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 **I**ndustry

HORIZON 2020 Project Nr. 693845

Analysis of the industrial sectors in different Countries: Italy

WP4: Picture of efficiency projects implemented by the Industry sector-by-sector and process-by-process

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1 General overview of industry in Italy

The final energy consumption of the Italian industry is around 27 Mtoe (Eurostat, 2013), amounting to 10% of the EU-28, with the following breakdown into the main industrial sectors (accounting for 85% of total energy consumption of industry):

Table 1: Sectors final energy consumption in Italy.

Sector group	Final energy consumption in 2013 [ktoe]	% share of total
Pulp, paper and print	2,020	9%
Iron and steel	5,207	23%
Non-metallic mineral	4,994	22%
Chemical and petrochemical	4,121	18%
Non-ferrous metal	639	3%
Food and beverage	2,657	12%
Machinery	3,356	15%
Total	**22,994**	

Regarding energy efficiency, the Italian Action Plan for Energy Efficiency, drafted in accordance with the Energy Efficiency Directive (EED), provides that industrial sector produces about one third of the 15.5 Mtoe of savings in end-use energy. In the period 2011-2015, the sector has achieved 31% of savings expected in 2020. The following data are referred to the year 2012, for which production data are available on the Eurostat database. For this reason, it was decided to use every data dating back to 2012.

2 Food and Beverage sector

Food and Beverage sector is represented in Italy by FEDERALIMENTARE and its 15 branches, that collect 6,850 companies belonging to every sector of F&B Industry:

- **AIDEPI** *pasta, sweets, bakery and confectionary*
- **AIIPA** *frozen, baby foods, dietetic products, spices*
- **ANCIT** *canned fish*
- **ANICAV** *preserved vegetables*
- **ASSALZOO** *animal feed*
- **ASSICA** *cured and processed meat*
- **ASSITOL** *olive oil, seeds oil and margarine*
- **ASSOBIBE** *soft drinks*
- **ASSOBIRRA** *beer and malt*
- **ASSOCARNI** *fresh meat*
- **ASSOLATTE** *milk and dairy products*
- **FEDERVINI** *wine, vinegar. spirits*
- **ITALMOPA** *flours, based flour mixes*
- **MINERACQUA** *mineral natural water*
- **UNIONZUCCHERO** *sugar*

The key economic parameters of the sector are (referred to 2015) reported in the table below.

Table 2: Key economic parameters for Italian Food and Beverage sector.

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**	53,221	389,736	113,174	19,735	109,064
Processing and preserving of meat and production of meat products	C10.1	3,458	57,500	22,713	2,850	23,395
Processing and preserving of	C10.2	402	5,432	2,541	356	2,037

fish. crustaceans and molluscs						
Processing and preserving of fruit and vegetables	C10.3	1,753	28,831	10,552	1,689	10,381
Manufacture of vegetable and animal oils and fats	C10.4	3,189	10,223	6,891	613	6,008
Manufacture of dairy products	C10.5	3,446	43,542	18,673	2,749	18,220
Manufacture of grain mill products. starches and starch products	C10.6	965	9,655	7,813	7,813	7,532
Manufacture of bakery and farinaceous products	C10.7	34,427	169,083	18,458	5,348	18,044
Manufacture of other food products	C10.8	5,062	58,134	20,426	4,677	18,875
Manufacture of prepared animal feeds	C10.9	519	7,337	5,108	625	4,571
Manufacture of beverages	**C11**	3,191	37,263	18,106	3,445	19,195
Distilling. rectifying and blending of spirits	C11.01	518	4,804	2,531	621	2,664
Manufacture of wine from grape	C11.02	2,007	19,969	8,748	1,513	8,910
Manufacture of cider and other fruit wines	C11.03	0	0	0	0	0
Manufacture of other non-	C11.04	53	156	35	7	35

distilled fermented beverages						
Manufacture of beer	C11.05	377	3,123	1,767	372	1,816
Manufacture of malt	C11.06	0	0	0	0	0
Manufacture of soft drinks; production of mineral waters and other bottled waters	C11.07	233	9,770	4,575	926	4,759

The agrifood system (primary production, processing and distribution) in the EU has a total turnover of 1,244 billion €. The food industry is characterized by 99.1% of small and medium-sized enterprises (SMEs), 90% of which are distributed mainly in Southern Europe. The food industry is one of the most important economic sectors in the EU manufacturing industry and the energy costs deriving from the activities of the numerous chains that characterize it are equally significant (Table below).

Table 3: Comparison between World-European-Italian Food and Beverage industry.

Agrifood system	Energy consumption [%]	Final energy consumption	Source
World	32%	95 EJ/year	FAO, issue paper 2011
Europe-27	26%	285 Mtoe	Elaboration of ENEA
Italy	12.75%	15.18 Mtoe**	ENEA-UTEE RAEE 2015

In Italy, the final energy consumption of the agri-food system totals 15.2 Mtoe (2014), of which 13.3 Mtoe from the agriculture and food industry, 0.2 Mtoe from the fisheries sector and 1.7 Mtoe by the forestry chain. The primary energy consumption of the sector was about half (4.7 Mtoe) than that of the food industry (8.6 Mtoe). Ultimately, the total energy consumption of the agri-food system represented 12.8% of final energy consumption at national level in 2014.

In terms of energy from secondary sources, the breakdown shows Low sulphur fuel oil and electricity among the highest demand carriers for the food industry, respectively 35.6% and 27.5%.

The Table below shows the strong disproportion between the energy contained in the products and the energy used in the processes of meat production, vegetable production, IV vegetable and frozen vegetables. The high ratio of cold chains and greenhouse production (20:1) is particularly significant, especially when compared to crop cultivation in the field with a ratio of 1.23 or cultivation of autumn cereals with a ratio of 2.53.

Table 4: Energy intensity of Food and Beverage industry in Italy.

TYPE OF FOOD PRODUCT	Energy Intensity [kWhout/kWhin]
Fresh meat (stalls consuming, slaughter consumption)	0.23
Frozen meat (stall, slaughter, refrigeration)	0.16
Fresh greenhouse vegetables (plant protection products)	0.04
Vegetables IV range (production, processing)	0.04
Frozen vegetables (production, processing, refrigeration)	0.03
Fresh field crops (plant protection, soil treatment)	1.23
Autumn-winter cereals (plant protection, soil treatment)	2.53

In 2014 the energy intensive sectors accounted about 2/3 of the total industry consumption in Italy (60%). Food industry registered a consumption share equal to 10.8% on the total.

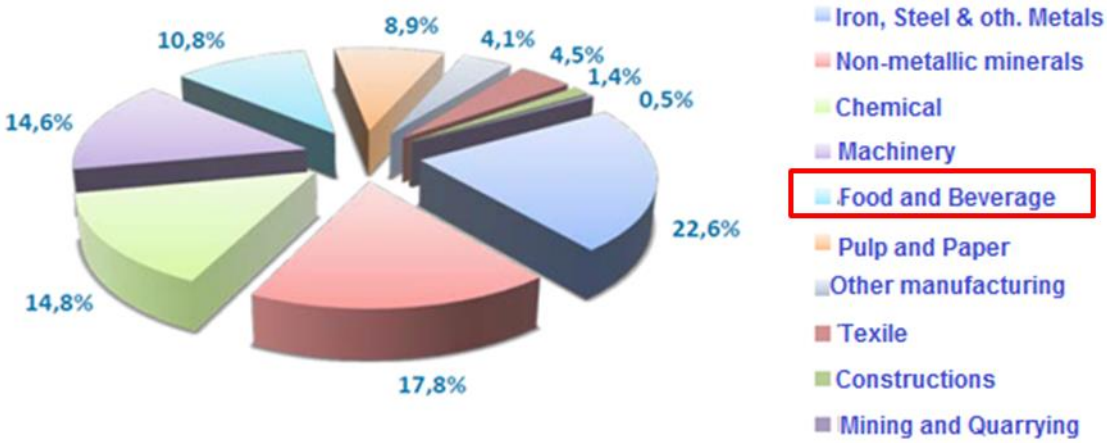

Figure 1: Energy consumption share of energy intensive sectors in Italy.

With respect to the energy produced from secondary sources, the table below shows Low Sulphur oil fuel and electric energy as the most demanded from the food industry with, respectively, 35.5% and 27.5% of total Italian consumption.

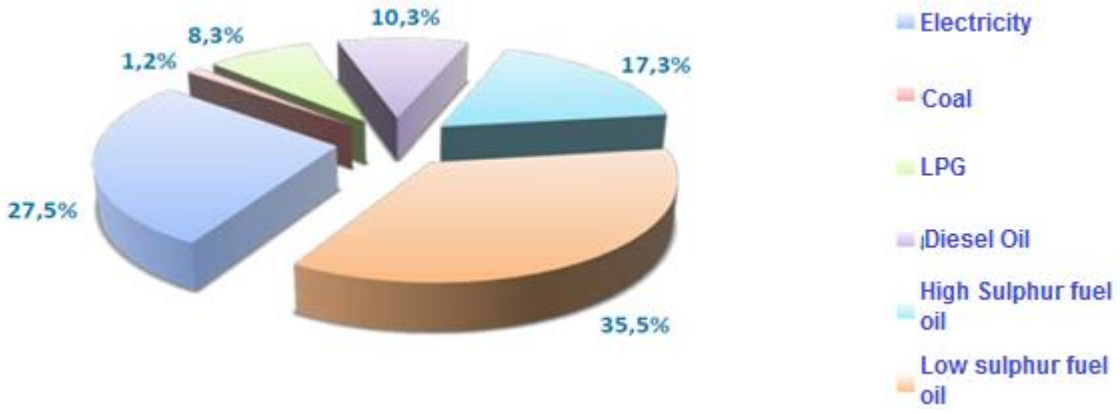

Figure 2: Fuel use in Food and Beverage industry in Italy.

3 Pulp, paper and print sector

Pulp, paper and print sectors covers NACE C17. It is divided into Manufacture of pulp, paper and paperboard (NACE C17.1) and Manufacture of articles of paper and paperboard (NACE C17.2), the first one being much more relevant in terms of energy consumption, even if the latter is more relevant in terms of number of enterprises and employees. Manufacture of Pulp, is not spread in Italy. However, there are important paper production areas (e.g. in Tuscany, in Lucca province), where many companies belonging to manufacture of articles of paper and paperboard are located. The key economic parameters of the sector are (referred to 2015) are showed in the table below.

Table 5: Key economic parameters for Italian Pulp and Paper sector.

Description	NACE group	NACE division	No. of enterprises [n]	No. of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of paper and paper products		C17	3,801	71,632	22,516	4,998	21,822
Manufacture of pulp, paper and paperboard		C17.1	211	10,834	5,269	980	4,723
Manufacture of pulp		C17.11	5	127	51	12	50
Manufacture of paper and paperboard		C17.12	206	10,707	4,971	968	4,631
Manufacture of articles of paper and paperboard		C17.2	3,590	60,798	17,246	4,018	17,098

The Italian pulp and paper industry uses recycled paper as raw material for about 49% of its production (data from Assocarta). The final energy consumption of the sector is reported in the table below.

Table 6: Paper industry energy consumption by energy carrier in Italy.

Energy Source	2013	2014
Electricity consumption (TWh/y)	7.11	7.01
Electricity production (TWh/y)	5.52	5.54
Of which produced through hydro or solar PV (%)	3.3%	3.0%

Of which produced with CHP	95.3%	95.6%
Use of natural gas (TJ/y)	87,300	86,700
Energy production from biomass and wastes (TJ/y)	500	500
Use of process heat (TJ/y)	44,300	43,400

4 Petroleum refineries sector

Two key groups are the most relevant in petroleum refineries sector: 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.

Table 7: Key economic parameters for Italian Petroleum refineries sector.

Description	NACE group	No. of enterprises [n]	No. of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of coke and refined petroleum products	C19	320	15,852	71,424.9	1961.7	53,307.0
Manufacture of coke oven products	C19.1	4	272	183.6	35.3	196.4
Manufacture of refined petroleum products	C19.2	316	15,580	71,241.3	1926.4	53,110.6

The sector generates over 50 billion € of revenues in Italy. Refined petroleum products are the largest subsector, accounting almost the whole production value. The money spent in research and development has not affected the gross domestic product significantly, as you can see from the tables below.

Table 8: Petroleum refineries in Italy - distribution of enterprises.

Sector	SMEs [n]	Large enterprises [n]
Manufacture of coke and refined petroleum products	305	15

Table 9: Petroleum refineries in Italy - research and development.

Sector	Expenditure in R&D [mil €]	% of Italian GDP
Manufacture of coke and refined petroleum products	17,368	0.001%

Exports represents near 40% of the production value, while imports are half of exports.

Table 10: Petroleum refineries in Italy - imports/exports.

Sector	**Production value** [mil €]	**Import value** [mil €]	**Export value** [mil €]
Manufacture of coke and refined petroleum products	78,962	10,577	20,513

5 Chemical sector

Nowadays, the chemical industry sector in Italy represents about 6% of the turnover produced by the manufacturing industry. The main parameters for statistical analysis are reported in the below table.

Table 11: Key economic parameters for Italian Chemical sector

Description	NACE group	No. of enterprises [n]	No. of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of chemicals and chemical products	C20	4,436	111,264	53,388.1	9,144.7	51,043.4
Manufacture of basic chemicals. fertilisers and nitrogen compounds. plastics and synthetic rubber in primary forms	C20.1	1,076	39,357	24,692.2	3,238.6	23,911.7
Manufacture of pesticides and other agrochemical products	C20.2	45	1,823	946.4	185.5	955.9
Manufacture of paints. varnishes and similar coatings. printing ink and mastics	C20.3	870	20,039	5,919.2	1,382.6	5,675.3
Manufacture of soap and detergents. cleaning and polishing preparations. perfumes and toilet preparations	C20.4	1,370	26,249	9,075.3	2,213.2	8,993.6
Manufacture of other chemical products	C20.5	1,033	20,796	11,400.2	1,961.7	10,147.7

Manufacture of man-made fibres	C20.6	42	3,000	1,354.5	163.1	1,359.1
Manufacture of basic pharmaceutical products and pharmaceutical preparations	C21	464	61,601	26,205	7,725.1	23,878.5
Manufacture of basic pharmaceutical products	C21.1	103	12,456	4,586.5	1,516.7	4,509.2
Manufacture of pharmaceutical preparations	C21.2	361	49,145	21,618.7	6,208.5	19,469.3

In pharmaceutical sector, 15% of the total enterprises are large enterprises, the highest percentage if compared to chemical sector and other sectors in general.

Table 12: Chemical industry in Italy - distribution of enterprises.

Sector	**SMEs** [n]	**Large enterprises** [n]
Manufacture of chemicals and chemical products	4,375	61
Manufacture of basic pharmaceutical products and pharmaceutical preparations	402	62

Technological innovation is a feature of this sector, although in recent years it has invested less in R&D: the following table shows that in 2012 expenditure in research and development was less than 1% of the turnover.

Table 13: Chemical industry in Italy - research and development.

Sector	**Expenditure in R&D** [mil €]	**% of Italian GDP**
Manufacture of chemicals and chemical products	385.6	0.02%

In manufacturing of chemical products, the exports represent about half of the production value, while the import is relevant, too. The energy consumption of the chemical sector is very high; it concurs for near 30% to the entire manufacture sector's consumption.

Table 14: Chemical industry in Italy - research and development.

Sector	**Production value** [mil €]	**Import value** [mil €]	**Export value** [mil €]
Manufacture of chemicals and chemical products	51,043	35,627	25,331

Chemical industry is very complex as it includes a lot of branches with different features: the following Figure, based on *Federchimica* data shows the distribution of chemicals production in Italy.

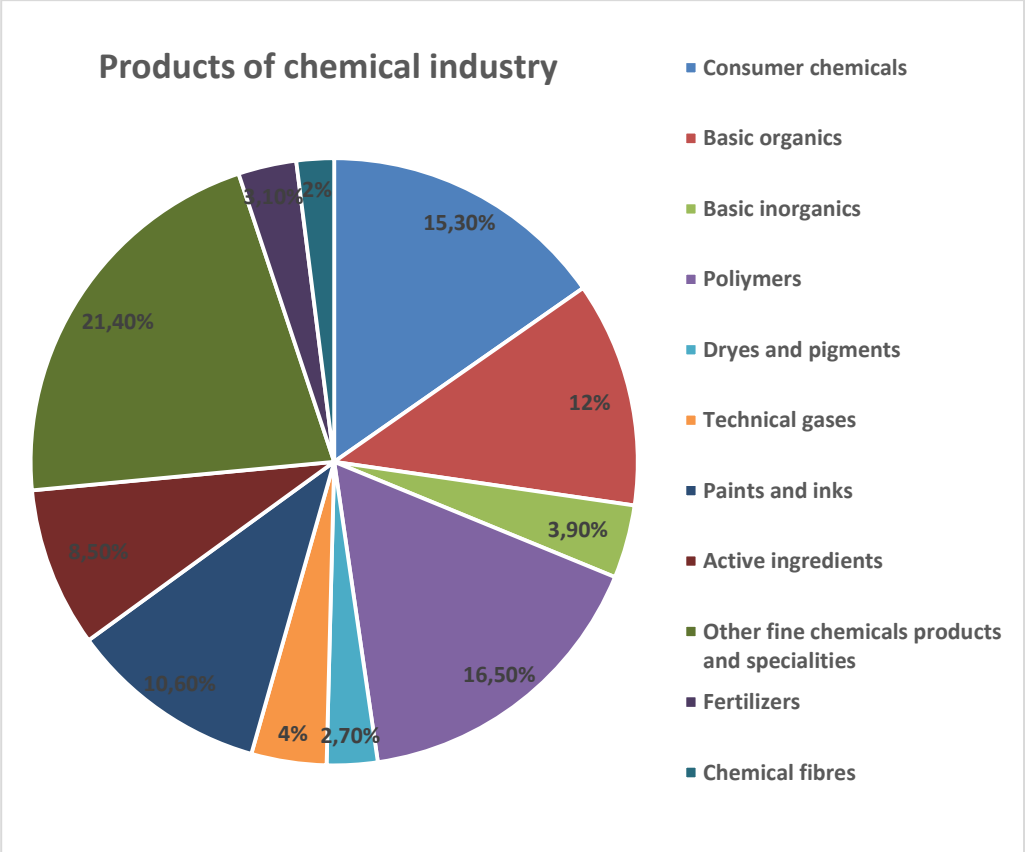

Figure 3: Products of chemical industry.

6 Non-metallic minerals sector

Non-metallic mineral products comprise of the production of cement, ceramics, glass and lime. Non-metallic mineral (C23) sector is composed by the following subsectors:

- 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 general statistic parameters for sector analysis are shown in the table below.

Table 15: Key economic parameters for Italian Non-metallic minerals sector.

Description	NACE group	No. of enterprises [n]	No. of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of other non-metallic products	C23	21,420	191,799	31,219.1	8,832.2	31,303.0
Manufacture of glass and glass products	C23.1	3,999	38,294	6,026.9	2,009.5	6,227.7
Manufacture of refractory products	C23.2	124	2,649	665.8	173.2	608.5
Manufacture of clay building materials	C23.3	762	29,932	5,488.1	1,690.7	5,436.8
Manufacture of other porcelain and ceramic products	C23.4	2,528	13,471	1,072.0	389.4	1,053.4
Manufacture of cement. lime and plaster	C23.5	191	9,485	2,487.7	743.4	2,775.0
Manufacture of articles of concrete. cement and plaster	C23.6	3,412	41,911	7,751.9	1,473.3	1,688.4
Cutting. shaping and finishing of stone	C23.7	9,360	43,935	4,920.9	1,484.5	4,844.7
Manufacture of abrasive products and non-metallic mineral products n.e.c.	C23.9	1,044	12,122	2,805.8	653.2	2,660.4

Considering the turnover, glass and cement industry are the most relevant subsectors, although stone industry (23.7) has the highest number of enterprises and persons employed. Almost the whole enterprises of the sector are SMEs.

Table 16: Non-metallic mineral in Italy - distribution of enterprises.

Sector	SMEs [n]	Large enterprises [n]
Manufacture of other non-metallic products	21,346	74

Table 17: Non-metallic mineral in Italy - research and development.

Sector	Expenditure in R&D [mil €]	% of Italian GDP
Manufacture of other non-metallic products	108.7	0.01%

The exports represent nearly 30% of the production value of the entire sector, while the imports have a lower weight.

Table 18: Non-metallic mineral in Italy - imports/exports.

Sector	Production value [mil €]	Import value [mil €]	Export value [mil €]
Manufacture of other non-metallic products	31,303	3,244	8,924

6.1 Glass sector in Italy

The glass industry consists of several branches, which differ on the type of finished product and on the production process.

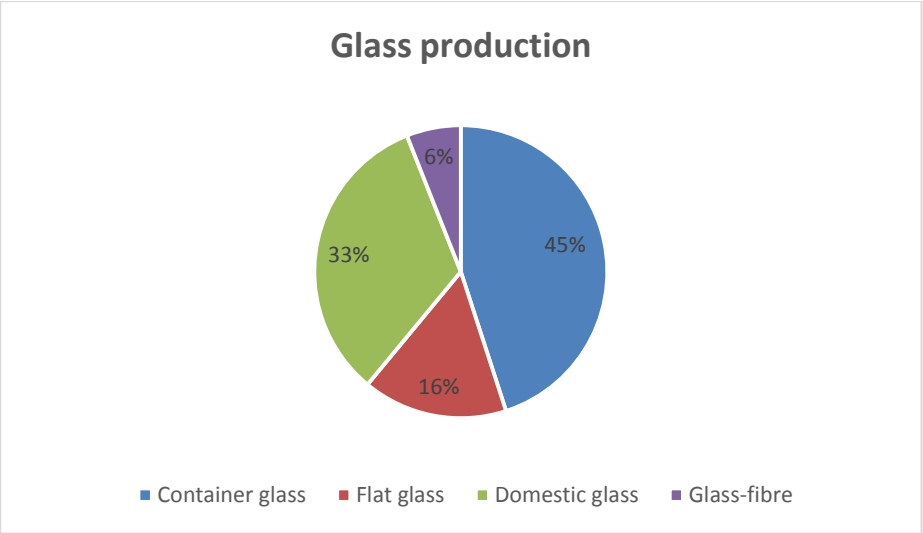

Figure 4: Products of glass industry in Italy.

Container glass is used properly in food and beverage sector, whereas flat glass is used for automotive and building. Imports and exports are quite relevant for all product types, compared to the national production (see table below).

Table 19: Imports/exports of glass industry (Source: Assovetro).

	Container glass	Flat glass	Domestic glass	Glass-fibre	Total
Production (ton.)	3,936,885	838,019	148,422	86,829	5,010,155
Import (ton.)	742,599	278,494	86,731	164,070	1,107,824
Export (ton.)	556,899	148,342	101,023	79,847	806,264

In 2015, the total production of container glass was 3,936,885 tonnes (source: Assovetro, Italian association of glass producers), 86% of which was bottles: other articles of this sub sector were containers for pharmaceutical industries and food jars.

6.2 Cement sector in Italy

The Cement industry consumes 85% of the total final energy of non-metallic mineral sector. This subsector is energy intensive and typically the costs related to energy uses are about 40% of total cost production. AITEC is the Italian association of cement producers. They have published the activities of cement industries in the last years, which is shown in the following table.

Table 20: Imports/exports of cement industry in Italy.

	2012	2013	2014
Production (ton.)	26,244,000	23,083,000	21,542,000

Import (ton.)	1,834,000	1,364,000	1,195,000
Export (ton.)	1,757,000	2,443,000	2,502,000

Imports and exports are scarcely relevant if compared to production values. This is in line with the expectations from cement industry. As reported in par. **Errore. L'origine riferimento non è stata trovata.**, it is not economically convenient to transport cement on long distances, so the production is usually focused in the radius of 200-300 km from the large construction sites.

6.3 Ceramic sector in Italy

The ceramic industries in Italy can be divided into some sub sectors, which are tiles, sanitary, flat and refractory: in particular ceramic tiles are one of the most developed product. Exports have a key role in ceramic sector; indeed, 84% of the overall turnover is attributed to overseas sales. Domestic market remains stable over the years. The following table, based on data of *Confidustria Ceramica*, the Italian association of ceramic industries, shows the results for the ceramic tiles market in the last years: a large percentage of the tiles produced is exported to foreign markets.

Table 21: Imports/exports of ceramic tiles industry.

	2013	**2014**	**2015**
Production (10^6 m^2)	399	375	395
Import (10^6 m^2)	17.7	14.0	17.0
Export (10^6 m^2)	301.8	305.6	317.0

7 Iron&Steel sector

The sector is made up of four main groups, with production of basic Iron&Steel and of ferro-alloys (generally indicated as "non-alloy") being the most significant sector in terms of revenues, value added and production value. This industrial sector is considered energy intensive. The key economic indicators for the iron and steel sector to be used for sector analysis in Italy are shown in the table below.

Table 22: Key economic parameters for Italian Iron and Steel sector.

Description	NACE group	No. of enterprises [n]	No. of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of basic metals	C24	3,811	124,667	57,395.8	7,441.1	57,256.1
Manufacture of basic iron and steel and of ferro-alloys	C24.1	460	41,441	22,248.6	2,255.2	22,336.3
Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	C24.2	360	17,256	9,088.2	1,513.6	8,986.2
Manufacture of other products of first processing of steel	C24.3	1,107	17,419	6,351.2	1,010.3	6,271.5

In 2012 the sector counted 3,800 enterprises, 2% of which are large enterprises.

Table 23: Iron & steel in Italy - distribution of enterprises.

Sector	SMEs [n]	Large enterprises [n]
Manufacture of basic metals	3,743	68

Table 24: Iron & steel in Italy - research and development.

Sector	Expenditure in R&D [mil €]	% of Italian GDP
Manufacture of basic iron and steel and of	53.34	0.01%

ferro-alloys		
Manufacture of basic precious and other non-ferrous metals	27.70	0.01%

Both imports and exports are particularly relevant for the manufacture of basic metals, equalling to more than half of the entire production value, which is an index of a prosperous market.

Table 25: Iron & steel in Italy - imports/exports.

Sector	**Production value** [mil €]	**Import value** [mil €]	**Export value** [mil €]
Manufacture of basic iron and steel and of ferro-alloys	57,256	30,898	32,874

The production of total crude steel has maintained almost constant during the last years, meanwhile stainless crude's production has had a considerable decrease between the years 2012 and 2014.

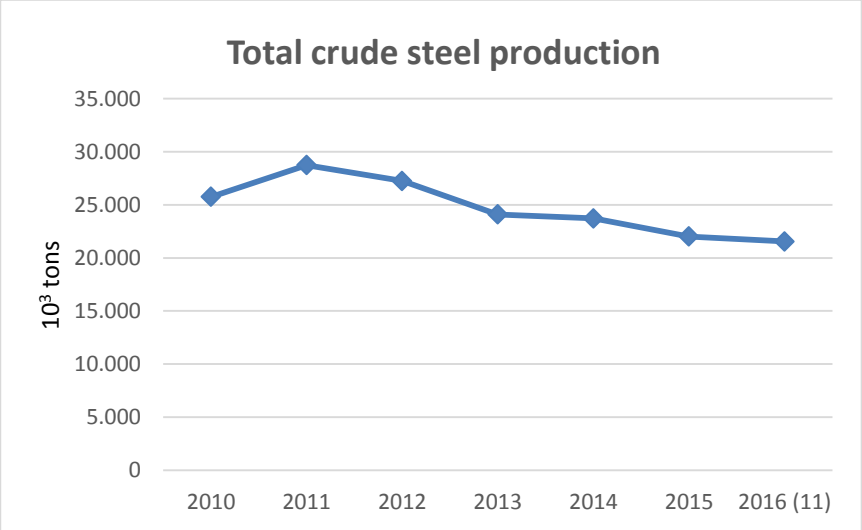

Figure 5: Total crude steel production in Italy.

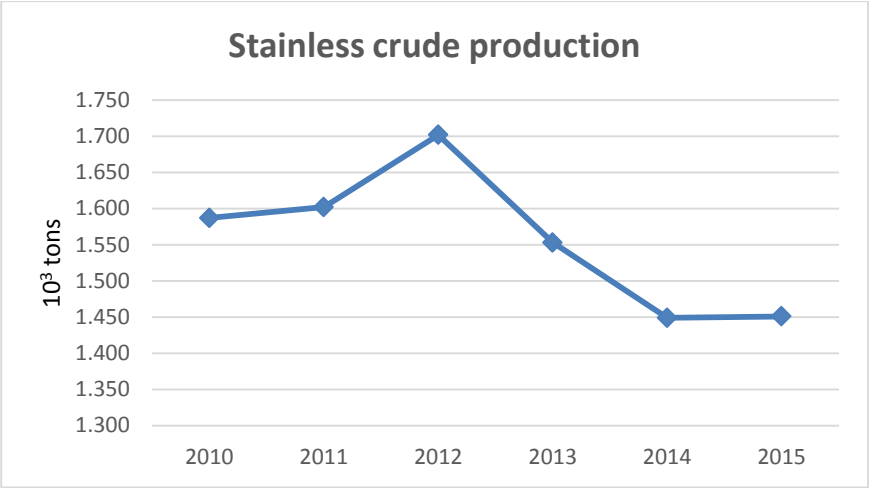

Figure 6: Stainless crude production in Italy.

Since 2012, imports of steel (both all qualities and stainless) have increased, especially from China and Asian market; exports have remained almost constant, except for a decrease of stainless in the years 2012-2013.

Figure 7: All qualities steel imports/exports in Italy.

Figure 8: Stainless steel imports/exports in Italy.

8 Other metals sector

The category of non-ferrous metals includes all metals that do not contain ferrous materials, such as cast iron, iron, etc. The main metals that fall into these classifications are: aluminium, nickel, lead, copper, tin, zinc. In some classifications, this category is treated together with the metallurgy in general, but in the following discussion is divided to be able to adapt to the classification of Eurostat.

Table 26: Key economic parameters for Italian Other metals sector.

Description	NACE group	No. of enterprises [n]	No. of persons employed [n]	Turnover [mil €]	Value added [mil €]	Production value [mil €]
Manufacture of basic precious and other non-ferrous metals	C24.4	741	18,921	13,286.2	1,181.4	13,232.6
Casting of metals	C24.5	1,143	29,630	6,421.6	1,481.0	6,429.5

9 Machinery sector

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 in Italy has over 107,000 enterprises and 1,260,000 people employed, while it contributed to a turnover of over 246,800 in revenue in 2012. The largest division of this sector is the manufacture of machinery and equipment (C28) with 45% of the sector's turnover and 45% of the sector's production value. Most of the companies are SMEs, over 99% of all that enterprises countless of 250 employees:

Table 27: Machinery sector in Italy - distribution of enterprises.

Sector	SMEs [n]	Large enterprises [n]
Manufacture of fabricated metal products, except machinery and equipment	69,436	92
Manufacture of machinery and equipment n.e.c.	23,489	196
Manufacture of electrical equipment	8,895	76
Manufacture of computer, electronic and optical products	5,469	51

This industrial sector has a turnover of 246,800 million €.

Table 28: Machinery sector in Italy - research and development.

Sector	Expenditure in R&D [mil €]	% of Italian GDP
Manufacture of fabricated metal products, except machinery and equipment	278.8	0.02

Manufacture of computer, electronic and optical products	1,295.70	0.08
Manufacture of electrical equipment	483	0.03
Manufacture of machinery and equipment n.e.c.	1,371.70	0.09

Unfortunately, there are not disaggregate data for each sub-sector, so the table reports the sum for every macro-sector even if there is some missing data. Moreover, it was not so easy define the quantities of production, import and export because of the different units of measurement adopted (e.g. p/st or kg)..

Table 29: Machinery sector in Italy - imports/exports.

Sector	**Production value** [mil €]	**Import value** [mil €]	**Export value** [mil €]
Manufacture of fabricated metal products, except machinery and equipment	78,962	6,779	18,189
Manufacture of computer, electronic and optical products	20,877	25,451	12,628
Manufacture of electrical equipment	37,670	13,301	19,940
Manufacture of machinery and equipment n.e.c.	109,152	22,367	71,607

According to Eurostat the main parameters to be used for the analysis of these sectors are reported in the table below.

Table 30: Key economic parameters for Italian Machinery sector.

Manufacture of fabricated metal products (except machinery and equipment)						
Description	**NACE group**	**No. of enterprises** [n]	**No. of persons employed** [n]	**Turnover** [mil €]	**Value added** [mil €]	**Production value** [mil €]
Manufacture of fabricated metal products except machinery and equipment	C25	64,366	502,504	75,064	24,885	78,962

Manufacture of structural metal products	C25.1	31,122	157,830	18,323	5,823	20,284
Manufacture of tanks reservoirs and containers of metal	C25.2	592	12,296	2,198	651	2,441
Manufacture of steam generators. except central heating hot water boilers	C25.3	123	2,536	590	145	599
Manufacture of weapons and ammunition	C25.4	224	7,067	1,941	624	2,473
Forging. pressing stamping and roll-forming of metal; powder metallurgy	C25.5	1,397	38,503	10,126	2,677	11,167
Treatment and coating of metals; machining	C25.6	14,891	131,126	16,803	6,525	16,780
Manufacture of cutlery tools and general hardware	C25.7	4,670	52,475	7,730	3,044	7,291
Manufacture of other fabricated metal products	C25.9	11,347	100,671	17,354	5,396	17,928
Manufacture of computer, electronic and optical products	C26	5,520.	108,692	21,019	6,797	20,877
Manufacture of electronic components and boards	C26.1	2,186	38,273	5,924	2,132	5,909
Manufacture of computers and peripheral equipment	C26.2	621	6,718	1,624	349	1,673
Manufacture of communication equipment	C26.3	848	25,271	5,182	1,593	5,044
Manufacture of consumer electronics	C26.4	210	2,228	525	105	460
Manufacture of instruments and appliances for measuring, testing and navigation; watches	C26.5	863	21,369	4,305	1,512	4,446

and clocks						
Manufacture of irradiation, electromedical and electrotherapeutic equipment	C26.6	629	12,530	2,914	940	2,871
Manufacture of optical instruments and photographic equipment	C26.7	140	2,222	533	164	462
Manufacture of magnetic and optical media	C26.8	23	81	9.3	2.9	9.3
Manufacture of electrical equipment	C27	8,971	164,365	37,543	9,912	37,670
Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus	C27.1	2,925	52,204	12,141	3,553	12,206
Manufacture of batteries and accumulators	C27.2	62	2,962	1,126	215	1,132
Manufacture of wiring and wiring devices	C27.3	925	17,582	6,054	1,124	6,659
Manufacture of electric lighting equipment	C27.4	1,525	16,972	3,055	846	3,015
Manufacture of domestic appliances	C27.5	510	39,552	8,698	2,159	8,019
Manufacture of other electrical equipment	C27.9	3,024	35,093	6,470	2,016	6,639
Manufacture of machinery and equipment n.e.c.	C28	23,685	452,440	110,045	30,235	109,152
Manufacture of general-purpose machinery	C28.1	2,892	100,407	29,907	7,692	28,812
Manufacture of other general-purpose machinery	C28.2	7,612	154,198	36,764	10,698	37,021
Manufacture of agricultural and forestry machinery	C28.3	1,897	31,165	8,604	1,680	7,558

Manufacture of metal forming machinery and machine tools	C28.4	1,883	36,518	7,276	2,116	7,337
Manufacture of other special-purpose machinery	C28.9	9,401	130,152	27,499	8,049	28,423

10 Energy Statistics

10.1 Energy consumption

The total gross inland consumption split by fuel for Italy in 2015 is reported in the below table.

Table 31: Italian gross inland energy consumption by energy carrier [ktoe].

Total all products	**156,169**
Solid fuels	**12,301**
Coking coal	1,662
Other bituminous coal	10,142
Sub-bituminous coal	200
Lignite / Brown Coal	1
Coke oven coke	296
Oil (total)	**57,160**
Crude oil	67,432
Refinery Feedstocks	5,704
Additives / Oxygenates	439
LPG	2,253
Motor Gasoline (w/o bio)	-8,349
Kerosene Type Jet Fuel	1,819
Other Kerosene	49
Naphtha	276
Gas/Diesel Oil (w/o bio)	-6,261
Fuel Oil	-4,868
Lubricants	-757
Bitumen	-1,380
Petroleum Coke	929
Paraffin Waxes	-22

Other Products	-107
Gas	**55,301**
Natural gas	55,301
Total Renewables	**26,269**
Hydro power	3,916
Wind power	1,276
Solar thermal	190
Solar PV	1,973
Solid biomass	8,578
Charcoal	42
Biogas (all)	1,871
Municipal wastes (renew.)	846
Bio gasoline	25
Biodiesel	1,144
Other liquid biofuels	938
Geo-thermal	5,469
Wastes (non ren.)	**1,149**
Industrial wastes	303
Municial wastes (non-ren.)	846
Electricity	**3,988**

The oil and natural gas consumption are almost equal, and each of them is around the double of Renewable Energy Sources. Solid fuels consumption is significant but is less than half of Renewable Energy Sources.

The total Final Energy consumption, including industry, transport and other sectors in 2015 was 116,444 ktoe (two thirds of the gross inland consumption). The split among the different sectors is shown in the table below:

Table 32: Final Energy consumption by sector in Italy.

Sector	**Final Energy Consumption** [ktoe]	**Share %**
Industry	26,023	22.3%
Transport	39,541	34.0%

Services	15,391	13.2%
Residential	32,494	27.9%
Agriculture / Forestry	2,663	2.3%
Fishing	188	0.2%
Non-specified (Other)	143	0.1%

Considering only industry, the split by different fuels is reported in the diagram below.

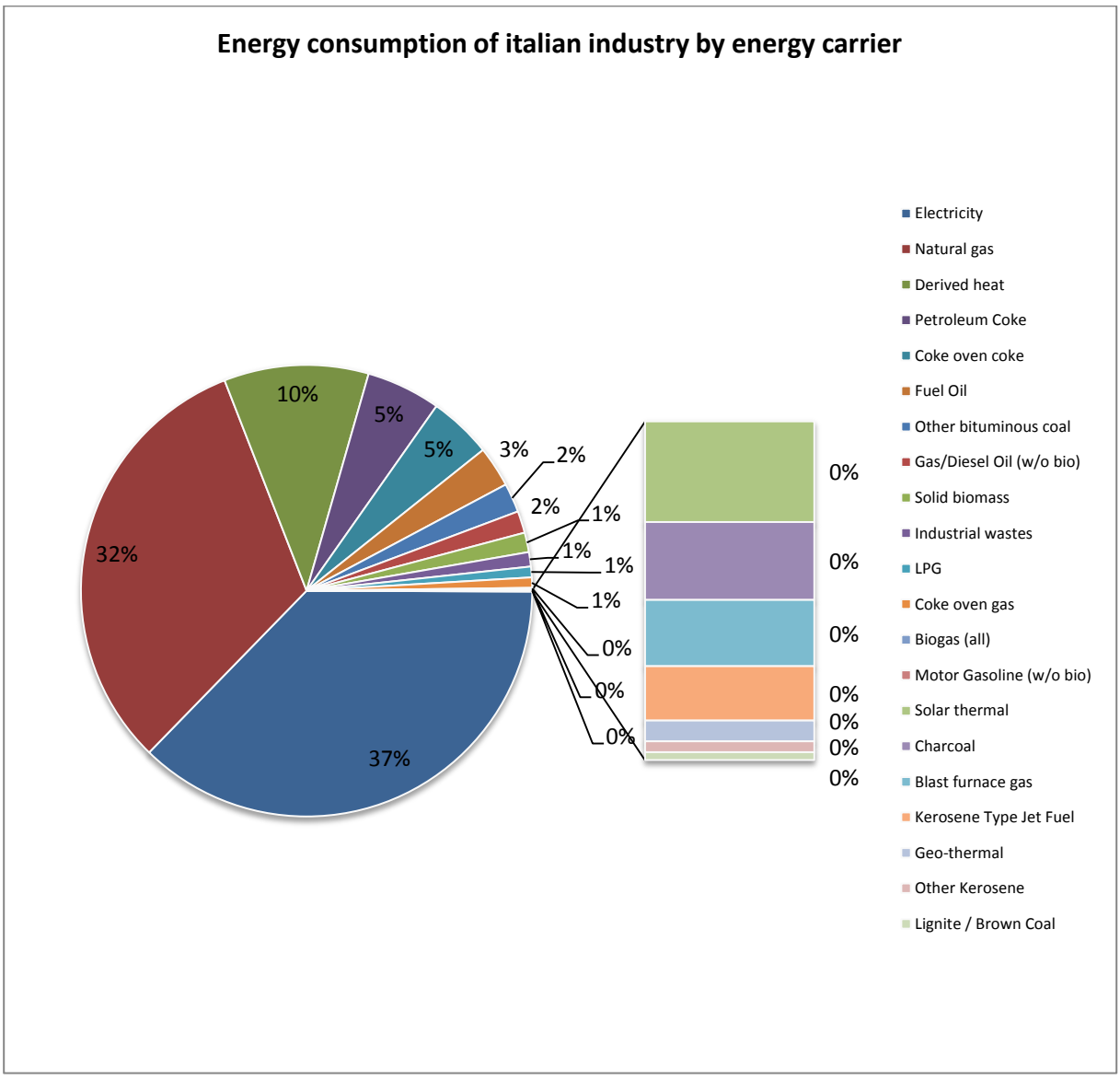

Figure 9: Final Energy consumption of Italian industry by energy carrier.

The most relevant energy carriers are Electricity and Natural gas with the highest energy saving potentials. Derived heat plays also an important role, with 10% share and overall 2,696 ktoe of consumption. The carriers from biogas to lignite/brown coal have a cumulative weight of 0.26%, so not influencing much the sector's consumption. The energy carriers' consumption by each manufacturing sector for 2015 is reported in the table below.

Table 33 Final Energy consumption per sectors per energy carrier in Italy [ktoe].

	Iron & steel	Chemical and Petroch.	Non-ferrous metal	Non-metallic Minerals (Glass, pottery & building mat.)	Transport Eq.	Machin.	Mining and Quarrying	Food and Tabacco	Paper, Pulp and Print	Wood and Wood Products	Constr.	Textile and Leather	Non-specified
Total	4,716	3,292	625	4,971	398	3,357	111	2,708	2,372	453	350	1,106	1,564
Solid fuels	1,579	1	3	138	0	0	0	0	0	0	0	0	1
Other bituminous coal	407	0	0	136	0	0	0	0	0	0	0	0	0
Lignite / Brown Coal	0	0	0	1	0	0	0	0	0	0	0	0	0
Coke oven coke	1,172	1	3	1	0	0	0	0	0	0	0	0	1
Oil (total)	90	266	30	1,687	0	279	25	194	68	0	22	82	34
LPG	14	5	11	94	0	38	2	16	5	0	1	8	3
Motor Gasoline (w/o bio)	0	0	0	0	0	17	0	0	0	0	0	0	0
Kerosene Type Jet Fuel	0	0	0	0	0	5	0	0	0	0	0	0	0
Other Kerosene	0	0	0	0	0	1	0	0	0	0	0	0	0
Gas/Diesel Oil (w/o bio)	14	114	6	47	0	98	21	34	16	0	21	26	10
Fuel Oil	61	142	13	164	0	119	1	144	46	0	0	48	21

Petroleum Coke	0	4	0	1,382	0	0	0	0	0	0	0	0	0
Gas	1,389	936	378	1,893	0	1,333	32	1,100	613	29	211	539	19
Natural gas	1,191	936	378	1,893	0	1,333	32	1,100	613	29	211	539	19
Coke oven gas	192	0	0	0	0	0	0	0	0	0	0	0	0
Blast furnace gas	6	0	0	0	0	0	0	0	0	0	0	0	0
Total Renewable	0	8	0	146	0	2	0	49	0	135	0	0	63
Solar thermal	0	0	0	0	0	0	0	0	0	0	0	0	10
Solid biomass	0	1	0	146	0	2	0	29	0	135	0	0	51
Charcoal	0	0	0	0	0	0	0	7	0	0	0	0	0
Biogas (all)	0	7	0	0	0	0	0	13	0	0	0	0	0
Geo-thermal	0	0	0	0	0	0	0	0	0	0	0	0	2
Wastes (non ren.)	0	71	0	168	0	3	0	0	0	0	0	0	27
Industrial wastes	0	71	0	168	0	3	0	0	0	0	0	0	27
Derived heat	160	811	0	166	96	25	1	320	940	31	0	35	110
Electricity	1,499	1,200	214	773	302	1,715	54	1,045	751	259	117	450	1,309

Iron and steel industry is by far the largest consumer of solid fuels, especially Coke oven and Bituminous coals, and one of the most relevant in terms of Natural gas consumption. Other energy carriers used in Iron and Steel sector (however in much lower quantities) are Coke oven gas, Derived heat and Fuel oil. Furthermore, electricity consumption is quite high, around 15% of the electricity consumption of whole industry. This originates from the structure of the industry, characterized by large furnaces either run with solid fuels and natural gas (Blast furnaces, Basic Oxygen Furnaces and, with lower consumption, annealing furnaces) or by electricity (Electric Arc Furnaces).

For chemical sector, the most relevant consumption is in Electricity, and in terms of fuels also Oil and Gas play an important role. Derived heat is also consumed in high quantities in this sector. Considering the variety of the products/processes, it is difficult to allocate these consumptions to specific technologies. Chemicals show also a relevant consumption of wastes, probably coming from the plants themselves and re-used as fuels and biogas.

For non-ferrous metals, whose process is similar to the one of Iron&steel but without the step in which coke is reduced to pass Carbon to Iron, the structure is also similar to the one of Iron&Steel, but without coke, showing a large consumption of electricity and natural gas and a smaller consumption of oil.

Non-metallic minerals are unique: they are almost the only consumers of Petroleum coke, mainly centered on cement manufacturing plants. In cement industry, Petroleum Coke, Coal and Fuel oil, plus a small amount of Natural gas, are burnt in large quantities in kilns, to transform the mixture of raw materials into clinker. In cement production, also the use of wastes is relevant, where End-of-life tyres play the most important role as replacements for fossil fuels in the kiln, while some renewable wastes (e.g. dried muds from sewage plants and solid biomass) are used for raw materials preparation and fuels preparation in the drying phases. For glass and ceramics, the use of fossil fuels is also very high, especially in the furnaces that are the core of the processes. Also, electricity consumption, partially in furnaces and partially in the forming sections, plays a relevant role. Considering the high temperatures of the furnaces and the constant need of heat in the plants, it is not surprising that also some derived heat is used in these sectors.

Machinery, like the chemical sector, comprises a large variety of different products/processes. The most relevant energy carrier are Electricity and Natural gas, followed by oil, but it is difficult to allocate the consumptions to specific processes.

Also, food and tobacco are characterized by several different products and processes, and their main consumptions are in terms of natural gas and electricity. A characteristic of this sector is the use of biomass and biogas, mostly coming as a waste from the production processes. Also derived heat plays an important role.

Also for pulp and paper sector derived heat is important, together with natural gas and electricity. The process for pulp and paper manufacturing foresees a high use of heat especially in the drying section, while electricity is mostly used in the other parts of the papermaking machines.

10.2 Energy costs

A comparison between Italy, European Union and Euro countries is shown in the table below.

Table 34: Electricity prices for industrial customers in Italy.

Consumption [MWh]	**Type of cost**	**Italy**[1] [c€/kWh]	**European Union** [c€/kWh]	**Euro area** [c€/kWh]
< 20	Before taxes	16.66	14.8	14.84
	After taxes	32.24	23.44	25.09
20-500	Before taxes	11.11	10.97	10.71
	After taxes	22.47	17.91	18.87
500-2.000	Before taxes	9.31	8.85	8.53
	After taxes	18.64	14.86	15.57
2.000-20.000	Before taxes	8.58	7.89	7.49
	After taxes	16.62	13.23	13.71
20.000-70.000	Before taxes	7.66	7.08	6.59
	After taxes	13.84	11.58	11.71
70.000-150.000	Before taxes	6.7	6.55	6
	After taxes	11.38	10.42	10.31

For electricity, the average cost in Italy is usually higher than in the rest of the EU. Before taxes, the difference is between 1% and 16%, while after taxes it is much higher, from 10% to 37%. This difference is usually (but not in all cases) higher when the comparison is between Italy and the rest of Euro area.

Consumption [1000 m^3]	**Type of cost**	**Italy** [c€/m^3]	**European Union** [c€/m^3]	**Euro area** [c€/m^3]
< 26	Before taxes	51.79	49.09	49.57
	After taxes	76.08	65.73	66.54
26-263	Before taxes	42.37	40.56	41.53
	After taxes	59.05	54.82	56.06
263-2,627	Before taxes	33.25	34.15	34.51
	After taxes	39.73	45.32	45.34
2,627-26,268	Before taxes	29.41	28.86	29.07
	After taxes	32.43	37.59	37.31
26,268-105,072	Before taxes	28.02	26.1	26.44
	After taxes	30.46	33.82	33.69

[1] The costs of natural gas and electricity for industry in Italy are available from the Italian Authority for Electricity, Gas and Water.

For natural gas, the average costs have a different trend when Italy and the rest of Europe are compared. A summary of the average prices for 2015 is reported in the tables below.

Table 35: Price of unleaded gasoline in Italy.

Month	**Price before taxes** [€/1000 l]	**VAT** [€/1000 l]	**Levies** [€/1000 l]	**Price after taxes** [€/1000 l]
January	478.19	265.45	728.4	1,472.04
February	492.46	268.59	728.4	1,489.44
March	555.13	282.38	728.4	1,565.90
April	567.2	285.03	728.4	1,580.63
May	594.59	291.06	728.4	1,614.05
June	601.79	292.64	728.4	1,622.84
July	603.94	293.12	728.4	1,625.46
August	556.7	282.72	728.4	1,567.82
September	496.8	269.54	728.4	1,494.74
October	479.15	265.66	728.4	1,473.21
November	466.14	262.8	728.4	1,457.35
December	460.68	261.6	728.4	1,450.68
Average	529.398	276.7158	728.4	1,534.51

Table 36: Price of industrial diesel oil in Italy.

Month	**Price before taxes** [€/1000 l]	**VAT** [€/1000 l]	**Levies** [€/1000 l]	**Price after taxes** [€/1000 l]
January	562.31	212.41	403.21	1,177.93
February	575.19	215.25	403.21	1,193.65
March	604.85	221.77	403.21	1,229.83
April	601.55	221.05	403.21	1,225.81
May	641.65	229.87	403.21	1,274.73
June	629.97	227.3	403.21	1,260.48
July	609.57	222.81	403.21	1,235.60
August	560.59	212.04	403.21	1,175.84
September	549.15	209.52	403.21	1,161.88
October	533.11	205.99	403.21	1,142.30
November	525.58	204.34	403.21	1,133.12
December	481.13	194.56	403.21	1,078.90
Average	572.888	214.7425	403.21	1,190.84

Table 37: Price of fuel oil in Italy.

Month	**Price before taxes** [€/ton]	**VAT** [€/ton]	**Levies** [€/ton]	**Price after taxes** [€/ton]
January	553.84	72.07	166.84	792.74
February	570.06	73.69	166.84	810.59
March	585.84	75.27	166.84	827.94
April	572.93	73.98	166.84	813.74
May	594.59	76.14	166.84	837.57
June	583.61	75.05	166.84	825.5
July	590.77	75.76	166.84	833.38
August	566.97	73.38	166.84	807.19
September	535.27	70.21	166.84	772.32
October	527.34	69.42	166.84	763.6
November	514.43	68.13	166.84	749.39
December	487.7	65.45	166.84	719.99
Average	556.946	72.37917	166.84	796.16

Table 38: Price of low-sulphur fuel oil in Italy.

Month	**Price before taxes** [€/ton]	**VAT** [€/ton]	**Levies** [€/ton]	**Price after taxes** [€/ton]
January	303.11	N/A	31.39	334.5
February	340.47	N/A	31.39	371.86
March	364.19	N/A	31.39	395.58
April	372.13	N/A	31.39	403.52
May	389.74	N/A	31.39	421.13
June	374.72	N/A	31.39	406.11
July	356.8	N/A	31.39	388.19
August	306.03	N/A	31.39	337.42
September	282.08	N/A	31.39	313.47
October	277.91	N/A	31.39	309.3
November	279.36	N/A	31.39	310.75

December	241.74	N/A	31.39	273.13
Average	324.023	N/A	31.39	355.41

For other energy carriers, there was no standard price or average price available for the whole MS.

10.3 Energy Statistics – CO_2 emission factors from different energy carriers

For CO_2 emission factors, the Italian Research Centre for Energy and Environment (ENEA) proposes the following conversion:

Energy carrier	**LCV**	**CO_2 emission factor** [kg/kWh]
Natura gas	9.45 kWh/Sm^3	0.21
LPG (70% Ethane + 30% Butane)	26.78 kWh/Sm^3	0.24
Diesel oil	11.86 kWh/kg	0.28
Fuel oil	11.47 kWh/kg	0.29
Coal	7.92 kWh/kg	0.37
Electricity from the national grid	-	0.46
District heating	-	0.30
Municipal waste (50% renewable, 50% non-renewable)	4.00 kWh/kg	0.17