liquid biofuels	0,00	Considered at 0 emissions
Biogasoline	0,00	Considered at 0 emissions
Biodiesels	0,00	Considered at 0 emissions
Other liquid biofuels	0,00	Considered at 0 emissions
Bio jet kerosene	0,00	Considered at 0 emissions
GAS	2,35	ISPRA
Natural gas	2,35	ISPRA
OIL	2,93	U.S. EPA - Average among the
		three types of Distillate Fuel
		Oil
Liquified petroleum gas (LPG)	2,45	U.S. EPA
Gasoline (without bio components)	2,90	Covenant of Mayors

Table 10: CO₂ Emission factors for different energy carriers.

Gas/diesel oil (without bio components)	3,11	Covenant of Mayors
Fuel oil	2,93	U.S. EPA - Average among the
		three types of Distillate Fuel
		Oil
Petroleum coke	3,94	DEFRA Greenhouse gas
		reporting
Hard coal	3,72	U.S. EPA
Coking Coal	4,50	U.S. EPA
ELECTRICITY	5,35	Covenant of Mayors
Waste heat	0,00	Considered at 0 emissions
N/A	0,00	Considered at 0 emissions
ELT - End of Life Tyres	3,41	ETRMA
RDS (Refuse-derived fuel)	3,60	EUROPEAN COMMISSION -
		DIRECTORATE GENERAL
		ENVIRONMENT
Solvents	2,94	U.S. EPA
Fossil dh	2,79	КРС
Biomass dh	0,00	Considered at 0 emissions

Some energy carriers have been assumed at zero emissions, because they are Renewable Energy Sources. Similarly, for biomass they are at "Zero Carbon Balance". This is valid for locally produced biomasses, while for the transported ones some CO_2 emissions related to their movement shall be considered. However, since it is impossible to estimate the travelled distance and most of the records involving biomass are related to local production and consumption, for all biomass the emissions are considered equal to 0.

The emissions for the energy carriers are related only to their hydrocarbon content and not to the whole Life-Cycle of the source. For some energy carriers, it has been possible to find an average European value from different sources (e.g. ISPRA, IEA, Covenant of Mayors), while for others it has been necessary to use national data.