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FINAL REPORT

For a study on composition and drivers of energy prices and costs in energy intensive industries: the case of ceramics, flat glass and chemical industries

About the Study & Cross-sectoral Analysis

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Dr. Fabio Genoese is the leading author of the cross-sectoral analysis.

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1. About the Study

The European Union has taken the lead globally in tackling the climate change challenge, with more stringent regulations and ambitious objectives. The European Commission published in 2011 a 'Roadmap for moving to a competitive low carbon economy in 2050', including challenging long-term targets. As part of its efforts to accelerate progress towards meeting these targets, the Commission adopted in March 2013 a Green Paper intended to stimulate debate and launch a public consultation on a new energy and climate framework for the period until 2030. This Green Paper addressed, among others, the challenge to secure the competitiveness of the EU economy under the new energy framework. The Council recently[1] welcomed this paper and also called on the Commission to '*present by the end of 2013 an analysis of the composition and drivers or energy prices and costs*'. The analysis should cover households, SMEs and energy intensive industries, and also look at the question of European competitiveness in the global context.

Drawing on the above call for action, this study has focused on energy prices for a selection of energy-intensive industries. More specifically, it has covered three types of energy-intensive industries: ceramics, float glass[2] and chemicals. In order to address a variety of different production technologies and processes as well as energy inputs, the study covers the following sub-sectors:

- Bricks and roof tiles (ceramics)
- Wall and floor tiles (ceramics)
- Ammonia (chemicals)
- Chlorine (chemicals)
- Ethylene (chemicals)
- Float glass

The main focus of the study has been:

- An overview of energy prices developments with particular attention to i) energy price levels, and ii) the structure of energy prices, i.e. the components of energy bills;
- Energy intensity/efficiency and changes thereof;
- An assessment of the impact of energy prices and of their components on the unit production costs and other key performance indicators, such as price-cost margin, EBIT and EBITDA for a selection of producers in the various sectors mentioned above;
- A comparison with non-EU production sites in the selected sectors.

[1] In May 2013.

[2] Float glass and flat glass are often used as synonyms in the literature, and also throughout this study. However, float glass is defined as flat glass produced with the float process. Hence, the term float glass refers both to a type of glass and to the process by which it is made. The term flat glass refers to flat glass regardless of the technology used to produce it (i.e. it could be produced with the float glass process or rolled glass process).

To undertake this study, information/data were collected at plant level for each sector and covered energy prices and costs, their drivers and recent developments. Specifically, data were collected on energy consumption and energy prices paid by the plant, the structure of energy bills (energy component, grid fees, RES levies and other non-recoverable taxes) as well as information on energy efficiency/energy intensity. Some respondents from the two ceramics sectors also provided data on plants located outside the European Union, thus allowing an international comparison. Separately, the sampled plants were asked about financial data to allow analysis of the production costs and margins of the sampled producers.

Plant specific data were obtained via questionnaires, which were sent to and filled in by industrial sites. Altogether 78 questionnaires[3] were received, of which 58 were used for the analysis of the energy intensive industries covered by the Sector Reports. In total, 65 questionnaires contained plausible data and were used in the cross-sectoral analysis (see Table 1).[4] The remaining questionnaires were excluded from the analysis, because there were plausibility issues that could not be resolved. The questionnaires contained 19 questions, covering the issues explained above.

Table 1. Total number of questionnaires received and used in the study

Industry Sector	Number of questionnaires received	Number included in the sample[5]
Ammonia	10	10
Chlorine	11	9
Float glass	10	10
Wall and floor tiles	24	12
Bricks and roof tiles	23	13
Total	78[6]	58
Number used in the cross-sectoral (excluding aluminum and steel)	65[7]	
Number used in the cross-sectoral (including aluminum and steel)	89[8]	

[3] This figure refers to the total number of questionnaires received for float glass, ceramics (bricks and roof tiles as well as wall and floor tiles) and chemicals (ammonia and chlorine).

[4] As described below, the cross-sectoral analysis uses data not only from the 5 sectors analyzed in this study (ammonia, chlorine, float glass, bricks and roof tiles as well as wall and floor tiles) but also from the separate cumulative cost assessment studies for the sectors of steel and aluminium

[5] Please note that in some cases there is a divergence between the total number of questionnaires included in the sample and the number used for the analysis of the different sections of the sector reports (energy prices trends, energy intensity, production costs, etc.). More info is presented in the sector reports.

[6] Of which, 65 included plausible data.

[7] This figure refers to the total number of questionnaires from the 5 energy-intensive industry sectors that was used in the cross-sectoral analysis; section 2.2 further differentiates between the number of questionnaires used for analysing electricity and natural gas costs.

[8] This figure refers to the total number of questionnaires used in the cross-sectoral analysis; however, please note that for natural gas this figure was reduced to 69; see section 2.2 for more details.

The analysis has been conducted between 24 July 2013 and 31st October 2013. The project, including data collection, did not involve any fieldwork neither in the EU nor in third countries. However, received questionnaires have been followed up by telephone calls to plant managers to discuss the findings and address issues that were unclear. In spite of the short available time frame to complete the study, CEPS remained in close contact with each plant for the entire duration of the study both by telephone and e-mail to continuously clarify open issues and increase understanding of plant specifics.

The period for which the assessment has been undertaken are the years 2010 to 2012.

The establishment of the different sectoral samples was made on the basis of *five* criteria:

- The *geographical criterion* has been used with a dual objective. First to reflect as much as possible the different contribution of member states to overall EU capacity in each sector. In addition, it aimed at creating a sample that included as many member states as possible;
- The *plant capacity* criterion was applied to ensure that the sample resembles as much as possible the actual composition of the plant (capacity) sizes across the EU and its regions;
- The production *technology* criterion was chosen to reflect the shares of different production technologies. This criterion was relevant only for the chemical sector;
- Finally, the *size criterion* was used to represent the sampled population in terms of company size, i.e. to denote the sector in terms of SMEs and large companies.

Whilst both the geographical and capacity criteria were employed for all sectors, the remaining ones were applied selectively to some sectors, depending on their relevance.

Finally, it is worth adding that although the analysis is principally EU-wide, the research team devoted particular attention to the member states with the relatively largest share of industry output when establishing the various samples.

This study was carried out in strict compliance with confidentiality and anti-trust rules. All presented information and data are anonymised, aggregated and/or indexed to ensure that no data can be attributed to any particular plant. This has meant that the sector-specific analysis is presented for regions (e.g. Central Northern Europe, Southern Europe, etc.) rather than for member states. Whilst general trends can be depicted and explained, there can be shortcomings in presenting the situation in member states. In some cases, trends in member states have been cancelling themselves out, e.g. an increase of energy prices in one member state was 'matched' with a decrease in another, thereby concealing member state trends.

This shortcoming could be addressed for four member states: Germany, Italy, Poland and Spain. For these four countries, a sufficient number of plants accepted to participate in the study across all covered sectors so as to allow country-specific analysis whilst ensuring the anonymity of plants. The results of this cross-sectoral analysis are presented below. As mentioned above, the cross-sectoral analysis also covers the sectors steel and aluminium, which were not part of this study. However, as similar data was gathered through questionnaires, the results were included in the cross-sectoral analysis (see section 2.1 for more details).

A major issue has been the validation of the data received via the questionnaires, which was addressed by a mixture of measures. First, CEPS conducted a plausibility test, e.g. by comparing 'comparable' plants across member states. In several cases, plants have been taken out of the sample due to inconsistent data with comparable plants and which could not be explained by desk analysis or subsequent interviews with the plant managers. A second validation source has been the cross-sectoral analysis, which allowed comparing plant data from different sectors for the same member states. A third type of validation relied on data sources from third parties. The level of detail of this comparative exercise and robustness depends upon the availability of information from secondary sources and/or information provided by sectoral experts. Further details on validation, sample and response rate are provided in the relevant sections of the Sector Reports.

Detailed findings of the report can be found in the Sector Reports. However and despite several attempts by the research team, CEPS did not receive a sufficient number of questionnaires to enable an authoritative analysis for the ethylene sector. As a result, the development of a report illustrating energy prices trends for ethylene was not possible.

All 5 Sector Reports are generally structured as follows:

- Sector description including production processes, value chain, capacities per member states etc.
- Sample selection
- Methodology including validation
- Energy prices trends for EU and regional differences
- Energy bill components for EU and regional differences
- Energy intensity developments for EU and regional differences
- Indirect ETS costs
- General impressions on the current state of energy policy and markets

Depending on the amount and quality of the information received as well as on the specific characteristics of each industry, some sectors also include the following sections:

- International comparison (bricks and roof tiles as well as wall and floor tiles - ceramics)
- Production costs (float glass, ammonia, chlorine as well as a case study for wall and floor tiles)
- Margins (float glass and a case study for wall and floor tiles)

2. Cross-sectoral analysis

2.1 Introduction

This section presents a cross-sector analysis of the total energy costs and the structure of energy prices. While the analyses in the Sector Reports were presented for regions (e.g. North-western Europe, Southern Europe, etc.) rather than for member states in order to ensure that no data can be attributed to any particular plant, this cross-sector analysis presents national data for a selected number of member states, namely Italy, Spain, German and Poland. For electricity, the analysis comprises the sectors bricks & roof tiles ("bricks"), wall & floor tiles ("tiles"), float glass, ammonia ("amm."), chlorine, steel and aluminium ("alum."). For natural gas, data from the chlorine and aluminium sectors was not available, as these industries hardly consume any natural gas in their production processes. It has to be noted that the assessment of cost data for the sectors steel and aluminium was not part of this study. Data for these two sectors have extracted from existing studies[9], although with a consistent methodology.

2.2 Sample size and methodology

Table 2 shows on the number of questionnaires that were evaluated for this cross-sector analysis. In total, electricity cost and consumption data from 89 plants was available. In the case of natural gas, the sample size is constituted of 69 plants.

Table 2. Sample size of the various sectors

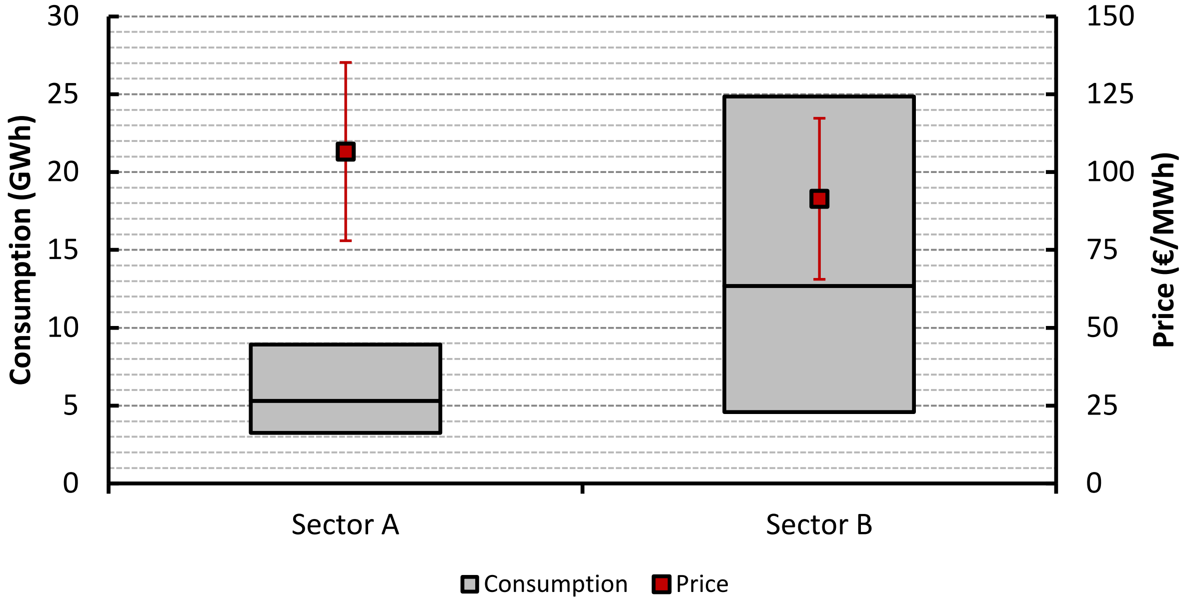
	Bricks	Tiles	Glass	Amm.	Chlorine	Steel	Alum.
Electricity	16	20	10	10	9	15	9
Nat. gas	16	20	10	10	0	13	0

In order to give an impression of the consumption and price ranges in the various sectors, graphs resembling Figure 1 were prepared. The consumption range is illustrated by a so-called box plot: the upper and lower boundary line of the grey box in the graph represent the first and third quartile of the data set. This means that 25% of the plants consume less than the value indicated by the lower line, while 25% of the plants consume more than the value indicated by the upper line. Put differently, the box comprises the middle half of the data sample. Moreover, the middle line that divides the box in two parts represents the median value.

[9] Renda et al. (2013): "Assessment of Cumulative Cost Impact for the Steel and the Aluminium Industry", Report for DG ENTR, available at: http://tinyurl.com/ktswbn5.

The average prices are represented by the red squares in the graphs. The vertical lines below and above the square illustrate the standard deviation of the price distribution. Roughly 68% of the values lie within one standard deviation of the mean.

Figure 1. Exemplary plot



Source: Own illustration.

2.3 Electricity

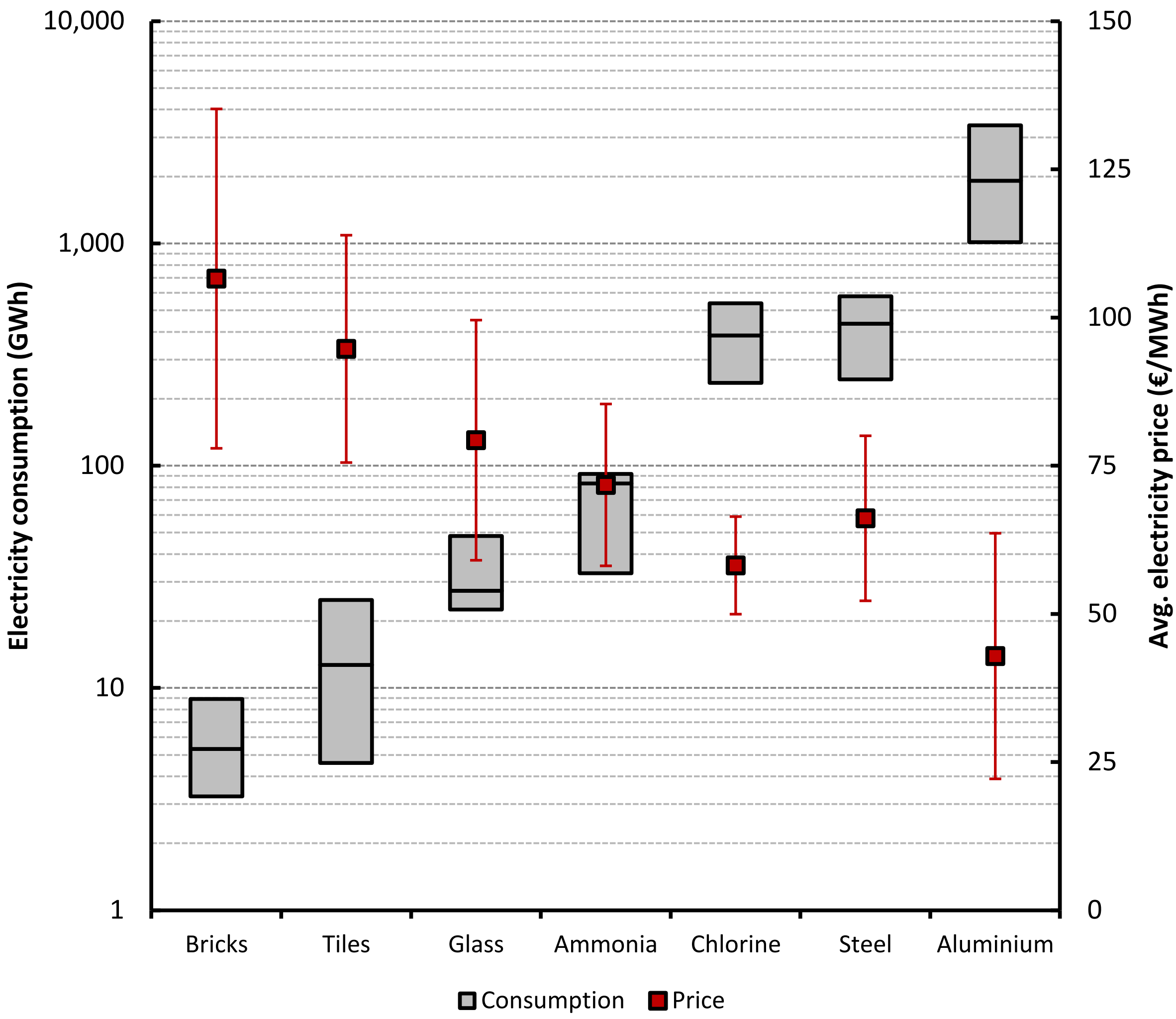
Figure 2 illustrates the variation of the data for each of the 7 sectors[10]. Generally, the consumption level increases when moving from the sector of bricks to the sector of aluminium. Increasing consumption levels are accompanied by decreasing power prices: The median electricity consumption in the latter sector is 361 times higher than in the bricks sector, whereas an average aluminium producer pays 42.9 €/MWh,[11] i.e. 63.7 €/MWh less an average bricks producer (see Table 3). Among the possible reasons for the decreasing price levels are: (i) more favourable supply contracts (e.g. long-term contracts that had been negotiated when the level of prices was much lower), (ii) discounts for large-scale consumers, or (iii) different level of levies and taxes (incl. exemptions for large-scale consumers). It is worth noting that these average prices represent the values aggregating multiple countries with different price levels and a different legislative framework. Therefore, national analy-

[10] Because of the differences in electricity consumption, a logarithmic scale is used for the axis displaying the consumption.

[11] In the aluminium report, an average value of 44.7 €/MWh was reported (p. 158). The average was weighted by 2012 production. For the cross-sectoral analysis, a different weighting factor has been applied, because production data was not available for all plants and all sectors. In order to apply the same methodology for all sectors, the research team used consumption data as a weighting factor. Therefore, the average value reported for aluminium in the cross-sectoral analysis slightly differs from the value reported in the dedicated aluminium report.

ses of the cost structure were also conducted. In the following, this national assessment is presented and discussed.

Figure 2. Electricity consumption and price variations grouped by sector (89 facilities)



Source: Own illustration.

Table 3. Mean electricity prices and median electricity consumption in the various sectors (89 facilities)

	Bricks	Tiles	Glass	Amm.	Chlorine	Steel	Alum.
Price[12] (€/MWh)	106.5	94.7	79.3	71.7	58.2	66.1	42.9
Cons.[13] (GWh)	5.3	12.7	27.4	83.2	384.8	436.0	1,915.0

[12] Mean value of sampled plants.

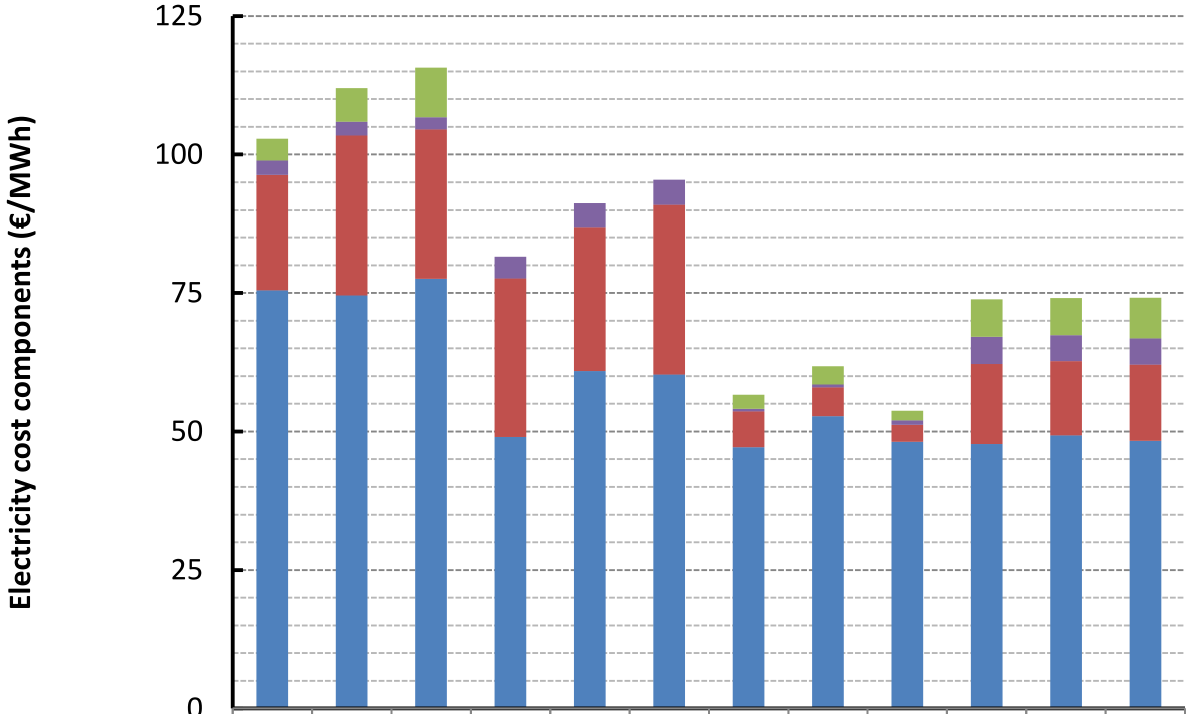
[13] Median value of sampled price.

Figure 3 shows the structure of electricity costs in 4 member states: Italy (5 plants, Ø consumption: 23 GWh/a), Spain (10 plants, Ø consumption: 14 GWh/a), Germany (8 plants, Ø consumption: 313 GWh/a) and Poland (5 plants, Ø consumption: 242 GWh/a). The total costs are grouped into the following four components: (i) the energy component, (ii) grid fees, (iii) other levies and taxes (excluding VAT) and (iv) RES levies.

In general, the figures indicate a rising level of costs with some exceptions. For the 8 analysed plants in Germany, the average price decreased from 2011 to 2012 because three out of four components were in decline: Grid fees, RES levies and the energy component. Decreasing grid fees in relation to the amount of electricity consumed do not necessarily imply decreasing figures in absolute terms. A certain share of grid fees is charged in relation to the connection power of a production plant (i.e. euro per watt peak) and is not related to annual consumption. Therefore, increasing the annual consumption would decrease the grid fees when expressed in euro per watt hours, as it is the case in this graph. Admittedly, it is still possible that one or more plants has been exempted from paying grid fees starting in 2012. Decreasing RES levies, however, unquestionably point out that new exemptions have been granted in that year, since the RES levy in Germany is charged in terms of Euro per watt hours and since it has constantly been on the rise for the period under study. The reasons behind the slightly decreasing energy component are ambiguous. It is possible that producers have benefitted from falling wholesale market prices in Germany.

The figures also show that producers pay different prices depending in which member state the plant is located. Among the selected countries and the selected facilities, plants located in Italy face the highest electricity prices. Despite the fact that the selected plants in Italy have a similar average consumption as the selected plants in Spain (23 vs. 14 GWh/a), Italian producers paid up to 21.3 €/MWh more than Spanish producers. A major part of this difference is due to higher costs for the energy component in Italy. The costs for the energy component are linked to the wholesale market price for electricity, which in Italy is higher than in Spain. A functioning and completed internal market would reduce this wholesale price differential.

Figure 3. Structure of electricity costs in Italy, Spain, Germany and Poland in absolute terms (€/MWh)



	IT (5 plants)			ES (10 plants)			DE (8 plants)			PL (5 plants)		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
RES levy	3.9	6.1	9.0	0.0	0.0	0.0	2.6	3.3	1.8	6.7	6.7	7.4
Other (excl. VAT)	2.6	2.5	2.2	3.9	4.4	4.5	0.5	0.5	0.8	4.9	4.7	4.7
Grid fees	20.8	28.9	27.0	28.6	25.9	30.6	6.5	5.2	3.1	14.4	13.4	13.8
Energy comp.	75.5	74.5	77.5	49.0	60.9	60.3	47.1	52.8	48.1	47.7	49.3	48.3

Energy comp. Grid fees Other (excl. VAT) RES levy

Note that grid fees are flat fees (mainly). Expressing them in €/MWh may be misleading but was chosen for consistency reasons.

Source: Own illustration.

To a lesser extent, the price difference between Italy and Spain is also due to higher costs for levies and taxes (incl. RES levies). In contrast to the other countries analysed, Spanish electricity consumers do not directly pay the costs for RES support through levies. Therefore, the RES levy figures equal zero. Instead, the Spanish government sets a so-called access fee ("peaje de acceso") to cover all costs that are not related to (conventional) production and commercialisation. Costs for RES support are therefore supposed to be included in the other components but may also partly be covered by the public budget.

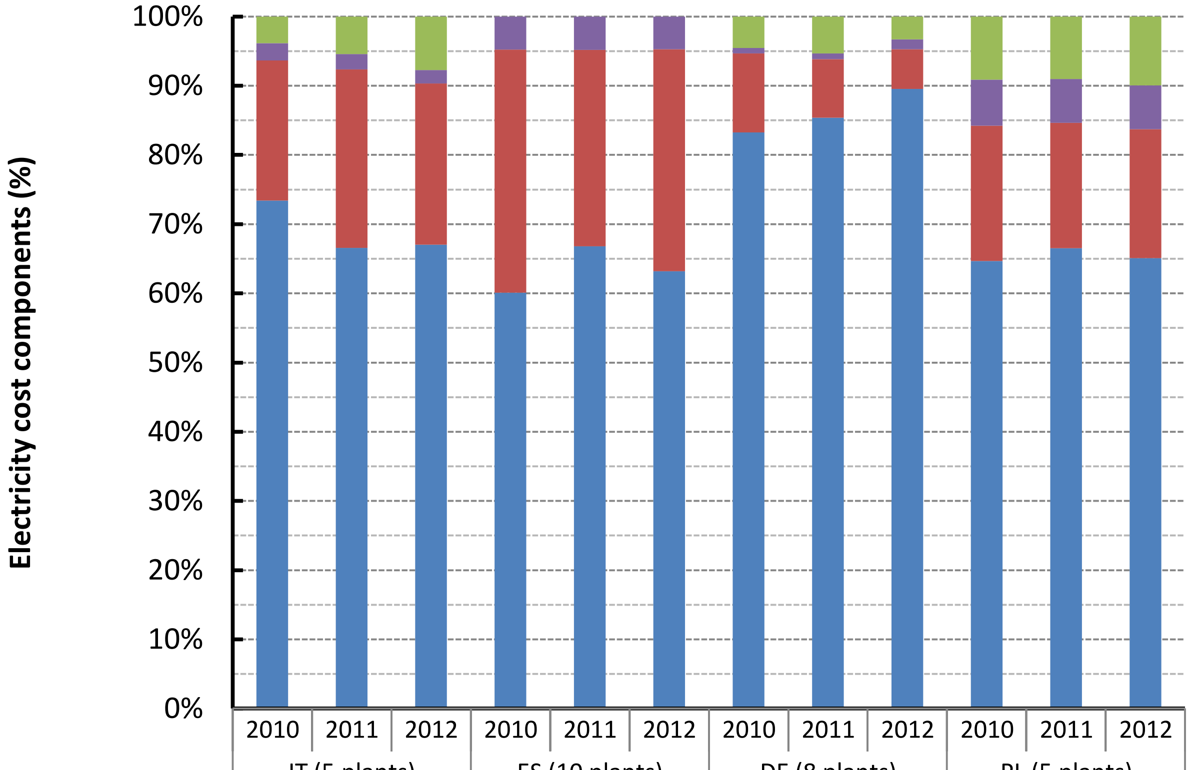
Compared to Polish and German producers, Italian and Spanish producers face higher grid fees. Among the possible explanations are: (i) exemptions from paying a certain share of grid fees, (ii) generally lower grid costs in Germany and Poland and (iii) avoidance of a certain share of grid fees, as some of the Polish and German plants are possibly connected to the high-voltage grid due to a higher level of electricity consumption.

It is worth noting that all figures presented include possible exemptions from taxes, levies or transmission costs. The research team asked the producers to communicate the electricity and natural gas costs they effectively had paid between 2010 and 2012. Therefore, their answers include exemptions/reductions if these are applicable. This is particularly evident for the German plants in the sample. In Table 4, the regular, non-discounted RES levies are confronted with the average values paid by the sampled plants. The figures show that the sampled German plants received – on average – a 93% reduction in the year 2012.

Table 4. RES levies in Germany – regular vs. average values paid by the sampled plants (in €/MWh)

	2010	2011	2012
RES levy (regular, non-discounted)	20.47	35.30	35.92
RES levy (Ø for sampled plants)	2.6	3.3	1.8

Figure 4. Structure of electricity costs in Italy, Spain, Germany and Poland in relative terms (%)



	IT (5 plants)			ES (10 plants)			DE (8 plants)			PL (5 plants)		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
RES levy	4%	5%	8%	0%	0%	0%	5%	5%	3%	9%	9%	10%
Other (excl. VAT)	3%	2%	2%	5%	5%	5%	1%	1%	1%	7%	6%	6%
Grid fees	20%	26%	23%	35%	28%	32%	11%	8%	6%	20%	18%	19%
Energy comp.	73%	67%	67%	60%	67%	63%	83%	85%	90%	65%	67%	65%

Energy comp. Grid fees Other (excl. VAT) RES levy

Source: Own illustration.

2.4 Natural gas

Figure 5 illustrates the variation of natural gas cost and consumption data for each of the 5 sectors. Generally, the consumption level increases when moving from the sector of bricks to the sector of ammonia. Increasing consumption levels are accompanied with decreasing gas prices. However, it is worth to note that this trend is less clear than in the case of power prices. The difference in the price of natural gas paid by an average producer of bricks and an average producer of ammonia is of 7.0 €/MWh (-26%, see Table 5). As gas prices are mainly determined by the energy component, electricity contracts offer more flexibility for eventual discounts/exemptions. Contrary to power prices, no clear trend can be observed in relation to price variations.

Figure 5. Natural gas consumption and price variations grouped by sector (69 facilities)

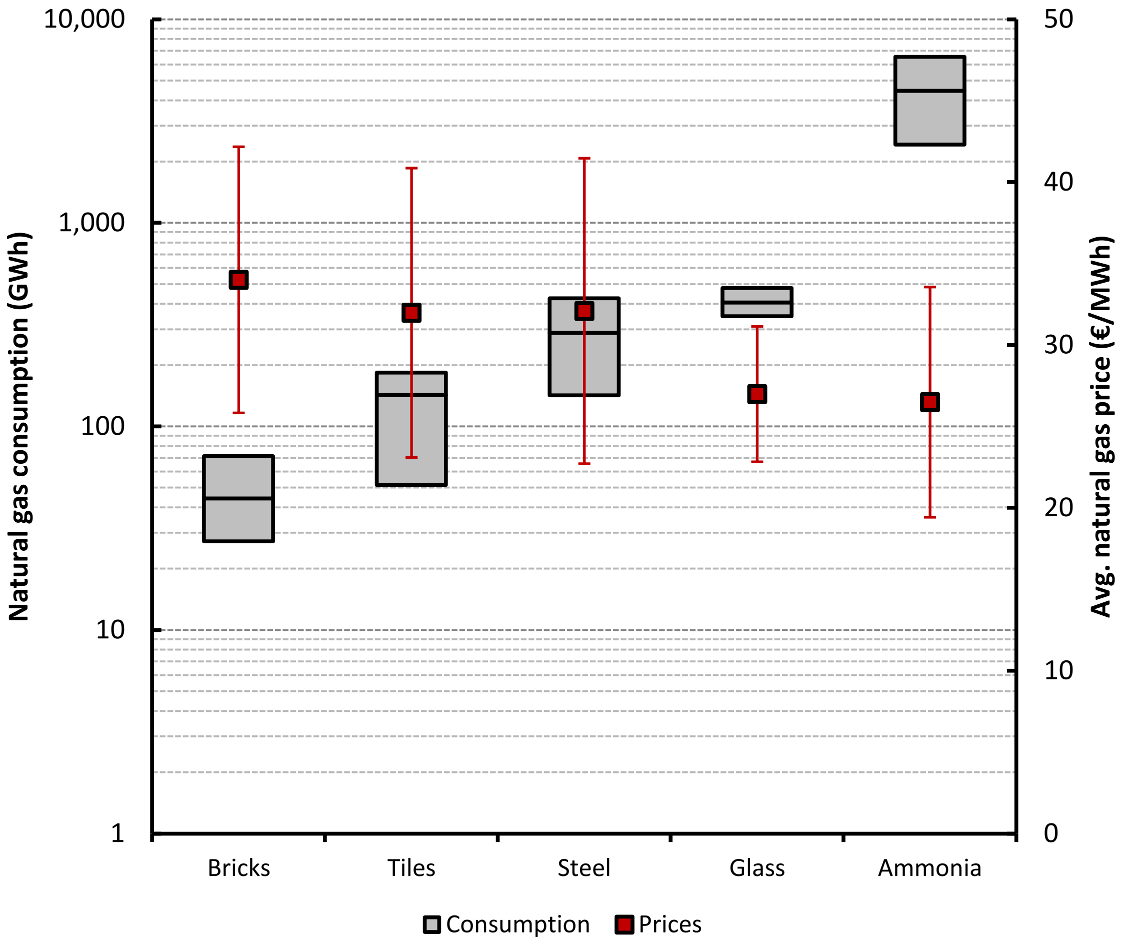


Table 5. Mean natural gas prices and median natural gas consumption in the various sectors (69 facilities)

	Bricks	Tiles	Steel	Glass	Ammonia
Mean price (€/MWh)	34.0	32.0	32.1	27.0	26.5
Median cons. (GWh)	44.3	142.5	288.0	406.2	4,446.3