Ref. Ares(2014)174452 - 27/01/2014

CENTRE FOR EUROPEAN POLICY STUDIES

FRAMEWORK CONTRACT

NO ENTR/2008/006 LOT 4

FOR THE PROCUREMENT OF STUDIES AND OTHER SUPPORTING SERVICES ON COMMISSION IMPACT ASSESSMENTS AND EVALUATION

FINAL REPORT

FOR A STUDY ON COMPOSITION AND DRIVERS OF ENERGY PRICES AND COSTS IN ENERGY INTENSIVE INDUSTRIES: THE CASE OF THE CERAMICS INDUSTRY - BRICKS AND ROOF TILES

CONTRACTOR
Centre for European Policy Studies

Prof. Christian Egenhofer & Dr. Lorna Schrefler (Team Leaders)

Dr. Fabio Genoese
Julian Wieczorkiewicz
Lorenzo Colantoni
Wijnand Stoefs
Jacopo Timini

Done in Brussels, 13 January 2014

DISCLAIMER

The information and views set out in this study are those of the authors and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission’s behalf may be held responsible for the use which may be made of the information contained therein.

TABLE OF CONTENTS

List of Figures and Tables

1. Bricks and roof tiles

1.1 Description and production

1.1.1 Introduction

The bricks and roof tiles sub-sector is constituted of four main categories of products, divided on the basis of their intended usage: (i) building bricks, (ii) roof tiles, (iii) paving bricks and (iv) chimney and other clay constructional products such as cowls, flue-blocks and chimney liners. These products are all made of the same raw material: clay. Usually, bricks and roof tiles are water and electricity resistant and fireproof. They are also characterized by a long functional life (Cerame-Unie, 2012).

The sub-sector of bricks and roof tiles is marked by seasonality. Winter is the season with the least activity which, together with the dependence on the building sector, leads to a widespread variability in demand.

1.1.2 Production process

The production of bricks and roof tiles consist of four main stages: (i) the preparation of the raw materials[1], (ii) shaping, (iii) drying and (iv) firing.

The first stage of the production process is the preparation of raw materials for shaping. Shaped products are dried in special chambers or tunnel dryers. Drying can last from 8 to 72 hours, at temperatures ranging from 75° to 90°. Drying is the most energy intensive stage of the production process (Cerame-Unie, 2013b). Dried products are then fired to acquire their main characteristics, i.e. water-resistance, fire-resistance and hardiness. The majority of the kilns employed by the producers are heated by natural gas (85% of cases). Coal and oil are usually employed when the latter is not available. Finally, products are exposed for cooling and later shipped to the distribution sites (EC, 2007).

Environmental and climate concerns related to the production of bricks and roof tiles are mainly related to the degradation of the extraction sites and CO2 emissions.

In 2011, under the implementation of the ETS Directive, bricks and roof tiles were added to the list of products at risk of carbon leakage. As a result of the transposition of the Directive 2004/08/EC, cogeneration has developed widely in countries which promoted combined heat and power (CHP) generation through incentives, particularly in Spain, Italy and Portugal. However, any new investments in CHP are being withheld in Spain following the removal of such incentives in 2012 (Cerame-Unie, 2012).

---

[1] The raw material employed by the industry is clay, together with a few other argilliferous materials (bentonite, fire clay, etc.); minerals such as manganese dioxide, titanium dioxide, calcium carbonate. Other materials could be added to obtain different colors or porosity.

1.1.3 Value chain

The production costs of bricks and roof tiles are driven by the costs of energy and transport. The energy-intensity of the sector is reflected by the share of energy in the total costs of production. Due to high transportation costs (reaching up to 10% of the total costs of production), extraction sites are usually located in the vicinity of production sites. As the sector of bricks and roof tiles is directly linked to the building industry, distribution channels are shaped in accordance (EC, 2007).

Table 1 illustrates the breakdown of productions costs for the bricks and roof tiles sub-sector. Note that the figures presented in Table 1 are referring to average EU values. According to the information provided by Cerame-Unie, the costs of energy are the most important cost-driver for the EU producers of bricks and roof tiles; Energy accounts for 30% to 35% of total production costs. Representing roughly 25%-30% of total production costs, labour costs also have a major impact on the costs of production of bricks and roof tiles.

Table 1. Breakdown of production costs (bricks and roof tiles)

Share in production costs	
Energy	30%-35%
Labour	25%-30%
Raw materials	20-25%
Other production costs	15%-20%
Total	100%

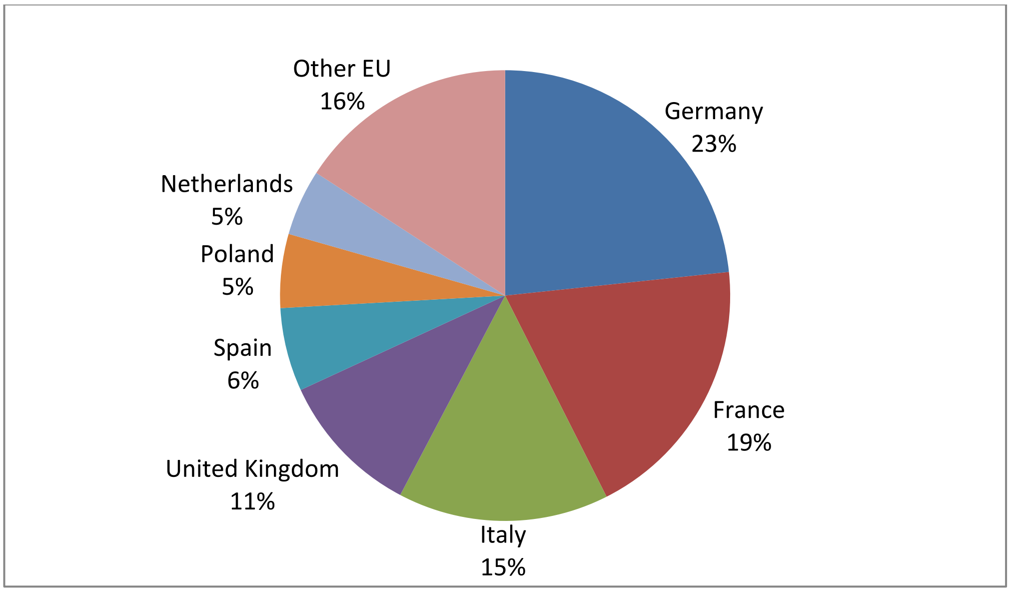
Source: Cerame-Unie (2013a)

1.2 Global and European markets

As a result of high transportation costs and due to their low value-added, there is neither a global nor a European market for bricks and roof tiles. The sub-sector is regionalised. By way of example, the British Competition Commission reports that 80% of bricks and roof tiles produced in the UK are sold not farther than 125 miles away from their production sites. However, Eurostat shows a growing trend in trade both inside and outside the EU, with a trade intensity of roughly 4% (EU extra) and 23% (EU extra and intra) in 2012. A detailed assessment shows that trade exposure of the member states located at the external borders of the EU is significantly above the EU average (Cerame-Unie, 2013a).

Figure 1 illustrates the distribution of the production of bricks and roof tiles among EU member states. In 2012, the joint production of six member states (Germany, France, Italy, the UK, Portugal and Poland) accounted for 79% of total EU production. While other ceramic sub-sectors are dominated by small and medium enterprises (SMEs), the bricks and roof tiles industry is composed almost equally by a number of regionally settled SMEs and larger producers (Cerame-Unie, 2012).

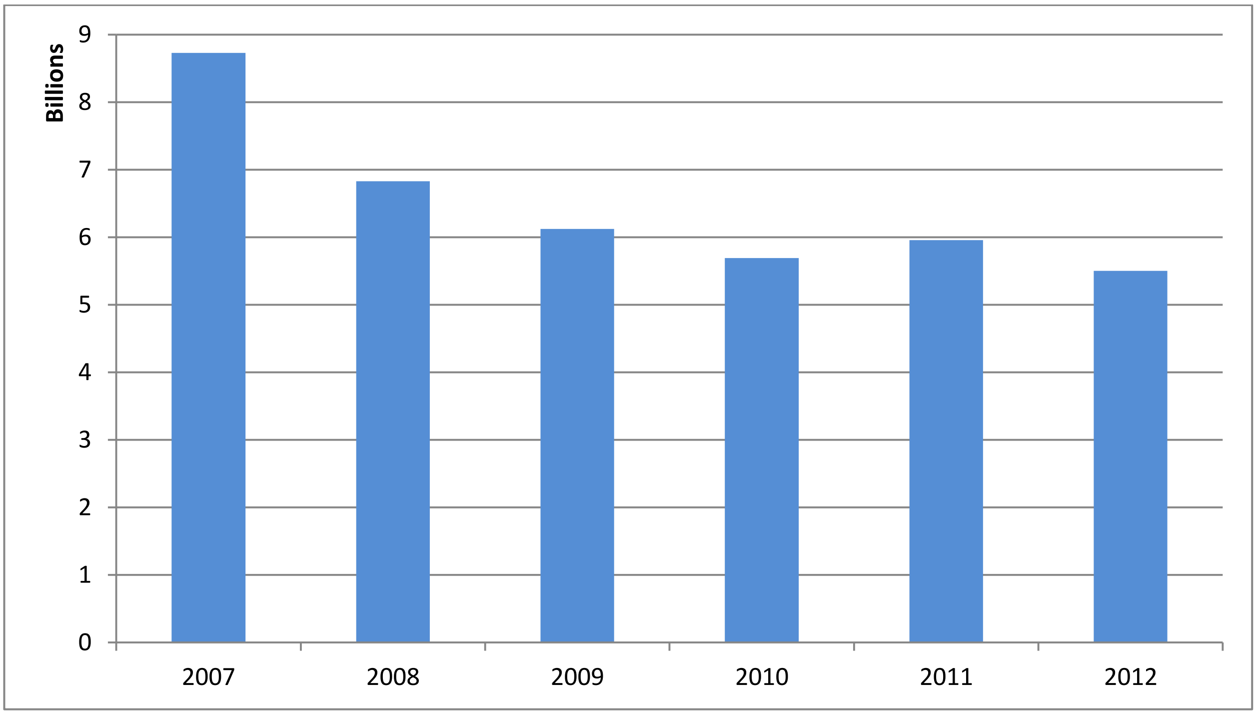
Figure 1. Bricks and roof tiles production in the EU-27 (in 2012)



Source: Eurostat (2012).[2]

Figure 2 reports the production value of the EU's bricks and roof tiles industry which, between 2007 and 2012, decreased from a level of 8.7 billion euros to roughly of 5.5 billion euros (i.e. -36%).

Figure 2. Production value of bricks and roof tiles in the EU (data expressed in billions of Euros)



Source: Eurostat (2012).[3]

---

[2] Eurostat database: http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

1.3 Selection of the sample and sample statistics

1.3.1 The selection of typical facilities

The objective of this sub-chapter is to define and assess the composition and drivers of energy prices and costs in the case of bricks and roof tiles. A total of thirteen plants have been sampled for the purpose of this exercise[4]. To define the sample of typical facilities, the authors of this study tried to apply the following criteria:

- Geographical coverage
- Capacity of plants
- Ownership
- Production technology

Not all of these general criteria could eventually be applied. This issue is described hereunder.

1.3.1.1 Geographical coverage

In this case, the following criteria were applied:

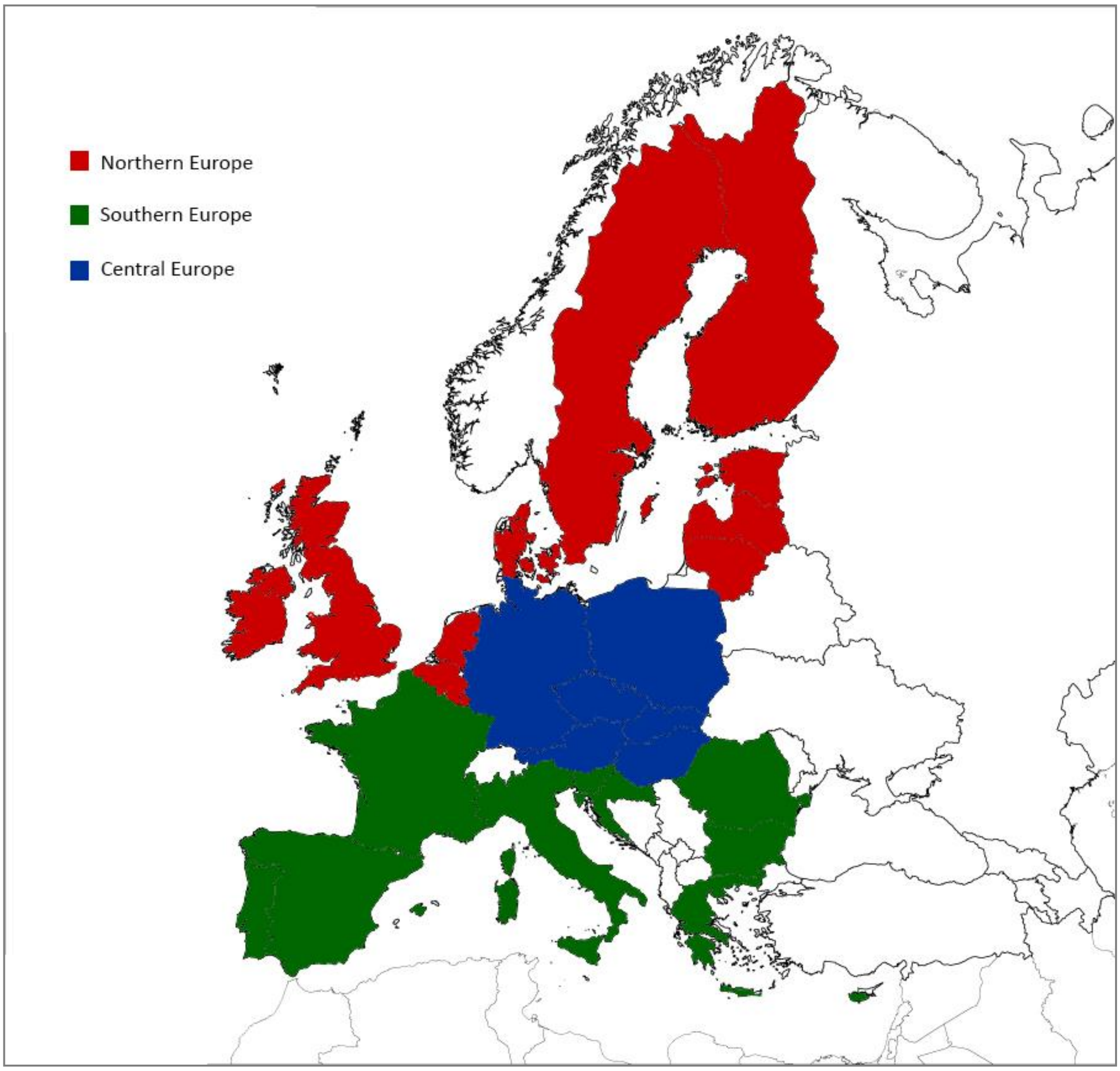
> Production per member state: four member states (Germany, France, Italy and the UK) covers 68% of the EU production of bricks and roof tiles. Therefore, a representative number of sampled plants are located therein.
>
> Heterogeneity: to the extent possible and without undermining the representativeness of the sample, an element of geographical diversity among the selected plants has been taken into consideration. In short, the sampled facilities are located in member states differing in (i) geographical location, (ii) size and in (iii) the length of their membership in the EU.
>
> For the abovementioned reasons, thirteen sampled facilities have been allotted to three geographical areas (as illustrated by Figure 3)
>
> - **Northern Europe** (Ireland, the UK, Belgium, Luxembourg, the Netherlands, Denmark, Sweden, Norway, Lithuania, Latvia, Finland and Estonia), which covers approximately of 38% the EU production in 2012. Five of the sampled facilities are located in this geographical area.
> - **Central Europe** (Germany, Poland, the Czech Republic, Slovakia, Austria and Hungary), which represents approximately 35% of the EU production in 2012. Three of the sampled facilities are located in this geographical area.

[3] Eurostat database: http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

[4] For more information on the number of collected questionnaires please see Table 3.

- **Southern Europe** (France, Portugal, Spain, Italy, Slovenia, Croatia, Bulgaria, Romania, Greece, Malta and Cyprus), which covers approximately 27% of the EU production in 2012. Five of the sampled facilities are located in this geographical area.

Figure 3. Bricks and roof tiles: division by regions



Source: Own illustration.

1.3.1.2 Capacity of plants

In general, plant capacity is an important element to establish a sample. Ideally, the sample should include plants that reflect the spectrum of production sizes across the EU. This would require detailed information on the capacity of all plants belonging to a sector. The authors of this study experienced difficulties in obtaining plant capacity data for the sub-sector of bricks and roof tiles as there is no external source of information. Due to the fragmentation of the sub-sector (according to the association, more than 700 companies are active in this sub-sector), the European Ceramic Industry Association was not in a position to provide this information. However, Cerame-Unie identified 21 plants producing bricks and roof tiles willing to participate in the exercise. Two additional questionnaires were submitted by producers operating in third countries. Having gained access to the information from these facilities, CEPS researchers adjusted the sample, including plants of varied production capacities (ranging from 25.000 to 250.000 t/year). This range is considered well representative of the sub-sector by the association.

1.3.1.3 Ownership

The sub-sector of bricks and roof tiles is composed almost equally by a number of SMEs and larger producers. The sample aims at reflecting the structure of the sub-sector. For this reason, out of thirteen plants, five are owned by SMEs and eight by large producers.

1.3.1.4 Production technology

The technology used by producers of bricks and roof tiles is standardised and had little bearing as a criterion for the sample.

1.4 Methodology

As previously described, the sample consists of 13 plants, which are located across three different regions.[5] For all 13 plants, cost and consumption data are available, i.e. annual and specific costs for the total amount of electricity and the natural gas consumed. One monthly energy bill is available for 6 out of 13 plants. Annual bills (i.e. 12 monthly bills) are available for 6 more plants. One of the sampled facilities was unable to submit an energy bill (neither monthly nor annual). This enabled CEPS researchers to perform a basic plausibility check of the information obtained via the questionnaires.

1.4.1 Data collection

The analysis of the energy prices and costs for the sector of bricks and roof tiles is based on questionnaires sent to all sampled plants. A confidentiality agreement was signed with Cerame-Unie. This agreement provided assurance that all collected data will be treated as strictly confidential.

All participants provided detailed data about their energy prices, structure of energy bills, and energy consumption. Having conducted a quality assessment of data received from all sampled participants, the research team eventually used 13 questionnaires for its analysis.

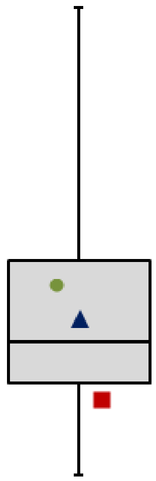
1.4.2 Data analysis and presentation

Box plots are used to display the reported cost ranges and to give an indication of the distribution among the units in the sample. An exemplary box plot is illustrated in Figure 4. The whiskers located below and above the box represent the minimum and maximum value of the sample. The box itself is divided in two parts by a horizontal line. This line in-

[5] Regions were developed by taking into account the need to reconcile the need for an adequate geographical coverage with confidentiality considerations.

dicates the median of the sample, i.e. the numerical value separating the higher half of the data sample from the lower half. The lower border of the box represents the first (lower) quartile of the sample. It splits off the lowest 25% of the data sample from the highest 75%. Correspondingly, the upper border of the box indicates the third (upper) quartile of the sample, thus separating the highest 25% of data from the lowest 75%. Put differently, the box contains exactly the middle half of the data. The height of the box is also referred to as inter-quartile range (IQR). It is a robust way of showing the variability of a data sample without having to make an assumption on the underlying statistical distribution.

Figure 4. Exemplary box plot



Source: Own illustration.

In order to ensure that no data are attributable to any specific plant, box plots are not created for the regional subsets of the sample, as these consist of only 3-5 plants. Instead, weighted average values are calculated and displayed next to or inside the box plots (see Figure 4). As weighting factors, the corresponding consumption data are applied, i.e. the annual consumption for electricity or natural gas, respectively.[6]

1.4.3 Calculation of indirect ETS costs

The objective of the ETS cost calculations per sector in this study to provide the indirect ETS cost for the sub-sector between 2010 and 2012. The level of information is aggregated on a regional level, though the definition of those regions differs from sector to sector.

[6] The same methodology has also been applied for the sub-sector of wall and floor tiles. Alternatively, annual production data can be used as a weighting factor. This was not possible, as the data on annual production provided in the questionnaires was incomplete. However, consumption and production values are typically correlated, i.e. the difference between the two approaches is expected to be minor.

The model for the indirect cost of EU ETS in is defined as:

Indirect cost (€/Tonne of product) = Electricity intensity (kWh/Tonne of product)

** Carbon intensity of electricity (Tonne of CO_2/kWh)*

** CO_2 Price (€/Tonne of CO_2) * Pass-on rate*

Where:

- Electricity intensity of production: the amount of electricity used to produce one tonne of product. This amount is sector, plant and process specific;
- Carbon intensity of electricity generation indicates the amount of tonnes of CO_2 emitted by utilities to generate one kWh;
- CO_2 Price: is the average yearly market price of CO_2.
- Pass-on rate: the proportion of direct costs faced by utilities (disregarding any mitigating effects from free allocation) that they pass on to electricity consumers.

Sources:

- Electricity intensity of production; this was acquired from interviews with and questionnaires answered by industry members.
- Carbon intensity of electricity generation: the maximum regional carbon intensity of electricity is utilised, provided by the Commission's Guidelines on State aid measures.[7] Note that these figures are not national. Member States who are highly interconnected or have electricity prices with very low divergences are regarded as being part of a wider electricity market and are deemed to have the same maximum intensity of generation (for example, Spain and Portugal).
- CO_2 Price: Yearly averages of the daily settlement prices for Dec Future contracts for delivery in that year. The daily settlement prices were reported by the European Energy Exchange.

Table 2. Average yearly prices per ton of CO2 (€)

Year	2010	2011	2012
CO_2 Price	14.48	13.77	7.56

1.4.4 Validation of information

All sampled plants provided detailed figures on the level and structure of energy prices as well as on energy consumption. The data was assessed, e.g. through a plausibility check

[7] Communication from the Commission: Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012 (2012/C 158/04).

and then evaluated. Table 3 presents the number of questionnaires received, selected in the sample and used in the analysis of each section.

CEPS conducted a validation of the collected data through EU energy statistics publications[8]. To further assess consistencies in the responses, the research team performed targeted interviews with sampled producers. The research team was not able to validate the energy prices data, for example, through external sources of information about the costs borne by EU producers at plant level.

Table 3. Number of questionnaires used in each section

Total number received	23
Number included in the sample	13
Energy prices trends	13
Energy bill components	13
Energy intensity	8
International comparison	6
Indirect ETS costs	11

Please note that all of the figures presented in chapters 1.5, 1.6 and 1.8 include possible exemptions from taxes, levies or transmission costs. The consultant asked the producers to communicate the prices they paid for energy carriers between 2010 and 2012. Therefore, their answers include exemptions/reductions if these are applicable. Note that all the replies were submitted on a plant level.

The consultant decided to use only 13 out of 23 collected questionnaires to (i) ensure the geographical representativeness of the sample and (ii) due to the poor quality of some of the received questionnaires. Note that all the questionnaires used by the consultant were submitted on a plant level[9].

1.5 Energy prices trends

1.5.1 Introduction

As mentioned, the most energy intensive stage of the production process is drying, where heating is typically provided by natural gas. This is reflected by the ratio of natural gas and

[8] Validation was conducted through the EU Statistical Pocketbook 2013 (European Commission, 2013; available at: http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf) and the EU Market Observatory & Statistics.

[9] In some cases, respondents provided information at company level, not at plant level, as they were not able to attribute costs and consumptions to different plants.

electricity costs, which is in the range of 2.7 and 3.0. This means that electricity has a share of 25 to 27% on total energy costs, whereas natural gas holds a share of 73 to 75%[10].

1.5.2 Natural gas

1.5.2.1 General trends

As shown by the median in Figure 5, the prices of natural gas paid by the sampled producers of bricks and roof tiles are on the rise. In 2010, the median EU price of natural gas paid by those producers was of 30.4 €/MWh. In 2012, that price rose by 17.8% to a level of 35.8 €/MWh.

Furthermore, since 2010, the gap of prices paid by different EU producers kept growing steadily. The increasing inter-quartile range, i.e. the difference between the lower and upper quartile, which represents the middle half of the data, also reflects this trend. From 2011 to 2012, the range between the median and the upper quartile increased considerably, especially in comparison to the length separating the median from the lower quartile. Moreover, the total range of prices has also been increasing since 2010, as indicated by the whiskers of the box plot. According to the data collected, one or more producers are exposed to natural gas prices of up to 63.5 €/MWh.

1.5.2.2 Regional differences

Figure 5 also illustrates the average prices of natural gas paid by European producers operating in different geographical regions. The following trends can be observed at regional levels:

Northern Europe

Augmenting from 28.9 €/MWh in 2010, to 39.7 €/MWh in 2012, the average price of natural gas in Northern Europe increased by 37.4%. It is worth nothing that in 2012, the average north European price of natural gas was closest to the average European price (i.e. 39.5 €/MWh).

Central Europe

Ranging from 30.0 €/MWh in 2010 to 31.9 €/MWh in 2012, the average price of natural gas in Central Europe only increased moderately. It is noteworthy to mention that in 2012, the average price paid by Central European producers fell below the lower quartile of prices for the whole sample. This development is due to the soaring prices of gas in other regions, especially in Southern Europe. Therefore, in 2012:

- Central European producers paid lower prices than producers operating in Southern and Northern Europe;
- An average producer operating in Central Europe paid lower prices than 75% of the plants in the sample.

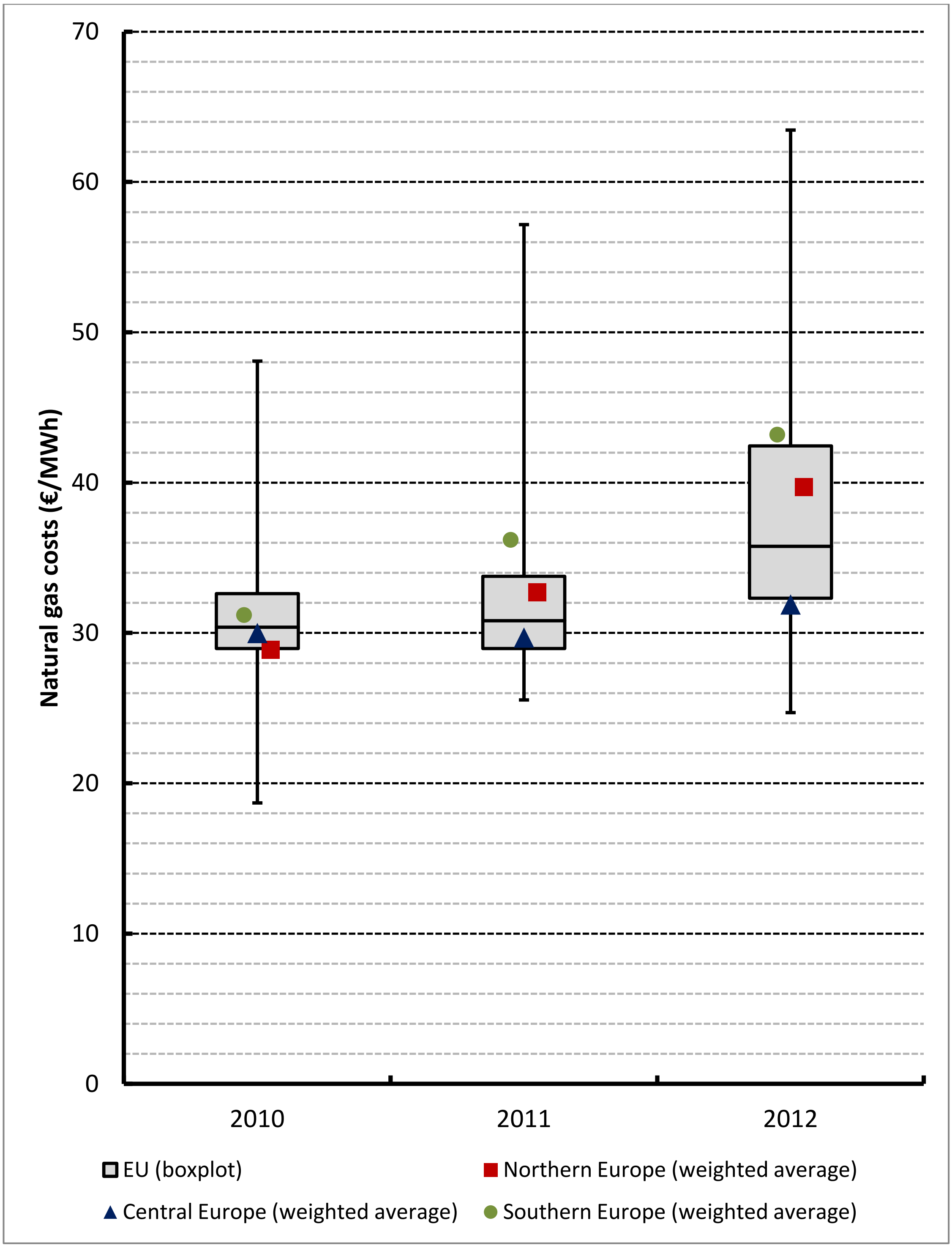
---

[10] Calculation based on the sample.

Southern Europe

Increasing from 31.2 €/MWh in 2010, to 43.2 €/MWh in 2012, the average price of natural gas in Southern Europe rose by 38.5% and was the highest among the three compared regions. The average price of natural gas paid by southern European producers exceeded the upper quartile of prices for all of Europe in 2011, remaining above this level in the following year. To summarise, the gap between the soaring prices in Southern and Northern Europe and the fairly stable prices in Central Europe grew rapidly.

Figure 5. Prices of natural gas paid by sampled EU producers (2010-2012)



Source: Own illustration.

Table 4. Descriptive statistics for natural gas prices paid by sampled EU producers (€/MWh)

	2010	2011	2012
Europe (average)	30.4	33.2	39.5
Europe (median)	30.4	30.8	35.8
Europe (IQR)[11]	3.7	4.8	10.1
Europe (minimum)	18.7	25.6	24.7
Europe (maximum)	48.1	57.2	63.5
Northern Europe (average)	28.9	32.7	39.7
Central Europe (average)	30.0	29.7	31.9
Southern Europe (average)	31.2	36.2	43.2

Source: Own calculation.

1.5.3 Electricity

1.5.3.1 General trends

Similar to natural gas, the median of electricity prices is on the rise (see Figure 6). For all plants in the sample, the median of costs has increased moderately from 93.8 €/MWh in 2010 to 100.9 €/MWh in 2012. This corresponds to an increase of 7.6%, which is 10.2 percentage points less than the value for natural gas. In 2012, electricity costs of 92.6 €/MWh or less occurred for 25% of the units (first quartile) in the sample. In the same year, 75% of the units (third quartile) had expenses for electricity of 120.7 €/MWh or less. In other words, 25% of the sampled units paid a price of 120.7 €/MWh or more.

The inter-quartile range has been thinning from 2010 to 2012. This means that - for the middle half of the plants in the data sample – the spread of electricity costs has decreased. According to the data provided by the plant owners in the sample, the lower quartile of electricity costs has been increasing faster than the upper quartile of electricity costs, thus reducing the inter-quartile range from 38.2 €/MWh (2010) to 28.1 €/MWh (2012). However, when also considering the whiskers of the box plot, which represent the outliers, it becomes evident that the spread between the minimum and maximum cost level does not follow the same trend but instead indicates an upward tendency. Augmenting from 91.4 €/MWh in 2010, to 128.0 €/MWh in 2012, the total range of electricity prices paid by the sampled facilities increased by 36.6 €/MWh with a limited number of plants exposed to electricity costs of up to 186.7 €/MWh.

1.5.3.2 Regional differences

In Figure 6, the weighted average prices of electricity paid by European producers in different geographical regions are illustrated.

[11] Inter Quartile Range.

In general, the differences between the regions considered in the sample were relatively low in 2010. In that year, expenses for electricity of plants located in Central Europe were about 8.4 €/MWh higher on average than the expenses for plants located in Southern Europe; the cost level in Northern Europe was in-between. This has changed recently (see **Table 5**) The following trends can be observed at regional level:

Northern Europe

The prices in Northern Europe show a slight upward tendency, increasing from 89.8 €/MWh to 95.0 €/MWh (+5.8%). For all years considered in the analysis, the price is below the median price of the sample, i.e. producers in Northern Europe have lower electricity costs than at least 50% of the plants in the sample.

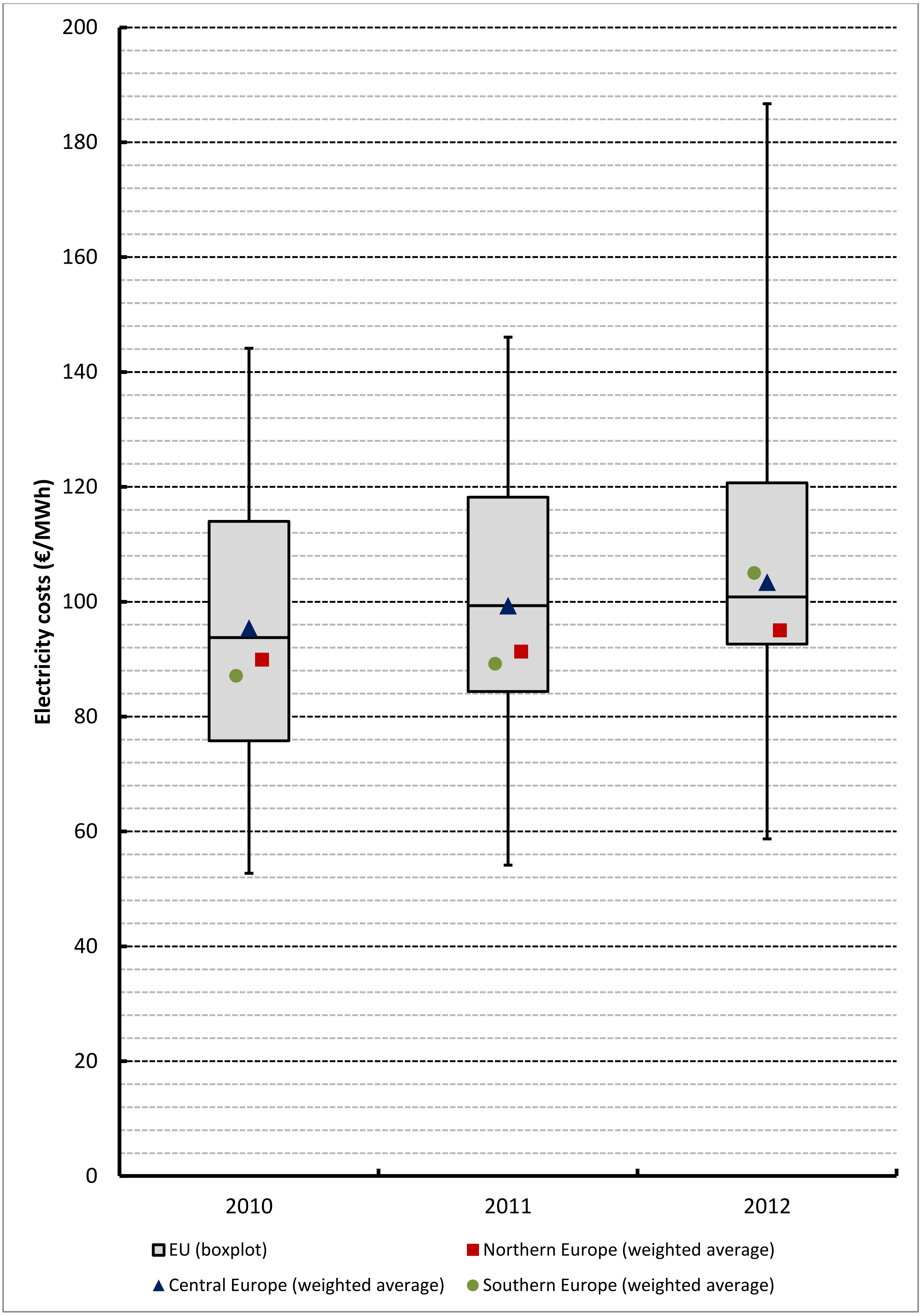
Central Europe

In Central Europe, the upward tendency is stronger, as prices augmented from 95.4 €/MWh in 2010 to 103.4 €/MWh in 2012 (+8.3%). In general, the average price paid by Central European producers is near to the median price of the sample.

Southern Europe

This region shows the strongest rise in prices. Increasing from 87.1 €/MWh in 2010, to 105.0 €/MWh in 2012, the average price of electricity in Southern Europe rose by 21% and is, as of 2012, the highest among the three compared regions. The average price of electricity paid by southern European producers exceeded the median price for the whole of Europe in 2012.

Figure 6. Prices of electricity paid by sampled EU producers (2010-2012)



Source: Own illustration based on questionnaires.

Table 5. Descriptive statistics for electricity prices paid by sampled EU producers (€/MWh)

	2010	2011	2012
Europe (average)	90.4	93.4	102.4
Europe (median)	93.8	99.3	100.9
Europe (IQR)	38.2	33.8	28.1
Europe (minimum)	52.7	54.1	58.7
Europe (maximum)	144.1	146.1	186.7
Northern Europe (average)	89.9	91.3	95.0
Central Europe (average)	95.4	99.3	103.4
Southern Europe (average)	87.1	89.2	105.0

Source: Own calculation.

1.6 Analysis of energy bills components

1.6.1 Introduction

In order to better understand the price developments, this section provides a breakdown of total costs into specific components. In particular, for natural gas, the total costs are grouped into the following three components: (i) the energy component, (ii) grid fees and (iii) other levies and taxes (excluding VAT). For electricity, there is one additional component, the RES levies.

It is worth noting that the CO2 cost component is not directly visible in this breakdown but is included in the energy component in the case of electricity. Given the relatively low CO2 prices between 2010 and 2012 and the limited share of electricity costs on total costs, the influence of CO2 prices on total costs for bricks and roof tiles was marginal for the period under study. For natural gas this depends on whether producers are getting free emission allowances. This was the case during the second phase of the ETS (2008-2012), i.e. there were no additional costs for CO2 certificates for the period under study. In the future, this cost component could become more important.

1.6.2 Natural gas

1.6.2.1 General trends

As shown by Figure 7 and Figure 8, the energy component is the major driver of natural gas prices for the sampled plants in Europe. In 2010, it amounted to roughly 26.4 €/MWh, reaching a share of 86.9% of the price of natural gas paid by an average European producer of bricks and roof tiles. The increase in natural gas prices was accompanied by a growing share of the energy component (92.7% in 2011 and 94.9% in 2012). However, this development is also related to the diminishing share of the other two components, namely grid fees and other levies and taxes. Between 2010 and 2012, the costs of grid fees decreased from 3.0 €/MWh to approximately 1.7 €/MWh (-42%). As illustrated by Figure 7, the impact of taxes (excl. VAT) and other levies on the prices of natural gas is marginal. In 2010, they accounted for 3.2% of the cost of gas by the sampled producers. In 2012, this share decreased to 0.7%.

1.6.2.2 Regional differences

Figure 7 also illustrates the breakdown of costs for the 3 different regions. The following trends can be observed at regional level:

Northern Europe

The developments in Northern Europe are in line with the EU trends (i.e. increasing share of the energy components vs. decreasing shares of other components). However, it is worth mentioning that the impact of taxes and levies in Northern Europe is almost non-existent. In 2012, they accounted for less than 0.1% of the average price paid by producers in Northern Europe.

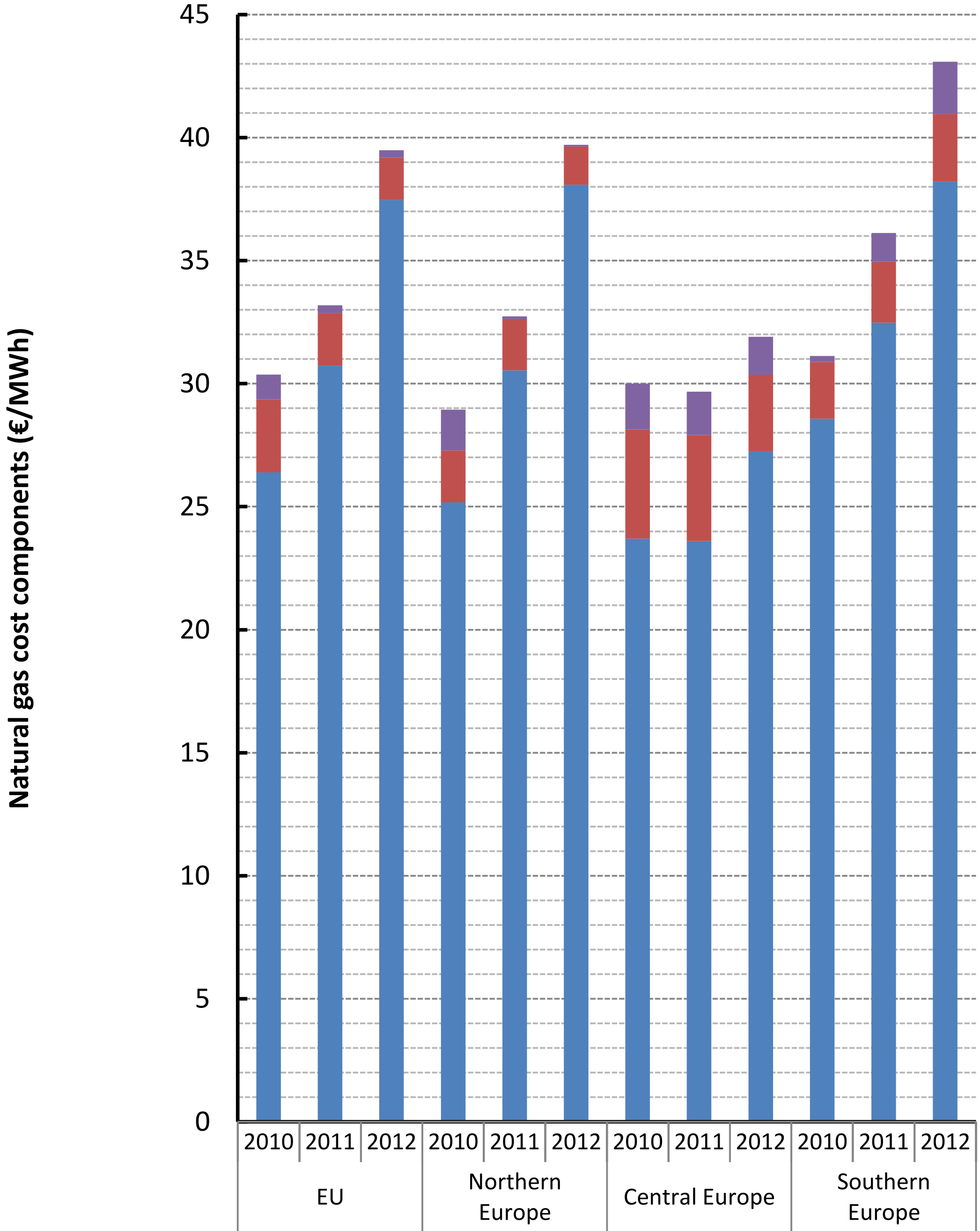
Central Europe

In comparison to the other regions, Central Europe is marked by a relatively strong influence of grid fees on the final price of natural gas (9.8% in 2012). As the share of taxes and other levies represented 4.8% of the price of gas, the impact of the energy component was the lowest among the three compared regions (85.3%, namely -9.6% in relation to the EU average). Such breakdown of the average gas price is particularly interesting. Indeed, among the three compared regions, producers operating in Central Europe benefit from the lowest prices for natural gas.

Southern Europe

The rising average price of gas paid by southern European producers was accompanied by a growing importance of taxes and levies. Ranging from 0.2 €/MWh in 2010, to 2.1 €/MWh in 2012 (+883%), the influence of this price driver remains limited, yet increasingly important. This can be illustrated by a comparison of the costs of the energy component in Northern and Southern Europe. In 2012, the costs of the latter were similar in the two regions, namely 38.1 €/MWh in Northern Europe vs. 38.2 €/MWh in Southern Europe. However, due to different taxation, the average price of natural gas paid by producers was higher in Southern Europe than in Northern Europe (by 3.4 €/MWh).

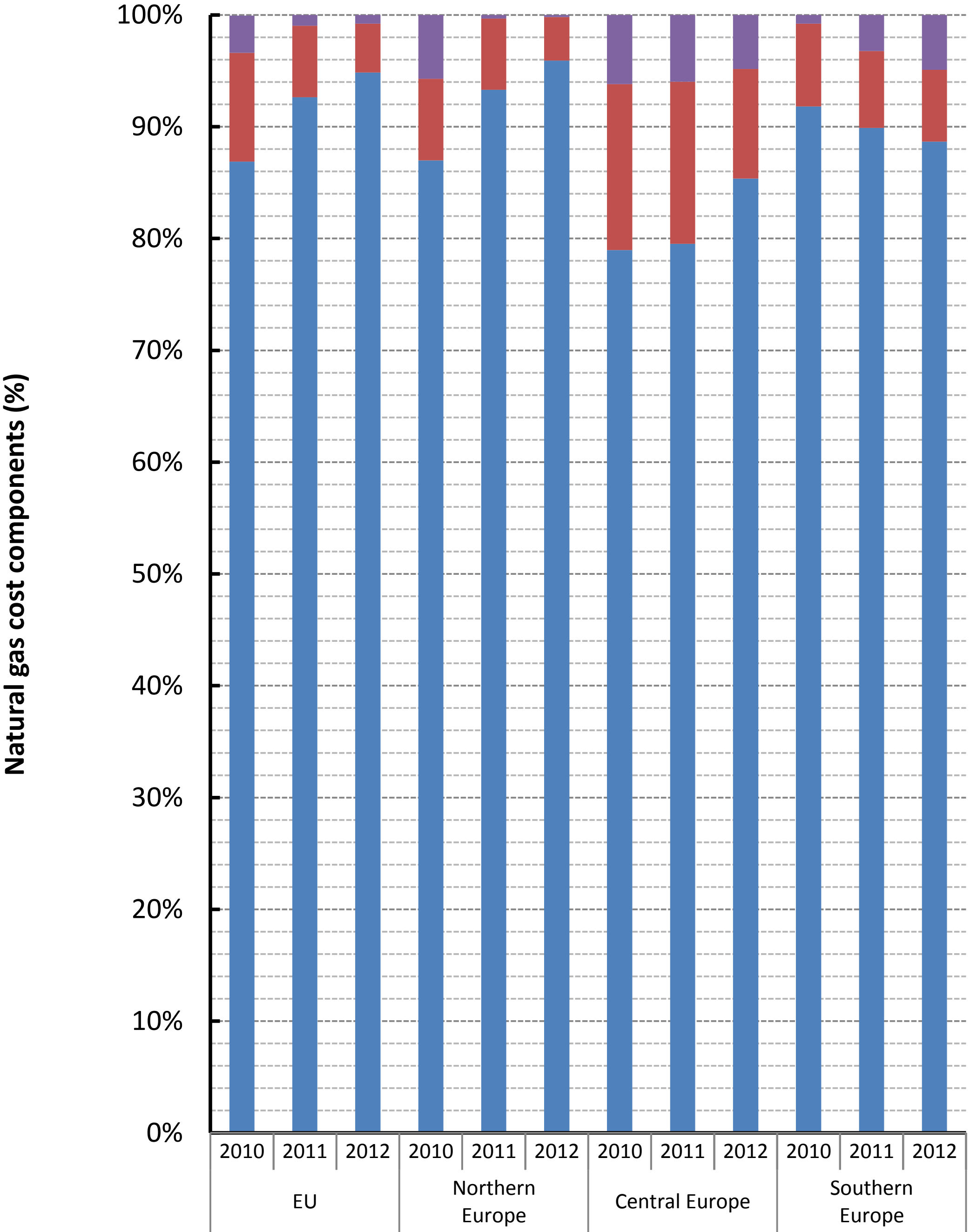
Figure 7. Components of the natural gas bills paid by the sampled producers in Europe (in €/MWh)



	EU 2010	EU 2011	EU 2012	Northern Europe 2010	Northern Europe 2011	Northern Europe 2012	Central Europe 2010	Central Europe 2011	Central Europe 2012	Southern Europe 2010	Southern Europe 2011	Southern Europe 2012
Other (excl. VAT)	1.0	0.3	0.3	1.7	0.1	0.1	1.9	1.8	1.5	0.2	1.2	2.1
Grid fees	3.0	2.1	1.7	2.1	2.1	1.5	4.4	4.3	3.1	2.3	2.5	2.8
Energy component	26.4	30.7	37.5	25.2	30.5	38.1	23.7	23.6	27.2	28.6	32.5	38.2

Source: Own calculation based on questionnaires.

Figure 8. Components of the natural gas bills paid by the sampled producers in Europe (in %)



	EU 2010	EU 2011	EU 2012	Northern Europe 2010	Northern Europe 2011	Northern Europe 2012	Central Europe 2010	Central Europe 2011	Central Europe 2012	Southern Europe 2010	Southern Europe 2011	Southern Europe 2012
Other (excl. VAT)	3%	1%	1%	6%	0%	0%	6%	6%	5%	1%	3%	5%
Grid fees	10%	6%	4%	7%	6%	4%	15%	15%	10%	7%	7%	6%
Energy component	87%	93%	95%	87%	93%	96%	79%	80%	85%	92%	90%	89%

Energy component   Grid fees   Other (excl. VAT)

Source: Own calculation based on questionnaires.

1.6.3 Electricity

1.6.3.1 General trends

In accordance with the structure of natural gas prices, the energy component is the most significant component of the electricity price paid by the sampled production facilities in Europe (see Figure 9 and Figure 10). However, in comparison to natural gas, this component is less dominant. In 2010, the energy component amounted for roughly 58.3 €/MWh, reaching a share of 64.5% of the electricity price paid by an average sampled European producer of bricks and roof tiles. In the same year, grid fees amounted to 17.6 €/MWh (19.5%), RES levies for 6.3 €/MWh (7.0%) and other levies & taxes (excl. VAT) for 8.1 €/MWh (9.0%).

Augmenting from 58.3 in 2010 to 59.9 €/MWh in 2012, the costs for the energy component have remained relatively stable in absolute terms. However, its share has been diminishing over the last two years, reaching a value of 58.4%. This development is related to the stronger increase of other components. From 2010 to 2012, average grid fees have increased by 3.7 €/MWh (+20.1%), RES levies by 4.6 €/MWh (+72.8%) and other levies & taxes (excl. VAT) by 2.3 (+27.9%). For the sampled facilities, the additional burden due to RES support schemes is clearly visible in the electricity bills.

1.6.3.2 Regional differences

On a regional level, the following trends can be observed:

Northern Europe

In comparison to the general situation, Northern Europe is marked by a stronger influence of grid fees on final electricity prices. In 2012, the share on total costs amounted to 29.5%. In contrast, the share of RES levies is significantly lower than in other parts of Europe (3.2% in 2012). The sum of all components has increased from 89.8 to 95.0 €/MWh (+5.8%) in the observation period.

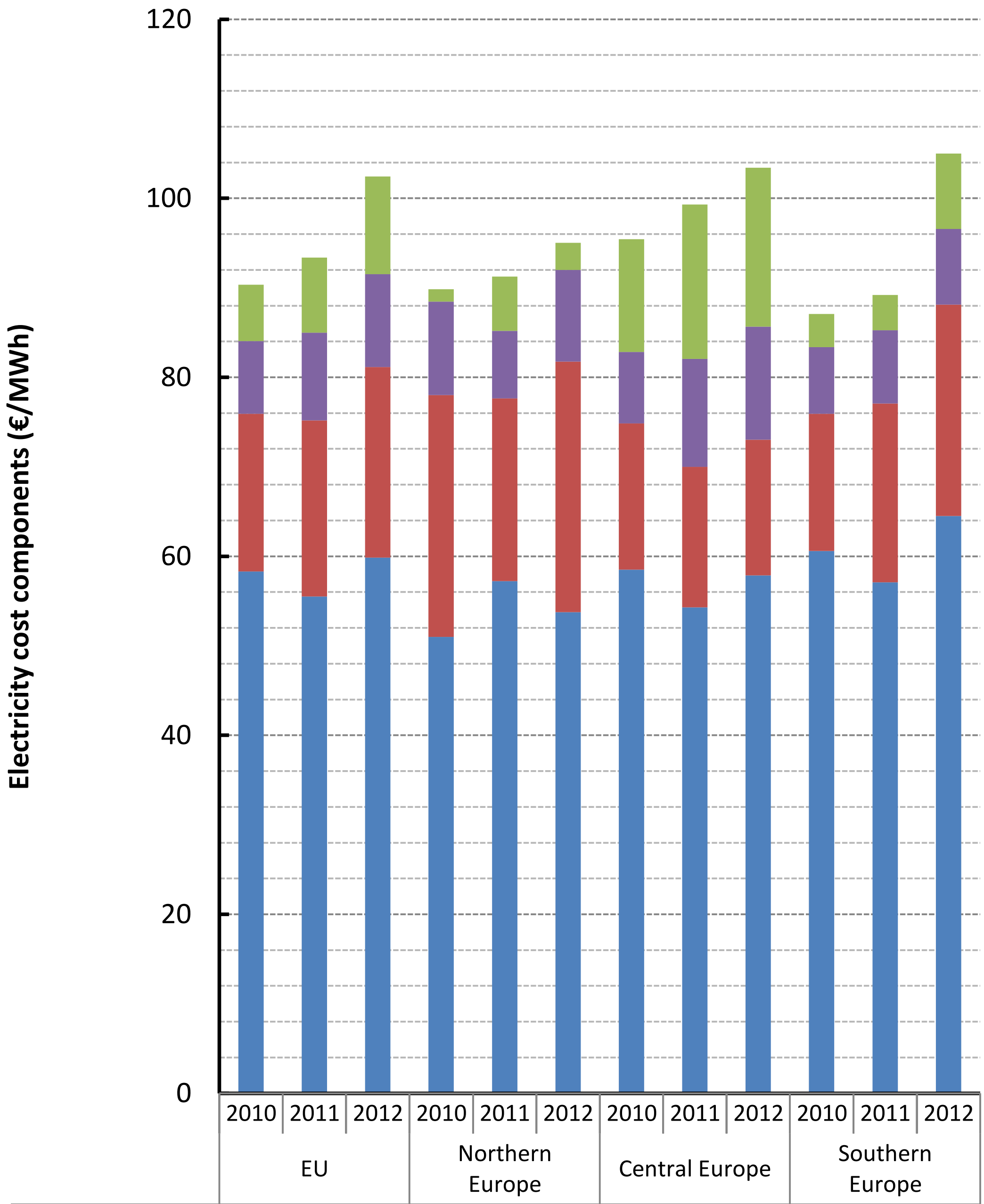
Central Europe

In Central Europe, RES levies have a higher impact on final electricity prices than they do in the other regions. In 2012, the share on total costs amounted to 17.2%. Other taxes & levies also have a greater influence compared to the European average of sampled producers (13.3% in 2012). As a result, grid fees are lower than in the other regions, both in absolute (15.2 €/MWh in 2012) and relative terms (16% in 2012). Augmenting from 95.4 to 103.5 €/MWh, the sum of all components has seen a 8.4% increase, i.e. a stronger increase than in Northern Europe.

Southern Europe

In comparison to the other regions, Southern Europe has shown the strongest increase of electricity in the observed period. Average electricity prices have increased from 87.1 to 105.0 €/MWh, which corresponds to a 20.6% increase. Augmenting from 3.7 €/MWh in 2010 to 8.4 €/MWh in 2012, the RES levy has seen a 129.0% increase. In the same period, grid fees have also been on the rise (+54.2%), while the trend of the energy component was not stable. From 2010 to 2011, the costs for this component fell by 3.5 €/MWh, but then regained 7.4 €/MWh from 2011 to 2012. As of 2012, the sampled plants of Southern Europe are exposed to the highest electricity prices among all the sampled facilities.

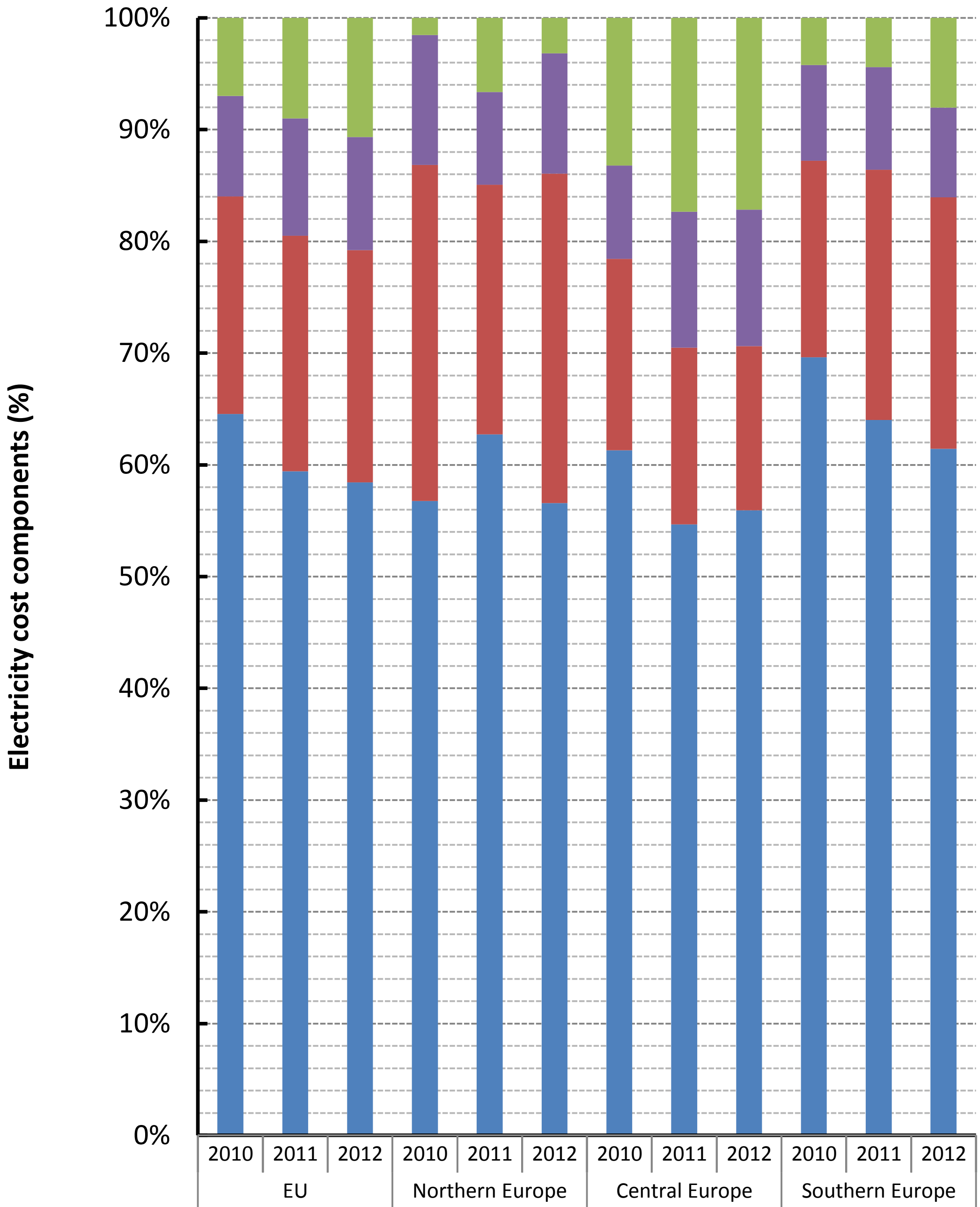
Figure 9. Components of the electricity bills paid by the sampled producers in Europe (in €/MWh)



	EU 2010	EU 2011	EU 2012	Northern Europe 2010	Northern Europe 2011	Northern Europe 2012	Central Europe 2010	Central Europe 2011	Central Europe 2012	Southern Europe 2010	Southern Europe 2011	Southern Europe 2012
RES levy	6.3	8.4	10.9	1.4	6.1	3.0	12.6	17.2	17.8	3.7	3.9	8.4
Other (excl. VAT)	8.1	9.8	10.4	10.5	7.6	10.2	8.0	12.1	12.6	7.4	8.2	8.4
Grid fees	17.6	19.7	21.3	27.0	20.4	28.0	16.3	15.7	15.2	15.3	20.0	23.6
Energy comp.	58.3	55.5	59.9	51.0	57.2	53.8	58.5	54.3	57.9	60.6	57.1	64.5

Source: Own calculation based on questionnaires.

Figure 10. Components of the electricity bills paid by the sampled producers in Europe (in %)



	EU 2010	EU 2011	EU 2012	Northern Europe 2010	Northern Europe 2011	Northern Europe 2012	Central Europe 2010	Central Europe 2011	Central Europe 2012	Southern Europe 2010	Southern Europe 2011	Southern Europe 2012
RES levy	7%	9%	11%	2%	7%	3%	13%	17%	17%	4%	4%	8%
Other (excl. VAT)	9%	11%	10%	12%	8%	11%	8%	12%	12%	9%	9%	8%
Grid fees	19%	21%	21%	30%	22%	29%	17%	16%	15%	18%	22%	22%
Energy comp.	65%	59%	58%	57%	63%	57%	61%	55%	56%	70%	64%	61%

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

Source: Own calculation based on questionnaires.

1.7 Energy intensity

1.7.1 General trends

The consultant asked the producers to provide information about the energy efficiency of their plants by disclosing figures on the energy intensity of their production processes[12]. Intensity is typically measured in terms of value added (unit: MWh/€) or in terms of physical output (unit: MWh/tonne). As several energy carriers are used in the production process, separate intensities should be calculated for each energy source (e.g. electricity, natural gas) to allow a correct interpretation of the data. Producers did not provide such a breakdown. However, it is possible to deduce these figures from the consumption values of each energy source given in the questionnaires.

The completeness of intensity data among respondents was varied. Out of the 13 sampled plants, only 10 provided intensity data in terms of physical output. In terms of value added, complete data was available for only 8 plants. The reduced size of the regional samples impedes the research team to disclose regional statistics due to confidentiality reasons. Instead, only EU-wide figures are given. The weighted average[13] and the median of both electricity and natural gas intensities in terms of physical output were calculated. To give an indication of the variability of the sample the inter-quartile range (IQR) is used. Minimum and maximum values cannot be disclosed due to confidentiality reasons.

Table 6. Descriptive statistics for the natural gas intensities for 10 out of 13 sample production plants in terms of physical output (MWh/tonne)

	2010	2011	2012
Europe (average)	0.52	0.54	0.56
Europe (median)	0.58	0.50	0.53
Europe (IQR)	0.24	0.22	0.29

The figures collected for natural gas are reported in Table 6. Although some plant owners have indicated that investments in energy efficiency have been made, the data does not show a clear trend. The median intensity decreased from 2010 to 2011 and then increased again from 2011 to 2012. Without further information, no interpretation for this dip can be given. The weighted average intensity was on the rise during the entire observation period. As indicated by the IQR, the difference between the 25% of the plants with the highest intensity and the 25% with the lowest intensity increased from 2010 to 2012.

The figures for electricity are reported in Table 7. In this case, the trend is more visible. While the median decreased, the weighted average remained at the same level. This means

[12] It is worth noting that energy intensity does not only depend on the physical features of machines and processes, but also on the capacity utilisation rate. Hence, difference in efficiency across multiple years may not only signal investments in energy efficiency, but also a better utilisation rate.

[13] Weighting factor: consumption.

that at least one smaller production plant (in terms of consumption) made progress and reduced its electricity intensity over the short time frame covered by this study, while for the rest of the sampled plants this was not evident. This development is also reflected by the increasing IQR. It is worth recalling that electricity has a share of 25 to 27% on total energy costs.

Table 7. Descriptive statistics for the electricity intensities for 10 out of 13 sampled production plants in terms of physical output (MWh/tonne)

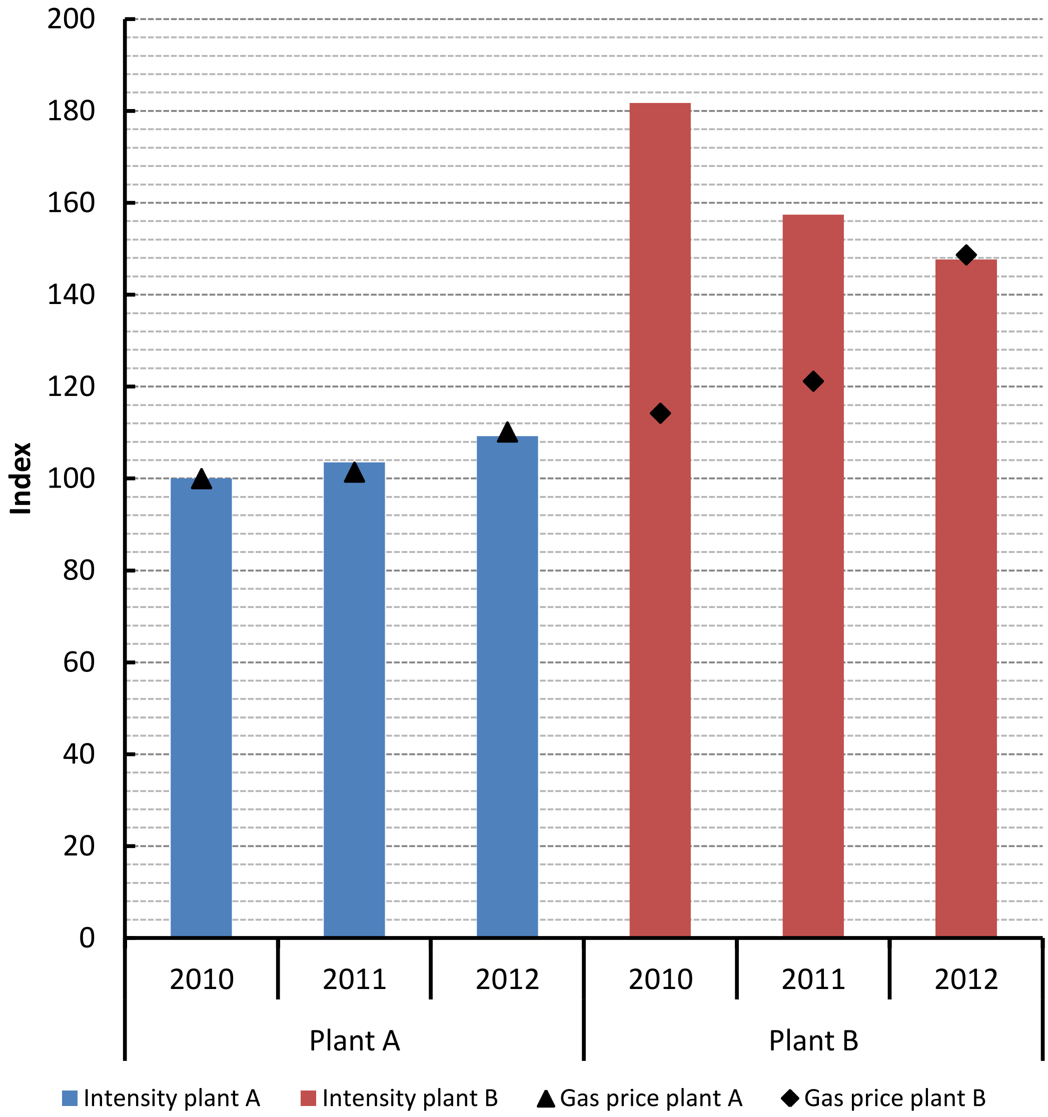
	2010	**2011**	**2012**
Europe (average)	0.07	0.07	0.07
Europe (median)	0.07	0.06	0.06
Europe (IQR)	0.03	0.03	0.04

1.7.2 Plant case study

Figure 11 shows the natural gas intensity of two sampled plants in relative terms[14]. Moreover, the corresponding gas prices paid by the producers were also indexed and have been included in the graph. In the case of plant B, energy efficiency improved over the years (i.e. natural gas intensity decreased), while gas prices were on the rise during the entire observation period (+35% since 2010). However, even after the improvements, plant B is not as efficient as plant A. As of 2012, the latter showed a 38% lower intensity when compared to plant B. In 2010, the difference between the two plants was of 82%. It is worth noting that the research team cannot exclude that drivers other than the rising gas price exist for the increase in energy efficiency.

[14] Indexed (relative) values have to be used in order not to disclose this highly confidential information.

Figure 11. Natural gas intensity and natural gas prices of two plants (indexed values, lowest value = 100)



Source: Own calculation.

1.8 International Comparison

The aim of this chapter is to compare the prices of energy carriers paid by producers based in the EU with the prices paid by manufacturers operating in third countries, namely Russia and the US. This section is based on a series of plant case studies. Data collected from two manufacturing sites located in Russia and the US has been confronted with figures collected through the questionnaires submitted by the sampled EU plants. Plants selected for this assessment are of comparable production capacities in order to avoid distortions that are due to different consumption levels of natural gas or electricity. In other words, the Russian plant and the EU plants "A" and "B" have similar production capacities. Likewise, the US plant and the EU plants "C" and "D" have comparable production capacity.

As the research team received only monthly energy bills for the Russian and US plant, only plausibility checks could be performed. It is worth noting that the research team cannot assess the representativeness of the Russian or US plants in their respective markets.

1.8.1 Natural Gas

1.8.1.1 EU vs. Russia

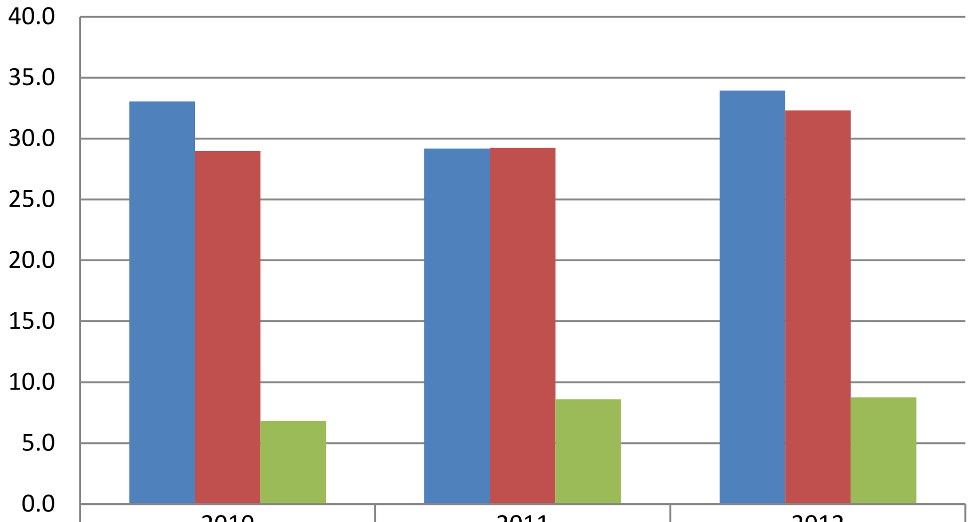
As shown by Figure 12, despite rising prices, the selected Russian facility benefited from the lowest prices of natural gas among the three compared plants during the entire observation period. Moreover, during the same timeframe, the prices paid by this specific Russian facility were lower than those of any EU plant included in the sample.

The prices of gas paid by EU plant "A" decreased from 2010 to 2011 (-12%) and then increased again to a level of 33.9€/MWh in 2012 (+16.1%). Without further information, no explanation for this dip can be given. EU Plant "B" experienced a similar trend; gas prices paid by that plant were augmenting throughout the observation period. Since 2010, they increased from 28.9 €/MWh to 32.3 €/MWh in 2012 (+11.7%). The differences between the two regions are probably due to the fact that prices are regulated in Russia.

1.8.1.2 EU vs. US

As illustrated by Figure 13, the prices of natural gas paid by the selected US facility were the lowest among the three compared plants. Decreasing from 25.2 €/MWh in 2010, to 14.1 €/MWh in 2012, prices diminished by 44.1%. In 2011 and 2012, the prices of natural gas paid by the US-based facility were lower than in any of the EU plants included in the sample. Contrary to the trend experienced by this specific US plant, the prices paid by the two EU facilities increased incessantly between 2010 and 2012. During the same period of time, the prices paid by EU plant "C" augmented from 32.6 €/MWh, to 42.45 €/MWh (+30%). In the case of EU plant "D", prices rose from 31.2 €/MWh in 2010, to 39.4 €/MWh in 2012 (+26.2%). The differences between the two regions are probably due to the fact that US consumers have access to abundant resources of unconventional fossil fuels driving natural gas prices down.

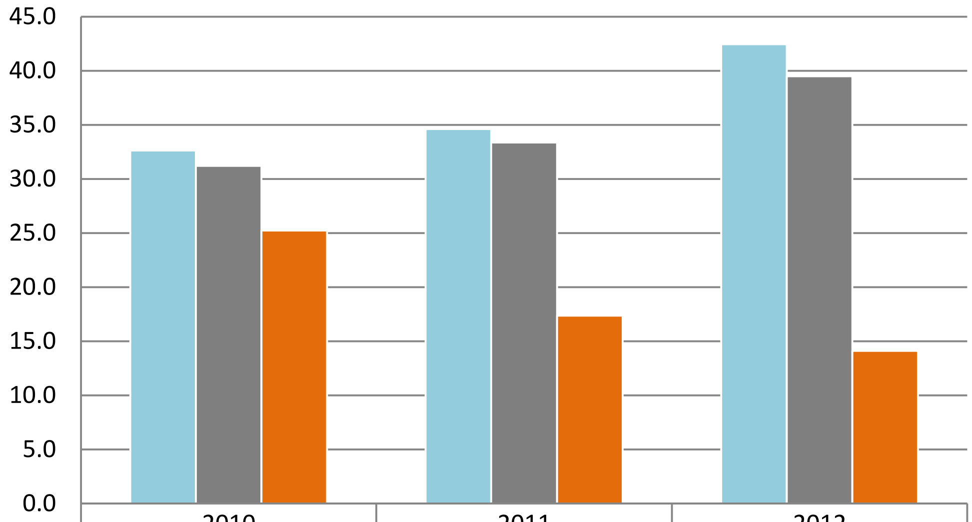
Figure 12. Prices of natural gas - EU vs. Russia (plant level data expressed in €/MWh)



	2010	2011	2012
EU Plant "A"	33.1	29.2	33.9
EU Plant "B"	29.0	29.2	32.3
RU Plant	6.8	8.6	8.7

Source: Own illustration.

Figure 13. Prices of natural gas - EU vs. US (plant level data expressed in €/MWh)



	2010	2011	2012
EU Plant "C"	32.6	34.6	42.5
EU Plant "D"	31.2	33.4	39.5
US Plant	25.2	17.4	14.1

Source: Own illustration.

1.8.2 Electricity

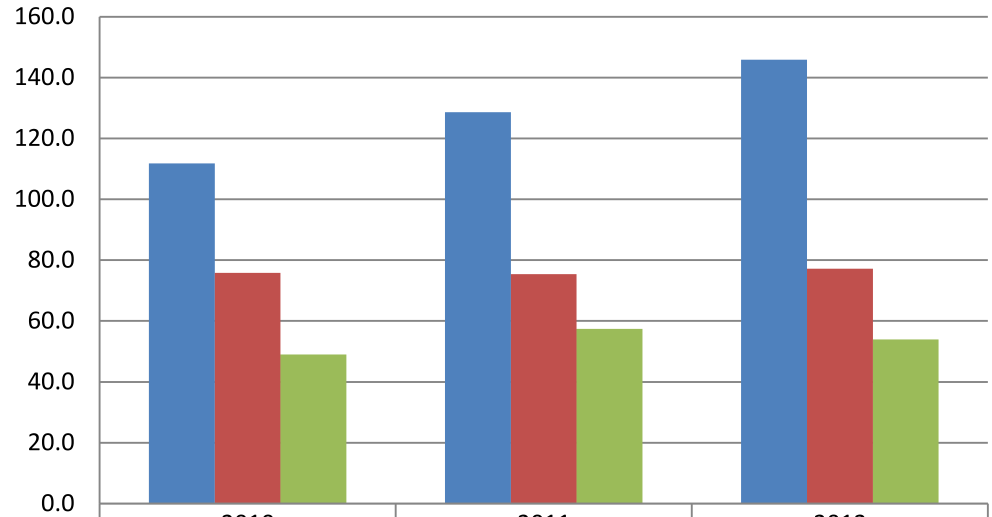
1.8.2.1 EU vs. Russia

As illustrated by Figure 14, the selected Russian plant benefited from the lowest electricity prices among the three production sites throughout the observation period (i.e. 53.9 €/MWh in 2012). As of 2012, the price paid by the Russian plant was lower than the price paid in any of the EU plants included in the sample (see Table 5). The prices of electricity paid by EU plant "B" increased almost unnoticeably. Between 2010 and 2012, power prices paid by the latter increased from 75.8 €/MWh, to 77.1 €/MWh (+1.7%). In the case of EU plant "A" the price increase was more important both in absolute and relative terms. Electricity prices augmented from 111.8 €/MWh in 2010, to 145.8 €/MWh in 2012 (+30.4%). The differences between the two regions are probably due to the fact that prices are regulated in Russia.

1.8.2.2 EU vs. US

As shown by Figure 15, the electricity prices paid by the selected US facility were the lowest among the three compared facilities. However, it is worth noting that at least one of the EU plants included in the sample benefited from lower power prices than this specific US facility during the entire observation period. What is more, the prices of electricity paid by the latter increased from 2010 to 2011 (+7%) and then decreased (-5.9%) to a level of 69.1 €/MWh in 2012. Overall, since 2010, the power prices paid by this specific US plant decreased by 0.8% and were lower than for the two EU facilities assessed in Figure 15. The prices of electricity paid by EU plant "D" decreased between 2010 and 2011 (-2.5%) to rise to a level of 75.1 €/MWh in 2012 (+11.3%). Between 2010 and 2011, the power prices paid by plant "C" kept a fairly stable level (+1.4%) and were roughly twice as high as in the other two selected plants. However, from 2011 to 2012 they soared by 27.8% to a level of 186.7 €/MWh. As of 2012, the price paid by EU plant "C" was 2.7 times higher than the price paid by the US plant. The differences between the two regions are probably due to the fact that US consumers have access to abundant resources of unconventional fossil fuels driving natural gas prices down, which also affects electricity prices. As no information was provided on the US structure of the electricity bill, no further interpretation is possible.

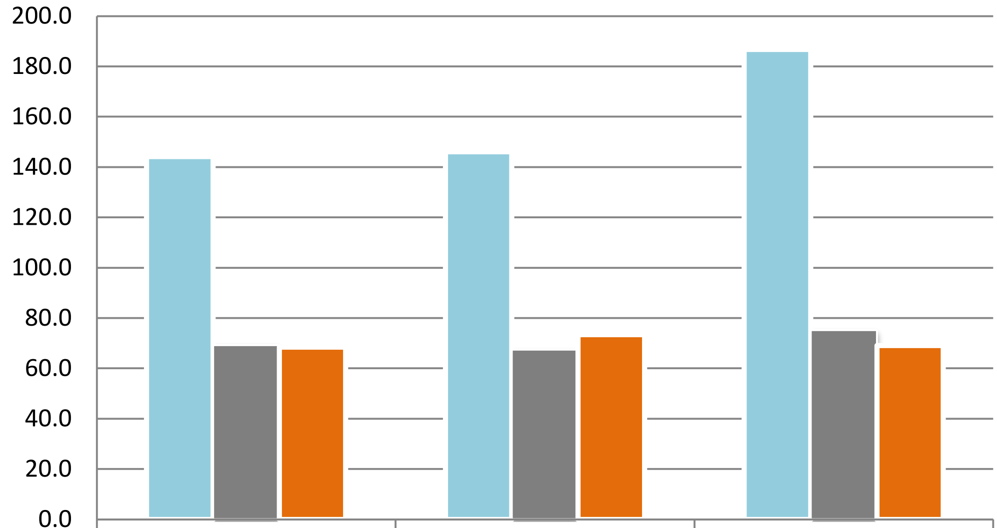
Figure 14. Prices of electricity - EU vs. Russia (plant level data expressed in €/MWh)



	2010	2011	2012
EU Plant "A"	111.8	128.7	145.9
EU Plant "B"	75.8	75.4	77.1
RU Plant	49.0	57.4	54.0

Source: Own illustration.

Figure 15. Prices of electricity - EU vs. US (plant level data expressed in €/MWh)



	2010	2011	2012
EU Plant "C"	144.1	146.1	186.7
EU Plant "D"	69.2	67.5	75.1
US Plant	68.5	73.4	69.1

Source: Own illustration.

1.9 Indirect ETS costs for the Bricks and Roof tiles Sector

1.9.1 Sample

Information on the indirect costs of ETS was obtained from the industry via questionnaires. As mentioned, bricks and roof tiles the research team has grouped producers in 3 different regions.

Two plants in the original sample were excluded from this part of the analysis; one from Central Europe and one from Northern Europe. Both were left out due to incomplete questionnaires: these two plants did not report yearly electricity intensity of production. Thus 11 plants were used for the analysis presented in this section.

1.9.2 Results

Table 8. Bricks and Roof tiles indirect costs, averages per region (€/tonne of bricks and roof tiles),

	Central Europe	Northern Europe	Southern Europe
2010	0.56	0.49	0.33
2011	0.50	0.41	0.31
2012	0.28	0.21	0.18

Pass-on rate: 0.6

Table 9. Bricks and Roof tiles indirect costs, averages per region (€/tonne of bricks and roof tiles),

	Central Europe	Northern Europe	Southern Europe
2010	0.74	0.65	0.44
2011	0.67	0.55	0.42
2012	0.37	0.29	0.24

Pass-on rate: 0.8

Table 10. Bricks and Roof tiles indirect costs, averages per region (€/tonne of bricks and roof tiles),

	Central Europe	Northern Europe	Southern Europe
2010	0.93	0.81	0.55
2011	0.84	0.69	0.52
2012	0.46	0.36	0.29

Pass-on rate: 1

In this sectoral analysis of indirect ETS costs, none of the plants in the sample have indicated that they either generate electricity themselves, or have a long term contract with a utility.

There are inter-regional differences in indirect costs, caused by two distinct factors. First the maximum regional CO2 emissions factor[15], which is lowest in Southern Europe and highest in Central Europe.

Second, differences in electricity intensities between plants. The plants in Southern Europe consume on average circa 0.05 MWh/tonne of bricks and roof tiles, compared with circa 0.07 in Central Europe and circa 0.08 in Northern-Europe.

The drop in indirect ETS costs across all regions between 2011 and 2012 can be largely attributed to a sharp decrease in EUA prices (from a yearly average of 13.77 Euros per EUA in 2011 to a yearly average of 7.56 Euros per EUA in 2012).

1.9.3 Key findings

Although the inter-regional differences are relatively low in comparison with other sectors covered by this study (most notably flat glass and ammonia), indirect costs in Central Europe are still significantly higher than indirect ETS costs in Southern Europe.

The inter-regional variations are caused by differences in the electricity intensity of production and differences in maximum regional CO2 emissions factors.

The average indirect costs for the plants in Southern Europe are significantly lower than for other regions. Several factors contributed to this: lower electricity intensity and lower maximum regional carbon intensity of electricity generation in the Southern European region.

The ETS indirect cost was significantly lower in 2012 compared to the previous years, because the price of EUAs was significantly lower in 2012.

---

[15] As defined and listed in Annex IV of the 'Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012' (2012/C 158/04).

1.10 General impressions

The research team used the questionnaires to (*inter alia*) ask EU producers about their impressions of the effects of liberalisation, investments in energy efficiency or the energy intensity of the sector.

Responders could not agree on the impacts of the liberalisation of the energy markets; while some manufacturers claimed that the liberalisation resulted in lower prices, others associated rising energy prices with the opening of the markets. Most of the respondents claimed that their facilities were not entitled to any reductions/exemptions from networks tariffs, taxes or levies. According to a large group of responders taxes and RES levies were the main cost drivers in their gas and power contracts. The majority of the interviewees admitted that the price of CO_2 was included in their electricity contracts. Most of the manufacturers did not switch their electricity suppliers. One of the producers invested in photovoltaic generation. Most of the respondents had yearly contracts with their energy utilities. Some of the contracts were concluded for a period of three years. One of the producers had a long term contract with its electricity provider. One of the producers (operating both inside and outside the EU) complained about the price volatility of natural gas in a member state located in Northern Europe.

References

Batier, R. (2009), *Competitiveness Issues in the Ceramic Sector: Drivers and Obstacles*, European Economic and Social Committee Consultative Commission on Industrial Change, Prague 2 April 2009, Speech.

Cerame-Unie, (2012), *Paving the way to 2050: the Ceramic Industry Roadmap*, 2012. Available at: http://www.cerameunie.eu/en/news

Cerame-Unie, (2013a), personal communication, 14 Nov. 2013.

Cerame-Unie, (2013b), personal communication, 19 Dec. 2013.

Ecorys, (2008), *FWC Sector Competitiveness Studies - Competitiveness of the Ceramics Sector*, Final report ENTR/06/054, 2008. Available at: http://tinyurl.com/qjzvzaq

European Commission, (2007), *Reference Document on Best Available Techniques in the Ceramic Manufacturing Industry*, 2007. Available at: http://tinyurl.com/ngg6nlb

European Commission, (2013), *EU Energy in figures, Statistical Pocketbook*, 2013. Available at: http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf

Eurostat. Available at http://tinyurl.com/qbkq7ga

Kalyoncu, R. (2000), *Graphite*, 2000. Available at: http://tinyurl.com/oqnc6h8