EUROPEAN
COMMISSION

Brussels, 30.11.2016
SWD(2016) 420 final

PART 5/13

COMMISSION STAFF WORKING DOCUMENT
Accompanying the document

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Energy prices and costs in Europe

{COM(2016) 769 final}

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6 Industry energy costs

This chapter looks at the effects of energy prices on the structure and the competitive position of the European economy, both at a broad macro-economic level and at sectors of selected energy intensive industries.

Main findings:

Compared with other factors of production, energy plays a relatively modest role in the formation of the gross value added in the economy. On EU level, its share is estimated at roughly 2% of the total production value for all businesses. For manufacturing that energy share stood slightly above 2% in 2013. The share of energy purchases to production value is even smaller for the services sector.

Yet, energy is at the very fabric of almost all products and services used in everyday life. In addition, several important manufacturing sectors also rely on energy as the biggest or the most critical factor of production.

Based on recent global metrics it appears that the economic performance and the overall competitiveness of the EU MS has remained stable compared to that of our main trading partners, despite the turbulent events that marked 2008 – 2015.

The full macroeconomic effects of the wide variations of the global energy commodity prices in recent years are yet to unravel. It seems that up to 2013 the impact on the overall competitiveness of the EU economy was limited as the real unit energy costs of large industrial subsectors remained stable.

With regards to the energy intensive sectors,

— Firms are confronted with different electricity and gas prices depending on their energy supply strategies, consumption level and patterns, connection type to grids as well as price and tax exemptions and reductions. This makes that price differences between firms may vary widely (estimated up to 50% in the same sector in the same country).

Looking at general analysis of sectors at high level of aggregation (at NACE 3 level) and the analysis of the case studies (NACE 4 level), some observations can be made on the role of energy costs and competitiveness in the Energy intensive sectors studied:

Between 2008-2013:

— EU **electricity prices** for industry, with a wide range of variation across the EU Member States, are in line with global competitors, higher than prices in the US but lower than most of Asian prices. The evolution of the exchange rate can play a very significant role. This was the case of China, with prices increase mainly driven by the appreciation of the Yuan.

— EU **gas prices** for industry are higher than most of the competitors examined, only lower than Asian gas prices.

In the 14 **energy intensive sectors studied in the Ecofys report (NACE 3 level):**

— **Energy costs shares** in the EU decreased in most of the Energy Intensive Industry sectors studied (11 sectors out of 14) while total absolute decreased in all. At the end of the period

under study, between 2011 and 2013, energy costs shares increased in half of the sectors studied (7 sectors out of 14). Despite the higher prices in the EU compared to the US, energy cost shares were lower in the EU than in the US. Conversely, energy cost shares in the EU were higher than in Japan despite the higher prices in Japan. Energy cost shares are falling in both EU and US, but they are in general falling more rapidly in the US and by 2013 approaching similar levels for many sectors. **Profit margins** (Gross operating surplus as percentage of production costs) are smaller in EU than in Japan and the US.

— For the few EU Member States for which data was available, **energy intensity** in the most intensive sectors (pulp and paper, basic chemicals, cement, lime and plaster and iron and steel) has increased driven primarily by downward pressure on Gross Value Added, which could be associated with decreasing profits and / or increasing production costs..

— **Energy efficiency** for most EU sectors has improved historically helping to reduce the impact of energy price rises. Between 2008-2014, energy efficiency improvements could have stalled in some energy intensive sectors probably due to lack of capital for investment.

Case studies from energy intensive sectors (five sectors studied in CEPS et altri) show that:

— **Electricity** prices: operators in (sub-) sectors with relatively lower energy consumption pay a much higher price than operators in (sub-) sectors with higher consumption levels. The same correlation could not be observed in **natural gas** prices most likely due to the lower weight of non-energy components (network costs, taxes and levies) in final prices, which reduces the impact of tax and price exemptions/reductions.

— For electricity in 6 out of 9 countries, the price in 2015 is higher than in 2008. For natural gas, prices were lower in 7 out of 11 countries. Although with some differences[1] these results are overall in line with the trends observed in retail prices chapters of this report (1.2.2 & 2.2.2). As described in previous chapters the overall trend is also largely due to decreases in the energy price component and increases in network costs and taxes and levies.

Other points to be highlighted from case studies (five energy intensive sectors studied in the Ecofys report at NACE level 4: Iron and Steel, Non -ferrous metals, paper, hollow glass and basic chemicals) are that:

— The main (net) imports come from China and Russia. For steel, South Africa but also Iran, Ukraine, South Korea and Turkey are very relevant. For paper, India and, for aluminium and glass, Turkey is a growing import origin. The USA is the major destination of net exports. The EU lost market share particularly to China in certain sectors, including steel, paper and aluminium. Production in the glass sector has remained relatively stable.

— Despite relatively higher energy prices in the EU than in some G20 competitors, particularly the US, Europe is a net exporter of many products, for example finished steel.

[1] In the industries assessed by *CEPS et altri* both electricity and gas prices peaked in 2012-2013 and then declined

— Some of the sectors under study are suffering from overcapacities and associated market consolidation and this can trigger increased competition from emerging economies

— Commodity products typically face strong international competitive pressure. However, competitiveness depends not only on energy prices, personnel and raw material costs but on many other factors such as proximity to the upstream and downstream markets, economic growth (global and regional) and institutional environment, including the conditions for research and development.

6.1 Competitiveness and the energy costs of industry

Defining competitiveness

The economic decision to invest and the willingness to do business in a given location are influenced by many factors that go beyond prices, costs and factor productivity. The country risk, the political stability, the regulatory environment and the investment climate (among others) are weighing heavily on such decisions and impacting directly the competitive position of each area of the world.

Several renowned international institutes and organisations have developed methodologies combining hard statistical data and surveys of experts' opinions to measure the factors that influence the competitiveness of a given economy.

The Global Competitiveness Indicator of the World Economic Forum (WEF) [2] and the World Competitiveness Scoreboard of the International Institute for Management Development (IMD)[3] are using similar bottom-up approaches to estimate economic performance. A wide range of parameters influencing the competitiveness of a given economy are first collected and quantified, to be later regrouped in main themes which will then feed into the global indices.

Energy costs and competitiveness

WEF defines the competitiveness on a national level "*the set of institutions, policies, and factors that determine the level of productivity of an economy, which in turn sets the level of prosperity that the country can earn*".

Drivers of competitiveness in the general economy

The following (Figures & Figure 179) illustrate the evolution of several indictors measuring the competitiveness of the European Union Member States against our main trading partners, defined as the non-EU members of the group of G20 of major world economies.

A similar message is emerging from the competitiveness indicators of the World Economic Forum (WEF) and: the economic performance of the EU has followed a pathway which is broadly comparable to that of the non-EU G20 major economies.

Based on the most recent data from WEF and IMD, the EU competitiveness vis-a-vis non-EU G20 members is actually slightly improving since 2014. This finding holds when economic performance is measured by actual score or by the ranking position of the countries that are being analysed.

[2] World Economic Forum; Global Competitiveness Report 2015-2016. The Global Competitiveness Indicator of the World Economic Forum (WEF) http://reports.weforum.org/global-competitiveness-report-2015-2016/

[3] The World Competitiveness Scoreboard of the International Institute for Management Development (IMD), http://www.imd.org/wcc/

Figure 178 – **Competitiveness of the EU according to IMD competitiveness indicator**

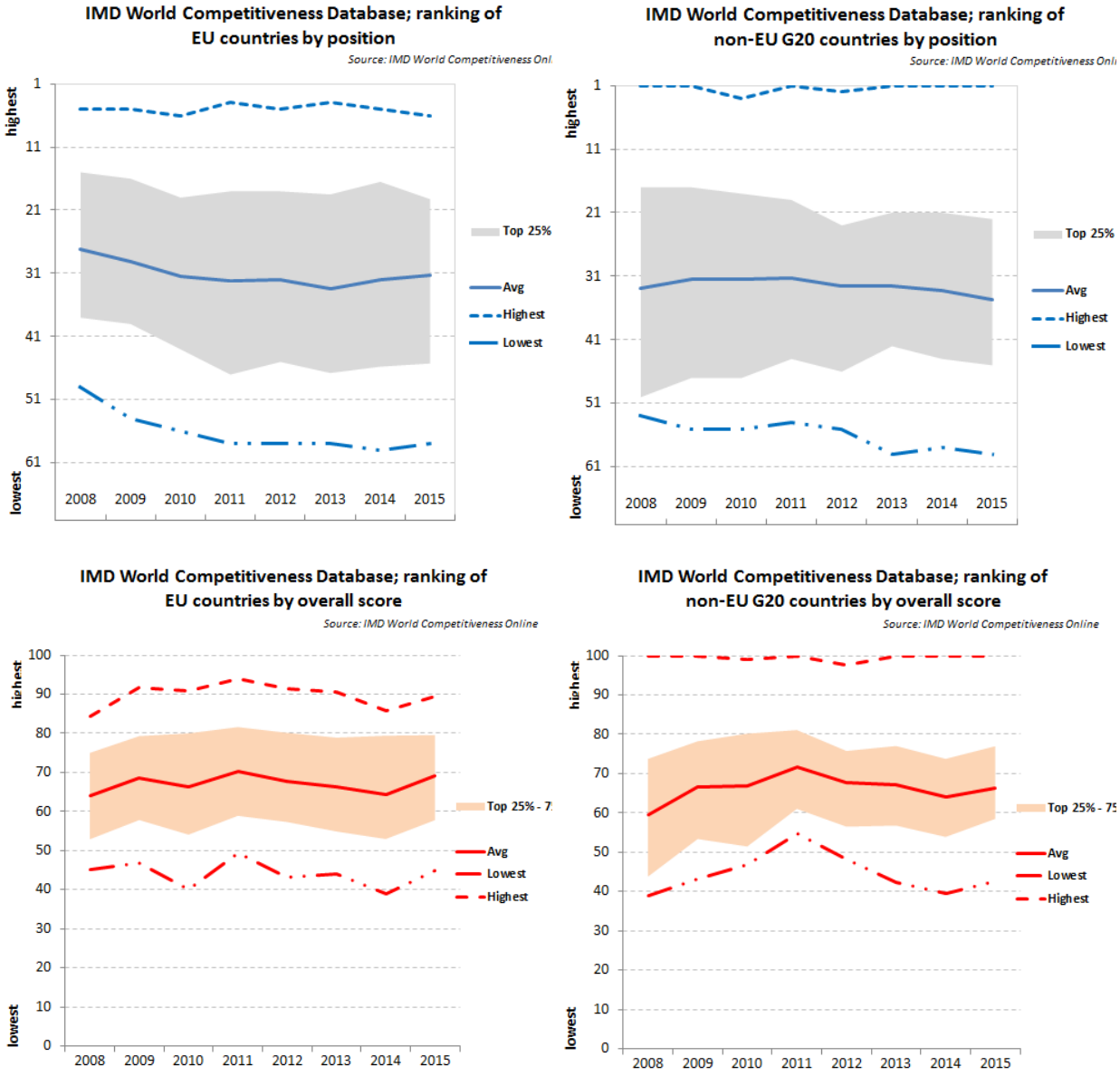
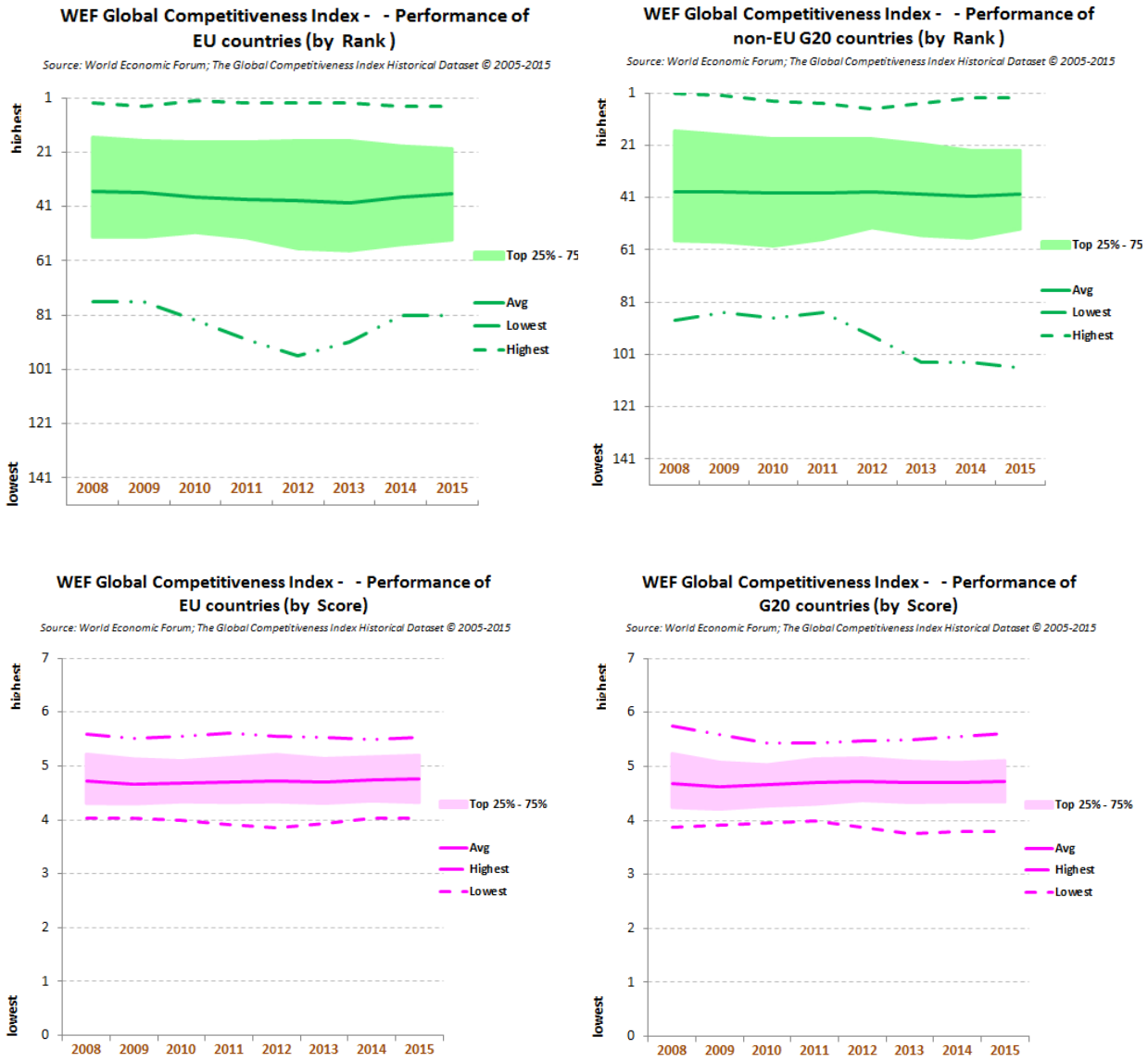


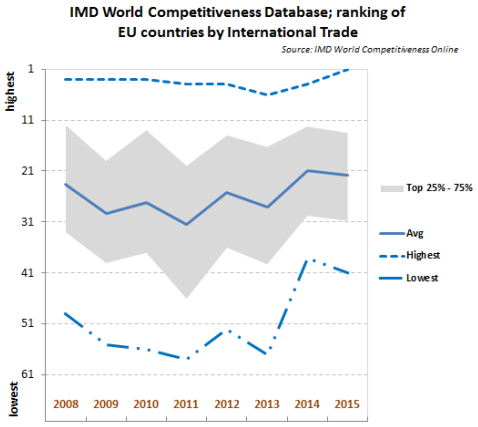
Figure 179 – **Competitiveness of the EU according to IMD competitiveness indicator**

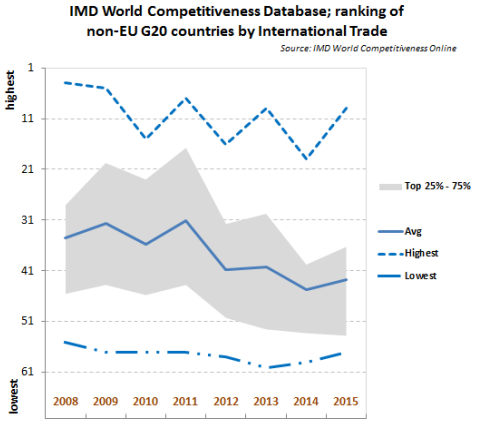


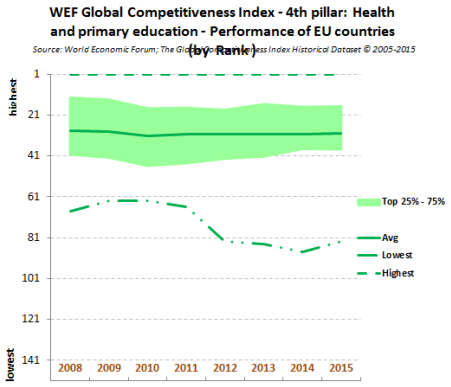
The next Figures (**Figure 180** & **Figure 181**) report on factors for competitiveness where the EU Member States and the non-EU G20 countries show relatively big differences in terms of performance – be it as a ranking or as a score. Those factors could also explain possible divergences of the level of macroeconomic competitiveness of the two groups of countries.

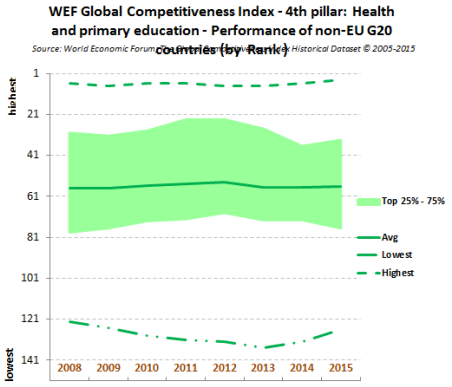
The WEF and IMD indices produce similar results indicating that the EU group seems to enjoy a clear competitive advantage over the non-EU G20 group in the following areas: **international trade; infrastructure – including electricity supply; health and primary education and ICT use**. On the other hand, the relatively **small size of EU economies** (taken separately), **the employment and flexibility of the labour market and fiscal policies** seem to be pushing down the economic performance of the EU group compared to the group of non-EU G20 countries.

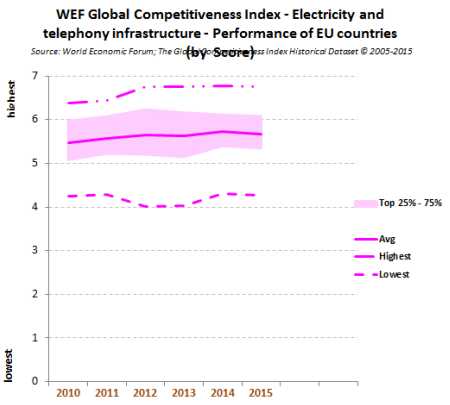
Figure 180 - **Results for selected favourable factors of competitiveness**

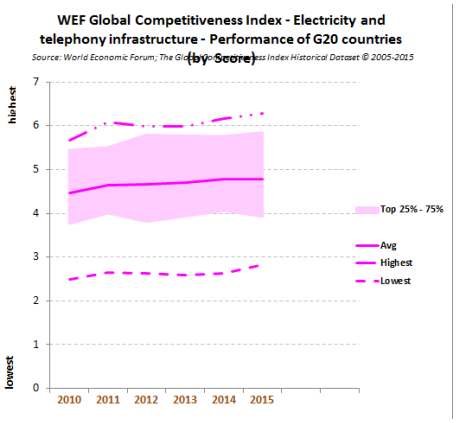


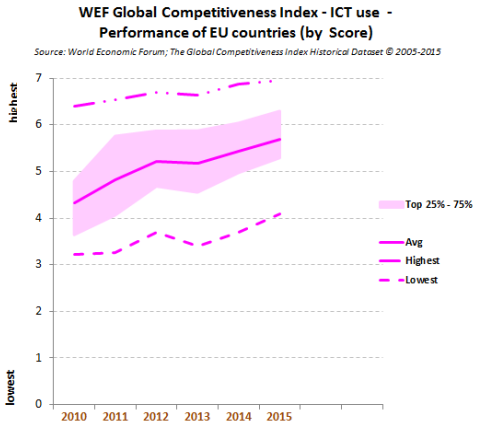












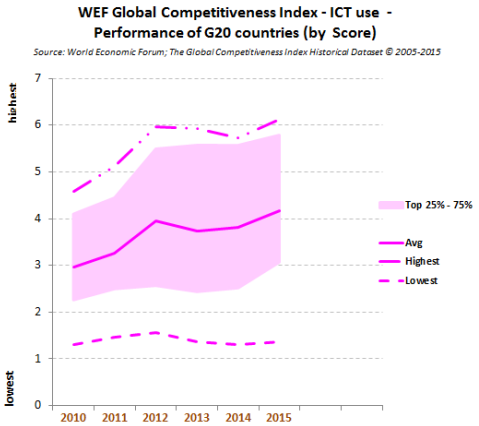
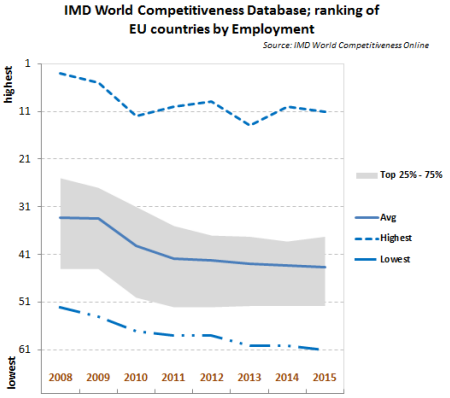
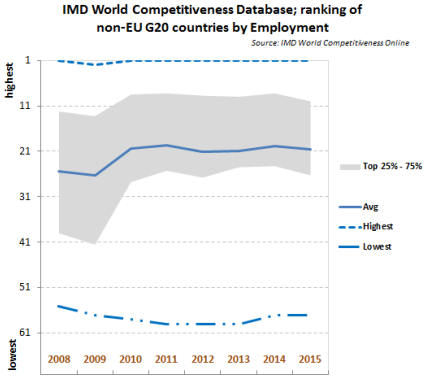
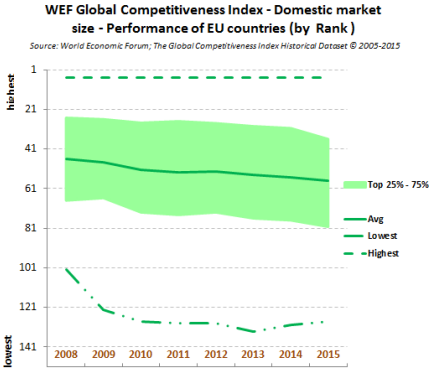
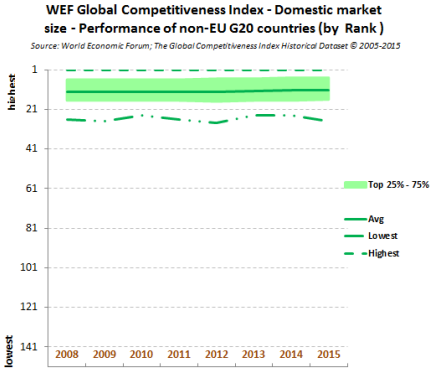


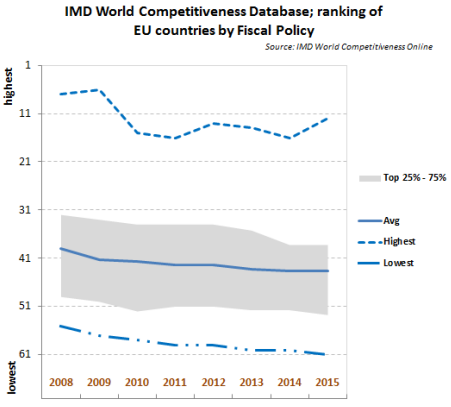
Figure 181 - **Results for selected less favourable factors of competitiveness**

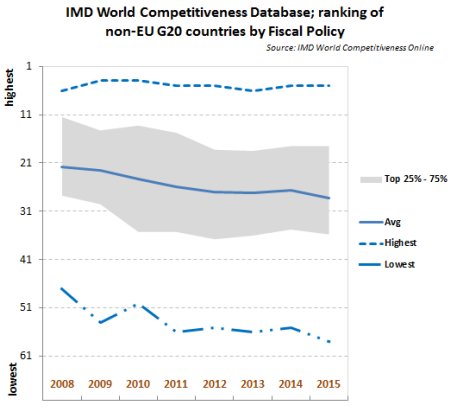






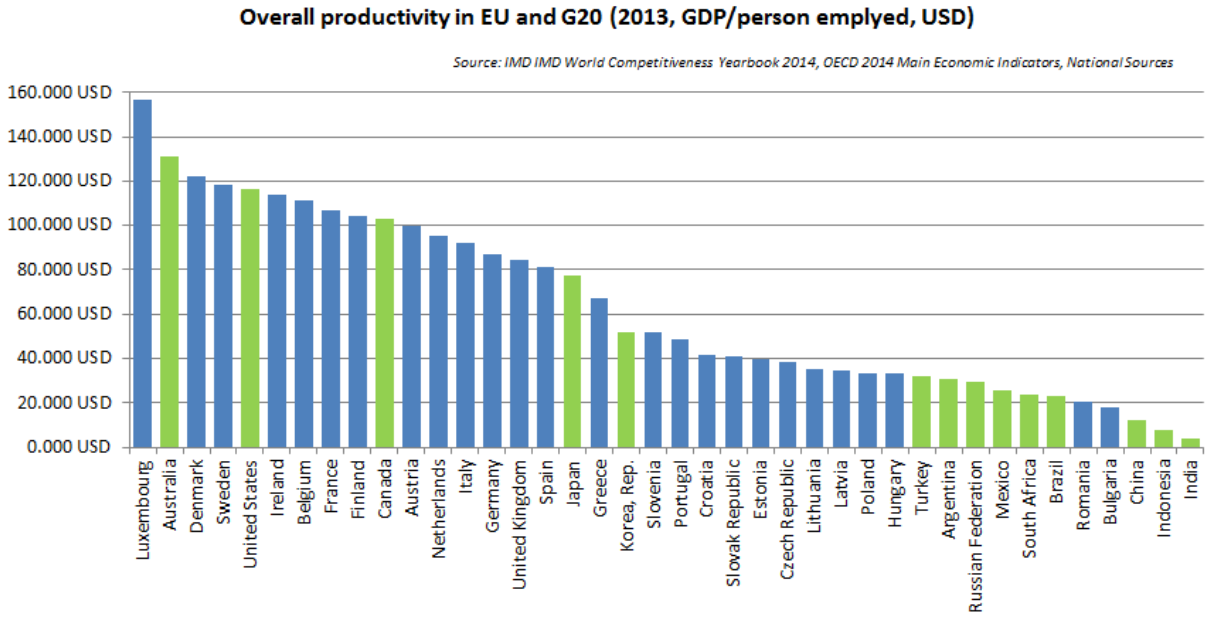






The recent improvement of EU economic performance is also confirmed by the European Commission report on Single Market Integration and Competitiveness[4].

Figure 182 – **Productivity in the EU and G20**



Notes:
1. Overall productivity is defined as the ratio of GDP over employment; employment data are estimates and are provisional for the most recent period;
2. Data for Cyprus, Malta and Saudi Arabia is not available

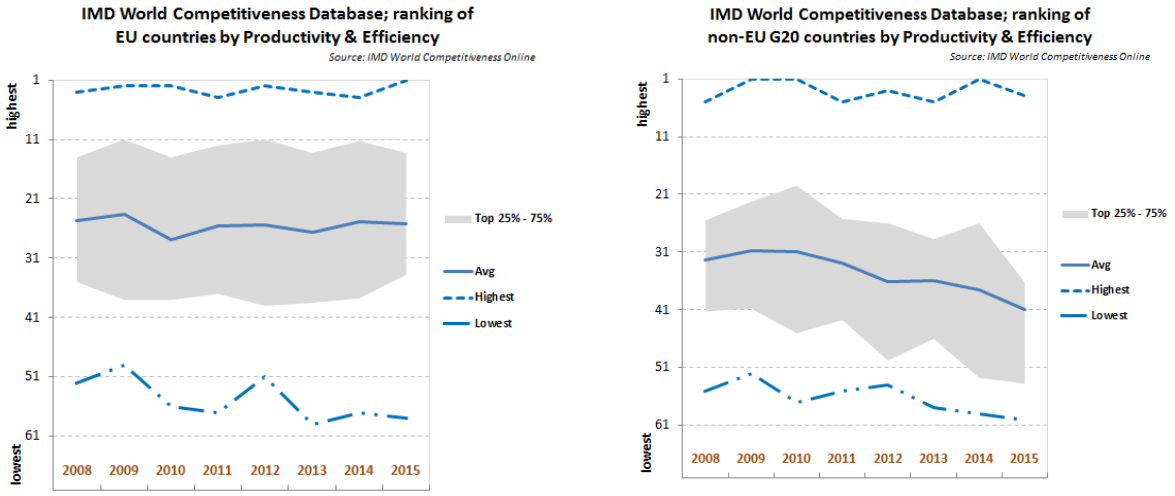
In terms of overall productivity, the majority of EU Member States are competing with the high-income members of the non-EU G20, as shown in the Figure above (**Figure 182**).

Over the recent years, the dispersion of productivity and efficiency rates across G20 economies has increased, with high income countries enjoying stronger growth rates than the low-income and less diversified economies of the non-EU G20. Whereas the group of EU countries perform better over the group on non-EU G20 (see **Figure 183** and Footnote 109) the 2015 Single Market Integration and Competitiveness report mentioned above (see footnote 105) points out that through the years many EU Member States have accumulated important productivity gaps with the United States and other high income G20 countries and that reforms enhancing the labour and total factor productivity of EU companies should be introduced at both national and EU level. The EU and national reforms are further discussed in separate reports of the European Commission[5]

[4] Report on Single Market Integration and Competitiveness in the EU and its Member States, 2015 DG GROW, http://ec.europa.eu/growth/industry/competitiveness/reports/single-market-integration-competitiveness/index_en.htm

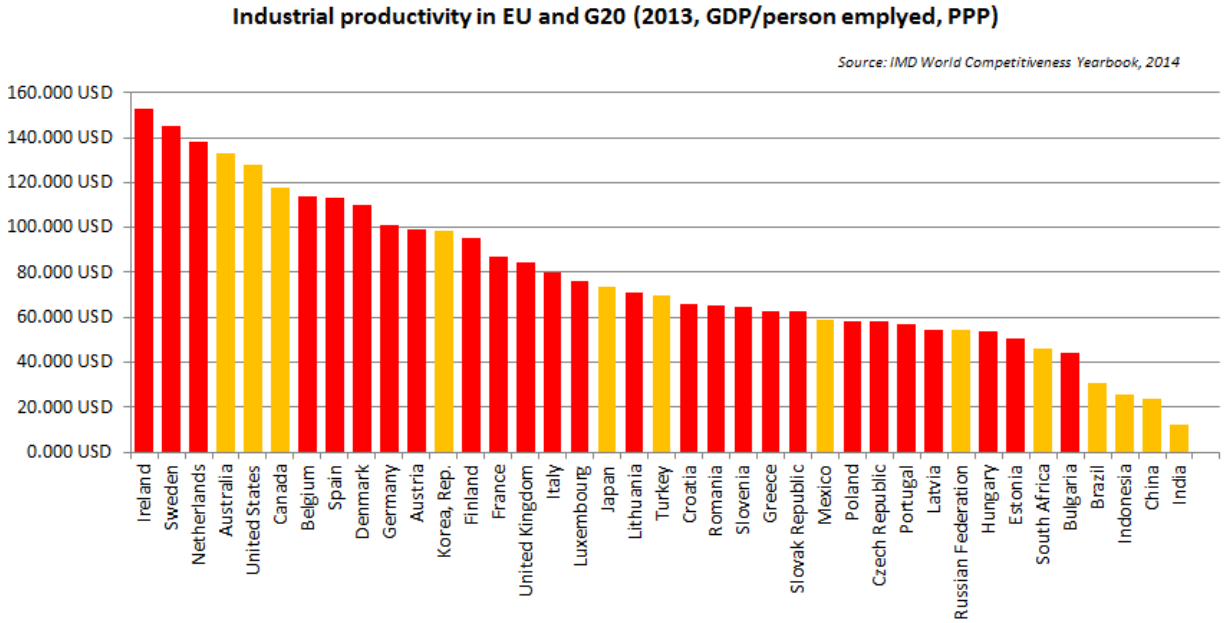
[5] These include the European Competitiveness Report, 2014 DG GROW http://ec.europa.eu/growth/industry/competitiveness/reports/eu-competitiveness-report/index_en.htm
and the Member States' Competitiveness Report, 2014 DG GROW http://ec.europa.eu/growth/industry/competitiveness/reports/ms-competitiveness-report/index_en.htm

Figure 183- **Competitiveness of the EU by Productivity and Efficiency**



The productivity spread across high- and low- income countries is less relevant when the monetary value used is switched to Purchasing Power Parities[6] instead of US Dollars and if the focus shifts to the manufacturing sectors only, as shown below in **Figure 184**.

Figure 184 – **Industrial productivity in the EU and G20**



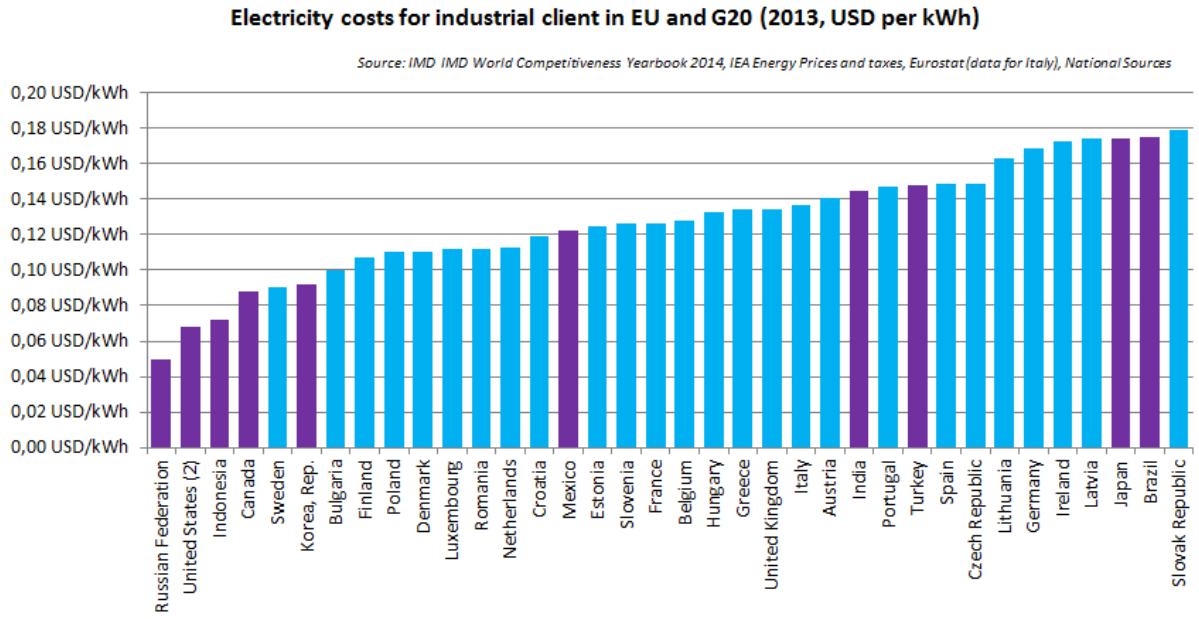
Notes:
1. Industrial productivity is defined as the ratio of related GDP (PPP) per person employed in industry; employment data are estimates and are provisional for the most recent period
2. Data for Cyprus, Malta, Argentina and Saudi Arabia is not available

[6] Purchasing Power Parities (PPP) are the currency exchange rates that equalize the purchasing power of different currencies. This means that a given sum of money, when converted into different currencies using the PPP exchange rate, will by the same basket of goods. PPP are currency conversion rates that eliminate the differences in price level across countries.

6.3.2. Energy's impact on competitiveness

Looking at the most recent prices for electricity for industrial users, the non-EU G20 countries appears again as a heterogeneous group. The G20 countries are rather split with regards to their endowment of energy resources as well as other factors that influence electricity prices. See **Figure 185**.

Figure 185– **Electricity costs for industrial clients in the EU and G20**



Notes:
1. Prices refer to the simple average of the domestic monthly reference with tax for electricity for industry;
2. US prices are net of taxes;
3. Data for Cyprus, Malta, Argentina, Australia, China, South Africa and Saudi Arabia is not available

Assessing the importance of energy as a production factor on the global macroeconomic level, and comparing the performance of EU countries against our main trading partners is not straightforward, with serious data availability and methodological issues.

In terms of the **absolute value of energy costs**, a recent report[7] from the European Commission estimates that the EU manufacturing sector has enjoyed some of the lowest **Real Unit Energy Costs**[8] together with Japan and similarly to the US. The improvements of the EU industry in terms of energy intensity have helped to offset the increase in real energy prices. Despite the already low starting point the EU manufacturers have steadily improved their energy intensity. Reasons for the improvements on energy intensity could be due to improvements of energy efficiency, the increasing specialisation in the EU manufacturing on less energy intensive industries and the trend of Value Added of the production between the period covered by the above mentioned study (1995-2011). Real unit energy costs across the European industrial clusters have remained broadly stable during the period 2010-2014.

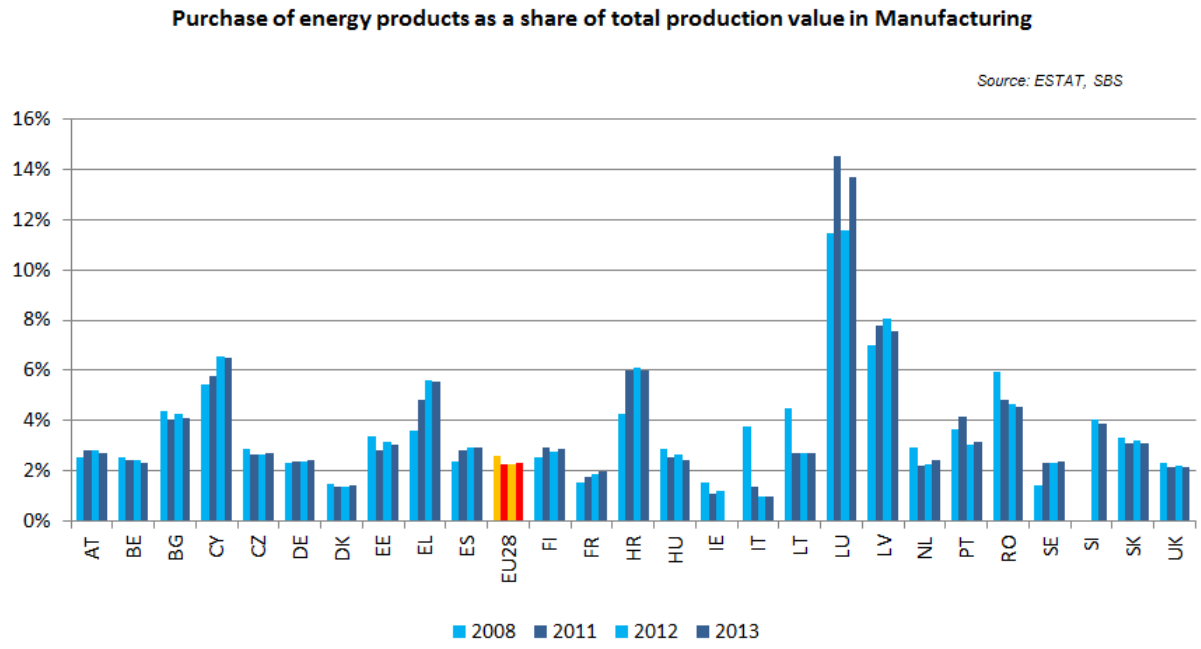
[7] Energy Economic Developments in Europe, 2014, DG ECFIN, http://ec.europa.eu/economy_finance/publications/european_economy/2014/pdf/ee1_en.pdf

[8] The Real Unit Energy Cost (RUEC) is defined as the ratio of energy costs in current prices over value added in current prices. RUEC can be represented as the product of real energy price and energy intensity.

The **relative share of energy in total factor production costs** can be proxied by the share of energy products in total production value, as reported by the Structural Business Statistics (SBS) tables in Eurostat. This approach has **several important limitations**, listed in Textbox below, but remains the only viable one in terms of harmonised and publically available data.

The next **Figure 186** represents factor production cost across the EU Member States and for the Manufacturing sector. During the 2008 – 2013 period and where data is available, the energy share stood slightly above 2% of total production value in EU 28. Member States with relatively smaller size would typically present a higher than average share; probably pointing to the fact that these economies have a relatively less diversified portfolio of Manufacturing industries.

Figure 186 – **Purchase of energy products as a share of total production value in Manufacturing**



Source: Eurostat SBS

Notes:
1. Data for Malta, Poland, Slovenia (prior to 2012) and Ireland (after 2012) is not available;

The energy use of Refining is not accounted in the above **Figure 186** (see also Textbox below for more explanations). Its share of the refining sector in total production value of manufacturing stood in the range of 7% - 9% for the EU from 2012 to 2014. The relative share of refining is quite dispersed among the 11 Member States declare the production value of refining as non-confidential, ranging from above 30% in Greece to around 20% in Belgium to less than 1% in Luxembourg, Slovenia and Latvia.

Box – Limitations of SBS statistics to analyse the energy share in total production costs

— There is no one-on-one mapping between the economic indicators of SBS and the profit and loss account of real companies;

— Capital expenditure (CAPEX) is difficult to collect in SBS, forcing the estimation of the energy component to rely solely on operating expenditure (OPEX); as a result the provided estimation is not assessing the long term investment and cannot determine the relative share of investment in improved energy performance tools over the total stock of investment;

— The purchases of energy product data is available only for NACE Rev. 2 sections B (Mining and quarrying), C (Manufacturing), D (Electricity, gas, steam and air conditioning supply) and E (Water supply, sewerage, waste management and remediation activities). It is not available for important industrial energy intensive sections such as Section F (Construction) and H (Transportation and storage) and, more importantly, it is not available for all services sectors. According to the 2015 Commission report (footnote 120), the relative share of the services sector in the 2014 Total Value Added in the EU 28 stood at almost 75%, as opposed to 15% for Manufacturing.

— Based on the definition of the Commission Regulation (EC) No 250/2009, the structural business statistics (SBS) code "20 11 0 Purchases of energy products" includes only energy products which are purchased to be used as a fuel. Energy products purchased as a raw material or for resale without transformation are excluded. As such, the energy products purchased by companies belonging to NACE Rev.4 Group 19.2 (Manufacture of petroleum products) are not included.

— The annual data for 2009 and 2010 is incomplete for the majority of EU Member States and thus not reported

6.2 Energy costs in energy intensive sectors

This chapter mainly relies on the presentation of the main findings of three studies. Two studies were commissioned by the Commission to external consultants: The study '*Prices and costs of EU energy'* by Ecofys BV and the study '*Composition and drivers of energy prices and costs: case studies in selected energy intensive industries'* by CEPS[9]. The third study '*Production costs from energy intensive industries in the EU and third countries'* was conducted by the JRC[10].

The Ecofys study looks at selected Energy Intensive Industries (14 sectors at NACE 3 level) and 5 case studies of less aggregated sectors (NACE-4 level) following a *top down* approach in which statistical information is used to understand the role of energy prices and costs in the competitiveness of these sectors. The studies by JRC and CEPS also cover case studies but follow a *bottom up* approach. In the study by CEPS calculated averages are based on direct collection of price and costs data at plant level via a questionnaire which allows to analyse samples of varying representativeness. The JRC study uses the latter approach for the aluminium sector. For the other sectors analysed in the JRC study, information provided by commercial data providers (that contained information for a representative sample of facilities) is used. The *bottom up* and *top down* approaches are complementary and provide a broader vision of the energy prices and energy costs paid by European industries.

In this Chapter we will first briefly discuss the conditions which make energy costs become a factor for competitiveness. We will also look at the various factors that affect the final prices paid by companies. On the basis of the analyses of the some selected energy intensive industries at relatively high level of aggregation (NACE 3 level) we will provide an overview of the evolution of energy costs in these sectors as well as of other indicators of competitiveness (like profit margins or energy intensity). International comparisons will then be made to see effects on energy competitiveness. Finally we include the main results from the various *case studies* at more disaggregated level which allows seeing in more detail the role of energy prices and costs in their competitiveness.

Factors of competitiveness

Firms compete offering products differentiated in terms of both price and quality. Prices are thus an essential element to compete which becomes increasingly important when the products in the market are more homogenous[11].

Prices are the result of production costs (labour costs, energy costs, capital costs) and profit margins. Differences in production costs and profit margins may stem from various competitive advantages from natural resources, geography, human capital, organisational structures, etc. In this document we will mainly look at the evolution of *energy costs* in some selected EU energy intensive sectors. We also look at how these energy costs have affected production costs and thereby influenced the competitiveness of such sectors

Energy costs as determinant of industrial competitiveness

On average energy costs represent a rather small share of the total production cost of manufacturing firms and therefore have a rather limited influence on the general competitiveness. As we have seen in section 6.3.2. at EU level it would be difficult to say that energy costs cause a problem of competitiveness at the economy-wide level..

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[9] Consortium composed of CEPS, ECOFYS and Economisti Associati - led by CEPS

[10] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC100101/ldna27729enn.pdf

[11] The more a product is commoditized, and thus presents the same quality features, the more producers compete on price, especially when price is fixed on the global market by commodities exchange

However, energy costs vary considerable across sectors reflecting different conditions and circumstances. For some of them energy is a factor for competitiveness. This may happen when i) energy costs have a very significant share in the cost structure ii) energy costs per unit of production value are higher than international competitors and iii) there is international trade exposure.

This is why we focus our analysis in this document on Energy Intensive Industries (where energy costs represent a significant share of total production costs) and in particular in those sectors with internationally traded products. Naturally, as indicated above, the overall competitiveness of firms in such industries will also depend on other production factors (e.g. labour costs, use of raw materials, etc.) which can influence profit margins.

Energy costs

Energy costs of a firm depend on the energy prices paid by the firm and its energy consumption.

Energy consumption can be improved by higher energy efficiency in the production process.

Energy prices usually attract attention as they are very volatile and can rapidly escalate increasing energy costs in a significant way. A general energy price escalation would allegedly affect all firms most of which are energy price takers. However, what counts for determining the competitive position of firms (which is a relative position with regard to other firms) would be the energy prices they actually pay. The price paid may vary a lot depending upon numerous factors. These factors include energy supply strategies (e.g. use of CHP, self-production using cheaper energy sources, common purchasing strategies, long term contracts of energy supply, etc.), the amount of energy consumed (different tariffs of consumption bands), connection to the transmission or distribution grids and the firm consumption patterns derived from the specific industrial process (e.g. during the day tariffs are usually cheaper when energy demand is low, like during the night hours).

The actual amount paid for energy also depends on price and tax exemptions and reductions[12] which can be granted by specific regulations that vary across member states (e.g. lower network tariffs for firms exceeding certain level of energy intensity, firms of sectors exposed to international competition, reduced taxes or levies for firms applying energy efficiency measures, etc.)

Summing up, depending on many characteristics, each industrial firm in Europe is confronted with a different price of energy. The price difference between companies of the same sector for the same energy carrier in the same country can exceed 50%[13]. See below **Figure 187** & **Figure 188** as well as **Figure 190** & **Figure 191**.

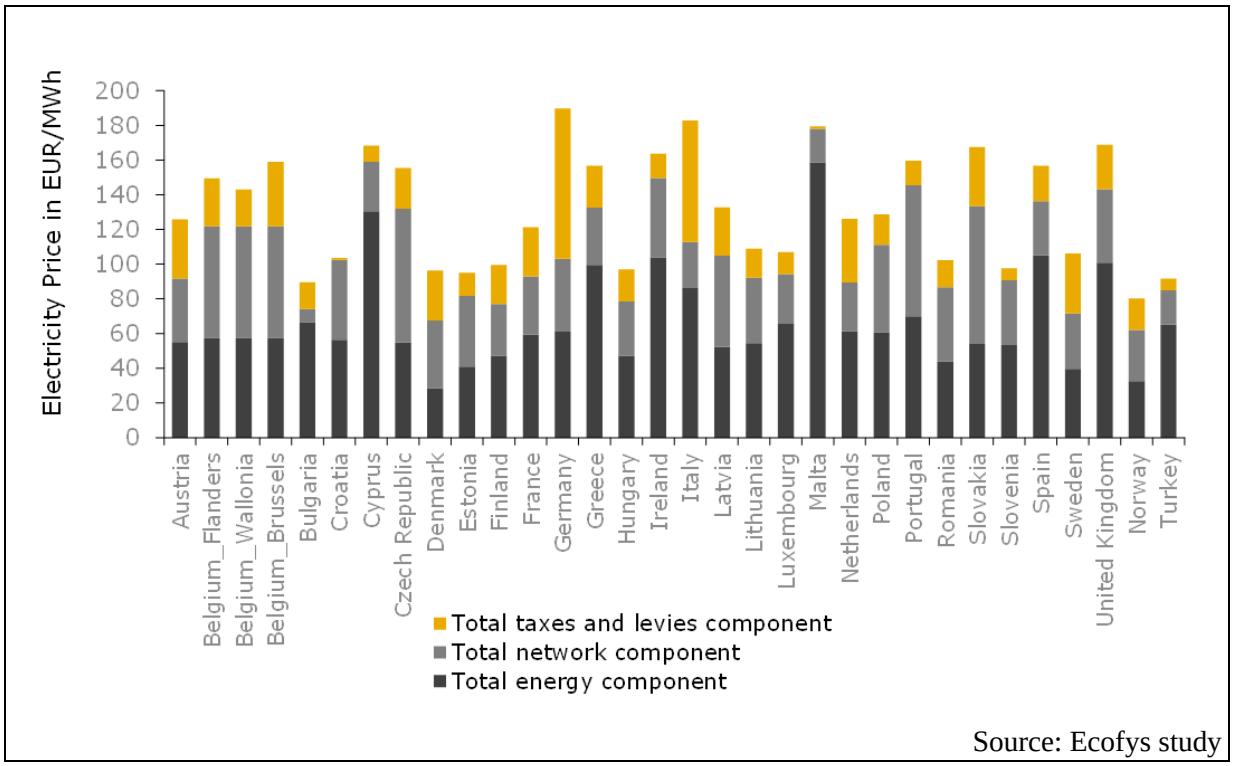
These price differences may have also evolved over time depending on issues such as the magnitude of taxes and levies or due to the introduction of changes in the regulation for price reductions and exemptions in each country (see Figure 188 and Figure 191)

[12] A detailed description of the criteria used by MS for applying price reductions and tax exemptions for gas and electricity prices can be found in Error! Reference source not found. and Error! Reference source not found.

[13] For the various reasons already explained in the text above, large industrial consumers (of bands IF and I5, for electricity and gas, respectively) compared to medium consumers (of bands IB and I2, for electricity and gas) normally pay less for their energy component and the network component. In addition, industrial consumers can also be granted reductions and exemptions in the taxes and levies component. To calculate the maximum possible differences in prices in each Member State, it is then assumed that all possible reductions and exemptions available in a MS for taxes and levies (due to various reasons, see Error! Reference source not found. and Error! Reference source not found. are applied to the large consumers (maximum price) and no exemptions and reductions are applied (as it is usually the case) to medium consumers (minimum prices).

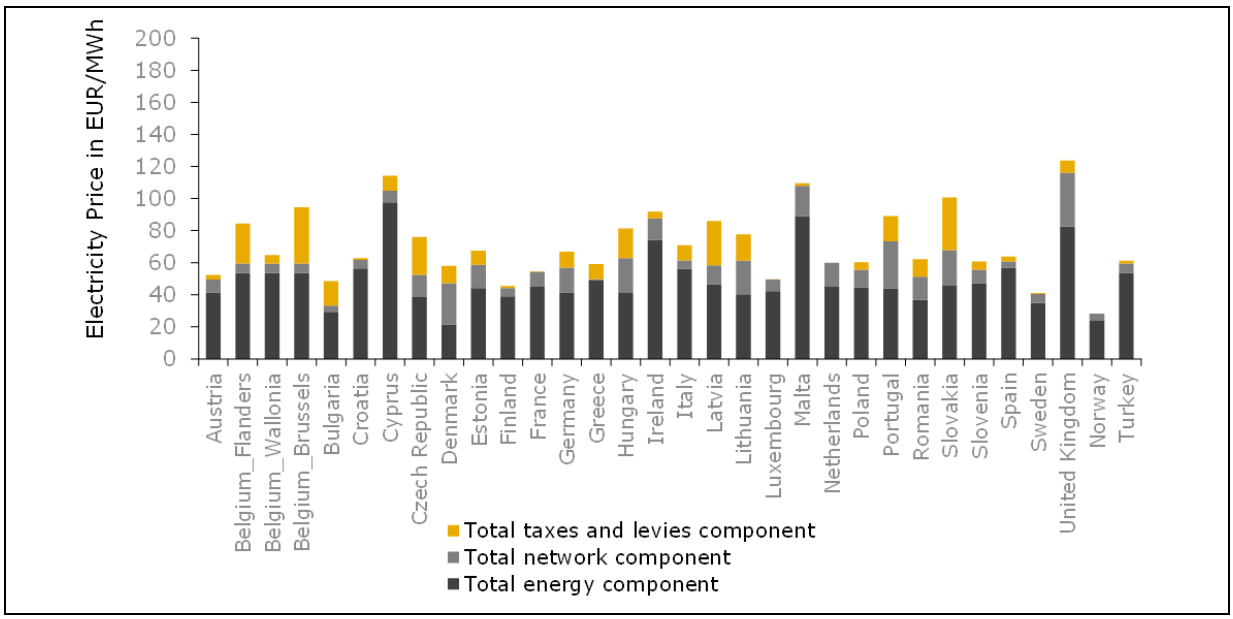
Range in ELECTRICITY prices due reduced tariffs and exemptions

Figure 187 - **Electricity retail prices in 2015 for companies not eligible for any compensation (Consumption band IB)**



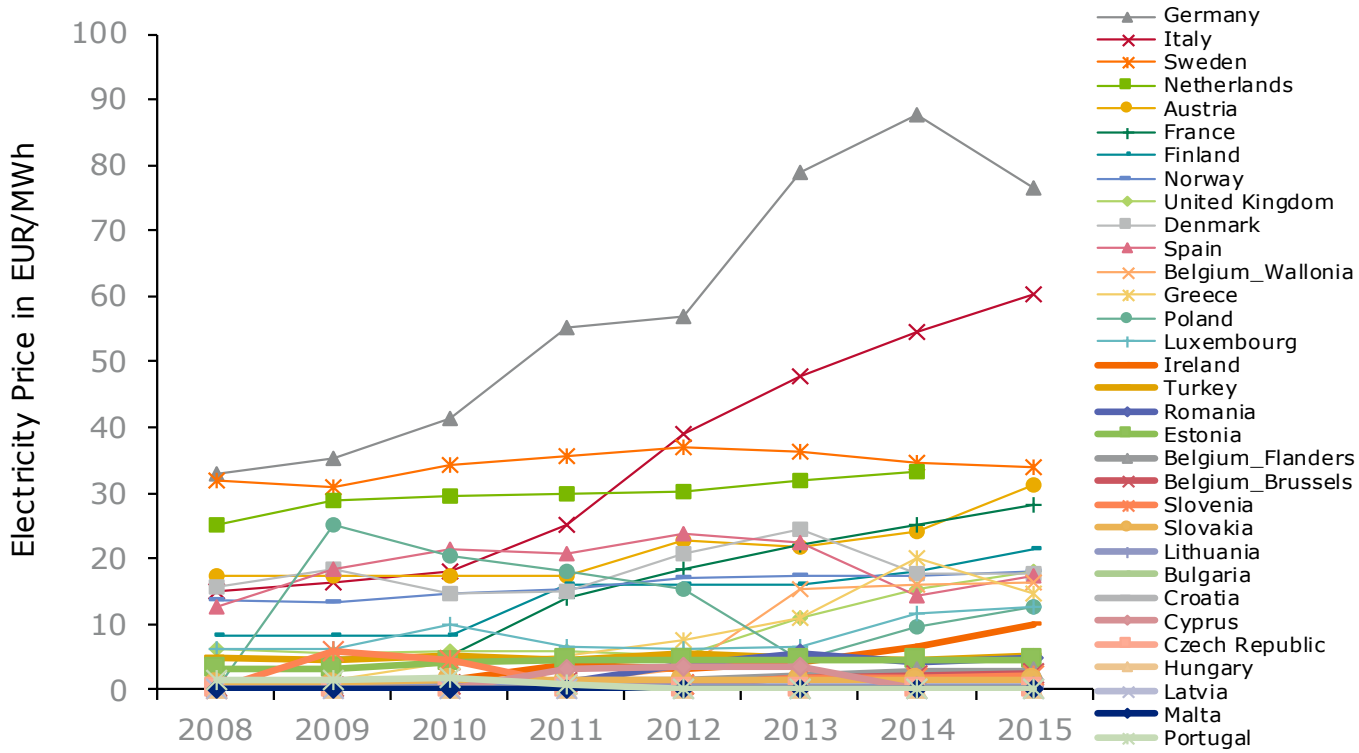
Source: Ecofys study

Figure 188 - **Electricity retail prices for industrial consumers eligible for all reduced tariffs and compensations in 2015 (Consumption band IF)**



Source: Ecofys study, EC data collection

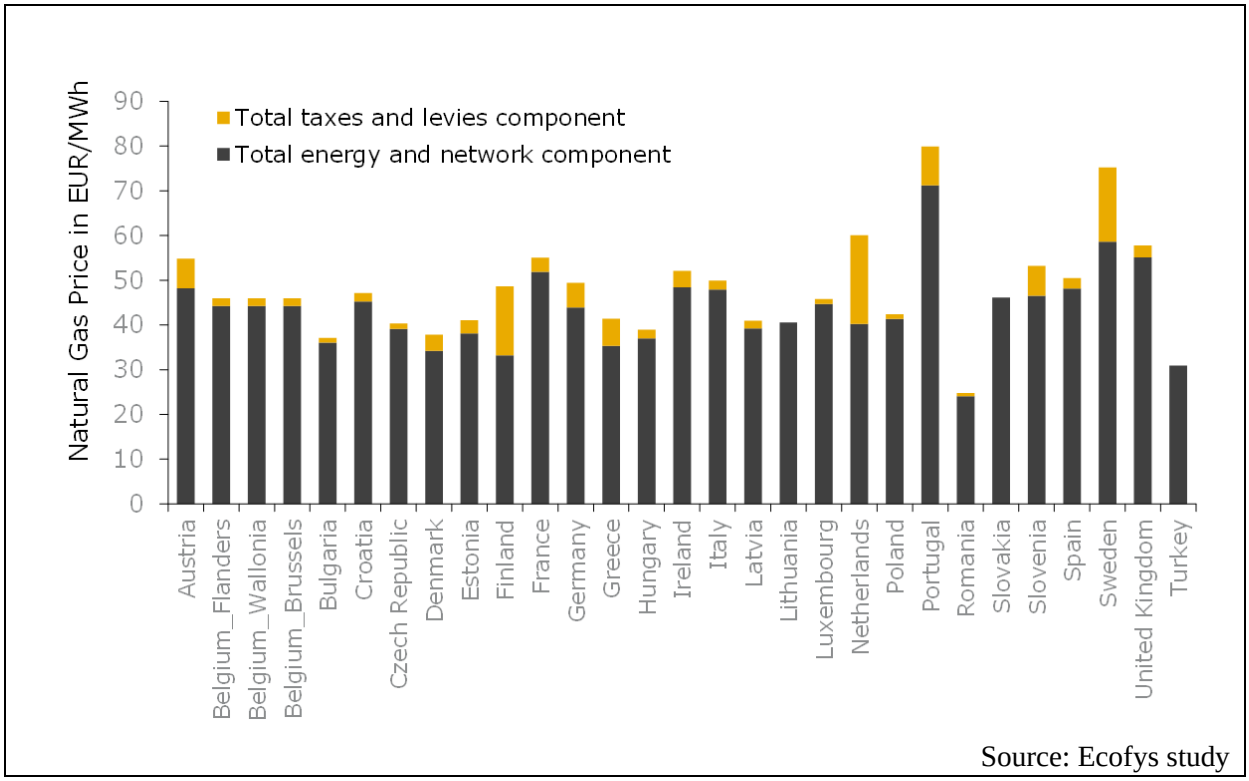
Figure 189 - **Maximum differences in total taxes and levies on electricity prices for industrial consumers**



Source: Ecofys, Frauhofer ISI, CASE

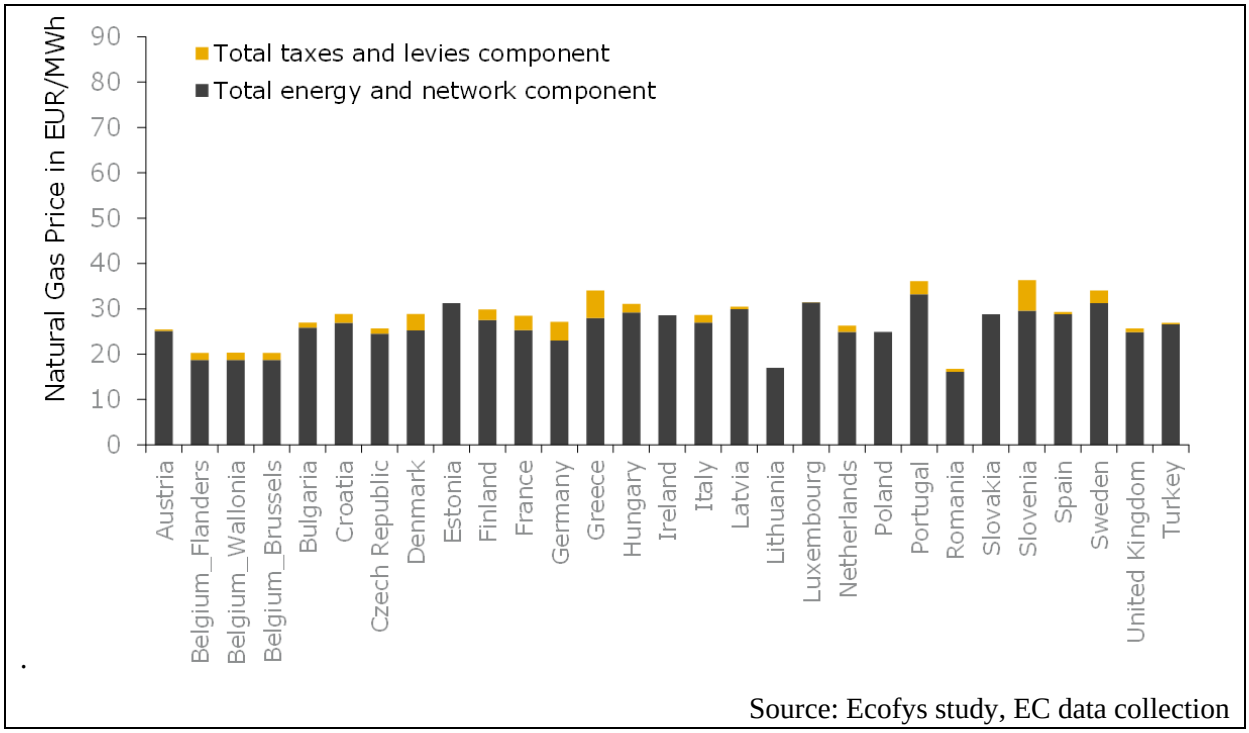
Range in GAS prices due to reduced tariffs and exemptions

Figure 190 - **Natural gas retail prices in 2015 for companies that are not eligible for any compensation (Consumption band I3)**



Source: Ecofys study

Figure 191 - **Natural gas retail prices for industrial consumers eligible for all reduced tariffs and compensations (Consumption band I5)**



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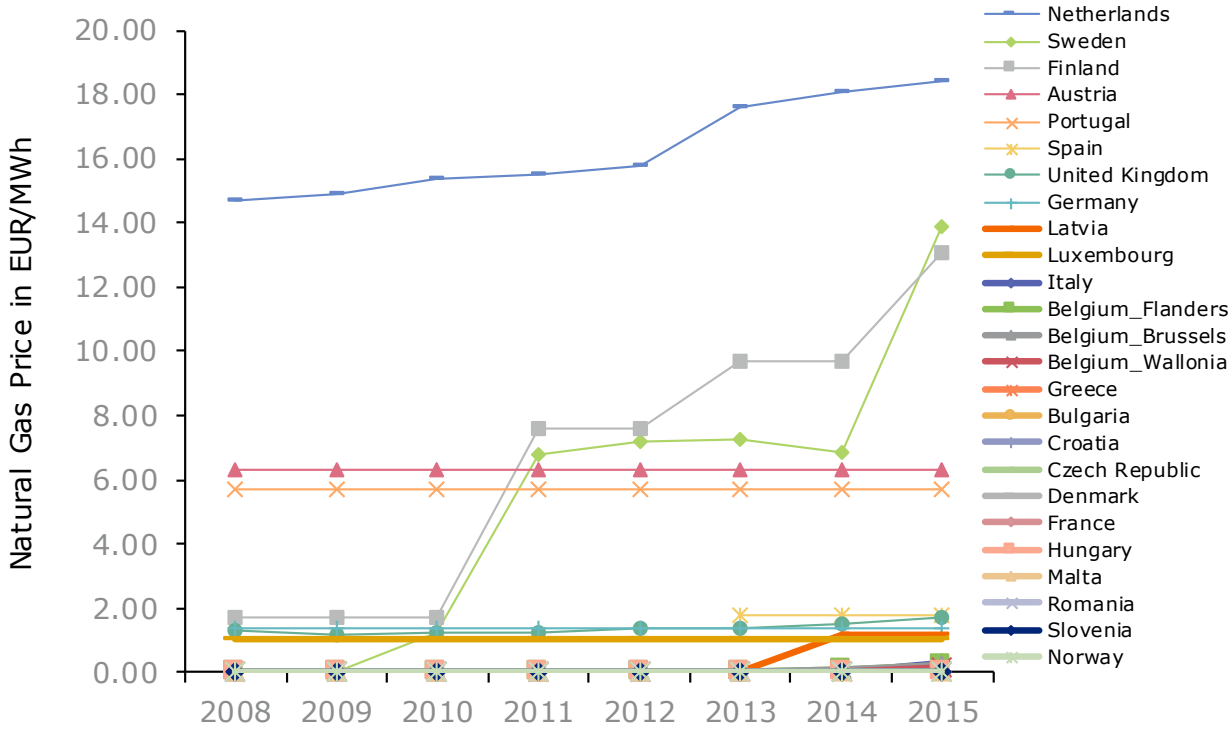
Source: Ecofys study, EC data collection

Figure 192 - **Maximum differences in total taxes and levies on natural gas prices for industrial consumers**



Source: Ecofys, Fraunhofer ISI, CASE

6.2.1 Energy costs analysis

Analysis of energy costs in selected Energy Intensive sectors

In the following sections we draw on the results of the sectorial analysis based on a study commissioned by the European Commission to Ecofys which analyses energy costs and other indicators across fifteen *NACE 3* sectors. Methodological details can be found in the Ecofys study. The main data source was Eurostat SBS. Energy cost shares are calculated by dividing the purchases of energy by total production costs, where total production costs are equal to total purchases of goods and services (including energy)[14] plus personnel costs.

Selection of sectors

The selection of sectors took account of energy intensity, added value and trade exposure of sectors. It therefore gives us a good overview of the industry sectors where energy may have a bigger impact on competitiveness.

[14] Total purchases of goods and services represents the value of all goods and services purchased during the accounting period for resale or consumption in the production process, excluding capital goods (the consumption of which is registered as consumption of fixed capital). This therefore, includes the costs of materials that enter directly into the goods produced (raw materials, intermediary products, components), non-capitalised small tools and equipment and the value of ancillary materials. Service costs, such as repairs and maintenance, transport and logistics, communication, insurance, legal and accountancy fees, are also included in this total.

Table 15. Coverage of the sectors (15 NACE 3 and 5 NACE-4)

Code	Description	Case study
C106	Manufacture of grain mill products, starches and starch products	
C132	Weaving of textiles	
C161	Sawmilling and planing of wood	
C171	Manufacture of pulp, paper and paperboard	C1712 - Manufacture of paper and paperboard
C192	Manufacture of refined petroleum products	
C201	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	C2013 - Manufacture of other inorganic basic chemicals, focus chlorine
C206	Manufacture of man-made fibres	
C231	Manufacture of glass and glass products	C2313 – Hollow glass, focus container glass
C232	Manufacture of refractory products	
C233	Manufacture of clay building materials	
C234	Manufacture of other porcelain and ceramic products	
C235	Manufacture of cement, lime and plaster	
C237	Cutting, shaping and finishing of stone	
C241	Manufacture of basic iron and steel and of ferro-alloys	C2410 - Manufacture of basic iron and steel and of ferro-alloys, focus crude steel
C244	Manufacture of basic precious and other non-ferrous metals	C2442 - Aluminium production, focus primary aluminium

Source: Ecofys study

Table 16. Energy intensity, share of GDP and trade intensity of NACE4 sectors

NACE4 category	Energy Intensity	Share of GDP	Trade intensity
C1712 - Manufacture of paper and paperboard	11.19%	0.09%	23.10%
C2013 - Manufacture of other inorganic basic chemicals	9.70%	0.05%	40.62%
C2313 - Manufacture of hollow glass	13.34%	0.04%	20.46%
C2410 - Manufacture of basic iron and steel and of ferro-alloys[15]	7.83%	0.16%	25%
C2442 - Aluminium production[16]	7.19%	0.05%	34.64%

Source: Ecofys study, calculations based on Eurostat data

Note: The criteria used to select five *NACE-4* sectors were energy intensity above 7%, trade intensity of more than 10% and a share of GDP greater than 0.02%

[15] NACE 2410 includes firms producing steel products with different value added and following different production processes (e.g. BF or EAF). The averages of the sector represent the industry as a whole and might not be fully representative of concrete processes in the sector, which may have different sensitiveness to energy costs.

[16] NACE 2442 includes both primary and secondary aluminium production. Primary aluminium is 20 times more energy intensive than secondary aluminium. The energy intensity in the production of primary aluminium is around 35% percent. Secondary (Recycled) aluminium's energy intensity is a few percentage points. Therefore, conclusions on averages of NACE 2442 have to be taken with prudence as high energy prices have a high impact on primary aluminium, but far lower on secondary aluminium.

Evolution of energy costs in Energy Intensive sectors

Table 17. Countries and sectors covered

	C106: Grain products	C132: Textiles	C161: Sawmills	C171: Pulp and paper	C192: Refineries	C201: Basic chemicals	C206: Man-made fibres	C231: Glass	C232: Refractory products	C233: Building materials	C234: Porcelain, ceramics	C235: Cement, lime, plaster	C237: Stone	C241: Iron and steel	C244: Non-ferrous metals
Austria	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Belgium	1	1	1	1	0	1	0	1	0	1	0	0	0	1	1
Bulgaria	1	1	1	1	0	1	0	1	0	1	1	1	0	0	1
Croatia	1	0	1	0	0	0	0	1	0	1	0	1	1	0	0
Cyprus	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0
Czech Republic	1	1	0	1	0	1	0	1	1	1	1	1	1	1	1
Denmark	0	0	1	1	0	1	0	1	0	1	1	0	1	0	1
Estonia	0	0	1	0	1	1	0	1	0	0	1	0	1	1	0
Finland	1	0	1	1	0	0	0	1	0	1	0	0	1	0	0
France	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0
Germany	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Greece	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hungary	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Latvia	0	0	1	0	0	1	0	1	0	0	1	0	1	0	0
Lithuania	1	1	1	1	0	1	0	1	0	1	1	0	1	0	0
Luxembourg	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	1	0	1	0	0	0	1	1	0	0	0	0	1	0	1
Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Portugal	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Romania	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1
Slovakia	0	1	1	1	0	1	1	1	1	1	1	1	1	0	1
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Sweden	1	1	1	1	0	1	0	1	1	0	1	1	0	1	1
UK	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Total data points included	**19**	**17**	**21**	**19**	**4**	**19**	**12**	**23**	**13**	**20**	**18**	**15**	**21**	**15**	**16**
Coverage of EU28 sector GVA of included data points [%]	**93**	**92**	**93**	**93**	**14**	**85**	**83**	**94**	**90**	**91**	**91**	**73**	**90**	**77**	**85**

Note: The sectors and countries for which a full time series 2008-2013 was available for the energy cost as a share of total production cost calculation are indicated with "1"(i.e. all data available) A "0" indicates that at least one year of one data point missing, therefore not included in the EU aggregate calculation

Table 18. Energy costs share of total production costs- Aggregated results at sector level

Sector	Average energy cost share: 2008-2013	Data points	Minimum value	Maximum value	Change 2008-2013 [%]	Change 2011-2013 [%]
C106 - Manufacture of grain mill products, starches and starch products	3.7%	19	1.3%	17.9%	-10.5%	-0.2%
C132 - Weaving of textiles	3.5%	17	0.5%	12.1%	-38.5%	-10.6%
C161 - Sawmilling and planing of wood	3.6%	21	0.6%	10.5%	2.1%	-11.4%
C171 - Manufacture of pulp, paper and paperboard	11.3%	19	2.8%	42.0%	-16.2%	-9.8%
C201 - Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	6.7%	19	0.0%	6.7%	-1.8%	-1.3%
C206 - Manufacture of man-made fibres	8.4%	12	0.0%	20.4%	-1.9%	18.9%
C231 - Manufacture of glass and glass products	9.2%	23	1.9%	24.2%	2.3%	14.0%
C232 - Manufacture of refractory products	6.1%	13	1.1%	33.1%	-0.9%	11.8%
C233 - Manufacture of clay building materials	13.0%	20	3.2%	42.4%	-18.3%	11.7%
C234 - Manufacture of other porcelain and ceramic products	5.3%	18	0.9%	17.4%	-1.8%	4.3%
C235 - Manufacture of cement, lime and plaster	19.6%	15	12.7%	35.6%	-8.7%	-8.3%
C237 - Cutting, shaping and finishing of stone	4.0%	21	0.6%	24.8%	7.9%	21.6%
C241 - Manufacture of basic iron and steel and of ferro-alloys	8.5%	15	2.1%	26.8%	-2.9%	10.0%
C244 - Manufacture of basic precious and other non-ferrous metals	4.2%	16	0.7%	29.8%	-7.7%	-3.4%

Source: Ecofys study

Note: Energy costs and production costs are aggregated per sector only for Member States where all data inputs are present across all years for the relevant sector so that a consistent basis of comparison is applied to all years. For France the personnel costs were estimated in 2009.
This somewhat limits the total number of data points and can lead to differences in results compared to analysis of a single year, where other Member States may be included. The refinery sector has been excluded as the energy cost data does not accurately reflect (significantly underestimates) the actual cost to the sector.

The exclusion of the manufacture of refined petroleum products sector

The refinery sector was selected as one of the focus sectors but is excluded from many of the following figures and analysis. This is because the Eurostat SBS dataset is the basis for the energy costs analyses made by the Ecofys study. The fact is that energy products, i.e. crude oil, are purchased and consumed by the refinery sector, but as a feedstock rather than for energy generation. However the SBS *energy purchases* does not include crude oil thereby excluding the largest part of energy costs for the refinery sector. This results in a calculated EU average energy cost share for the refinery sector of 3% of total costs. Clearly this does not accurately reflect the actual energy costs of the sector which will be much higher. The European Competitiveness Report (2014) estimated energy costs at 62% of production value (gross output) for the Coke, refined petroleum and nuclear fuel sector in 2011. Analysis by Solomon Associates (2016) suggests that the average energy costs per barrel of oil for EU28 has increased slightly between 2008-2012 but decreased again by 2014. In the same period, US energy costs have decreased to below those in EU28 along with Russia and Middle East. Korea/Singapore and India have higher average energy costs than the EU in 2014. In terms of net cash margin, the US and Korea/Singapore have higher average margins than the EU28 while the other competitors are close to or below the EU28.

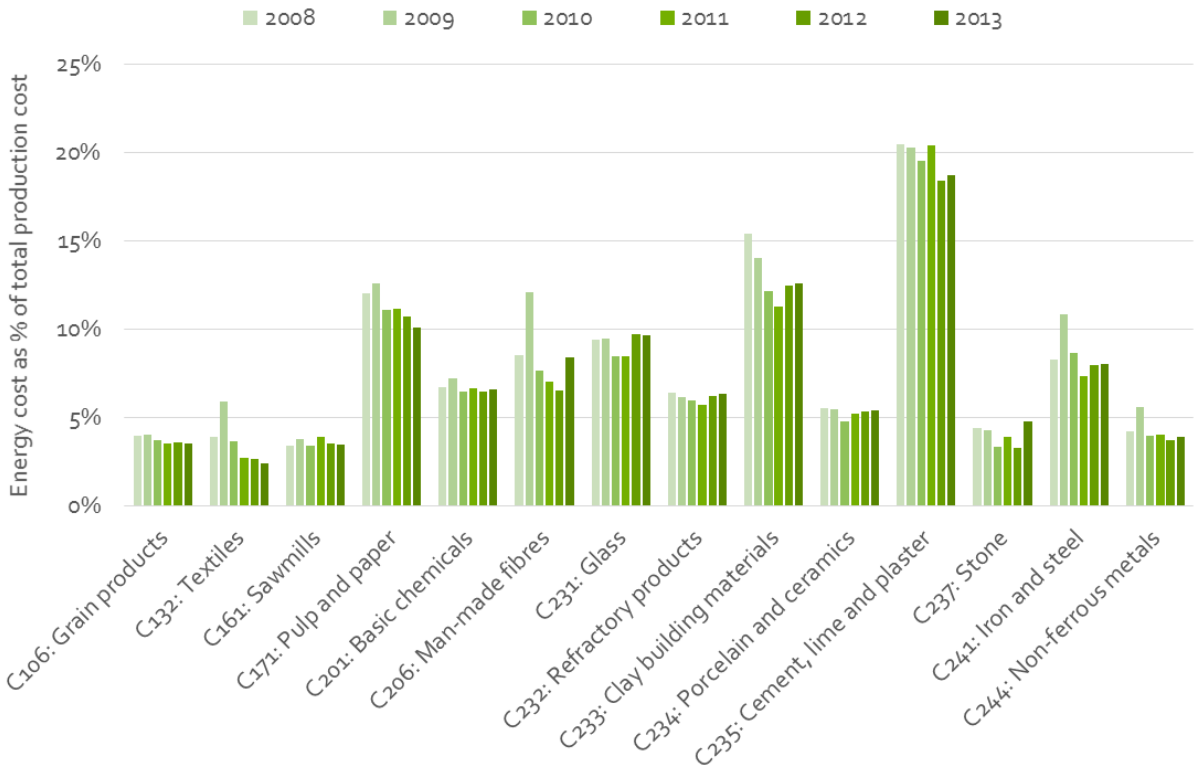
Energy costs for most of the selected sectors are ~3-10% of total production costs, only for the manufacture of pulp and paper, clay building materials and cement, lime and plaster do energy costs appear to be more than 10% of production costs[17].

The results of the analysis showed that ***between 2008-2013 energy costs shares in almost every sector under study (except sawmills, glass, stone cutting) and total absolute energy costs have fallen in all the studied sectors.***

Between 2011-2013, there is a change in the trend in some sectors. ***Energy cost shares increased in half of the sectors studied*** (man-made fibres, glass, refractory products, clay building materials, stonecutting and iron and steel with increases between 4-22%) and in three of these cases (sawmills, glass and stonecutting) this happened due to energy costs decreasing less than other production costs.

Between 2008-2013 total production costs decreased across almost all sectors, by 0-30% and ***increased in only two sectors*** (grain and pulp and paper, by 8% and 1% respectively).

Figure 193 – **Energy costs shares of selected Energy Intensive sectors**



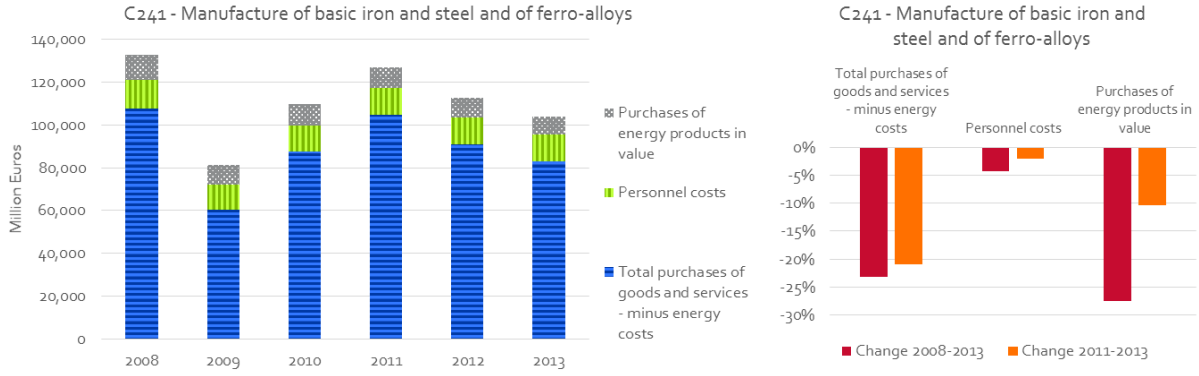
Source: Ecofys study, Eurostat SBS.

On average between 2008-2013 total energy costs have changed more favourably, i.e. increased by less, decreased by more, than other production costs in absolute terms, and therefore have reduced their share in total costs. Energy costs typically scale very closely with

[17] Note that refineries were excluded from the analysis for the reasons presented in the box above. It is also important however to remind the level of aggregation considered, e.g. under code C2442 - Aluminium production includes both primary production (with energy costs equal to a third of the total) and secondary production, which a share of only 5%.

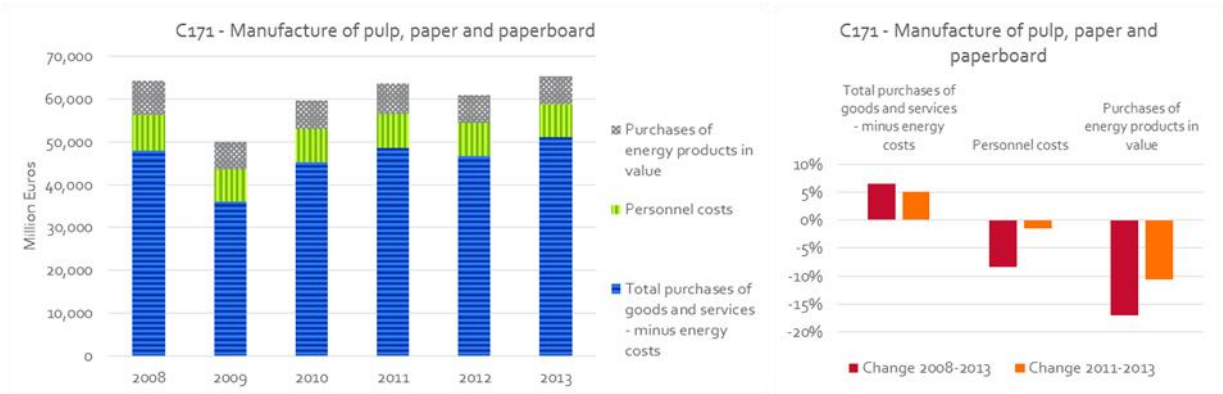
production volumes, yet other costs, i.e. personnel, rent, rates, services, may not be so flexible. In times of declining production, energy costs could fall quickly while other costs must still be paid or are difficult to reduce. The evolution of the costs from non-energy purchases of goods and services depends on many factors and can also affect energy costs shares in total production costs. E.g. The non-energy purchases of goods and services cost can be driven up by price spikes in some commodities (e.g. commodity boom over the period 2008-2011) or dragged down by falling production volumes. See examples below where the non-energy purchases have opposite behaviour.

Figure 194 - **Absolute and relative changes in main production cost components for the paper and pulp and iron and steel sectors, 2008-2013 and 2011-2013,**



Source: Ecofys study

Note: EU aggregates based on data points in Table 17



Source: Ecofys study

Note: EU aggregates based on data points in Table 17

With regard to Member States, the analysis of the sectors shows that: i) **the energy cost shares within a sector vary considerably,** from Member States where the energy cost share is only a small percentage of the total production cost, to Member States where the energy cost share is many times the average, and more than 40% of total production costs in some years. ii) A **cluster of countries (BG, HR, CY, EL, HU, LT, LV, PT, RO, SK) typically have higher than average energy cost shares within total production costs,** which is

consistent with average wages being lower in these countries and therefore personnel costs contributing a lower share of total costs than elsewhere.

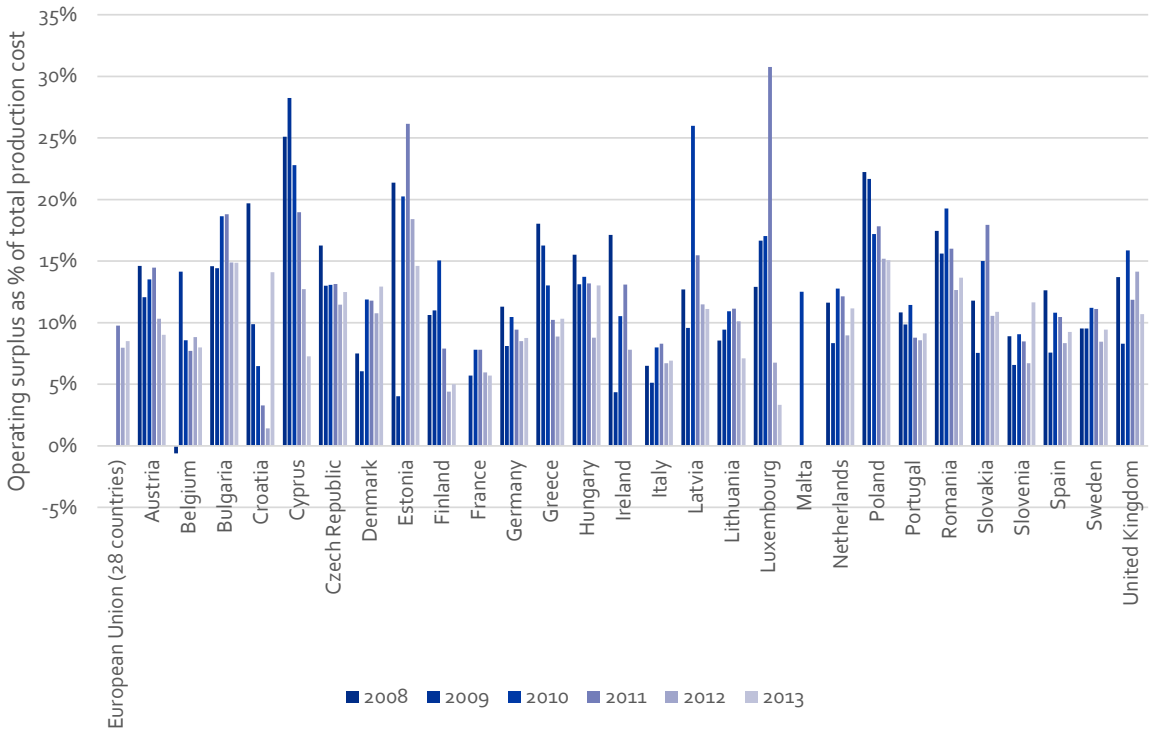
Box -Gross operating surplus (profit margins) in Selected Energy Intensive Industries

Profit margins together with production costs do determine the final prices. The evolution of profits can therefore also play an important role in the competitiveness of firms.

On the basis of SBS statistics (Ecofys study) the level and evolution of Gross operating surplus[18] (GOS, which broadly correspond to profits) of the selected Energy Intensive Industries are presented in this box. GOS is expressed as a % of total production costs. This analysis will also be useful when we make international comparisons of GOS in the next section.

With regard to ***Member States***, the result of the analysis of the sectors **over the period 2008-2013** shows that at **EU level** the average gross operating surplus is generally **in the range of 8-10%** per annum and **declined across all but four Member States (BG, DK, IT, SI)** particularly since 2011. This could be that average margins are under significant pressure in the EU. However, in **some Member States in some years (CY, EE, LV, LU, PL)** the average gross operating surplus **exceeds 20-30%.**

Figure 195 - **Gross operating surplus as % of total production costs, average across sectors, at EU28 and Member State level, 2008-2013.**

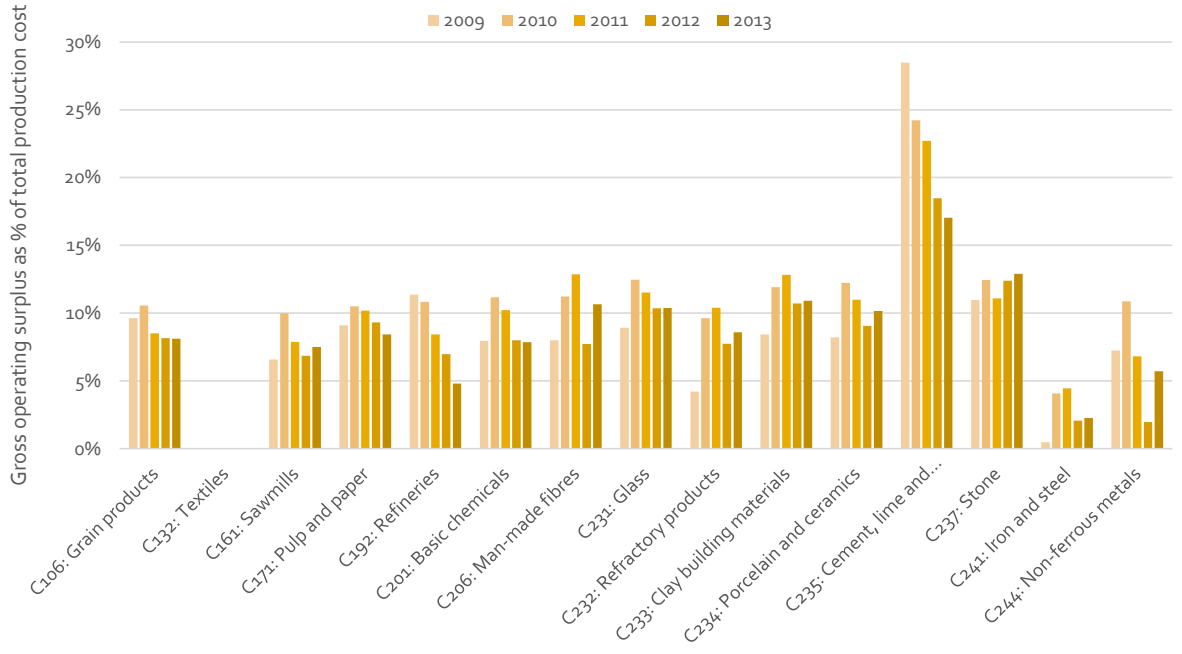


Source: Ecofys study

From a ***sector*** **perspective** (see main report and Annex 4 of Ecofys study for all results regarding sectors) it can be highlighted that average gross operating surplus **increased in more than half of the available Member States in the *sawmill, paper and pulp*** sectors and were **significantly lower than average in *non-ferrous metals*** and **especially in the *iron and steel*** sector.

[18] Gross operating surplus presented are the result of subtracting personnel costs from value added using Eurostat SBS statistics

Figure 196 - **EU average gross operating surplus as % of production costs, aggregate of MS for which total production cost and gross operating surplus data available for all years.**



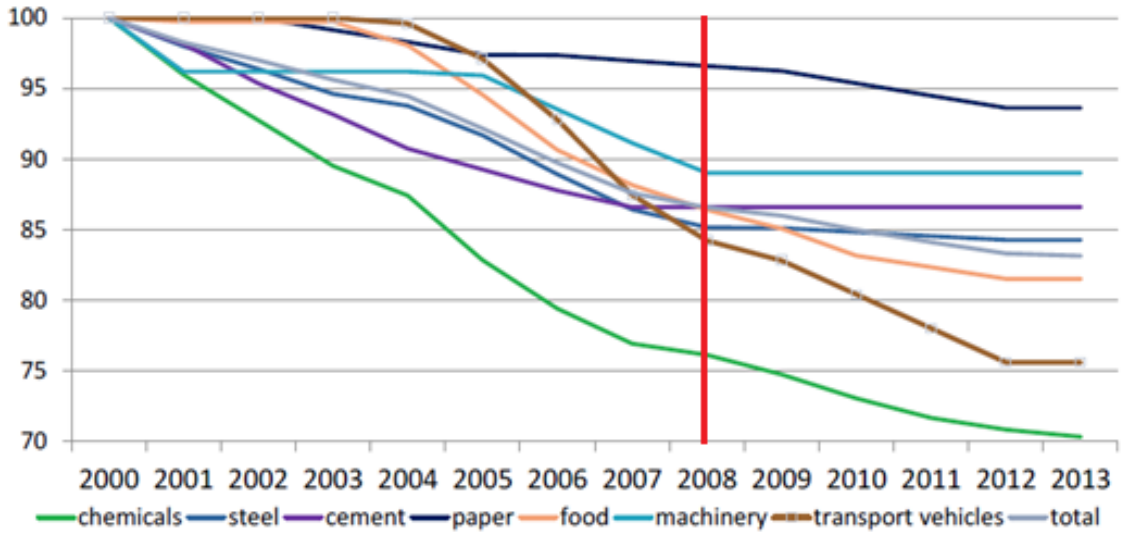
Source: Ecofys study

6.2.2 Exploring energy intensities and energy costs sensitiveness to prices

The efficiency of energy use has a crucial bearing on the energy costs of a sector.

Energy efficiency trends in industry (NACE 2 Level) seem to have evolved positively. **Figure 197**. In many sectors energy efficiency has improved over 2000-2013, especially in the chemical sector. As from 2008, energy efficiency improvements in the cement and iron and steel sectors seem to have come to a halt. The rate of energy efficiency improvement is driven by a number of factors including state of energy efficiency at the beginning of the reference period, technical possibilities for improvement, capacity utilisation rates and availability of capital to invest. Obviously; the financial situation since 2008 could have had implications for investments generally; including in energy efficiency. In addition our analysis on the evolution of retail prices in the previous chapters shows that electricity and gas price increases for industry were slowing down during the last years and even declining in the last year under study (2014-2015). Wholesale prices have also declined sharply in recent times (See Chapters 1 and 2). This fall in energy prices could also be reducing incentives for investment in energy efficiency in industry inter alia in more energy efficient industrial processes.

Figure 197 - **Energy efficiency index in EU industry, figure 18 from IEE (2015) Energy efficiency trends and policies in industry**



Data on the energy consumption and physical units of production of sectors at a high level of disaggregation is however rather limited and energy efficiency is difficult to estimate.

In this section we look at the *energy intensity* of selected (NACE-3) Energy Intensive sectors in the EU. Energy intensity of a sector measures the energy required to generate a unit of value added (VA). This indicator contains valuable economic information and indirectly contains information of the energy efficiency of the sector.

Interpretation of energy intensity

Energy intensity has to be clearly distinguished from energy efficiency. It measures the energy required to generate a unit of value added (VA). Intensities across sectors cannot be compared to provide insight into the energy efficiency of a sector. Energy use can be dictated simply by the required processes. For example the energy intensity of the iron and steel sector could be high, but the sector can be (relatively) highly efficient for the energy required to manufacture these products. Indeed, it can be argued that sectors with relatively high energy intensities are more highly incentivised to pursue energy efficiency measures to reduce costs.

A further complexity of the energy intensity measure is the role of value added. Value added is the sum of returns to labour and capital, which is effectively the sum of personnel costs and gross operating surplus, the latter being a proxy for profit. Obviously many different factors such as salary costs, other personnel costs, pricing strategies, health of domestic markets, etc., can have an important bearing on the amount of value added generated. Therefore energy consumption is not the only important variable in this ratio. To more closely understand trends in efficiency in a sector a production volume at a sufficient level of disaggregation rather than value based measure would be preferred e.g. kWh/tonne of cement. Given that these data are not available across the range of sectors and for the Member States analysed, we use energy intensities to track trends over time in a particular sector. We also compare the same sectors across countries, although in neither case can we disaggregate the effect of different or changing product mix from energy efficiency.

The ***results of the analyses presented in this section are based on a small share of the value added of sectors [Value Added covered by sectors ranges from 6% to 24%] and a rather limited coverage of EU Member States.*** (Table 19)- This is due to limitation on energy consumption data at sector level, with energy consumption breakdown per fuel. The breakdown per fuel is necessary to be able to perform price sensitivity analysis. Gross Value Added was sourced from the Eurostat SBS statistics (value added at factor cost).

Table 19. Coverage of sectors for which energy consumption data per carrier was obtained

Code	Description	Countries	Coverage of GVA
C106	Manufacture of grain mill products, starches and starch products	DE	7%
C132	Weaving of textiles	DE	6%
C161	Sawmilling and planing of wood	DE	7%
C171	Manufacture of pulp, paper and paperboard	DE, SE, FI	25%
C192	Manufacture of refined petroleum products		#N/A
C201	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	DE	17%
C206	Manufacture of man-made fibres	DE	22%
C231	Manufacture of glass and glass products	DE, FR	20%
C232	Manufacture of refractory products	DE	14%
C233	Manufacture of clay building materials	DE	8%
C234	Manufacture of other porcelain and ceramic products	DE	17%
C235	Manufacture of cement, lime and plaster	DE, UK, FR	15%
C237	Cutting, shaping and finishing of stone[19]	DE, ES	16%
C241	Manufacture of basic iron and steel and of ferro-alloys	DE, AT, IT, FR	14%
C244	Manufacture of basic precious and other non-ferrous metals	DE, UK, FR	24%

The results on energy intensity cover 13 sectors (See Table 19**) and show a mixed picture** The sectors that appear as the most energy intensive are *Pulp and paper; Cement, lime and*

[19] Not covered by the energy intensity analysis

plaster; Iron and steel[20] (>20 kWh per Euro of GVA) followed by *Basic chemicals* (a bit less than 15 KWh per Euro of GVA).

***Between 2008 and 2013 energy intensity increased mainly in the most energy intensive sectors in a general context of declining consumptions[21] and added value*:**

— **Energy intensity increased in 6 of the 13 sectors:** *Pulp and paper; Cement, lime and plaster; Iron and steel; Basic chemicals* (i.e. the four most energy intensive sectors) plus *sawmills* and *man-made fibres***.**

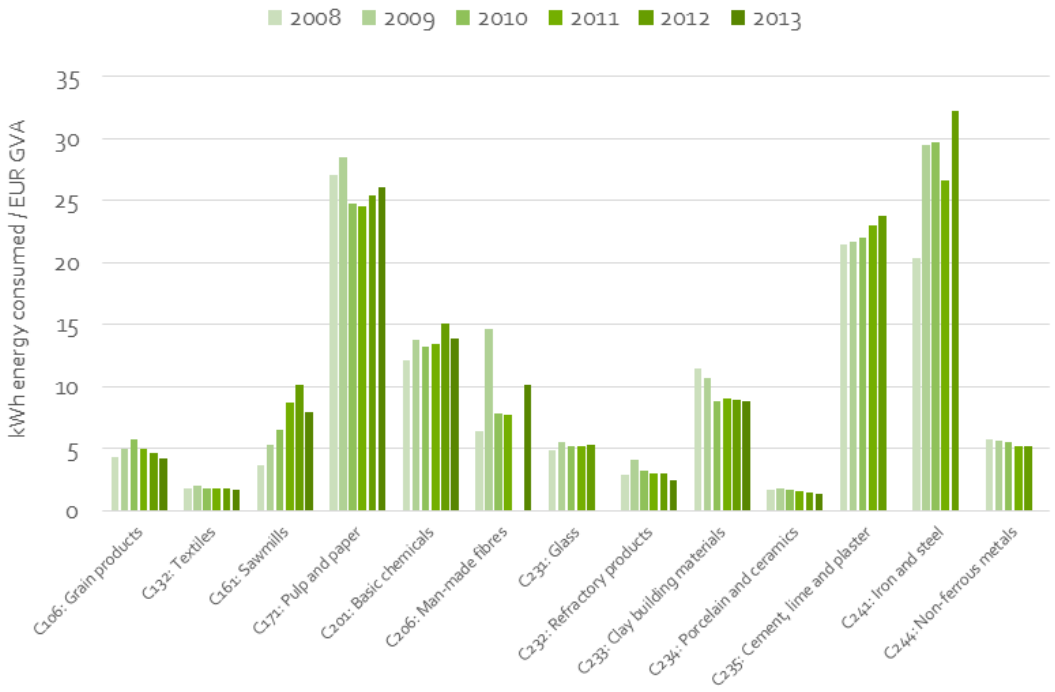
— **Gross Value Added was constant or decreasing in 10 of the 13 sectors**. This is consistent with falling margins (and therefore GVA) in recent years which could be due to an increase in intensity of global competition. GVA only increased in *grain products* (+15%), *basic chemicals* (+5%) and *clay building materials* (+23%).

— **Energy consumption declined in 9 of the 13 sectors (Figure 199** based on limited data points as per Table 19). The four sectors with increasing energy consumption were *grain products* (+9%), *sawmills* (+118%), *basic chemicals* (+20%) and *man-made fibres* (+28%). Of these four, only the *grain products* sector saw an energy intensity decrease due to a higher increase in GVA than in consumption.

Figure 198 - **Energy intensity of selected EU Energy intensive sectors 2008-2013 [kWh energy consumed per Euro of GVA]**

[20] Normally we would also expect to see the refineries sector also included in this group of sectors. But there is a problem with the source statistics. Namely that although energy products are consumed by the sector, they are not consumed for the purposes of energy generation and therefore are not included in the energy consumption statistics, this leads to a significant underestimate of refinery sector energy consumption, to the point where it does not make sense to include the sector in many of the analyses below.

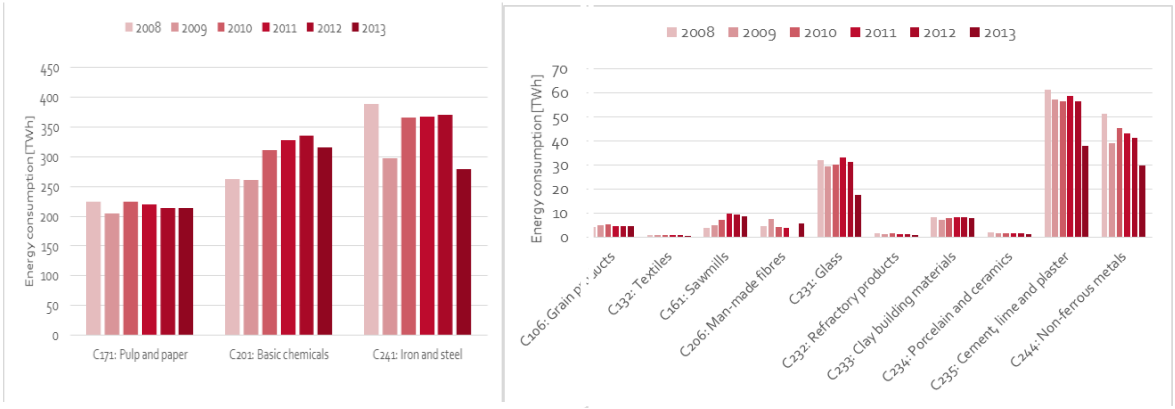
[21] The energy intensity of Basic chemicals also increased over the period but followed a different dynamic, ie +20% of energy consumption and 5% increase in Gross Added Value



Source: Ecofys study

Note: Data based on limited number of EU Member States (see Table 19 for coverage)

Figure 199 - **Total energy consumption per sector 2008-2013 [TWh] aggregate of countries with available data for all years**



Source: Ecofys study

Note: Data based on limited number of EU Member States (see Table 19 for coverage

Energy carriers and price sensitivity

In this subsection we first present the results of the analysis of the importance of some energy carriers in consumption of sectors over the period 2008-2013. Then the results of the sensitivity analysis of total energy costs to price changes in energy carriers are presented.

As for the energy intensity ***the analyses presented in this section are based on a small share of the value added of sectors [Value Added covered by sectors ranges from 6% to 24%] and a rather limited coverage of EU Member States.***- See **Table 19.**

In addition to that the analysis of energy costs only covers *electricity, gas, coal,* and *oil products* and excludes other carriers like biomass or heat for which prices were not available. This is most relevant for the sawmills (84% of energy consumption), pulp and paper (43%), basic chemicals (35%) and cement, lime and plaster sectors (38%). In all other sectors other energy consumption was less than 5% of the total.

Data on consumption of energy carriers per sector comes from National statistics and the Odyssey-Mure dataset. Prices for gas and electricity are typical prices for firms in the sectors derived as indicated in box (#).Price data for oil (petroleum products) was sourced from Eurostat: prices for Heating Oil without taxes. Price data from coal is based on the monthly prices reported in the Platts CIF ARA 6,000 NAR.22

The results of the analysis are presented as averages of available data points and give a rough indication of the importance of fuels per sector. This shows that overall electricity has the biggest influence on total energy costs followed by gas while oil (petroleum products) and especially coal have a relatively small influence even if consumption is high. This seems to indicate that energy costs in the sectors studied could be driven by price element of the energy carrier (electricity is usually expensive and coal cheap) rather than the consumption. See Figure **200** and Figure **201**

Figure 200 - **Average energy consumption shares per sector – based on available data points, split by energy carrier, 2008-2013 averages, excluding other energy carriers.**

[22] The Platts CIF ARA 6,000 NAR is a daily 15-60 day forward price assessment for thermal coal shipped from Colombia, Russia, South Africa, Poland, Australia or the US to the northwest European trading hub of Amsterdam, Rotterdam and Antwerp. The term '6,000 NAR' refers to the net calorific value (heating value) of the coal in kilocalories per kilogram.

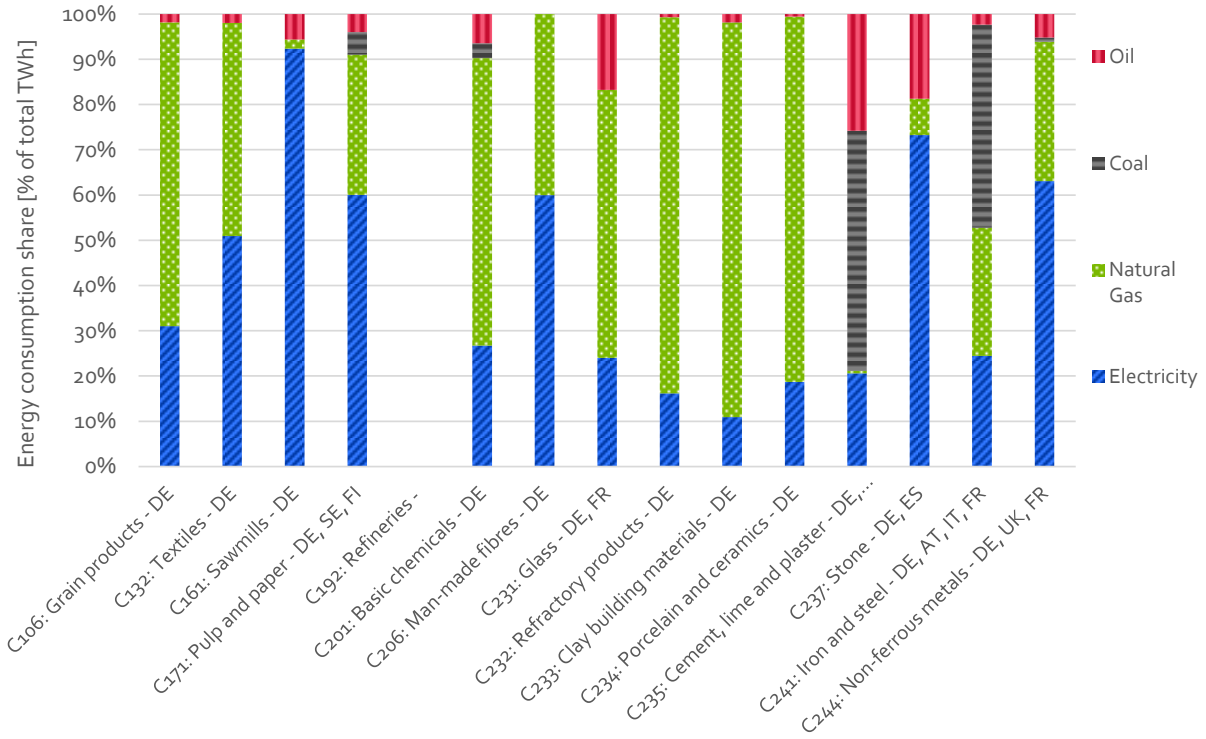
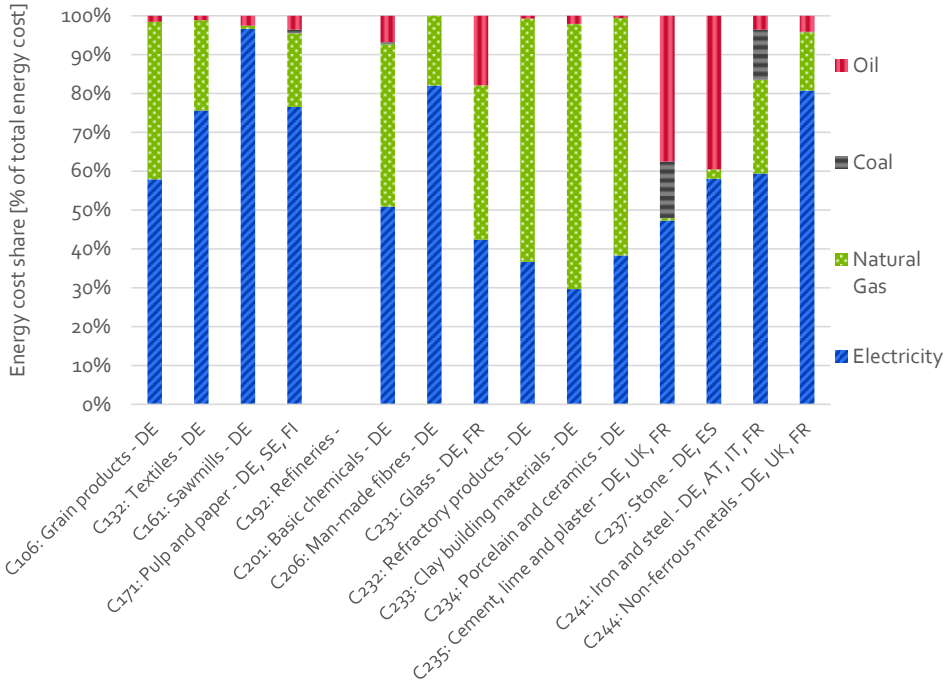


Figure 201 - **Average energy cost shares per sector – based on available data points, split by energy carrier, 2008-2013 averages**

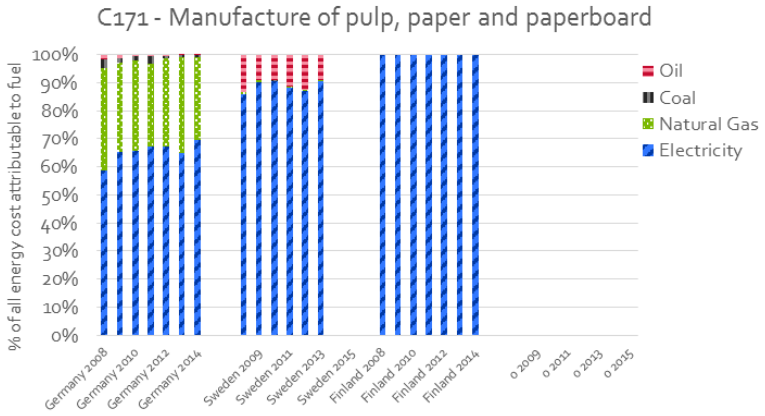


The average figures per sector presented above have to be taken with precaution not only due to the limited available data but also because averages do not show national specificities. Two examples below illustrate this**.**

C171 – manufacture of paper, pulp and paperboard (**Figure 202**)– In the sector in Germany there is significant consumption and costs due to natural gas. Natural gas is not used in either Sweden or Finland. Natural gas prices in Germany are therefore important for this sector, while electricity prices are crucial in

Sweden and Finland, with the costs of other energy carriers (heat, biomass) also of particular importance in Sweden.

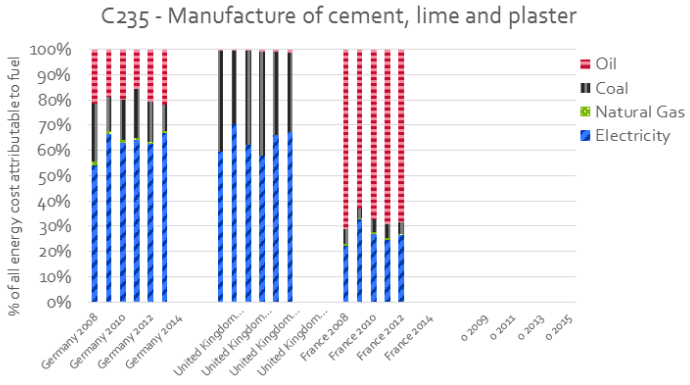
Figure 202 - **Energy cost structure for the paper and pulp sector**



Source: Ecofys study

C235 – Manufacture of cement, lime and plaster (Figure 203)– a divergence in energy costs can be observed between each of the three Member States, Germany and UK both incurring around 60% of their energy costs from electricity, despite its share in consumption being relatively low (10-15%) in each. Part of this is explained by other (non quantified) energy consumption increasing the relative importance of each energy carrier including electricity. It also exemplifies the role of relatively high electricity prices and especially the role of relatively low coal prices. The cost share for electricity in France is much lower as electricity prices for the sector are around 30-40% lower than in Germany and the UK.

Figure 203 - **Energy cost structure for the manufacture of cement, lime and plaster)**



Source: Ecofys study

Sensitivity of energy costs to price changes

In this section we present an analysis of how the changes in prices of different energy carriers could affect the energy costs as a share of total productions costs in different sectors. The results of this sensitivity analysis have to be taken with even more precaution that the previous results. In addition to the limitations in the data coverage and information of relevant energy carriers for some sectors, additional assumptions are needed to undertake the analysis which limits even further any generalisation of the results. Namely:

— The energy carrier split is based on only a limited number of data points.
— The energy carrier split is assumed to remain constant over time, no fuel switching.
— The other production costs are also assumed to remain constant over time.

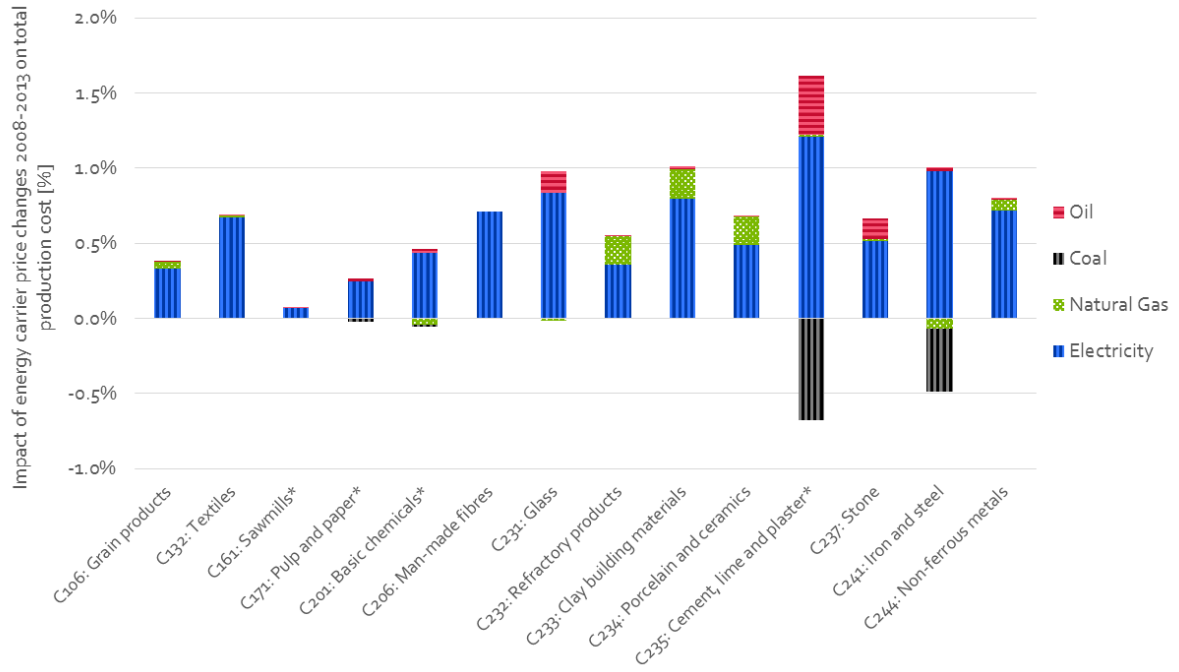
The assumptions on energy price changes for 2008-2013 were based on the changes on the EU averages of electricity and gas prices per sector, calculated on the basis of the estimated prices after applying exemptions of Member State for a typical firm in a sector with an estimated typical electricity and gas consumption (between 2008-2013 calculated electricity prices increased from 5-25% and gas prices varied from -3.5% to 16%, depending on the sector)[23].-. Oil (petroleum products) prices were calculated to have increased by 9% in all sectors, and coal, on the basis of the Platts CIF ARA prices were calculated to have decreased by 38% across all sectors.(details on approach on Ecofys study section 5.6.2)

The analysis shows - by sector, **over the period 2018-2013 -** the impact of the change in the price of energy carriers on the share of energy in total production costs (**Figure 204**).

This shows that: **the net effect on total production costs of energy price changes is relatively small (increase between 0.2 and 1.2% per sector) and that sectors which use coal may have benefitted from price changes, or at least offset the impact of increasing prices of other energy carriers.**

[23] See Section 5.6.3 of Ecofys study for a detailed methodological description of the calculations

Figure 204 - **Estimated EU average impact of changes in price of energy carriers 2008-2013 on total production cost of sector**



Source: Ecofys study

Note: Analysis based on energy cost shares calculated in section 6.2 *=sectors where other energy carriers, whose costs were unquantifiable play a significant role and for which greater uncertainty in the results exists.

6.3.3 International comparisons

6.3.3.1 Energy costs in the EU vs the US and Japan

Although the analysis of industrial competitiveness involves many more factors than only energy, here we concentrate on the differences in energy costs between countries. It is difficult to draw general conclusions as there is a lack of comparable data at a sufficient level of detail for competitor countries. The energy prices used for international comparison do not account for individual industries exemptions or reductions. On consumption and energy costs shares, data is only available at a relatively high level of sector aggregation.

Some general observations on energy prices and costs trends can nevertheless be provided. The case studies on specific sectors and products (Annex 4 and 5 of Ecofys Study) do not allow considerations at company level.

EU energy cost shares in the sectors analysed have to be compared against trading partners to understand their impact on competitiveness.

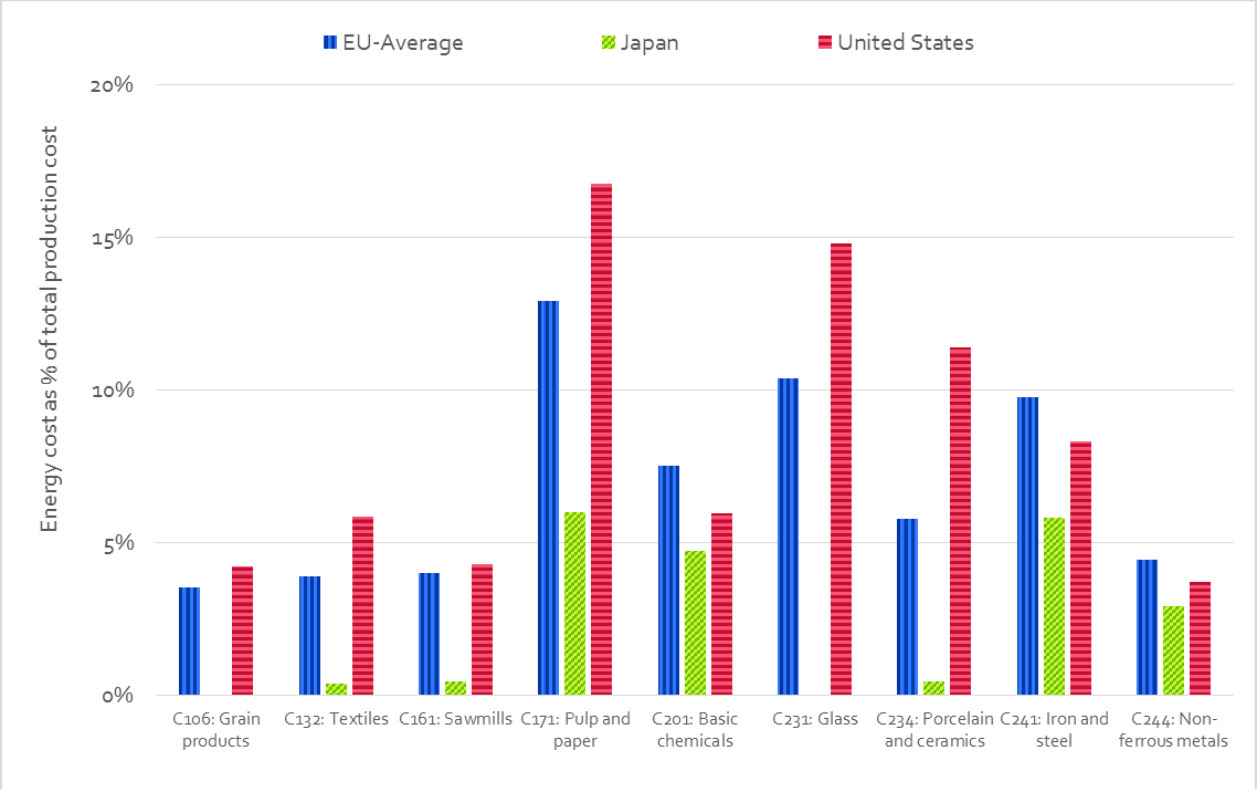
The results of comparison with data available for US and Japan[24] indicate that (

Figure **205) EU energy cost shares were on average higher than the Japanese across all the analysed sectors** (in some cases EU cost shares were more than double Japanese levels)

[24] Data available only for some years and some sectors

and **lower than the US in 6 out of 9 sectors** (significantly lower in textiles, pulp and paper, glass and porcelain and ceramics although higher in basic chemicals, iron and steel and non-ferrous metals)

Figure 205 - **Comparison of [%] average energy cost shares per sector, 2008-2013 averages for available years and sectors**

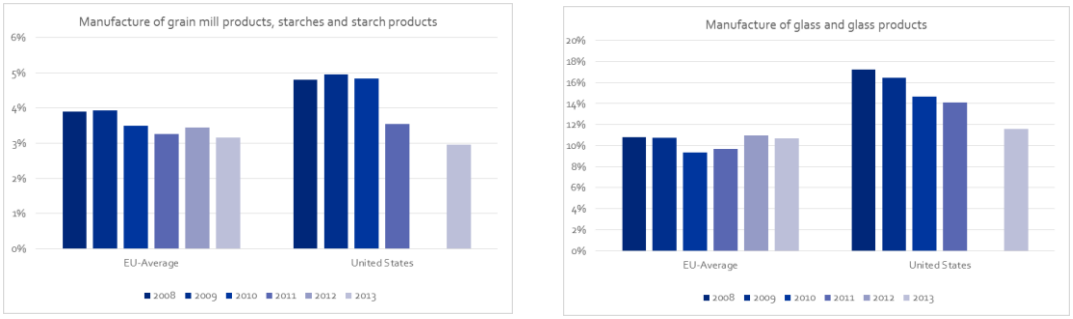


Source: Ecofys study

Note: Available data is for all years for the EU, 2008-2010 for Japan, 2008-2011 and 2013 for the US.

Between 2008-2013 energy cost shares have fallen in both the EU and US, but faster in the US in most of the sectors analysed (8 of the 11 sectors in which comparisons could be made). The following examples illustrate this trend.

Figure 206 - **Energy cost shares as a % of cost for selected sectors**



Source: Ecofys study

In the following sections we examine the key price and efficiency (intensity) drivers of these trends.

Industrial energy prices

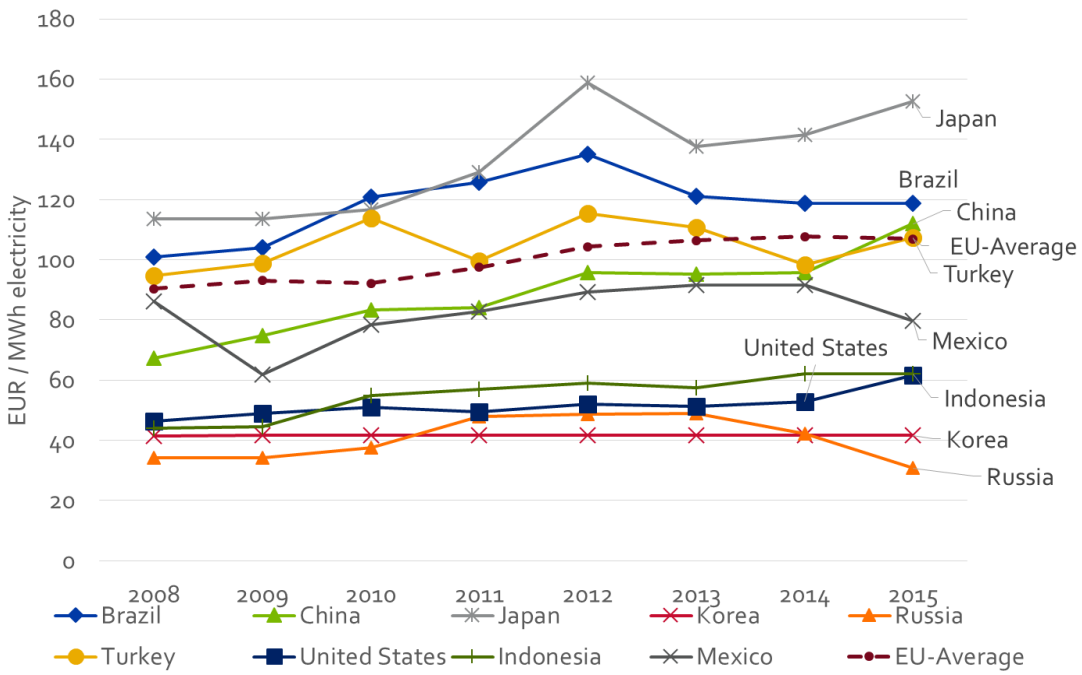
The price paid for energy is a key driver of energy costs. In this section we look at data on electricity and gas prices (excluding VAT and recoverable taxes and levies) for industrial consumers in the EU and EU trading partners[25]. By comparing the prices paid internationally we can provide insight into the relative role of energy prices in energy costs.

Data are however scarce, particularly for gas and the price data used come from different sources and cannot always be easily compared (for G20 countries, excluding the EU Member States, IEA and private sources (CEIC) databases were used; EIA was also a source for US; Details in Annex 4 and Ecofys report)

[25] Please note that the prices only exclude VAT and other recoverable taxes and levies. Other price and tax reductions or exemptions that could be granted to companies in the EU and trading partners are not accounted for in these prices

6.3.3.2 Electricity prices

Figure 207 - **Average electricity prices paid by industrial consumers in EU major trading partners**



Source: Brazilian Ministry of Mining and Energy, Chinese Price Monitoring Center, NDRC, Indonesian State Electricity Company, Russian Federal State Statistics Service, and for Turkey, Korea, Japan, US and Mexico EIA data have been used. WB and ECB.

Within the EU, prices paid for electricity can vary significantly across Member States. In some sectors and countries electricity prices will be considerably higher than the average, in others considerably lower and comparable with the lowest prices paid internationally..

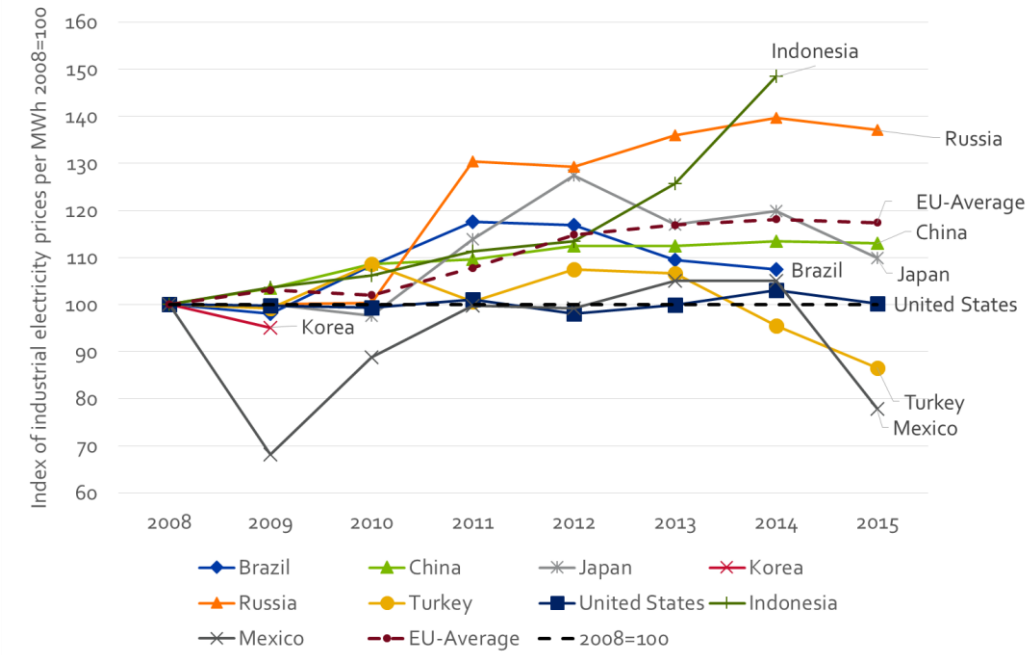
The analysis of this data shows that average **EU industrial electricity prices[26] are around the average paid internationally** (around €110/MWh), ***higher than*** **those paid in Russia, Indonesia, the US and Mexico, *slightly lower than* those paid in Turkey, China, Brazil and *clearly lower* than those paid Japan**

Over 2008-2015 the EU average was relatively **stable** while prices were increasing in many trading partners. **Japan and China prices have markedly increased** (34% and 66%, respectively, making **Chinese prices** now higher than the EU average prices). **US** (+32%) and **Indonesia** (+41%) prices have also significantly **increased but remain well below the EU average.**. In other countries prices did not change much (between €10-20/MWh).

Indeed, the appreciation of the US$ and the Chinese Yuan with respect to the Euro have significantly amplified price increase trends in China and the United States. Conversely, the depreciation of the Russian rouble, the Turkish lira and the Brazilian real has mitigated or even reverted the domestic price increases in national currencies (e.g. prices in Russia increased by 30% in the national currency terms but decreased by 10% in Euro terms). See **Figure 208** , which describes the evolution of prices in national currencies, in conjunction with **Figure 209**, which describes the evolution of exchange rates.

[26] These prices refer to those paid by the general industry (i.e. by the industry with medium energy consumption (Eurostat Band ID) and not Energy Intensive Industries which usually are large energy consumers)

Figure 208 - **Industrial electricity prices in national currencies 2008-2013, indexed to year 2008=100**



Source: Ecofys study calculations on the basis of data from Brazilian National Petroleum Agency, Chinese Price Monitoring Center, NDRC, Russian Federal State Statistics Service, American Energy Information Administration, and IEA for Turkey and Canada

Note: In the case of Japan and Russia prices are indexed to 2009=100 as no 2008 values are available

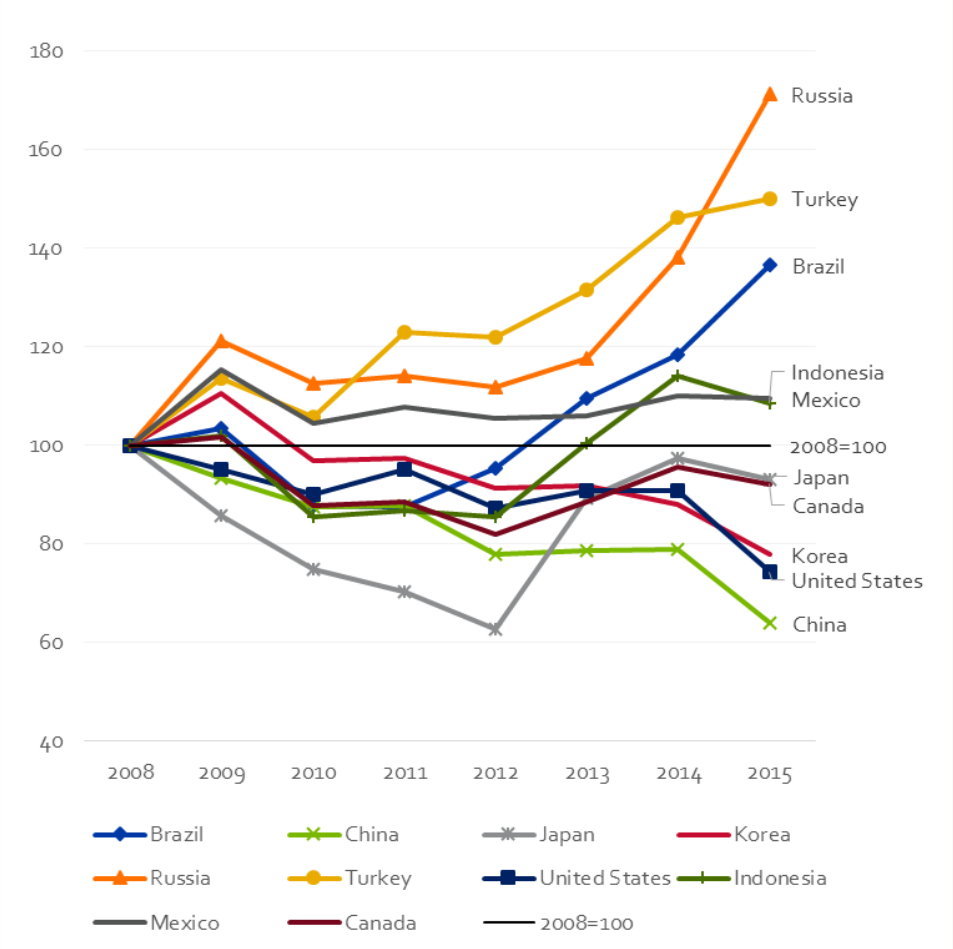
Role of exchange rates in international price comparisons

Comparing international prices requires conversion to a common currency, this introduces an exchange rate effect when analysed over time, in addition to any changes in price in the original currency. Exchange rates can move for a variety of reasons unrelated to the energy sector. Therefore, it is also important to consider these movements and the impact they have on the energy prices presented here.

Energy prices are analysed and converted to euros using exchange rates from the European Central Bank. The following figure provides an illustration of the currency movements with respect to the Euro over the period 2008-2015, indexed to the exchange rate in 2008=100. This shows that over the period 2008-2015 the Russian rouble depreciated significantly against the Euro, as did the Turkish Lira and the Brazilian Real. The Indonesian Rupiah, Mexican Peso, Japanese Yen and Canadian Dollar remained relatively stable to the euro, a fluctuation of around +/-10% either compared to 2008. The Korean Won, US dollar and Chinese Yuan appreciated by 20-40% against the Euro between 2008-2015.

These trends can mask or accentuate the actual trends in national energy prices, for example an increase in Russian, Turkish or Brazilian energy prices would not necessarily be reflected in euros, due to the exchange rate movements, and vice-versa.

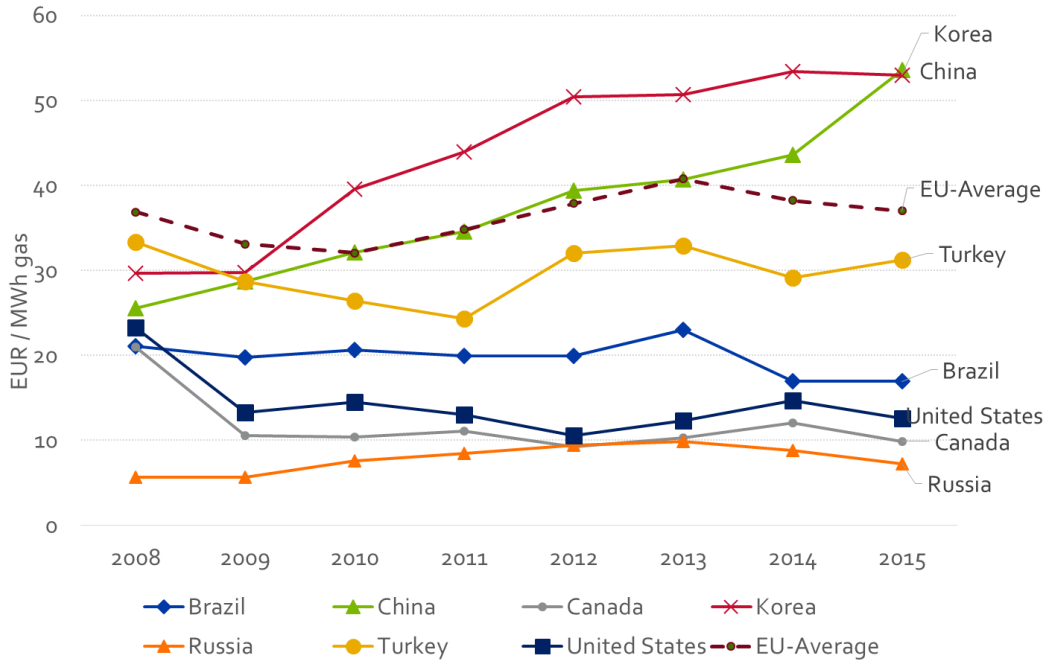
Figure 209 - **Exchange rate movements indexed to Euro exchange rate in 2008=100.**



It is important to note also that these types of currency movement can also have an effect within the EU for the countries outside the Eurozone.

6.3.3.3 Gas prices

Figure 210 - **Average natural gas prices paid by industrial consumers in EU major trading partners.**



Source: IEA, Brazilian National Petroleum Agency, Chinese Price Monitoring Center, NDRC, Russian Federal State Statistics Service, American Energy Information Administration, and for Turkey and Canada EIA. WB and ECB.

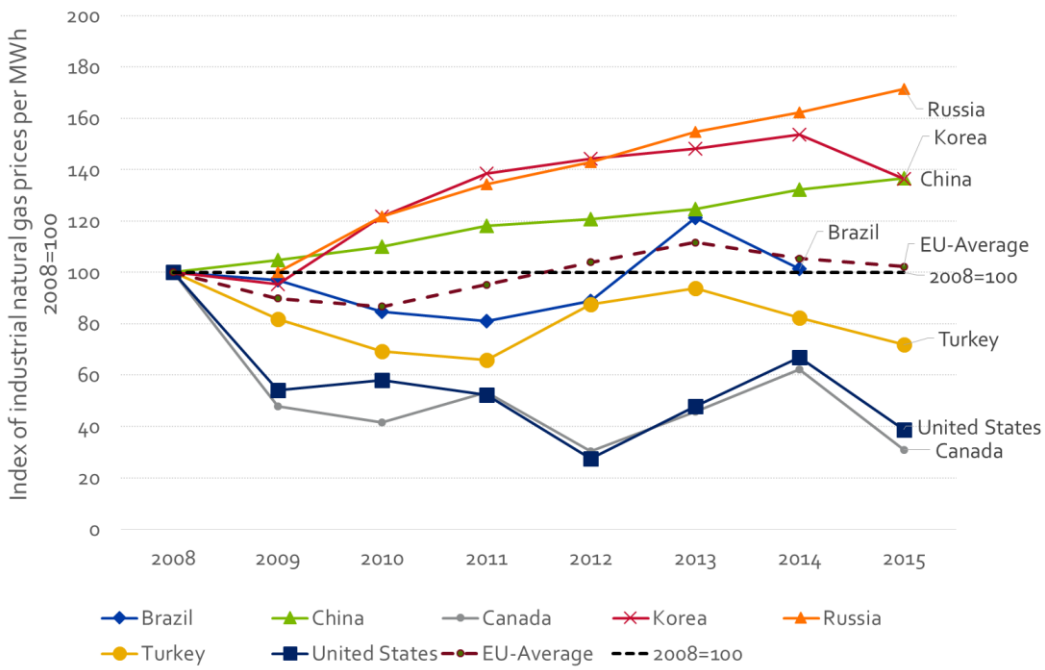
As for electricity, EU prices for natural gas can vary significantly across Member States and sectors within Member States.

The analysis of gas prices show that average **EU industrial natural gas prices are relatively high** compared to those paid internationally (€37/MWh), ***higher than*** **prices paid in Russia, the United States, Canada, Brazil and Turkey** and ***lower than*** **prices paid in Korea and China**.

Over 2008-2015 gas prices fluctuated importantly (declining from 2008-2010; increasing in 2010-2012, and (mostly) decreasing since 2012). The EU average has however not changed significantly. Prices in China (+109%) and Korea (+79%) have considerably increased, becoming much higher than the EU average. Prices in the US (-46%) and Canada (-53%) declined mainly due to the US shale gas boom.

The appreciation of the Chinese Yuan and the Korean Won with respect to the Euro has accentuated the price increases in Euro terms of China and Korea gas prices. The depreciation of the Brazilian real and Russian rouble mitigated the gas prices increases in Euro terms (prices increased in Russia by more than 65%, but only 27% in Euro terms. For Brazil, a 35% increase became a 16% increase in EUR terms). The depreciation of the Turkish lira is hiding completely the increase in gas prices in Turkey (by more than 40% in lira terms that become a decrease of 7% in EUR terms). Finally the appreciation of the US dollar is mitigating the strong decrease in gas prices in the US (where gas prices fell by more than 70% but only by 45% in EUR terms). See **Figure** 209 which describes the evolution of exchange rates in conjunction with **Figure 211**; which describes the evolution of prices in national currencies

Figure 211 - **Industrial natural gas prices in national currencies 2008-2013, indexed to year 2008=100.**



Source: Ecofys study calculations on the basis of data from Brazilian National Petroleum Agency, Chinese Price Monitoring Center, NDRC, Russian Federal State Statistics Service, American Energy Information Administration, and IEA for Turkey and Canada
Note: In the case of Russia prices are indexed to 2009=100 as no 2008 values are available.

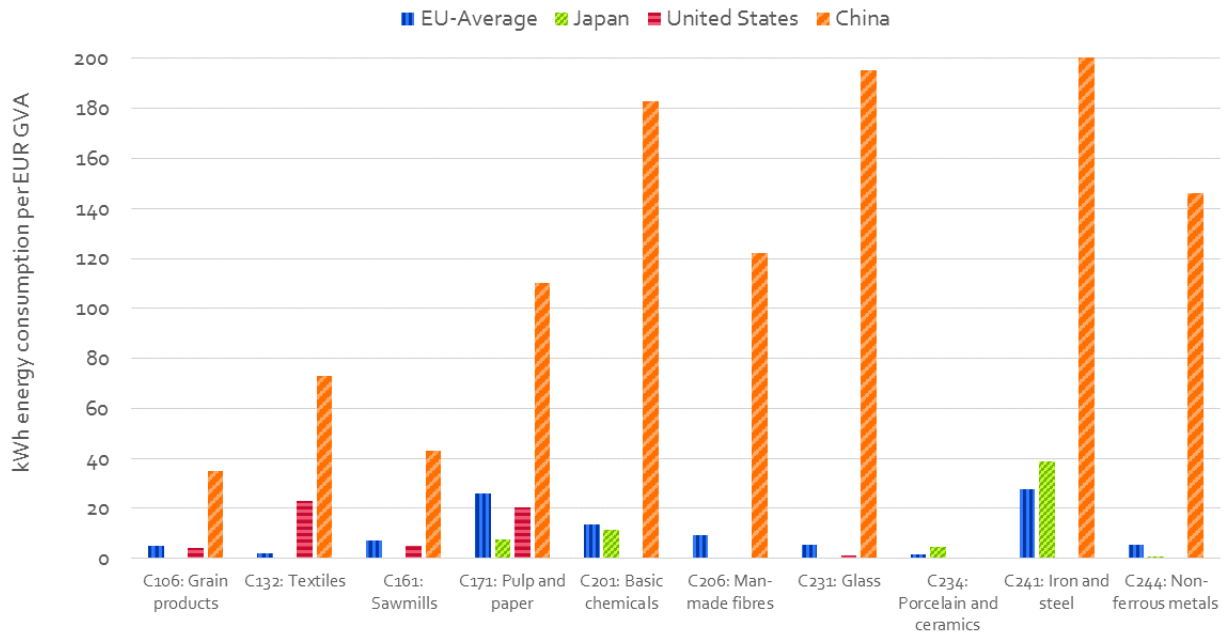
6.3.3.4 Exploring energy intensities differences with trading partners

The analysis of energy intensities of EU selected sectors was based on a rather restricted data set over the period 2008-2013. Data on energy intensity for the United States and Japan is available but only for some years and some sectors. Limitations when interpreting these findings are thus important also due to potential differences in sector definitions, the heterogeneity of products and differences in statistical methods.

In addition the role of exchange rates is important. As highlighted in the 2014 European Competitiveness report this is particularly relevant for China where exchange rates are understood to be significantly undervalued in the reference period. This impacts by lowering the value added expressed in Euros and makes the energy intensity in China look higher, although as noted in the 2014 ECR that value added is generally lower in China. This makes that rather likely that the energy intensity of China expressed in the national currency is lower than presented in **Figure 212**

China is by far the most energy intensive of all of four economies over this period. While this is likely to be partly driven by relative energy inefficiency, it is also subject to the data limitation of an undervalued exchange rate noted above, statistical errors and relatively low value added.

Figure 212 - **Energy intensity [kWh energy consumption per Euro of GVA generated] per sector**



Source: Ecofys study, Eurostat

Note: The Figure presents average values for 2008-2013, for EU and Japan typically all years (2008-2013), for US only for 2010, for China 2008-2011

Comparing the EU and the US **Figure 213** shows that **the EU is more energy intensive than the US in four out of five sectors.**

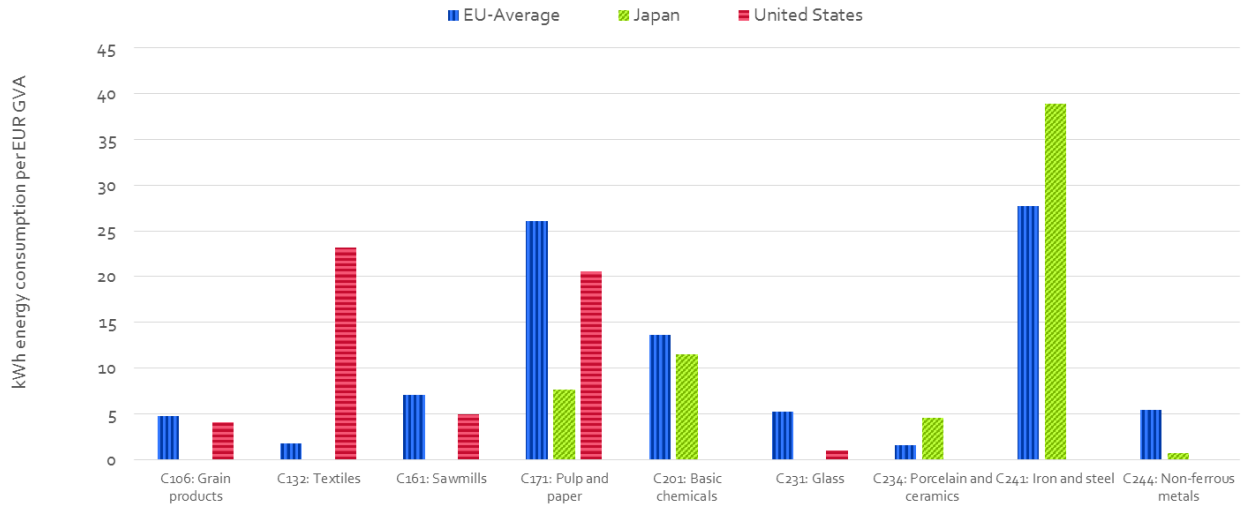
This is not in line with the findings of the Commission 2014 Energy Competitiveness Report (2014 ECR), which showed that the EU had the lowest energy intensity compared to the US, China and Japan in 2009 (EU has the lowest energy intensity followed by Japan, then the US, then China). According to the 2014 ECR Energy intensity decreased in all economies between 1995-2009. However the results of these studies are hardly comparable. The differences on the results from the Ecofys study and 2014 ECR may stem from the different methodologies used as well as the periods covered (1995-2009 in 2014 ECR vs 2008-2013 in the Ecofys study) and the level of sectoral aggregation (NACE 3 level sectors in the Ecofys study vs NACE 2 in the 2014 ECR)[27].

Also comparing the EU and Japan, the outcomes vary by sector and need to be interpreted carefully because of potential differences in sector definitions. For pulp and paper, basic chemicals and non-ferrous metals the EU is more energy intensive[28]. For porcelain and ceramics and iron and steel the EU is less energy intensive than Japan.

[27] See Ecofys study (section 5.7.3, Table 19) for more detailed explanations and comparisons of the results of these two studies.

[28] For non-ferrous metals, the large EU-China difference can be partly explained by the higher share of highly energy intensive primary production in China.

Figure 213 - **Energy intensity [kWh energy consumption per Euro of GVA generated] per sector**

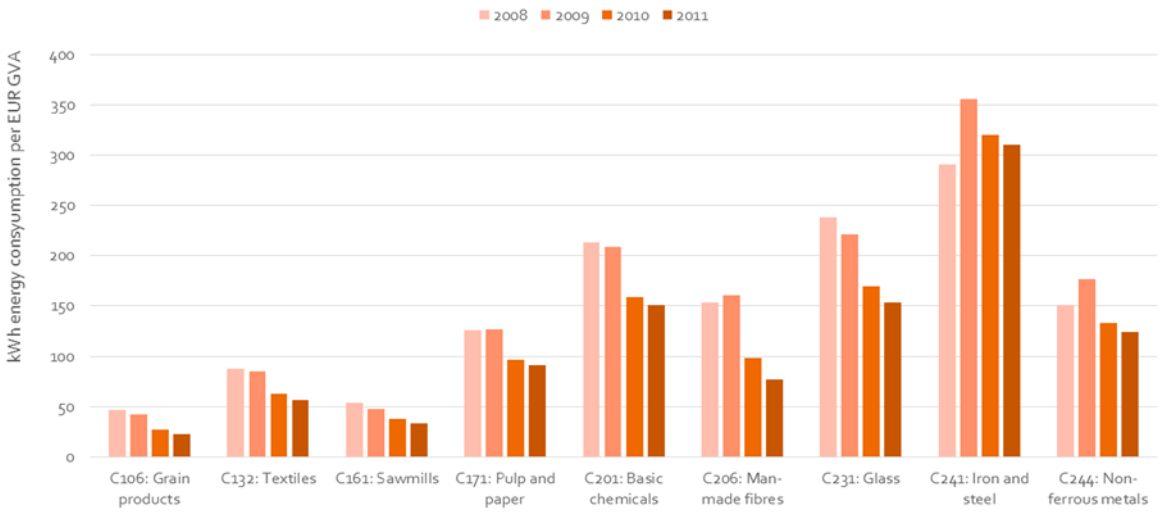


Source: Ecofys study, Eurostat

Note: The Figure presents average values for 2008-2013, for EU and Japan typically all years (2008-2013), for US only for 2010

Looking at sector trends over time **energy intensity in China rapidly declined in almost every sector 2008-2011**(**Figure 214**) - yet it remains far above the energy intensities of the EU, US and Japan. If an undervalued exchange rate and relatively low value added were able to be factored in then we would expect China to be much more comparable, although still more intense, than the other countries.

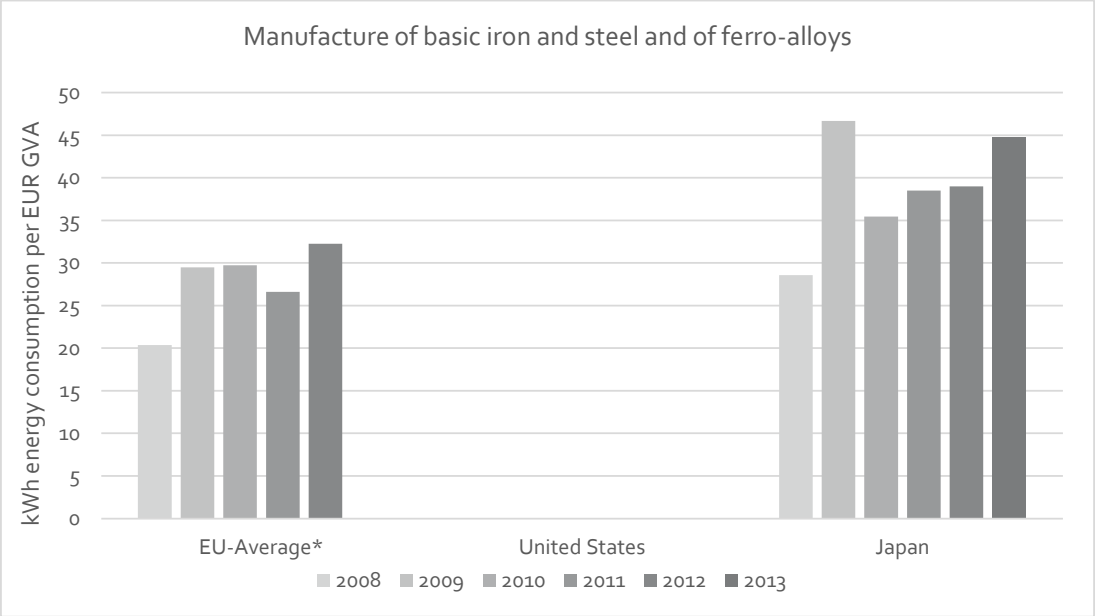
Figure 214 - **Energy intensity trends in Chinese industry 2008-2011**



Source: Ecofys study

Energy intensity in the iron and steel sector for EU and Japan has increased over the period 2008-2013 (**Figure 215**), driven by declining GVA, which is declining faster than energy consumption. No time series data is available for the US.

Figure 215 - **Trends in the energy intensity of the iron and steel sector, kWh energy consumption per Euro of GVA.**



Source: Ecofys study

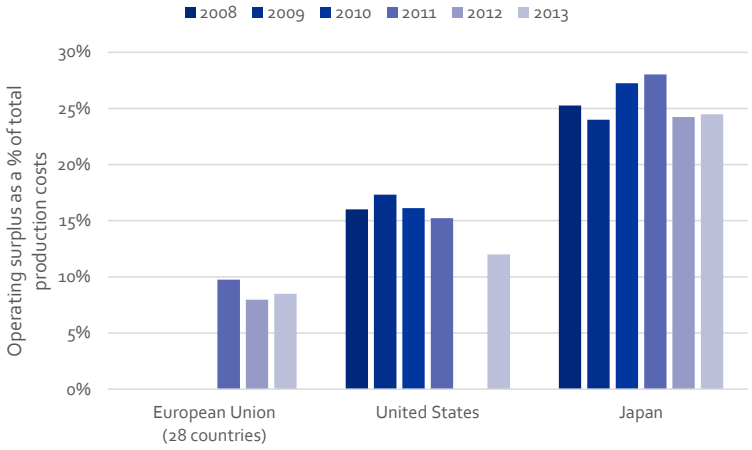
Note: Comparison of EU-average (limited number) data points and Japan, 2008-2013

Operating surplus

Comparison of gross operating surplus

It is interesting to see if international competitors are also facing similar competitive pressures on margins. Unfortunately the data analysed faces similar limitations as the ones described in the analysis of energy intensities and the results have to be taken with precaution. The data seem to indicate that the ***on average gross operating surplus for United States and Japan are higher than those in the EU*** (**Figure 216**), in the range of 12-17% in the US and 24-28% in Japan compared to 8-10% in the EU. US margins were declining but remain more than 4 percentage points higher than those in the EU. Japan margins were stable over the period but could be overestimated because labour costs are underestimated (may not include social contributions).

Figure 216 - **Gross operating surplus as % of total production costs, average across all sectors for the EU28, United States and Japan, 2008-2013**

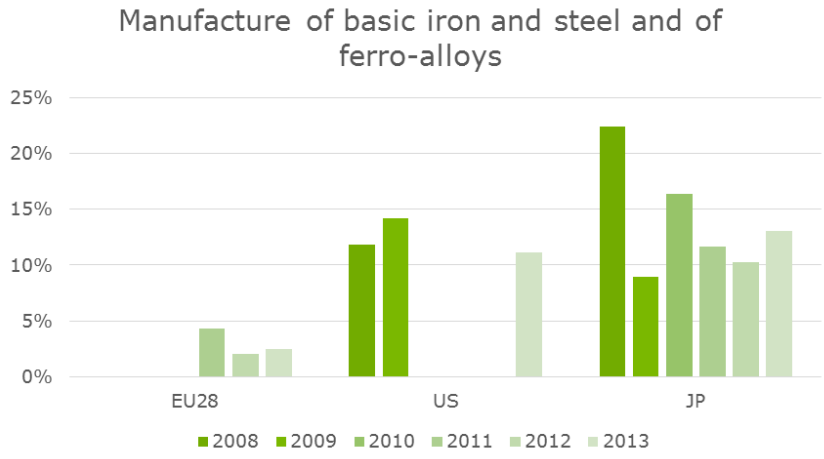


Source: Ecofys study

At the sector level (See Ecofys study Annex 4) there some exceptions:

- Grain products: where the EU has higher average surplus than the US, 8-9% compared to 5-7%.
- Sawmills and basic chemicals: where EU and US surpluses at 6-7% and 8-10% respectively are broadly the same.
- Glass and Cement, lime and plaster: where US surpluses are around double EU levels, although the gap has closed over time.
- Porcelain and ceramic products: where surpluses at 35-45% in Japan are significantly higher than the EU (and US) figures.
- Iron and steel: gross operating surpluses are lower than average for all countries but those for the EU remain lowest (**Figure 217**)

Figure 217 - **Average industrial gross operating surplus [as % of total production cost] for the EU28, United States and Japan, 2008-2013**



Source: Ecofys study

6.4 Case Studies

In this section we will look at energy prices and costs in some selected Energy Intensive sectors at a more disaggregated level and the role they can play in their competitiveness.

The results presented here are mainly based on the three studies referred to in section 6.4. These studies are characterized by very different methodologies and scope. Despite some overlaps, they also have a different coverage in terms of industrial sectors assessed (see **Table 20**). However, the conclusions of these studies together aims at providing an as complete as possible overview of the situation in these sectors. This approach is also justified by the lack of a single, readily-accessible and comprehensive data sources for analyses on energy prices, consumption and costs, which represent strategic (often confidential) information.

Where appropriate and possible the results of this subsection are put into perspective with more general results in this chapter and with the general trends observed in energy price and costs as described in other parts of this report.

Table 20. Coverage of sectors and product markets by various studies

Ecofys study	*CEPs study*	*JRC study*
Paper and paperboard (C1712)	---	---
Other inorganic basic chemicals (C2013)	---	Chemicals: ***Ammonia, methanol, ethylene and propylene***
Hollow glass (C2313) -	---	---
Basic iron and steel and of ferro-alloys (C2410) -	***Steel***	***Steel*** *(hot rolled coil and wire rod)*
Aluminium production (C2442)	*Primary* ***Aluminium***	Non-ferrous metals: *Primary* ***Aluminium*** *(hot rolled coil and wire rod)****, copper and zinc***
---	---	***Cement***
---	***Tiles*** *(Wall & floor tiles)*	---
---	***Bricks*** *(Bricks & roof tiles)*	---
---	***Refineries***	---

6.4.1 Cross-Sectorial comparisons

Cross-sectorial comparisons and conclusions on Energy Intensive Industries were made in the previous sections of this chapter on the basis of a top down approach analysing statistical information of prices at a rather aggregated level (NACE 3).

It is also interesting to zoom in and look at more disaggregated sectors/subsectors and at data on price and consumption resulting from collecting information from individual companies (bottom up approach). The main reason for this is that estimations based on a top-down approach may not be always fully capturing the specificities of sectors/subsectors where energy costs are most relevant and may affect competitiveness. It is thus interesting to look at the results from the specific case studies, see if trends appear and how they fit with the results of other sections.

The *CEPS et altri* study follows a bottom-up approach and looks at five energy intensive sectors. The combination of plant-level data allows for sectoral comparisons regarding the relation between the price paid and energy consumption as well as across Member States.

For the cross-sectorial comparisons CEPS analysed price and consumption data from 116 plants (electricity) and 108 plants (natural gas)[29]. The plants surveyed represented different shares of their respective EU sector capacity: 13.7% of the steel (EAF) sector, 11.4% of steel (BOF) sector, 93% of primary aluminium, 10% of tiles, 10.5% of bricks and 24.5% of the refinery rector.

Case studies: Prices versus level of consumption

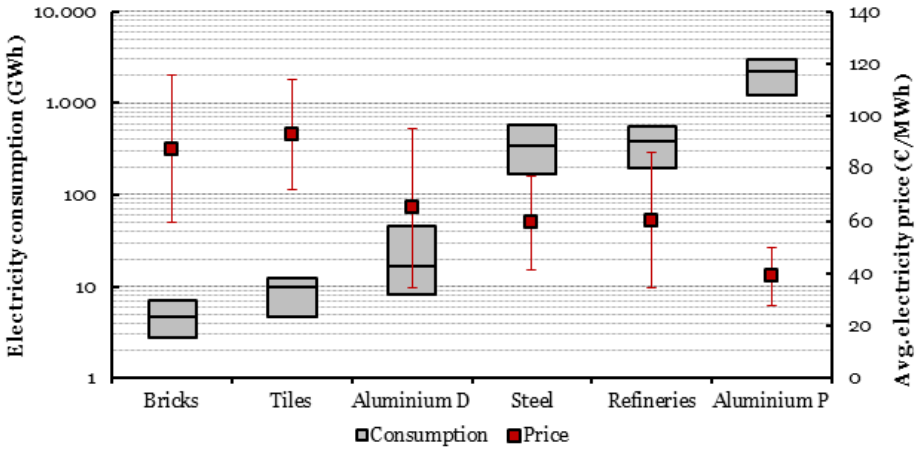
Focussing on the EU average **electricity** price (weighted by consumption) paid in each (sub-)sector assessed, it can be observed that ***operators in (sub-)sectors with relatively lower energy consumption pay a much higher price than operators in (sub-)sectors with higher consumption levels***.

The sector averages are associated in most cases with high price spreads, which reflect the high variability of conditions in different Member States. Still the correlation seems robust and can be explained by various reasons like the fact that larger industrial consumers can have stronger bargaining power when concluding energy supply contracts - including the possibility of long-term contracts [30]– as well as the fact that larger consumers may be granted partial or full exemptions from certain taxes and levies or benefit from these exemptions being progressive. It should be underlined that all data assessed in the case studies are 'net' of possible exemptions and reductions in different Member States and across sectors, giving therefore indication of the real prices paid and costs faced by respondents.

[29] The selected plants were distributed between the five studied sectors as follows: for electricity, 60 plants from Bricks, 22 from Tiles, 14 Refineries, 22 from Steel, 10 from Primary Aluminium and 17 from Secondary Aluminium; for gas, 60 plants from Bricks, 22 from Tiles, 14 Refineries, 22 from Steel, 7 from Primary Aluminium and 14 from Secondary Aluminium

[30] Bilateral contracts are still possible, although they need the clearance from the EC

Figure 218 - **Electricity consumption & price variations by sector (116 facilities) weighted average, 2008 – 2015**

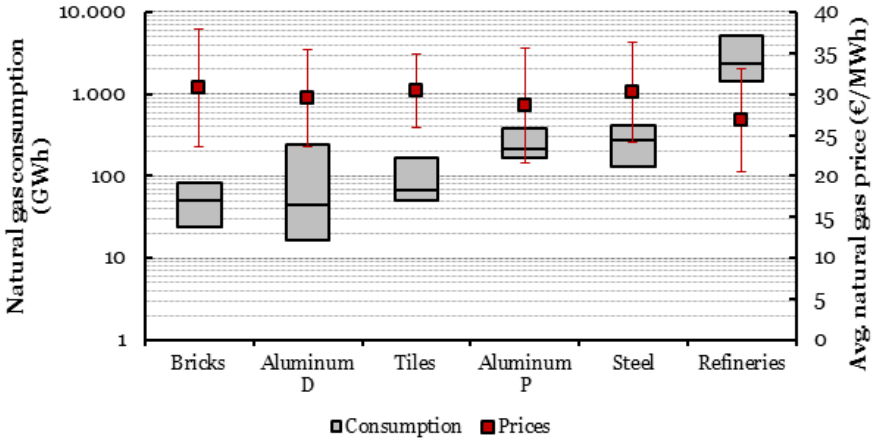


Source: CEPS et al.

Note: *Aluminium P*:primary aluminium / *Aluminium D*: secondary aluminium

The same clear correlation cannot be observed when looking at ***natural gas*** prices. This may be explained by a lower disparity in natural gas consumption levels across the five sectors assessed and mainly by the much lower weight of non-energy components (network costs, taxes and levies) in final natural gas prices, which reduces the impact of possible governments' interventions, including via exemptions and reductions granted.

Figure 219 - **Natural gas consumption and price variations by sector (108 plants), weighted average, 2008 – 2015**

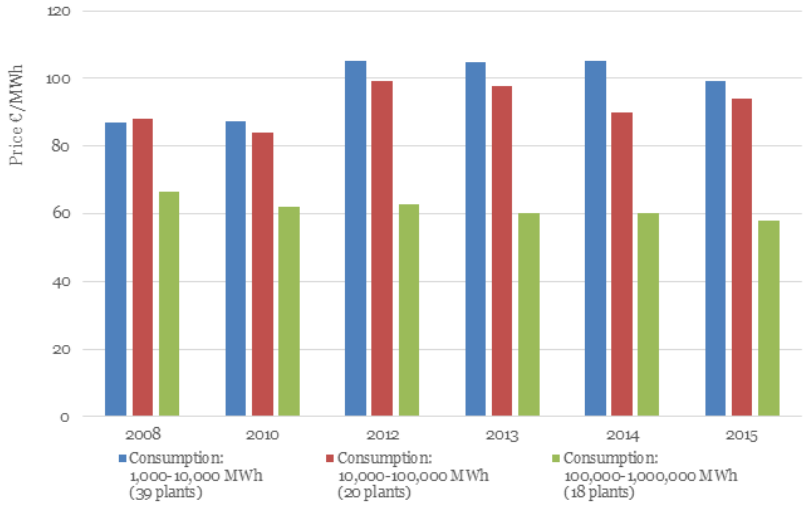


Source: CEPS et al.

Note: *Aluminium P*:primary aluminium / *Aluminium D*: secondary aluminium

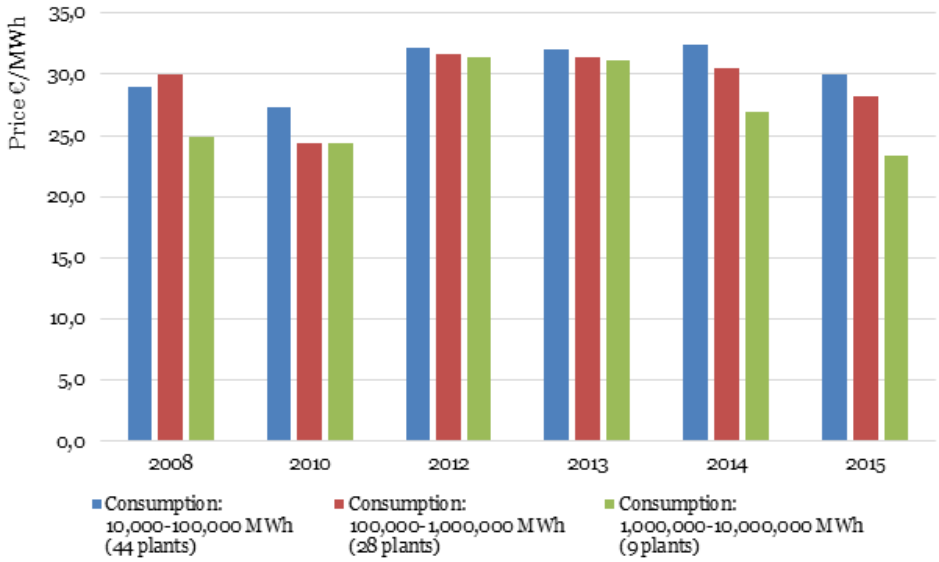
The impact of consumption levels on energy prices paid both for electricity and – although to a lesser extent – natural gas is clearly visible also when looking at different consumption bands – without differentiation between sectors.

Figure 220 - **Electricity consumption and price variations by plant consumption (116 plants)**



Source: CEPS et al.

Figure 221 - **Natural gas consumption and price variations by consumption level (108 facilities)**



Source: CEPS et al.

Prices at different sector aggregation levels

We proceed now to shortly compare estimated energy prices of Energy Intensive sectors-(NACE 3 level, Ecofys study) with average prices calculated from case specific studies (CEPS et altri study). The available data allow for comparison in only two sectors: steel and aluminium. First we introduce the methodology and estimated prices from the Ecofys study (top down approach) and then we compare them with the average prices calculated in the CEPS et altri study (bottom up approach)

Estimated prices in Ecofys study (NACE 3 level)

In the Ecofys study electricity and natural gas prices per sector were derived taking into account information of exemptions in Member States. To do so an assumed consumption band for the typical firm in a given sector was estimated on the basis of energy consumption data available from a limited number of countries (Table 19) divided by the number of firms active in the sector in those countries (see Table 21).

Table 21. Assumed consumption and resulting consumption bands per sector for electricity and natural gas

Sector	Assumed average firm electricity consumption [GWh]	Eurostat electricity consumption band	Assumed average firm natural gas consumption [GWh]	Eurostat natural gas consumption band
C106: Grain products	14.0	ID	26.9	I3
C132: Textiles	4.4	ID	3.7	I3
C161: Sawmills	3.2	ID	0.0	I2
C171: Pulp and paper	87.4	IF	127.1	I4
C201: Basic chemicals	75.0	IF	177.2	I4
C206: Man-made fibres	31.1	IE	58.9	I4
C231: Glass	10.3	ID	33.3	I4
C232: Refractory products	3.5	ID	15.8	I3
C233: Clay building materials	6.3	ID	47.1	I4
C234: Porcelain and ceramics	3.0	ID	11.1	I3
C235: Cement, lime and plaster	46.7	IE	19.5	I3
C237: Stone	2.2	ID	0.3	I2
C241: Iron and steel	222.2	IF	663.4	I5
C244: Non-ferrous metals	51.5	IE	32.1	I4

Source: Ecofys study

The price corresponding to that consumption band in each MS was derived taking into account available information on price and tax exemptions. EU averages price were then calculated using as weights the Member State share in total EU production costs. Only Member States and sectors for which data is available for all years were used. The resulting weighted average prices per sector are presented below:

Table 22. EU production cost weighted average industrial electricity prices (including exemptions) per sector 2008-2013 [EUR/MWh]

Sector	2008	2009	2010	2011	2012	2013	2008-2013 Change	2014	2015
C106: Grain products	97.20	95.48	94.24	101.57	108.25	112.62	**15.9%**	113.28	114.84
C132: Textiles	107.66	108.82	106.20	115.26	128.89	134.76	**25.2%**	132.55	130.86
C161: Sawmills*	87.52	90.32	91.15	94.17	96.87	98.50	**12.5%**	96.56	97.20
C171: Pulp and paper*	78.29	74.88	79.75	82.82	83.36	82.19	**5.0%**	81.35	78.54
C201: Basic chemicals*	82.45	79.61	82.14	90.44	93.01	98.87	**19.9%**	101.10	98.69
C206: Man-made fibres	102.18	97.66	96.38	104.14	111.34	112.76	**10.4%**	113.00	109.34
C231: Glass	91.57	93.00	91.94	99.12	105.11	111.70	**22.0%**	111.29	111.54
C232: Refractory products	100.07	102.13	101.72	107.28	113.50	115.96	**15.9%**	115.12	116.01
C233: Clay building materials	105.27	105.93	103.40	111.58	122.64	128.22	**21.8%**	126.14	123.16
C234: Porcelain and ceramics	93.01	94.03	93.32	102.62	108.39	116.23	**25.0%**	115.83	116.78
C235: Cement, lime and plaster*	85.57	85.84	85.05	93.54	99.44	103.52	**21.0%**	102.61	100.00
C237: Stone	106.38	107.77	105.43	112.73	125.81	129.88	**22.1%**	128.29	126.88
C241: Iron and steel	78.46	76.90	81.79	86.23	87.80	93.86	**19.6%**	92.37	88.96
C244: Non-ferrous metals	87.41	85.77	85.14	95.42	98.96	105.92	**21.2%**	105.91	102.79

Source: Ecofys study

Table 23. EU production cost weighted average industrial natural gas prices (including exemptions) per sector 2008-2013 [EUR/MWh]

Sector	2008	2009	2010	2011	2012	2013	2008-2013 Change	2014	2015
C106: Grain products	38.17	29.77	31.08	34.59	38.37	39.46	**3.4%**	36.47	36.10
C132: Textiles	38.86	29.00	31.49	34.82	38.50	39.35	**1.3%**	36.05	35.83
C161: Sawmills*	47.72	45.94	46.56	51.92	57.15	55.31	**15.9%**	52.23	51.57
C171: Pulp and paper*	36.84	31.38	31.12	35.35	36.37	36.85	**0.0%**	32.97	32.00
C201: Basic chemicals*	36.21	29.01	29.32	32.30	34.06	35.33	**-2.4%**	31.32	30.77
C206: Man-made fibres	34.48	27.20	28.84	32.00	33.89	34.37	**-0.3%**	30.62	30.35
C231: Glass	34.86	27.74	28.83	31.80	34.03	34.71	**-0.4%**	31.37	30.81
C232: Refractory products	39.31	31.37	33.87	36.90	38.53	41.25	**4.9%**	37.48	36.98
C233: Clay building materials	33.98	25.74	27.60	31.22	34.61	34.76	**2.3%**	31.86	31.07
C234: Porcelain and ceramics	39.44	30.30	32.89	36.49	39.01	41.83	**6.1%**	38.02	37.64
C235: Cement, lime and plaster*	36.43	28.77	31.56	35.03	39.26	40.92	**12.3%**	37.74	36.88
C237: Stone	41.25	34.25	36.58	41.54	46.48	47.98	**16.3%**	45.21	43.81
C241: Iron and steel	34.54	26.97	27.95	31.42	33.61	33.35	**-3.5%**	30.29	29.44
C244: Non-ferrous metals	30.49	22.76	27.98	30.91	33.34	33.91	**11.2%**	29.10	29.06

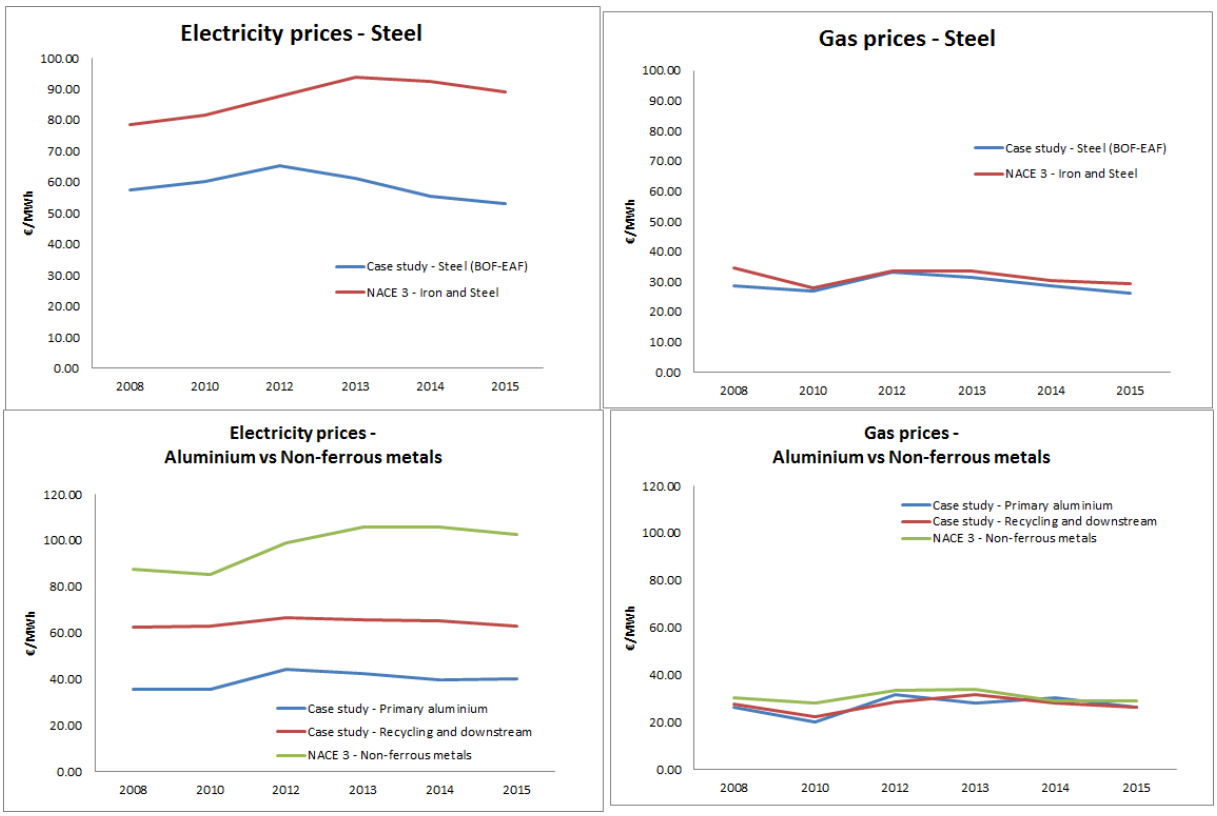
Source: Ecofys study

Comparison of estimated prices

The estimated prices in the Ecofys study correspond to highly aggregated sectors (NACE 3 level) which include subsectors with different processes or products having different energy consumption patterns, trade exposure, etc. As indicated in section 6.4 the price paid by firm depends on many factors (e.g. energy supplies strategies of the firm, consumption pattern, tax/price reductions) which can appear diluted or not fully captured in the statistical information on prices for larger aggregated group.

The comparison, with evidence collected bottom up, shows significant differences in average price levels for electricity which, beyond the methodological differences of the approaches considered, is in line with the fact that bottom up evidence better captures the impact of tax/price exemptions and reductions. For gas, the taxes and levies are less important which translates into much more aligned price levels. The analysis shows similar trends in price levels over time for both electricity and natural gas.

Figure 222 – **Electricity and gas prices for Steel and Aluminium by levels of aggregation**



Source: EC on the basis of CEPS and Ecofys studies

Prices of surveyed plants across Member States

Data collected bottom up in the CEPS study also allowed comparisons of calculated average prices at national level. Overall, considering all five sectors studied together, both ***electricity and natural gas prices have been declining in most of the Member States assessed after peaking in 2012-2013***.

For electricity in 6 out of 9 countries, the price level in 2015 is higher than in 2008. Conversely, for natural gas, prices were lower in 7 out of 11 countries. These results are overall in line with the trends observed in retail prices chapters of this report (1.2.2 & 2.2.2)

The overall trend is largely due to a generalized decrease in the energy supply component of prices, rising network costs and rising taxes and levies.

Focussing on electricity, still considering all five sectors assessed, only in the UK, the energy supply component has been increasing - although gradually -. This, associated with the increase in other components, implied an overall increase of the average electricity price observed.

As expected the highest differences in average electricity prices across Member States are observed with regard to the regulatory price components (i.e. network costs, taxes and levies like those related to RES support). In most cases the shares of such components in total price, in particular network costs and renewable support, have been increasing.

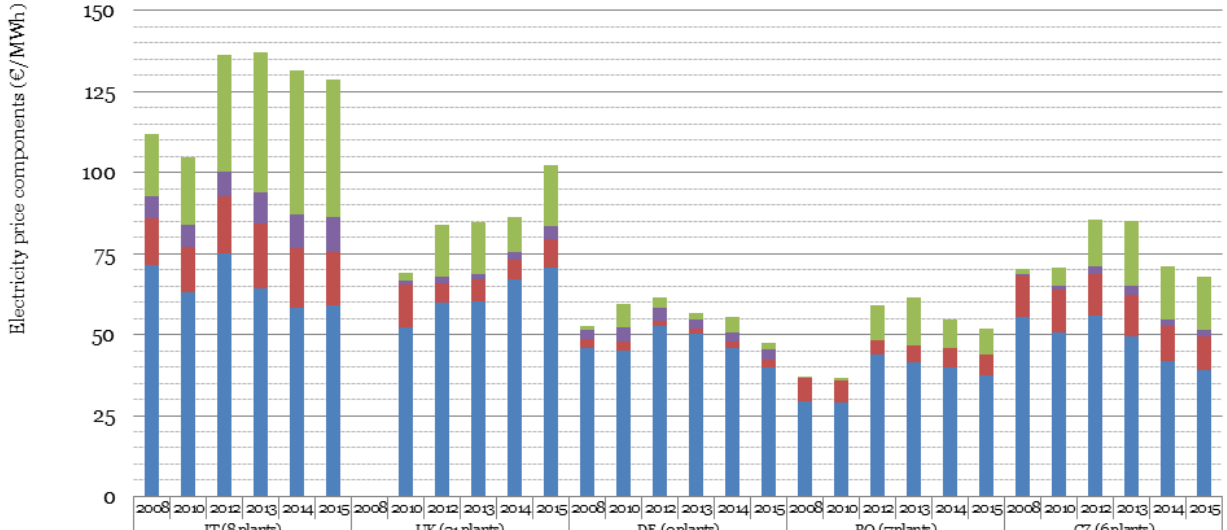
As indicated above, the data collected represent 'net' prices after possible reductions and exemptions are applied. This highlights the high variability of operating conditions and regulatory frameworks across countries.

Looking at some examples, RES support payment for surveyed Italian plants increased from 19.2 €/MWh in 2008 to 42.5 €/MWh in 2015 (down from 44.6 €/MWh in 2014, and after RES exemptions were introduced in the country). In the UK, RES support has increased from 2.6 €/MWh in 2010 to 19 €/MWh in 2015 while network costs have decreased from 13 €/MWh in 2010 to 8.9 €/MWh in 2015.

Electricity prices in Germany confirm the impact of exemptions and reductions for renewable support which - although fluctuating in the reference period – represent in 2015 less than 5% of the total price. This contrasts with the 41% that renewable support represents in the industrial price for large energy consumers[31] (not necessarily Energy Intensive Industries) in Germany and 19% in EU as a whole.

For other Member States such as Spain, Portugal and the Netherlands, RES support is not explicit in electricity bills and is included under other price components.

Figure 223 - **Structure of electricity prices in the surveyed plants in Italy, UK, Germany, Romania and Czech Republic in absolute terms (€/MWh)**

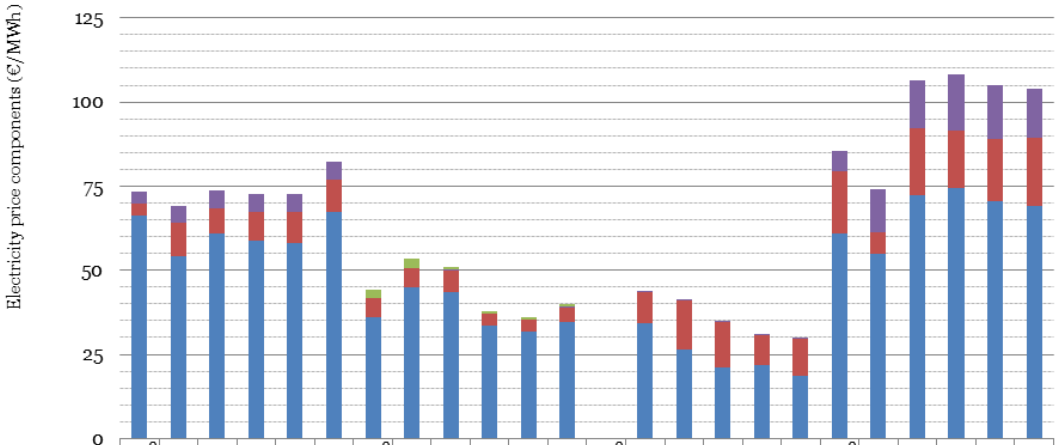


	IT (8 plants)						UK (21 plants)						DE (9 plants)						RO (7 plants)						CZ (6 plants)					
	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015
RES support payment	19,2	20,8	35,9	43,5	44,6	42,5	0,0	2,6	16,0	16,1	10,9	19,0	1,3	7,3	3,5	1,8	4,7	2,1	0,1	0,9	10,9	14,7	9,1	8,0	1,4	5,8	14,6	20,1	16,2	16,3
Other taxes and levies (exd. VAT)	6,7	6,7	7,8	9,5	10,4	10,7	0,0	1,2	1,9	1,4	2,2	3,8	3,0	4,5	3,8	2,8	2,8	3,1	0,0	0,0	0,0	0,0	0,0	0,0	0,4	1,0	2,3	2,6	2,0	2,1
Network costs	14,7	13,8	17,6	20,2	18,3	16,5	0,0	13,0	6,3	7,0	6,2	8,9	2,7	2,8	1,7	1,9	2,3	2,5	7,5	6,8	4,6	5,3	5,8	6,4	12,9	13,1	12,9	12,6	10,7	10,4
Energy supply costs	71,3	63,1	74,9	64,1	58,2	58,9	0,0	52,4	59,6	60,1	67,0	70,5	45,8	44,9	52,6	50,1	45,7	39,8	29,4	29,0	43,7	41,5	39,8	37,5	55,5	50,8	55,8	49,6	41,9	39,1

Source: CEPS et al.

[31] Eurostat consumption band IF

Figure 224 - **Structure of electricity prices in the surveyed plants in Spain, France, the Netherlands and Portugal in absolute terms (€/MWh)**

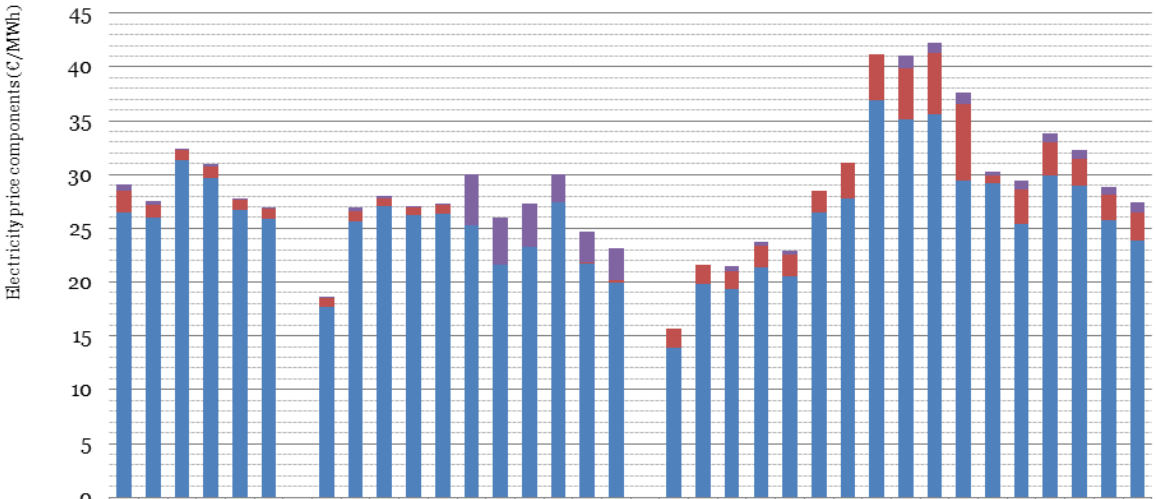


	ES (12 plants)						FR (12 plants)						NL (3 plants)						PT (3 plants)					
	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015
RES support payment	0,0	0,0	0,0	0,0	0,0	0,0	2,4	2,8	0,9	0,5	0,4	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Other taxes and levies (excl. VAT)	3,6	4,8	5,5	5,4	5,3	5,2	0,0	0,0	0,5	0,3	0,3	0,2	0,0	0,2	0,3	0,3	0,3	0,4	6,0	12,5	14,5	16,6	15,7	14,6
Network costs	3,5	10,0	7,5	8,3	9,4	9,5	5,6	5,8	6,3	3,4	3,3	4,5	0,0	9,2	14,7	13,6	8,9	11,2	18,4	6,4	19,7	17,1	18,7	20,1
Energy supply costs	66,2	54,2	60,8	58,9	57,9	67,3	36,1	45,0	43,5	33,6	31,9	34,5	0,0	34,2	26,4	21,1	21,7	18,5	61,0	55,0	72,4	74,4	70,4	69,2

Source: CEPS et al.

Compared to electricity, average prices across Member States show much less variation in the case of natural **gas**. This can likely be attributed to the lower impact of regulated price components. Across the countries assessed only Portugal shows higher prices since 2012

Figure 225 - **Structure of gas prices in the surveyed plants in Italy, UK, Germany, Romania, Portugal and Hungary in absolute terms (€/MWh)**

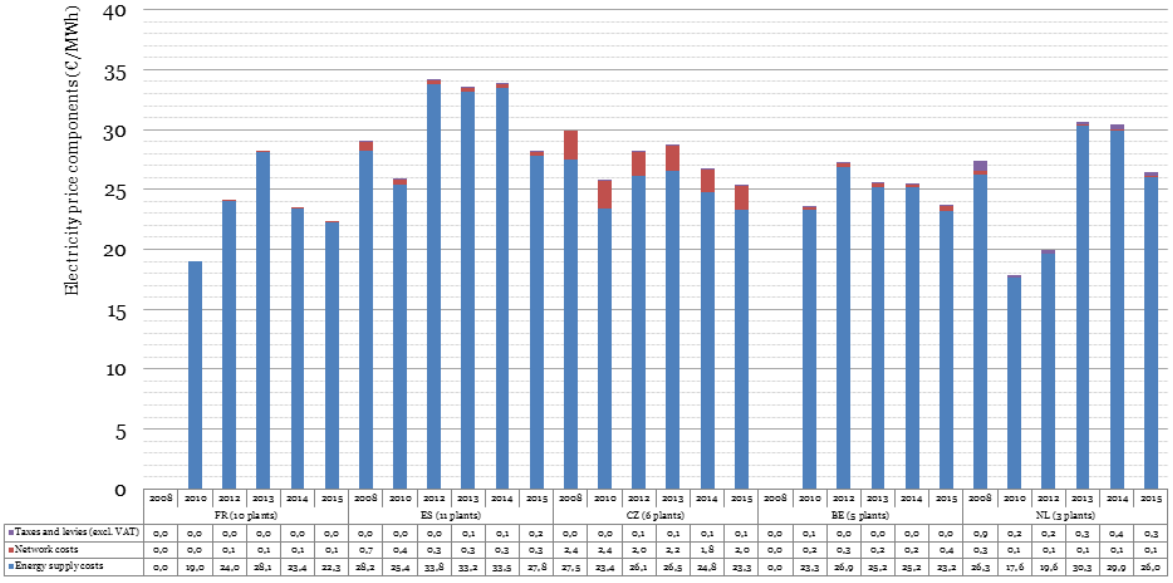


	IT (9 plants)						UK (21 plants)						DE (4 plants)						RO (6 plants)					
	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015
Taxes and levies (excl. VAT)	0,6	0,4	0,2	0,2	0,1	0,1	0,0	0,1	0,3	0,3	0,1	0,0	4,7	4,4	4,0	2,7	2,8	3,0	0,0	0,0	0,0	0,5	0,4	0,4
Network costs	2,0	1,3	0,9	1,2	0,9	1,0	0,0	0,7	0,9	0,7	0,7	0,8	0,0	0,0	0,1	0,0	0,2	0,2	0,0	1,7	1,7	1,6	1,9	1,9
Energy supply costs	26,5	26,0	31,4	29,6	26,7	25,8	0,0	17,7	25,7	27,0	26,3	26,3	25,3	21,6	23,2	27,4	21,7	19,9	0,0	13,9	19,8	19,4	21,4	20,6

	PT (3 plants)						HU (3 plants)					
	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015
Taxes and levies (excl. VAT)	0,0	0,0	0,0	1,2	1,0	1,1	0,3	0,7	0,9	0,8	0,8	0,9
Network costs	2,1	3,3	4,2	4,7	5,7	7,1	0,7	3,3	3,1	2,5	2,4	2,7
Energy supply costs	26,5	27,7	36,9	35,2	35,6	29,5	29,2	25,4	30,0	28,9	25,7	23,8

Source: CEPS et al.

Figure 226 - **Structure of gas prices in the surveyed plants in France, Spain, Czech Republic, Belgium and the Netherlands in absolute terms (€/MWh)**



	FR (10 plants)						ES (11 plants)						CZ (6 plants)						BE (5 plants)						NL (3 plants)					
	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015	2008	2010	2012	2013	2014	2015
Taxes and levies (excl. VAT)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,2	0,0	0,0	0,1	0,1	0,1	0,1	0,0	0,1	0,0	0,0	0,0	0,0	0,9	0,2	0,2	0,3	0,4	0,3
Network costs	0,0	0,0	0,1	0,1	0,1	0,1	0,7	0,4	0,3	0,3	0,3	0,3	2,4	2,4	2,0	2,2	1,8	2,0	0,0	0,2	0,3	0,2	0,2	0,4	0,3	0,1	0,1	0,1	0,1	0,1
Energy supply costs	0,0	19,0	24,0	28,1	23,4	22,3	28,2	25,4	33,8	33,2	33,5	27,8	27,5	23,4	26,1	26,5	24,8	23,3	0,0	23,3	26,9	25,2	25,2	23,2	26,3	17,6	19,6	30,3	29,9	26,0

Source: CEPS et al.

6.4.2 Overview of results of specific case studies

This report also looks at the main features on production cost structures and international competitiveness of various energy intensive sectors/subsectors combining the results from the case studies in the three studies mentioned in section 6.4. The three studies have different methodological approaches and sectoral scope. Some sectors are covered by the 3 studies and some only by one (see **Table 20**). When we look at each sector we highlight the *energy prices* paid, the *energy costs* and *production structures* and when possible we make *international comparisons*. Technical descriptions of production processes and technologies in each sector and detailed trade analyses are not reported here. The heterogeneity of sources and sector coverage is reflected by the different detail of the presented results.

The relative competitive position of European sectors ranges from the comfortable position of the highly productive European copper and zinc smelters to other sectors like the aluminium, steel and refinery going through difficult situations due to various reasons. The case studies show the energy costs plays a significant role in determining the costs of the industries looked at. However, they also show that other non-energy productions costs are very relevant and also play a very significant role in the competitiveness of these sectors. In some cases, transport costs are sufficiently high to 'protect' the European industry from their relatively higher (energy) costs. (e.g. paper, cement industries where transport costs per added value of the product are high). The reality of the sectors studied is rather diverse and big differences in costs and energy costs appear even between subsectors of the same sector (e.g. primary and recyclers/downstream producers in the Aluminium sector or in the steel sector between the Electrical Arc Furnace route (recycling) and the Blast Furnace-Basic Oxygen Furnace route). The analysis covers energy feedstock in some cases and is particularly useful to show the importance of energy costs for the refinery sector which could not be captured by the Ecofys study alone.

The details of the sector analysis are presented in **Annex 2**.