EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 1/11

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(2019) 1 final}

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Introduction

The European's Commission *Clean energy for all Europeans* package adopted in November 2016[1] included capital energy policy initiatives to roll out the Energy Union and set strengthened foundations to meet the EU's climate and energy targets and its international commitment under the Paris Agreement. The (previous) 2016 energy prices and costs report was part of that package and provided evidence assessing and underpinning the need for various European energy policy actions.

Two years after, most of the initiatives of that package have already been agreed between Parliament and Council and will start to be implemented soon. In November 2018, the European Commission has just presented the *Long-term EU strategy for the reduction of greenhouse gas emissions in accordance with the Paris Agreement*[2]. In a similar vein as in 2016, the 2018 edition of the energy prices and costs report comes at a timely moment and contributes to assess energy policies on the basis of the new evidence coming from the analysis of energy costs, prices and support interventions. The evidence of the report highlights the important role of international fossil fuel prices in driving energy prices in the EU making the case for pursuing our efforts to decarbonise our energy system. Data also shows the impact of dollar-denominated international energy prices on our energy bill, underpinning our efforts to reduce dependence on fossil fuels and highlighting the benefits of pricing the transactions of energy products in euros to reduce the uncertainty brought by exchange rate volatility[3].

The first part of the report (Part I – Energy Prices, comprising Chapters 1, 2 and 3) looks at the developments on wholesale and retail energy prices for electricity, gas and oil products between 2008 and 2017-18. On retail prices, the European Commission has again conducted an *ad hoc* data collection of the cost elements making up retail prices. The report presents the most detailed available breakdown of these elements affecting prices, in particular the various taxes and levies, and provides an insight on the evolution, composition and drivers of retail prices. International comparisons of the prices for petroleum, gas and electricity products are also presented in the chapters of Part I.

The impact of the energy costs on the economy, the industry and households is addressed in the second part of the report (Part II – Energy costs). Chapter 4 on the import bill assesses the developments in the EU energy bill and the reasons behind them. Chapter 5 looks at impact of energy prices and costs on energy poverty including an assessment of the energy expenditure shares by income level. Finally, Chapter 6 analyses the impact of energy costs on the (cost) -competitiveness of the European industry. The analysis includes an assessment of the costs for whole industry and services sectors and for 45 specific manufacturing and non-manufacturing sectors, including energy intensive industries. Their energy costs shares, energy intensities and energy prices are examined and, to the extent possible by the available data, compared with those in the third countries. The chapter presents a combination of results coming from studies using highly aggregated statistical data and sectorial data collected at plan level. Part II is complemented by Annex 1, which presents case studies for a number of sectors/subsectors of energy intensive industries, and by Annex 2, which includes sectorial decomposition analyses of energy costs.

[1] COM(2016) 860
[2] COM(2018) 773
[3] COM(2018) 796

Government interventions and revenues from energy products are addressed in Part III of the report. Chapter 7 presents the result of the analysis of the data collected on support interventions across member states (more than 1400 types of interventions) from 2008-2017. This constitutes the most updated and detailed inventory of energy subsidies of the EU Member States. The impact of these subsidies on the prices and costs for consumers and industry, particularly energy intensive sectors, is also estimated using a combination of analytical and econometric techniques (that distinguish the impact on prices at wholesale and retail level). Chapter 8 also assesses the nature and importance of energy tax revenues in government's budgets.

Part IV of the report (Chapter 9), looks forward, and assesses the relation between future expected prices and costs in the electricity market and how this can affect the incentives for investment in the different energy technologies in the 2030 horizon. It analyses the various underlying factors driving the price-cost relation together with expected developments on future demand which is significantly influenced by our policy decisions.

Finally, Part V looks at the impact of regulation on prices. Chapter 10 assesses in detail the impact of price regulation on the existence of competitive prices, quality of service and the propensity to invest between 2008 and 2016. It looks at how price regulation/de-regulation affects Member States by analysing indicators on various groups of Member States, those which with have been fully liberalised prices (prior or during the period of study) versus those which are in transition to price deregulation (less than 50% of the market is with price regulation) and those which still have significant part of their market (more than 50%) with price regulation. Finally, on the basis of data collected from Member States, section 10.2 of the chapter includes estimates of the benefits from switching from regulated prices to fully liberalised dynamic price contracts.

Country-factsheets with energy prices and costs key indicators are included in Annex 3.

PART I

ENERGY PRICES

1 Electricity prices

1.1 Wholesale electricity prices

- Over the last ten years wholesale electricity prices showed a significant volatility in Europe, reaching their peak in 2008 and their lows in early 2016. Since spring 2016, when the European Power Benchmark (EPB) index, in parallel with many wholesale electricity market prices, fell to ten year lows and reached 30 €/MWh, there was a general price recovery and by August 2018 the EPB went up to 60€/MWh.
- Price convergence across the European regional wholesale markets varies over time. Wholesale electricity prices tended to diverge more in general price spike periods (e.g.: in 2008 or in early 2017), or when low prices could be observed in some local markets (e.g.: periods of abundant hydro power generation in the Nordics).
- Different regional markets in Europe face different prices, owing to differences in local generation mixes and interconnection capacities.
- EU and national level policies resulted in increasing wind and solar generation in many European countries. Integration of renewable generations sources to the grid and investments in infrastructure capacities are indispensable to accomplish a properly working internal electricity market in the EU. Market couplings now cover the majority of EU wholesale markets, enabling more efficient cross-border trade and better convergence of prices between neighbouring markets.
- Several factors impacting wholesale electricity prices can be identified both on the demand side and on the supply side of the electricity market. Since 2008 GDP in the EU-28 was up by 10%, while at the same time electricity consumption decreased by 6%, pointing to less electricity intensity of the EU economy. On the supply side there were fundamental changes in the EU electricity generation mix since 2008: the share of fossil fuels decreased while the share of renewable energies practically doubled, reaching an estimated 38% in April 2018.
- The price of coal and natural gas has an important role in shaping electricity generation costs, as coal-fired and gas-fired generation ensures the marginal generation costs on the electricity market. Coal and gas prices peaked in 2008; then fell sharply in 2009. After a recovery, between 2012 and 2016 they decreased again, whereas in the last two year they rebounded. After being at low levels for several years, emission allowance prices tripled between mid-2017 and mid-2018, starting to impact again wholesale electricity prices. Wholesale electricity prices showed a strong co-movement with fossil fuel prices.
- In international comparison, which is useful for analysing the competitiveness of electricity intensive industries, wholesale electricity prices in the EU were higher than in the US, Canada, Australia and Russia during most of the time in the last ten years, however, they were lower than prices in China, Japan, Mexico, Turkey, Brazil and Indonesia. Electricity price differentials between the EU and its trading partners do not give in all cases a comprehensive explanation for competitiveness of products manufactured by energy intensive industries, other factors of competitiveness need to be taken into consideration.

1.1.1 Evolution of wholesale electricity prices

Over the last decade, wholesale electricity prices in the European markets showed significant volatility. In 2008, as all energy commodity prices reached their top, wholesale electricity prices also peaked. Subsequently during 2009, in parallel with the economic crisis the wholesale electricity prices fell back. Between 2010 and 2012 a solid price recovery took place, however, in the following four years a downward trend could be witnessed, and in early 2016 wholesale electricity prices fell to a decade low in many European markets. Compared to these lows, wholesale electricity prices increased until mid-2018 again.

The next chart **(Figure 1)** shows the evolution of the European Power Benchmark (EPB) and the range of minimum and maximum wholesale electricity prices in each month between 2008 and 2018. EPB is an index computed as the weighted average of the day-ahead prices of the most liquid wholesale electricity markets, serving as a general European benchmark,. In different periods convergence across European markets reached a different degree; in the periods of general price spikes (e.g.: in 2008 or in early 2017) prices became more divergent, however, very low prices in some national markets (e.g.: Nordic markets during summertime, a high level of hydro power generation, or markets with high share of variable renewable penetration) can also lead to significant price differentials across Europe.

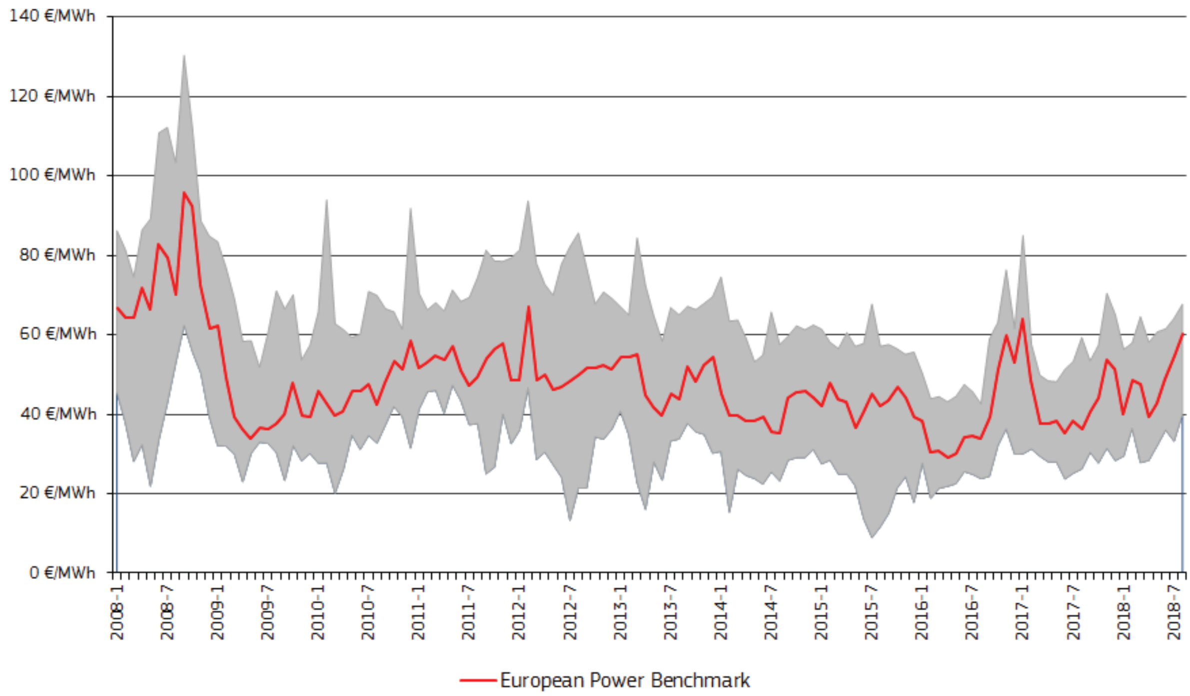


Figure 1 - Evolution of monthly average wholesale day-ahead baseload electricity prices in Europe, showing the European Power Benchmark and the range of minimum and maximum prices across the markets

Source: Platts, European power markets

Zooming on the market developments of the last two years (since the publication of the 2016 edition of the *Energy Prices and Costs in the EU* report), , we can see that in the second half of 2016 wholesale electricity prices started to increase, owing to higher electricity generation costs in parallel with increasing coal and gas prices (see **Figure 2)**. This increase was reinforced at the beginning of 2017 as an ongoing cold weather, coupled with lower than usual nuclear electricity generation in some Western European countries (mainly France and Belgium), resulted in high wholesale electricity prices. At the end of 2017 safety inspections also reduced the availability of nuclear fleet in the same markets. All-in-all, since spring 2016, when the EPB index was around 30 €/MWh, a measurable wholesale price increase could be observed by August 2018, as the benchmark was above 60 €/MWh in that month.

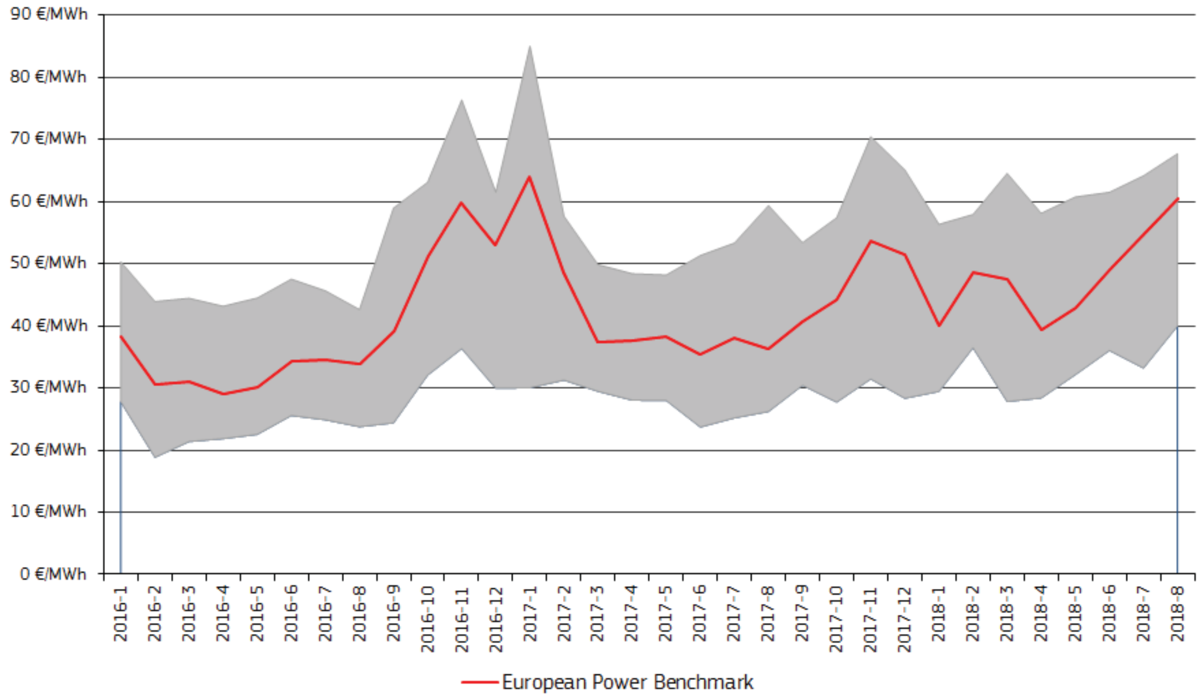


Figure 2 - Evolution of wholesale electricity prices in Europe since 2016

Source: Platts, European power markets

As it was already mentioned, there might be significant differentials in wholesale electricity prices across Europe in some periods, thus it is worth taking a look at the price evolution of the regional markets.

Figure 3 shows the regional wholesale electricity prices in the North Western Europe (NWE) market coupling area, including Central Western Europe (Germany, France, Austria and the Benelux), the UK, the Nordic markets (Norway, Sweden, Denmark, Finland and the Baltic States) and Iberian market (Spain and Portugal). Nordic markets had normally the lowest wholesale price across Europe over the last two years, owing to the important role of hydro power generation and increasing of wind and solar. In Central Western Europe (CWE), where prices were also lower than the EPB during most of this time period, increasing renewable penetration and the important role of nuclear power resulted in competitive electricity generation costs.

In the Iberian region prices significantly impacted by hydro reserves and generation; from mid-2016 to the beginning of 2018 a dry period resulted in lower than usual hydro power generation that increased the wholesale price level above the EPB. During most of the time in 2016-2018 the highest wholesale prices could be observed in the UK; owing to significant electricity import needs of the country and the climate change levy that directly impacts the UK wholesale electricity price.

Although the NWE region is the largest flow based market coupled area in Europe, significant differences in wholesale prices exists across its different regions. This suggests further integration of all electricity generation sources (especially variable renewables like wind and solar) and further investment in infrastructure (e.g.: interconnection capacities) could help to diminishes cross-market price differentials.

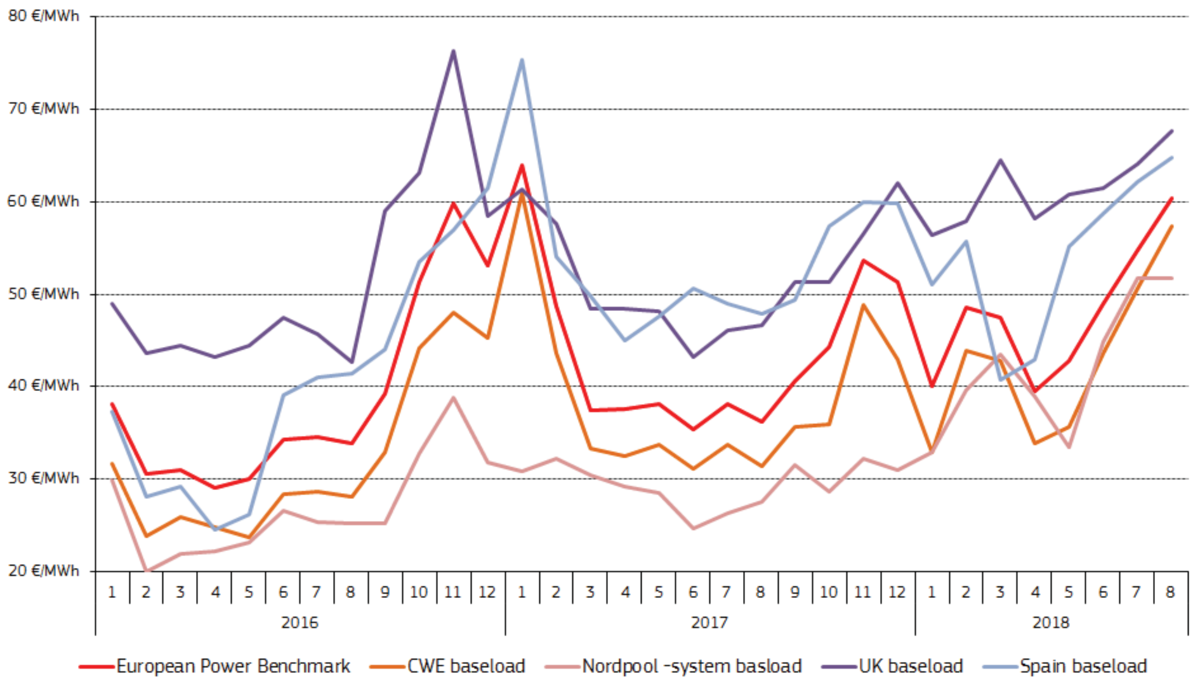


Figure 3 - Regional market prices in the North-Western Europe coupled area

Source: Platts, European power markets

In the Central and Eastern Europe region (CEE – Poland, Czech Republic, Slovakia, Hungary, Romania, Croatia and Slovenia) prices behaved similarly to the European benchmark between 2016 to (August) 2018 (see **Figure 4**). Besides abundant fossil fuel (mainly coal and lignite) and nuclear power generation in the region as a whole, market prices in the Central Eastern Europe are impacted by electricity imports from Central and Western Europe and the Balkans, where hydro generation is important. At the end of 2016 and 2017, when nuclear availability in the CWE region was low due to the aforementioned reasons, prices in the CEE region were lower than in Western Europe.

In the CEE region four national markets (Czech Republic, Slovakia, Hungary and Romania) are coupled and wholesale electricity prices are well aligned in the majority of trading hours. Poland is price coupled with Sweden (and thus with the NWE region). Croatia and Slovenia are not coupled with the rest of the CEE region.

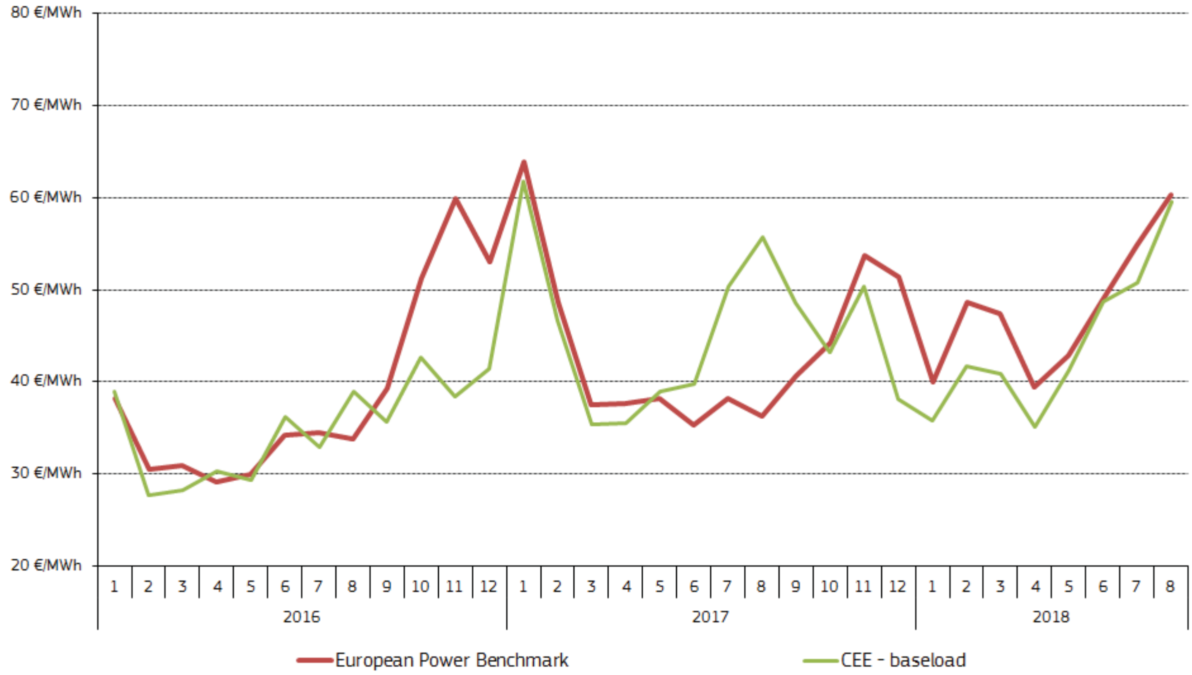


Figure 4 - The Central Eastern Europe average wholesale price and the EPB benchmark

Source: Platts, European power markets

In Italy and Greece wholesale electricity prices between 2016 and 2018 so far were usually higher than the EPB benchmark (**Figure 5**). Italy has traditionally been a net electricity importer, as the cost of import (mainly from the CWE region) is competitive to the domestic, primarily gas-fired power generation. During the summer period renewable generation picks up in Italy and imports are lower. Greece is also traditionally net electricity importer, the country's domestic production is largely based on domestic lignite and gas fired generation. Imports from the Balkans are competitive against domestic generation.

Bulgarian wholesale prices were however lower than European prices between 2016 and 2018 so far, owing to favourable costs of domestic electricity generation (largely based on solid fuels and nuclear). Bulgaria is normally a net electricity exporter, but in some periods (e.g.: the cold snap in January 2017) exports were banned[4]

[4] https://ec.europa.eu/energy/sites/ener/files/documents/platts_report_final_version_rrr.pdf

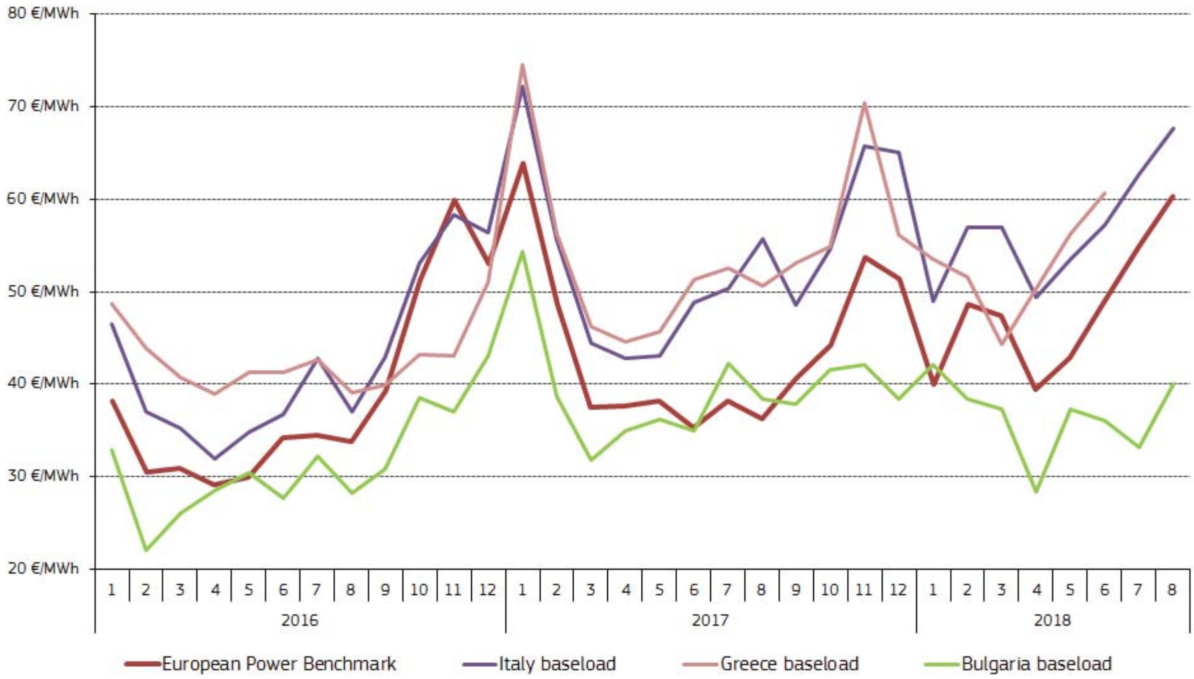


Figure 5 - Regional market prices in Italy and South Eastern Europe

Source: Platts, European power markets

1.1.2 Factors impacting the evolution of wholesale prices

Wholesale electricity prices are determined by market forces. In this section we look at demand side and supply side factors that explain their evolution.

On the demand side of the electricity market, residential electricity consumption is determined by needs for various purposes, for example lighting, heating and using household appliances. For businesses, the consumption of electricity is mainly determined by the level of economic activity, which can be measured by the evolution of the Gross Domestic Product (GDP).

The next chart (**Figure 6**) shows that electricity consumption in the EU has strong seasonality (see blue dashed line in **Figure 6**). During wintertime the industrial activity and the lighting and heating needs of households are higher than in summertime, all this resulting in higher electricity consumption during the winter period.

In order to assess the relation between electricity consumption and economic activity we need to compare their trends. The seasonality of electricity consumption can be mostly eliminated by applying a four-quarter moving average (red line), which can then be compared to the evolution of the overall economic activity. In the second quarter of 2018 GDP in the EU was up by more than 10% compared to 2008; (after the crisis in 2008-2009 the recovery took several years) at the same time electricity consumption was down by 6%. This decoupling of the GDP trend from the electricity consumption shows a decreasing electricity intensity of economic activity over the last ten years.

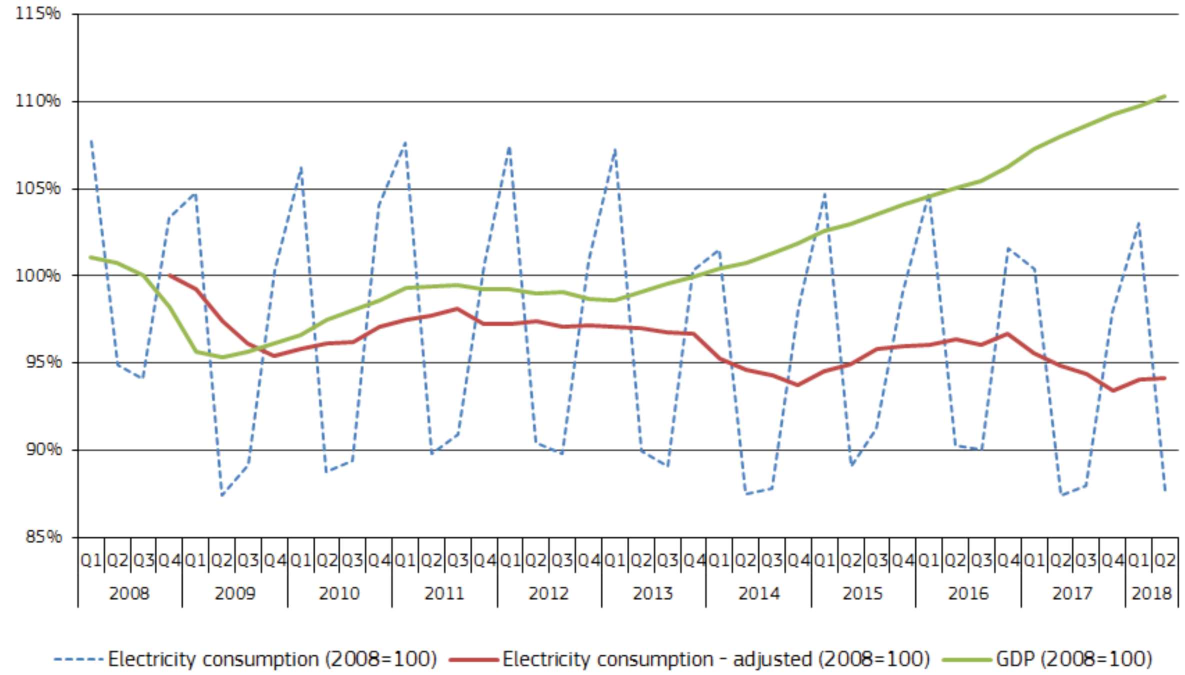


Figure 6 - Electricity consumption and economic growth

Source: Eurostat

On the supply side of the wholesale electricity market, it is the electricity generation mix, the marginal costs of the generation technologies and the electricity imports, as competing alternative that determine the overall generation costs and electricity prices. The next chart (**Figure 7**) shows the changes in the shares of the generation technologies in the EU electricity mix between 2008 and the first quarter of 2018. The share of fossil fuel generation (lignite, coal, gas and oil) decreased significantly (from 54% in 2008 to 37% in 2017 and to 34% in January-August 2018). At the same time the share of renewables (including wind, solar, hydro and biomass) increased from 17% to 33%. The share of nuclear remained practically constant, showing minor changes from one year to another.

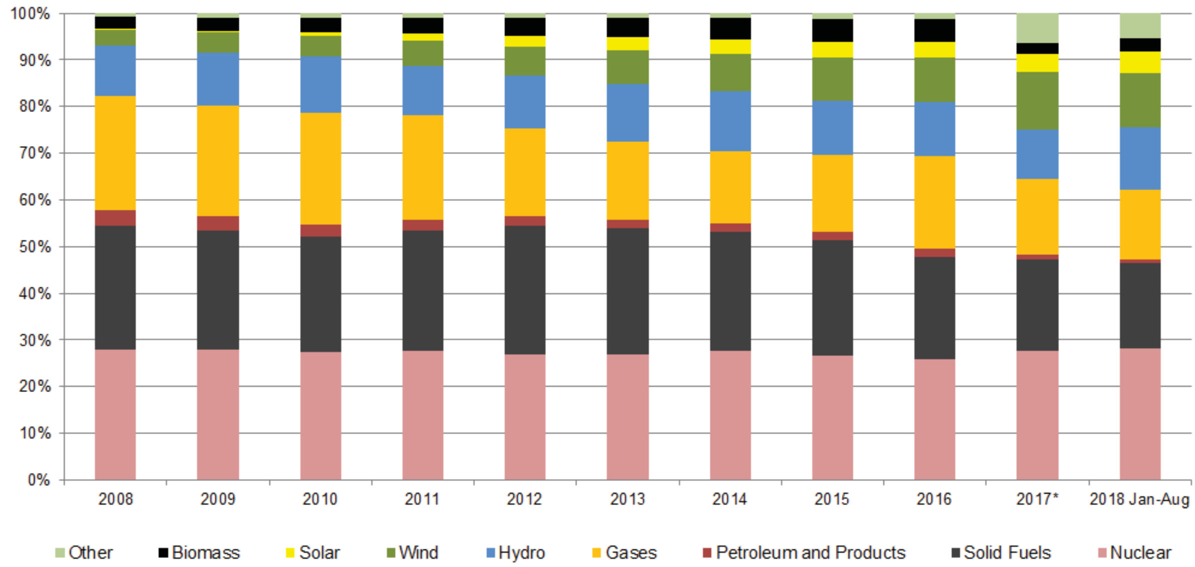


Figure 7 - Electricity generation mix in the EU-28 (actual power generation)

Source: Eurostat and ENTSO-E. *2017 and 2018 Jan-Aug data are not fully comparable with earlier periods, as a part of biomass generation seems to be reported under 'Other'

Within renewables, the share of hydro power remained constant over time (although the hydro share can vary on the short term depending on weather conditions, namely the amount of precipitation).

The increase in the share of renewables within the EU electricity generation mix was largely owing to wind power, whose share went up from 3.5% to 12% between 2008 and 2017 (in some periods, for example in December 2017 the share of wind was almost 17%).

The amount of generated electricity from the main sources and their share in the total generation can also be seen in **Figure 8**, Nuclear energy had an important but slightly decreasing share over the last two-three years in the EU. Its variability is small and mainly due to maintenance cycles. Both wind and solar power had an intra-annual seasonality in the EU over the last few years: while the share of solar increased during summertime, the share of wind generation was the highest in the stormy wintry period. In April 2018 the combined share of wind and solar was 19% in the EU electricity generation mix. Biomass had a relatively stable share over time. Hydro availability strongly depended on weather and the amount of precipitation. Both coal and gas had higher share in winter periods, however, coal, as baseload technology had a smaller seasonality than natural gas.

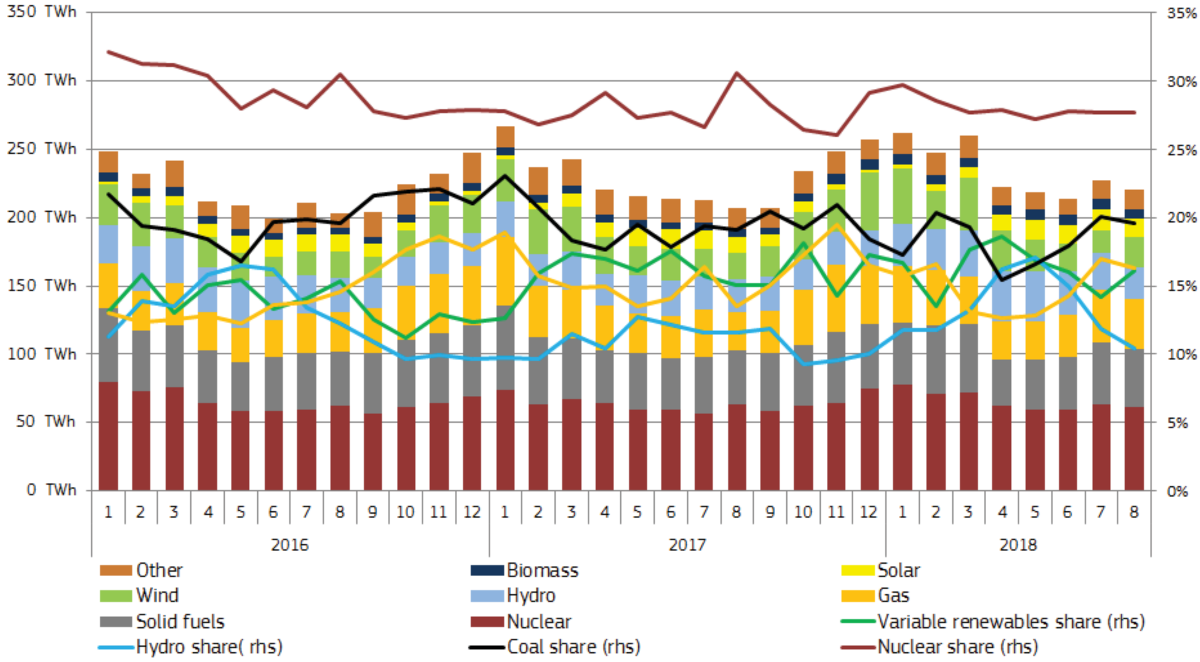


Figure 8 - Monthly electricity generation in the EU and the share of some generation sources in the EU electricity mix

Source: ENTSO-E

Besides the generation mix the marginal cost of each generation technology impacts the supply of electricity on the wholesale market. Generation technologies like wind, solar, hydro have very low or negligible marginal generation costs. Nuclear and biomass also have low marginal costs, whereas coal, gas and oil fired generation have higher marginal generation costs, so these latter normally set the marginal cost on the market; they are on the higher end of the electricity supply curve (the so-called merit order curve). Variable renewables (wind, solar) and other low marginal cost technologies can impact the total electricity supply by shifting the merit order curve towards the right (more generation at the same cost level) and thus result in lower equilibrium price assuming the same electricity demand curve.

Figure 9 shows the monthly coal, gas and emission allowance (carbon) prices, compared to the average of 2008, and the share of renewable sources in the EU electricity generation mix. Both coal and gas prices, after reaching a peak in 2008, fell back amid of the economic crisis in 2009, and recovered in 2010-2011. After 2012 both coal and gas prices started to decrease and in the first half of 2016 they reached the lowest since the crisis year of 2009. In 2016-2018 they rebounded from these low levels. If looking at the evolution of wholesale electricity prices (see **Figure 1**) there is a high degree of correlation between fossil fuel prices and the wholesale electricity market. However, increasing share of renewables (between 2008 and 2018 the share of renewables practically doubled in the EU generation mix) had a downward impact on the wholesale market. A recent study estimates conducted by the EC (*Trinomics et altri, 2018*) that one percentage point increase in the share of renewables in Germany results in a decrease of the wholesale electricity price by 0.5 €/MWh.

Carbon prices showed a sharp decrease between 2008 and spring 2013, as they went down by 80% (in June 2008 the average carbon price peaked at 28 €/MtCO_2e, while in April 2013 it was below 4 €/MtCO_2e). Since then until mid-2017 they showed only minor variations, not being able to significantly impact competition between coal, gas and renewables, and not being effective in driving investments towards the decarbonisation of the European electricity sector. However, as market players anticipated that regulatory changes in the so-called Market Stability Reserve of the EU Emission Trading System might reduce the oversupply of allowances in the carbon market – a measure to enter into force as of January 2019 – the price of emission allowances doubled between mid-2017 and mid-2018, reaching 21 €/MtCO_2e[5] by the end of August 2018, which was the highest since October 2008.

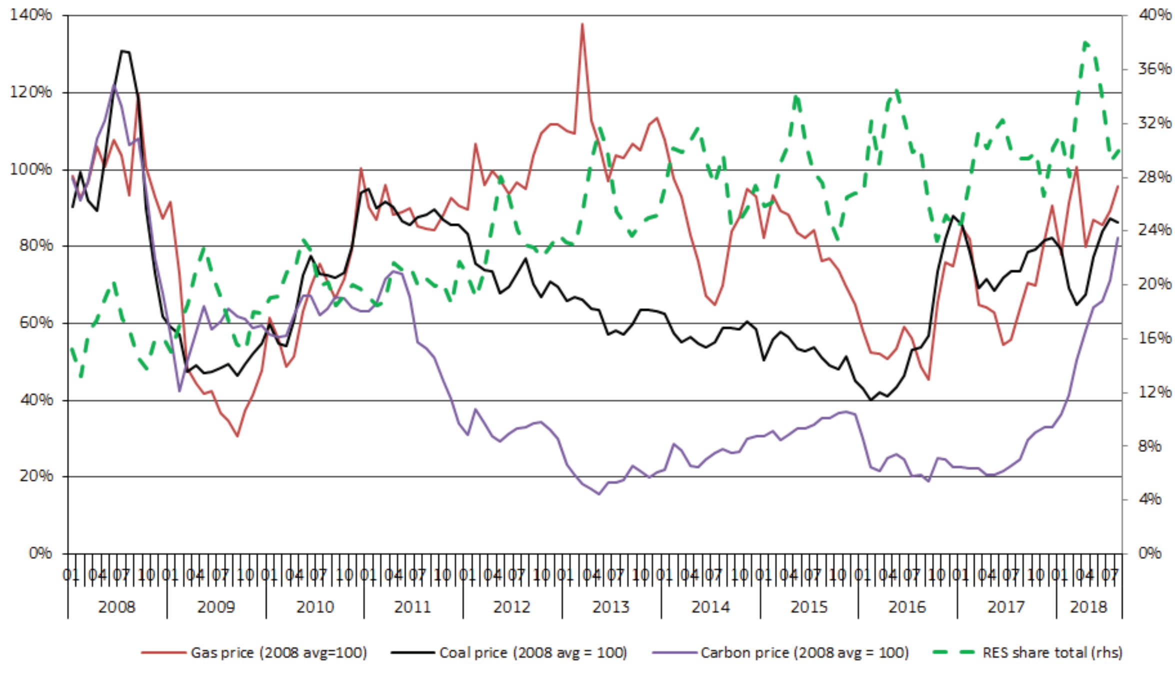


Figure 9 - Monthly coal, natural gas and carbon price indexes, compared to the 2008 average price and the share of renewable energy (right hand scale)

Source: ENTSO-E

[5] At the end of November 2018 the was around 19 €/MtCO2e

National and EU level policies played a role on incentivising the increase of the share of variable renewable technologies. EU Member States have to fulfil their 2020 renewable objectives, for which different instruments, such as feed-in-tariffs, feed-in-premiums, renewable quota obligations, etc. have been implemented. Increasing renewable capacities and less reliance on fossil fuels, in parallel with moderate growth in demand for power, have led to overall overcapacities in many European electricity markets, resulting in a downward pressure on wholesale electricity prices.

Furthermore, as the integration of the European wholesale electricity markets moves forward, the importance of cross-border electricity trade increases and market-based instruments, such as the aforementioned coupling of neighbouring markets have been implemented, contributing to more efficient cross-border electricity trade, and generally better convergence of wholesale electricity prices. EU policies aim at achieving a better market integration through improving market liquidity, cross border trade and better integration of variable renewable generation sources to the power grid.

At EU level electricity imports do not have significant influence on wholesale market prices as extra-EU electricity imports are negligible compared to the bloc's total consumption. However, looking at individual power regions (see **Figure 10)** the situation is different, as some regions (e.g.: the Baltic states and Italy) might have significant import needs on the top of their domestic production to satisfy all consumption needs. Other regions, such as Central and Western Europe, the Nordic region or South Eastern Europe recently, produce more electricity than their domestic needs, therefore they are net exporter. As electricity normally flows from low priced areas to higher priced ones, net exporter regions have lower wholesale prices as net importers.

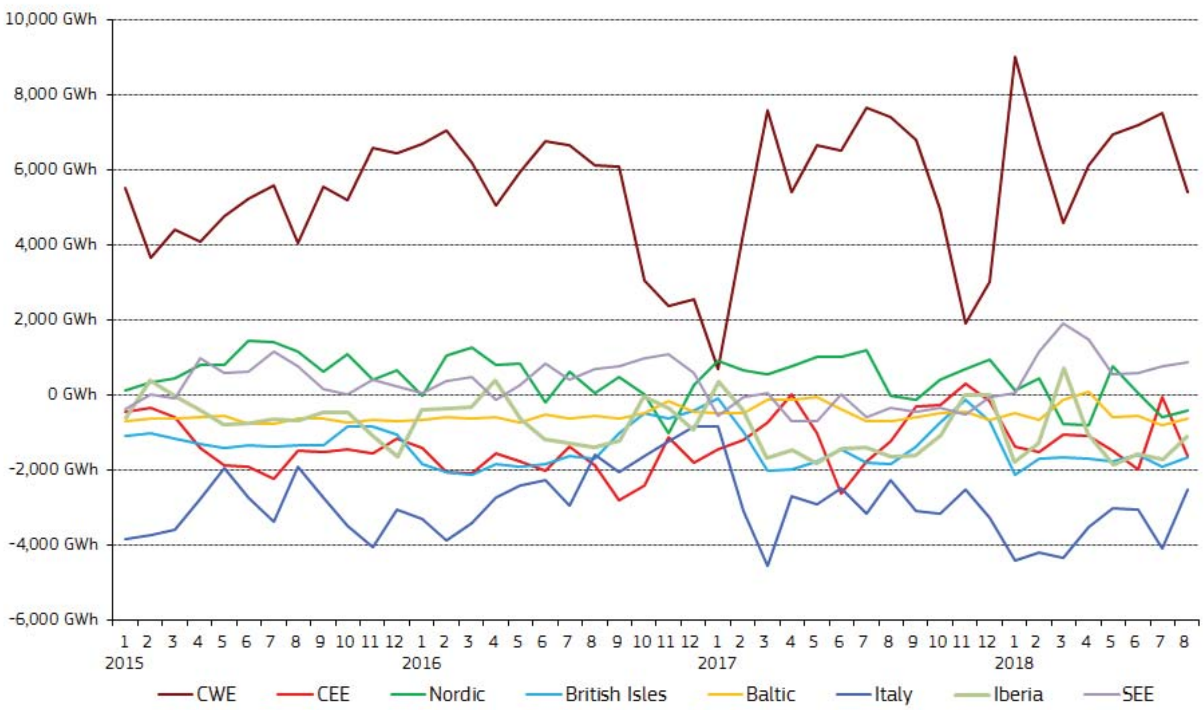


Figure 10 - Net electricity flow position compared to domestic electricity generation in the European power regions

Source: ENTSO-E

1.1.3 International comparisons

Comparing the European electricity benchmark wholesale price index (EBP) with the wholesale prices in the most important trading partners of the EU can provide a useful analysis on how energy costs differentials can impact the competitiveness of European energy intensive industries with a high trade exposure. Electricity costs are only one factor of international competitiveness and other aspects (such as business environment, labour costs, etc.) are also important. A more detailed analysis of the impact of prices on competitiveness can be found in chapter 6.

Figure 11 shows that, since 2008, wholesale electricity prices in the US have been for most of the time lower than in the EU, with the EU-US price ratio reaching the magnitude of 2 sometimes. In contrast, prices in Japan showed a huge increase after the Fukushima nuclear incident in March 2011, and as nuclear capacities were put offline, and the increasing reliance on gas fired generation resulted in Japanese prices being 3-4 times as the EU average between 2012 and 2014. Since 2016, as nuclear capacities were gradually put back in operation, the wholesale price gap between Japan and the EU decreased.

In China the wholesale electricity prices have been constantly higher by several magnitudes (2-3) than in the EU, implying that competitiveness problems of some energy intensive industries (e.g.: steel sector) vis-à-vis China do not actually stem from electricity prices.

Figure 12 shows some further examples on wholesale prices of important EU trade partners. In Canada wholesale prices were one of the lowest over the last ten years among countries presented below. In Australia, based on competitive domestic coal fired generation, wholesale prices were also lower than in the EU (however in the summer period in 2017 there were some price spikes). In Russia wholesale electricity prices were also lower than in the EU.

On the other hand, prices in Mexico and Turkey, albeit following a decreasing trend, were higher than the European benchmark. Prices in Indonesia were comparable with the EPB between 2009 and 2013, however, the price gap with Europe has widened since and at the end of 2017 local wholesale electricity prices were twice as high as in Europe. Among all analysed countries wholesale electricity prices were the highest in Brazil.

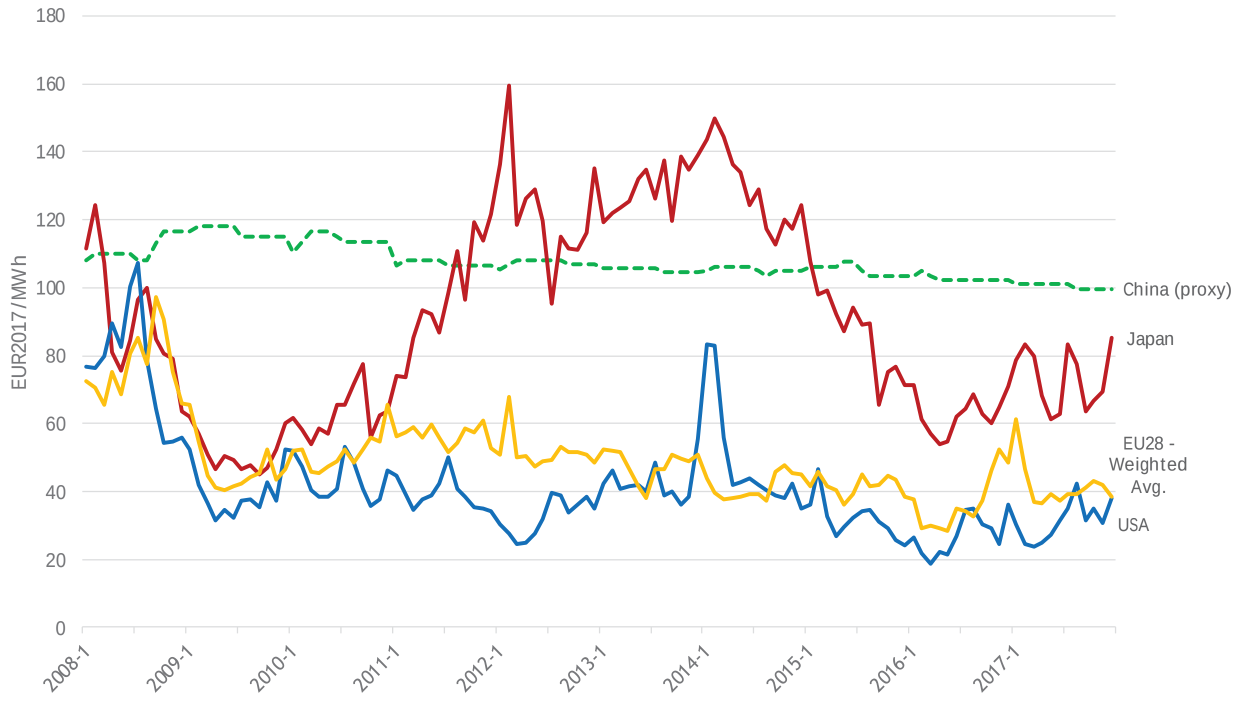


Figure 11 - Comparison of wholesale electricity prices in the EU with global trade partners

Source: Trinomics et atri study (2018)

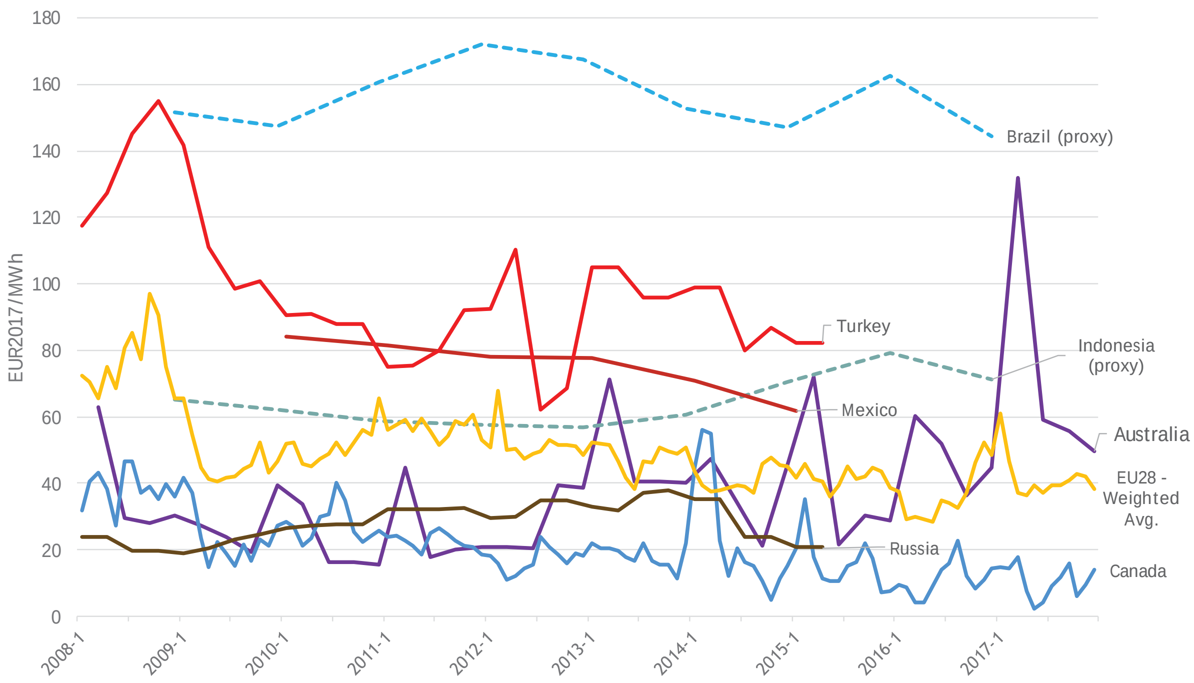


Figure 12 - Comparison of wholesale electricity prices in the EU with global trade partners

Source: Trinomics et altri study (2018)

1.2 Retail Electricity Prices

Main findings

The last two years brought major departures from decade long trends in the evolution, composition and drivers of electricity prices:

- The EU household price decreased for the first time. This means that from 2016 to 2017 prices fell for all consumer analysed types.
- The decade long trend of taxes and network charges driving household prices up also came to an end. Taxes kept increasing for all industrial consumer types, albeit these increases were smaller than the decreases in energy components, leading to falling prices.
- Progress towards the completion of the single energy market continued. This is reflected by the fact that national energy components are gradually converging: they became 15% less spread out since 2008. For industrial consumers even total prices converged by 8%, as such prices are less impacted by varying national taxation.[6]
- The energy component, which consists mostly of wholesale prices, remained on a steadily decreasing trajectory due to EU policies, such as market coupling and increased interconnection capacities. The energy component diminished both in absolute and relative terms. In other words the only part of the price which is set by market forces is contracting while the share of the regulated part is growing, reaching 40% EU- wide.
- Wholesale prices have been increasing since the spring of 2016. This development has not yet factored in to the energy component of retail prices. Similarly, decreasing wholesale prices in the period 2012 to 2016 were not fully passed on to retail prices.
- Electricity prices remained heavily impacted by policy support costs and fiscal instruments, albeit to a varying degree across Member States.
- The cost of supporting renewable energy also started to fall for households after a decade of steep increases. This is remarkable as the share of renewables in the EU's generation mix kept growing. RES support costs decreased in the last reporting year by 1% for households, but increased by 7% for medium industrial and by 17% for large industrial consumers. RES levies ranged from 1 to 73 EUR/MWh across reporting countries.
- Excise duty rates range from 5 to 122 EUR/MWh, while VAT rates spread from 6% to 27% displaying a highly differentiated picture of energy taxation across the EU.
- The EU household electricity price grew annually by 2.1% since 2008 and reached 195[7] EUR/MWh in 2017. The EU medium industrial electricity price grew at the annual rate of 1% and averaged at 103 EUR/MWh in 2017. The EU price for large industrial consumers even experienced a decrease of 0.3% annually and reached 80 EUR/MWh by 2017, down from 83 EUR/MWh in 2008.

[6] Simple averages of the analysed bands.
[7] Weighted average "Most representative" price.

Methodological framework

Table 1 - Key figures on the evolution and drivers of retail electricity prices

Consumer type	Household (DC)			Industrial (ID)			Large Industrial (IF)		
Component	Annual growth	Share 2017	Δ Share	Annual growth	Share 2017	Δ Share	Annual growth	Share 2017	Δ Share
Energy	-1.5%	33%	- 12 p.p.	- 4.7 %	40%	- 28 p.p.	- 4.8%	49%	-25 p.p.
Network	+2.5%	27%	+ 1 p.p.	+ 3.5%	22%	+ 5 p.p.	+ 2.7%	17%	+ 4 p.p.
Taxes	+ 6.1%	40%	+ 11 p.p.	+12.3%	38%	+ 23 p.p.	+ 11%	34%	+21 p.p.
Total	2.10%			+ 1%			- 0.3%		

Source: DG ENER in-house data collection

Aim and scope of the chapter

The following chapter analyses retail electricity prices. It takes an in- depth look at the evolution, composition and drivers of prices paid by final consumers on EU as well as on national level in 30 European countries from 2008 to 2017.

The analysis serves as an objective, evidence based tool to determine how the composition of retail prices changed over time, how did various policies and fiscal instruments impact prices and which elements contribute the most to increasing or decreasing prices. The data collection designed and conducted specifically for the purpose of this report, introduces a high level of harmonization and transparency. This allows for the comparison of price developments over time and across countries.

A Decade of Data

The chapter is based on an in-house data collection by the Directorate General for Energy of the European Commission (DG Energy). Data for this in-house survey was provided by the competent authority of each reporting country, in most cases the statistical office, ministry or regulator representing the country in the European Statistical System. Data was provided by 26 EU Member States and 3 non-member countries, Montenegro, Norway and Turkey.

Greece and the United Kingdom provided no data. Figures for these countries are substituted by Commission estimates.

Structure along Eurostat legislation

The chapter is structured along different consumer types of the two energy products. Consumer types are defined by Eurostat methodology under Regulation (EU) 2016/1952 of the European Parliament and of the Council of 26 October 2016 on European statistics on natural gas and electricity prices. It differentiates household and industrial consumers[8], whereas both consumer types are further broken down into consumption bands. Consumption bands cover different volume ranges of annual consumption. Different bands are applied to electricity and natural gas.

The chapter commences by examining the most representative household electricity price on EU level and in each reporting country. Next, the chapter looks at electricity prices paid by

[8] 'Industrial' consumers are currently referred to in Eurostat statistics as 'Non-households' consumers

industrial consumers. It differentiates between 3 levels of industrial consumption in order to provide the best possible picture of a diverse group of consumers, ranging from small businesses to manufacturing industries consuming large amounts of energy. The chapter first examines prices paid by industrial consumers with a median volume of consumption. This consumer band is often used to describe economy- wide industrial price developments. The analysis is completed by a comparison of prices paid by consumers of small versus large volumes of electricity.

General observations that hold for all bands are presented only under the section of household prices and are not repeated in each section.

Harmonized methodology for comparable results

Total prices provide no information on the drivers of price developments. To facilitate a more focussed identification of price increase drivers, total prices are further decomposed into three main components. The components Energy, Network and Taxes disaggregate the total price along the value chain. DG Energy further disaggregates taxes into 10 sub-components. These were designed to showcase national characteristics based on harmonized sub-components to the fullest extent possible, while minimizing the number of elements designated as "other". The same components and sub-components are applied to both electricity and natural gas.

DG Energy provided extensive guidance to the reporting national authorities to ensure that elements are assigned to components and sub-components in a harmonized manner across all countries.

All EU figures are weighted averages of EU Member States only. It is to be noted that the number of countries included in each EU average changes according to energy product and consumption band. For example, there are no consumers in the largest electricity bands.

Data cooperation

DG Energy would like to thank for the cooperation of national authorities from 29 countries who provided essential data for the retail prices sections of the report:

Country	Organization	Expert
Austria	E- Control	Esther Steiner
Belgium	Belgian Ministry of Economic Affairs	Marc Vos
Bulgaria	National Statistical Institute of Bulgaria	Iveta Minkova Ivanka Tzvetkova
Cyprus	Electricity Authority of Cyprus	Marios Skordellis
Czech Rep.	Czech Statistical Office	
Germany	BDEW Bundesverband der Energie- und Wasserwirtschaft e.V.	Christian Bantle
Denmark	Danish Energy Agency	Ali A. Zarnaghi
Estonia	Statistics Estonia	
Spain	Ministerio para la Transición Ecológica	
Finland	Statistics Finland	Marianne Rautelin
France	Ministère de la Transition écologique et solidaire	Pascal Levy
Croatia	Croatian Bureau of Statistics	Mirjana Petanjek Željka O. Kelebuh
Hungary	Hungarian Energy and Public Utility Regulatory Authority	
Ireland	Sustainable Energy Authority of Ireland	Mary Holland Martin Howley
Italy	Italian Regulatory Authority for Energy, Networks and Environment	Gabriella Antonel
Lithuania	Statistics Lithuania	Virginija Jasionienė
Luxembourg	Institut national de la statistique et des études économiques du Grand-Duché de Luxembourg	Olivier Thunus
Latvia	Central Statistical Bureau of Latvia	Anna Paturska
Malta	National Statistics Office of Malta	Ronald Tanti
Netherlands	Statistics Netherlands	Eva Witteman
Poland	Polish Energy Market Agency	Krzysztof Dziedzina
Portugal	Direccao Geral de Energia e Geologia	Elisa Oliveira
Romania	Romanian National Institute of Statistics	Michaela Chirculescu
Sweden	Statistics Sweden	Viktor Ahlberg
Slovenia	Statistical Office of the Republic of Slovenia	Marko Pavlič
Slovakia	Statistical Office of the Slovak Republic	
Norway	Statistics Norway	Thomas Aanensen
Montenegro	Statistical Office of Montenegro	Suzana Gojcaj
Turkey	Turkish Statistical Institute	Mehmet Gedik

1.2.1 Household Electricity Prices

The following section analyses prices paid by household electricity consumers. It examines weighted EU averages and the most representative band in each country. "Most representative" is defined as the consumption band accounting for the largest share in total household consumption, in other words the price for which the most electricity was sold. It is irrespective of the number of consumers in the band. Due to data availability restrictions, weighted EU averages are built uniformly from the consumption band defined by Eurostat terminology as DC, covering annual consumption of 2500 to 5000 kWh. For 2017 a "Most representative" weighted average is also presented.

Evolution of household electricity prices

Total prices grew at 2% annual rate from 2008 to 2017. In absolute terms the EU price grew from 166 to 200 EUR/MWh in the same period. When considering the most representative band in each country, instead of uniformly considering the consumption band DC, the EU average falls slightly lower, at 196 EUR/MWh. Prices grew faster than inflation, which averaged at 1.2% annually during the same period.

In 2017 the EU price fell for the first time by 3%. This is a significant departure from almost a decade of continuous increases. The decreasing EU average is however to be interpreted with caution. From 2016 to 2017 prices of the most representative bands actually increased in 13 reporting countries. Prior to 2016 the direction of developments on EU level, were mostly the same as the direction of developments in the majority of reporting countries. Since 2016, we can observe more divergent developments.

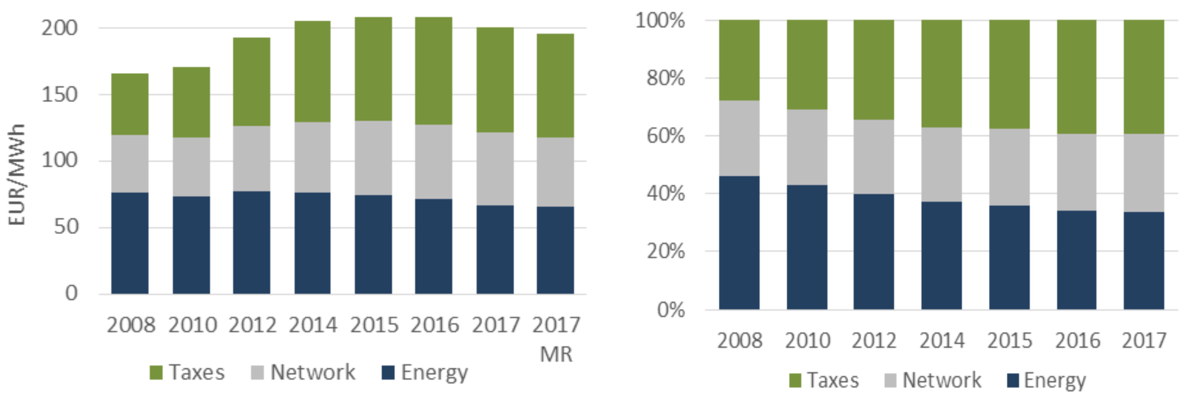


Figure 13 - Evolution and composition of the EU household price (DC). MR = Most representative

Source: DG ENER in-house data collection

Composition of household electricity prices

Over time the composition of prices changed significantly. The share of the energy component in the total price decreased by 13 percentage points from 46% to 33% in 2017. In the beginning of the observation period, the energy component was the largest of the three components in all reporting countries.

In absolute terms, the energy component decreased on average at an annual rate of 1.5% and reached 67 EUR/MWh in 2017. The contraction of the energy component can be linked to EU energy policies: increased competition resulting from market coupling and the growth of power generation capacity with low operating costs, such as wind and solar power, in addition to existing nuclear and hydro power. On national level 11 Member States reported actually higher energy components in 2017 than in 2016. In these countries wholesale prices either increased or their fall has not translated into a reduction of the energy component. Such results may imply that price competition in a number of retail markets is weak, allowing suppliers to avoid passing on wholesale price reductions to final consumers.

The share of the network component remained almost constant at about quarter of the price from 2008 to 2017. In absolute terms the network component grew at the annual rate of 2.5% and reached 54 EUR/MWh in 2017.

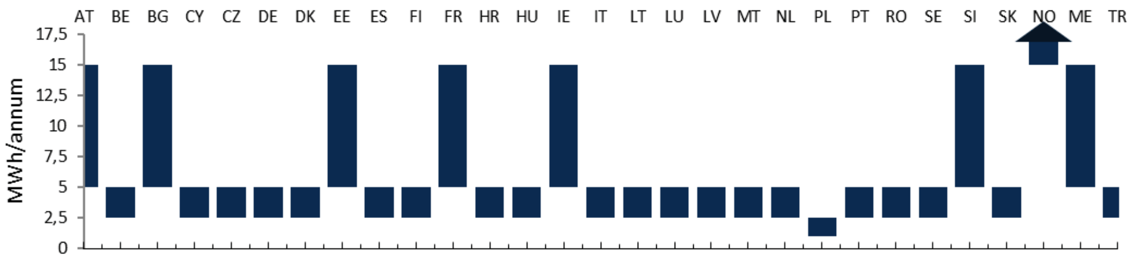
The share of the taxes component grew by 12 percentage points. It accounted for 28% of the weighted average EU price in 2008 and for 40% in 2017, meaning that it was the largest of the three components. In absolute terms, taxes grew at the annual rate of 6% and reached almost 80 EUR/MWh in 2017. The section "Composition of taxes, levies, fees and charges" analyses in detail which specific policies and fiscal instruments were driving this increase.

Box – Definition of most representative band

Household electricity consumption is broken down into 5 bands. The most representative band is defined as the one of these five bands with the highest share in total consumption. In other words, the price for which the most electricity was sold.

The 2016 edition of the Energy Prices and Costs series as well as all regular Eurostat press releases uniformly analyse consumption band DC for each country. In many of our reporting countries however only a smaller portion of consumption falls into DC. Household consumption varies highly across countries. It is determined by several factors including household size, climatic conditions (availability of sunlight and consequent lighting needs, heating and cooling needs), GDP (number and size of electric appliances on one hand and the efficiency of these appliance son the other hand), and prevalence of electrification in the transport and heating sectors. In northern countries consumption is typically above DC while in southern countries typically below.

To analyse prices that are truly representative, DG Energy introduced the possibility of reporting the price of the most representative band in each country. This feature of the in-house data collection serves the purpose of better catering to needs of Member States. One third of the countries made use of this possibility. It is important to note that if a country did not provide data for the most representative band, it was automatically assumed that DC is such. Typical consumption falls in the following ranges in the reporting countries.



Source: DG ENER in-house data collection

Drivers of Household Electricity Prices

2017 brought a significant departure from the decade long trend of increasing prices: the EU household electricity price fell for the first time. Between 2008 and 2016 the price was steadily increasing, driven by the combined impact of network charges and taxes – both components steadily growing until 2016. At the same time, smaller decreases in the initially large energy component slightly moderated the growth of the total price. Since 2017 both network charges and taxes have been decreasing on average, in addition to the energy component that has been contracting throughout the whole period. Decreases in all three components led to an overall price reduction.

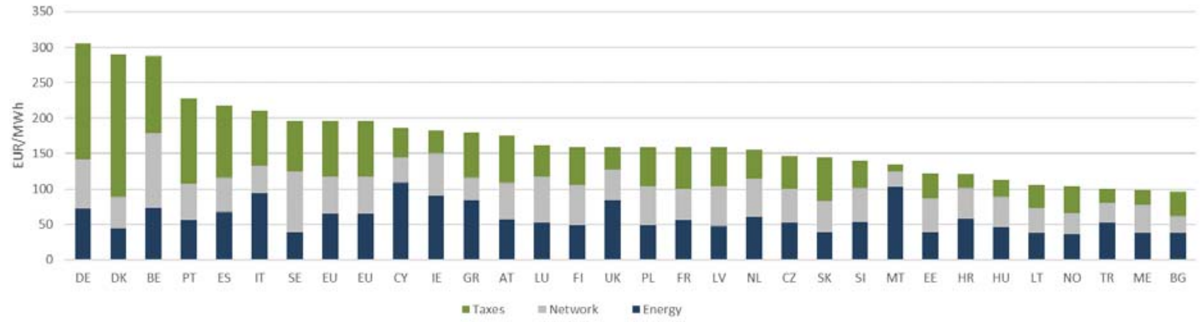


Figure 14 - Household rices in 2017 (most rep.)

Source: DG ENER in-house data collection

In 2017 Germany reported the highest price of 305 EUR/MWh, overtaking Denmark with a price of 289 EUR/MWh. Denmark reported the highest price from 2008 to 2017. Bulgaria reported the lowest price of 97 EUR/MWh among all EU and non- EU countries. The ratio of the largest to smallest price across the EU decreased by 4% over the last decade, indicating progress towards the completion of the internal energy market. In 2017 the largest price was 3.1 times of the smallest.

Denmark and Germany reported the highest tax components of almost 200 and 166 EUR/MWh respectively. In Germany this tax component consists of a number of elements. Support to renewable energy is the largest of those elements (45%), followed by excise duties and concession fees (each 13%). In Denmark the tax component consists mostly of excise duty (61%) and to a much lesser extent of support to renewable energy (10%). The three countries (BE, DE, DK) that reported the largest total prices also reported the highest tax components, indicating a strong correlation between overall price levels and taxation.

Belgium reported the largest network component of 105 EUR/MWh which is double that of the EU average (52 EUR/MWh), followed by Sweden with a network component of 85 EUR/MWh.

The largest energy components were reported by the islands of Cyprus and Malta. Relatively high energy components result from the characteristics of non- interconnected island systems: limited economies of scale, higher proportion of costs to ensure security of supply and the lack of gas and electricity interconnections. Limited land availability and resulting expensive land occupation fees might also contribute to higher energy components.

Italy and Ireland reported the highest energy components among interconnected countries. In Italy, it results mostly from the prominent and increasing role of natural gas in the country's generation mix. There is no nuclear generation in Italy and coal plays a very limited role. Production from renewable sources decreased by 3.3% in 2016, mostly due to a significant drop in hydroelectric production, resulting from reduced availability of water resources. As hydro generation decreased by 3.3 TWh and gas fired generation grew by 7 TWh, the latter's share increased to almost half (47%) of the country's gross electricity production. At the same time, wholesale prices of gas also returned to growth. These developments are reflected in the energy component.

In Ireland, much like in the case of isolated island systems, the lack of interconnections is contributing to a higher energy component. The level of interconnection in Ireland is relatively low, at below 5% of all installed capacity or at 6.6% of dispatchable generation. The share of natural gas is also a contributing factor in Ireland: at 50% the highest in Europe.

Natural gas is mostly the price setting, marginal plant of the merit order and as such, relatively expensive.

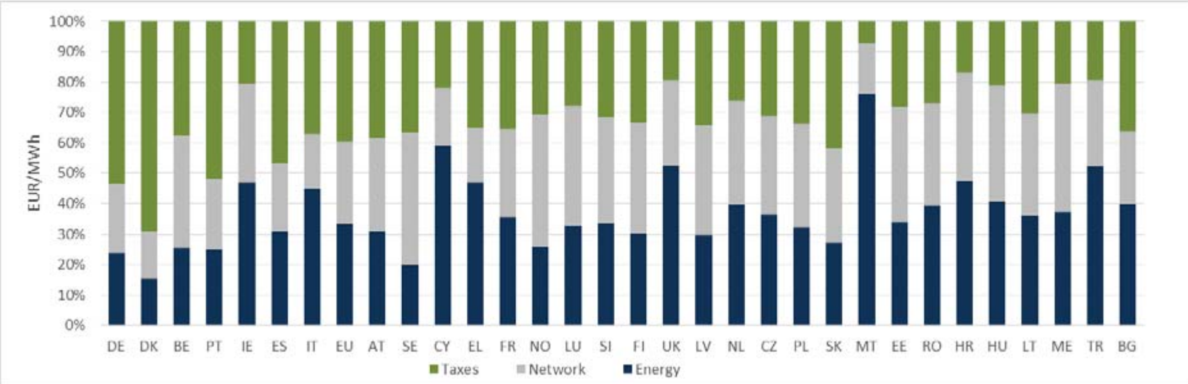


Figure 15 - Composition of hosehold prices in 2017 (most rep.)

Source: DG ENER in-house data collection

Box – European Commission efforts to increase interconnection capacities

As we saw above, interconnections – or more precisely the lack thereof – is a key contributing factor to high energy components. The socioeconomic value of electricity interconnectors comes from their ability of reducing costs by increasing the efficiency of the electricity systems and in parallel improving security of supply and facilitating the cost effective integration of the growing share of renewables.

The framework for the trans-European energy networks (TEN-E) and the Projects of Common Interest (PCIs) are the main tools of the EU energy policy to increase the physical electricity exchange capacity between Member States. The PCIs aim particularly to better connect the peripheral regions such as for example the Iberian Peninsula with the rest of Europe or to integrate rapidly growing share of renewables from remote generation areas such as the Northern Seas. On the current third Union list, there are 110 PCIs in electricity, which benefit from a streamlined permit granting procedures, improved regulatory conditions and under certain conditions are eligible for funding through the Connecting Europe Facility.

In addition, the 10% electricity interconnection target by 2020 has provided political momentum to advance key cross-border projects. As a result, seventeen Member States have already reached the target and seven more are on the path to reaching the target by 2020 through the completion of PCIs currently under construction.

In November 2017, the Commission proposed to operationalise the 15% interconnection target by 2030 through a set of additional and more specific thresholds which serve as indicators of the urgency of the action needed. The new thresholds reflect the three headline goals of European energy policy: increasing competitiveness through market integration and better prices, guaranteeing security of supply and achieving the climate targets through increased use of renewable sources. In total, approximately 22 electricity infrastructure PCIs have been completed or will be in operation by the end of 2018. Another 31 important projects are scheduled to be completed around 2020.

Composition of taxes, levies, fees and charges

In order to better understand how specific policies and fiscal instruments impact taxation levels- which in turn impact total prices- taxes and levies are broken down into 10 sub-components. These sub-components were designed to showcase national characteristics to the fullest extent possible, while minimizing the number of elements designated as "other". DG Energy provided extensive guidance to reporting authorities to ensure that the wide range of tax elements that exist across the countries are assigned to sub-components in a harmonized manner.

It is important to note that we consider only policy support costs that directly impact retail prices. Also, not every tax sub-component exists in each Member State. The following graph displays EU averages.

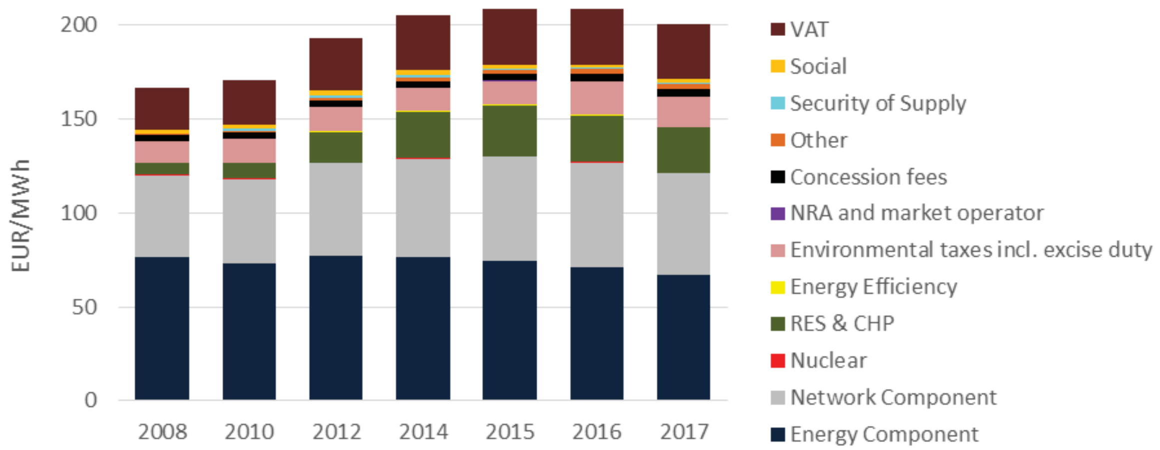


Figure 16 - Breakdown of household prices (DC)

Source: DG ENER in-house data collection

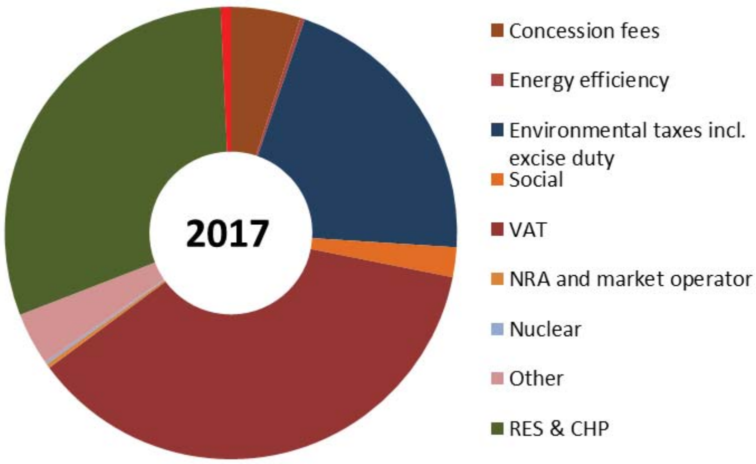


Figure 17 - Composition of taxes in 2017 (Most rep.)

Source: DG ENER in-house data collection

Value Added Tax

VAT is imposed on household electricity prices in all reporting countries. The EU VAT Directive explicitly allows Member States to apply reduced rates to electricity. As a result, VAT rates range from 6% in the United Kingdom to 27% in Hungary. As the largest sub-component, VAT accounted for 37% of the tax component and 17% of the total price. VAT is an ad valorem tax, its absolute value is based on the value of all other elements in the price. Even if VAT rates remain unchanged but other elements increase, the absolute amount of VAT increases. The average amount of VAT paid by households across the EU was 29 EUR/MWh in 2017, an increase of 31% since 2008.

Environmental taxes incl. excise duty (Non- Earmarked Taxes)

The sub-component includes any manifestation of excise duty, environmental, greenhouse gas emission, transmission and distribution taxes. Their common characteristic is that normally revenues from these taxes are not earmarked to energy, climate or environment related policies. In other words, revenues flow into the central state budget regardless of the name of the tax. Minimum excise duty levels on energy products are harmonised on the EU level and are defined by the Council Directive 2003/96/EC22. The sub-component excludes VAT.

Non- earmarked taxes grew from 11 to 16 EUR/MWh by 2017. They made up 21% of the taxes component and 8% of the total price, representing the third largest sub-component after VAT and RES&CHP. This reflects an annual growth rate of 1%, significantly lower than for industrial consumers.

Renewable Energy and Combined Heat and Power

This sub-component includes any support to renewable energy (RES) and combined heat and power generation (CHP). Explicit RES & CHP support costs are presented for 25 EU Member States and Montenegro. In Finland and Malta the renewable energy support scheme is not financed through an explicit levy on consumer bills but from the central state budget. France has been following the same example since 2016.In Hungary household electricity consumers, unlike their industrial counterparts, are exempted from the RES levy (a value of 0 is reported). Therefore in these 4 countries the direct cost to households is zero. It is important to note that consumers still pay for the support of renewable energy, albeit in an implicit way. Data for the United Kingdom is estimated and includes support to energy efficiency. In several countries renewable energy is supported also from sources additional to taxes on consumer bills.

The average EU household paid 24 EUR/MWh for RES&CHP support in 2017. This figure equals 30% of the taxes component and 12% of the total EU price. The sub-component experienced a fast increase from 2008 to 2015 as it grew annually by 15%. An important departure from this trend is to be observed in 2016 when the cost of RES&CHP support on EU level started to fall. A 2% decrease is remarkable especially as the share of renewable energy in the EU's energy mix grew by 16% from 2015 to 2016. These developments mean not only that the average EU household pays less but also that the lower cost enables more renewable energy.

Box - The French energy taxation and support to RES

France recently overhauled its energy taxation. Until 31 December 2015 a Public Service Obligation was levied on electricity (CSPE) and natural gas (CSPG) bills. The PSO consisted of three main elements: support to renewable energy, support to vulnerable consumers and national tariff equalization[9]. All three PSO elements are accounted for separately in our report and the latter two are classified as social levies. The RES support levy ranged from 2 EUR/MWh for large industrial consumers to 11 EUR/MWh for households.[10] The RES element of the PSO on natural gas bills specifically supported bio-methane. At the same time, a separate consumption tax was applied to both electricity (TICFE) and gas (TICGN). Rates of this tax on electricity rates ranged from 1.5 EUR/MWh for large industrial consumers to 12 EUR/MWh for households.[11]

From 1 January 2016 the explicit RES levy, as well as both other PSO elements were discontinued. Vulnerable consumers and national tariff equalization are financed through the general budget. The dedicated budget line "Public service of energy" also includes smaller elements of the discontinued PSO such as, support to combined heat and power and CDC (Caisse des dépôts et consignation, the French National Promotional Bank) management fees. Until 2017 RES was supported through a transitory system.

In 2017 the electricity consumption tax (TICFE) increased to 9 EUR/MWh for large industrial consumers and to 31[12] EUR/MWh for households. The natural gas consumption tax increased to about 5 EUR/MWh for households and median industrial consumers, while large industrial consumers remained exempted. Revenues from these taxes feed into the general budget and do not support any specific policies.

From 2017 onwards, renewable energy is supported through the revenues of two fossil fuel taxes. TICPE, which is applied to the end use of petroleum products and TICC, which is applied to coal consumption, including coal used to generate electricity. Consequently, the financing of renewable energy is no longer directly connected to electricity or natural gas bills. This is reflected in our data: From 2017 onwards the RES sub-component is zero.

CSPE: Contribution au service public de l'électricité. Discontinued PSO.
CSPG: Contribution au service public du gaz. Discontinued PSO.
TICFE: Taxe intérieure sur la consommation finale d'électricité. Current consumption tax on electricity.
TICGN: Taxe intérieure sur la consommation de gaz naturel. Current consumption tax on gas.
TICPE: Taxe Intérieure sur les Produits Énergétiques. Fossil fuel tax on petroleum products.
TICC: Taxe Intérieure sur la Consommation de Charbon. Fossil fuel tax on coal.

[9] National tariff equalization enables consumers on isolated island energy systems to pay prices similar to those on mainland France.
[10] Graphs in the body of the report as well as in the French graphical country profile display a RES levy of around 18 EUR/MWh for households and 3.4 EUR/MWh for large industrial consumers in 2015. This is due to a late data revision request by the French Ministry of Ecology, Sustainable Development and Energy that could no longer be reflected on our graphs. This box contains the updated data.
[11] Combined excise duty and local tax
[12] Combined excise duty and local tax

Social Charges

Social charges include support to vulnerable consumers, social tariffs, last resort supplier, national tariff equalization, pension funds and support to sectorial employment policies. They were the second most important energy policy relevant charges across the EU in terms of the cost to consumers as well as in terms of the number of countries applying them[13]. Still, the impact of social charges remained limited. They made up 3% of the taxes component and 0.8% of the total price. They grew at the annual rate of 3% and reached 2.15 EUR/MWh in 2017. More telling is the number of countries that applied explicit social charges: it grew from 6 in 2008 to 9 in 2017. In Bulgaria and Portugal in certain years between 2015 and 2017 the sub-component was negative as rebates were effective, which decreased total prices in these countries. The United Kingdom's Warm Home Discount is a redistributive levy. All households pay towards this levy via their gas and electricity bills. All the revenues collected are recycled back as £140 annual rebates on the electricity bills of eligible low-income and vulnerable households. As such, the net effect of the policy on average dual fuel (gas and electricity) bills is £0. The underlying report however reflects the gross cost, as the rebate applies only to smaller a subset of households.

Security of Supply

Security of supply related levies were imposed by 9 Member States in 2017, up from 6 in 2008. The impact of security of supply related charges remained limited, at below 1% of the EU price.

Concession Fees

Concession fees, in most cases for the occupation of public land, accounted for 2% of the EU price and 4% of the taxes component. Such fees, averaging at 3.7 EUR/MWh, were imposed by 5 Member States (AT, BE, DE, PL, PT) on household electricity prices. The presence of concession fees in the EU average is due to a higher fee of 20.5 EUR/MWh in Germany.

Other energy policy relevant charges

The explicit impact of other energy policy relevant charges remained limited. Cost elements imposed to support energy efficiency, the nuclear sector or the national regulatory agency, each made up less than 1% of the average EU price. Charges for the financing of the National Regulatory Agency or a market operator are levied in 6 Member States (BE, CZ, PT, SK, SI, ES). Nuclear sector levies are imposed by 4 Member States (BE, IT, SK, ES). The nuclear sub-component includes only levies that directly impact retail prices by supporting the sector. Taxes paid by generators of nuclear energy - imposed on the wholesale level - are therefore not considered. Support to energy efficiency measures is explicitly levied in 4 Member States (BE, IT, SI, UK[14]). The residual sub-component "other" includes a limited number of elements such as, deficit annuities in Spain, public television fee in Turkey or R&D in Denmark.

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[13] VAT and non- earmarked taxes are not considered energy policy relevant as their revenues not necessary support energy or climate policies.

[14] Data is available for the United Kingdom until 2015.

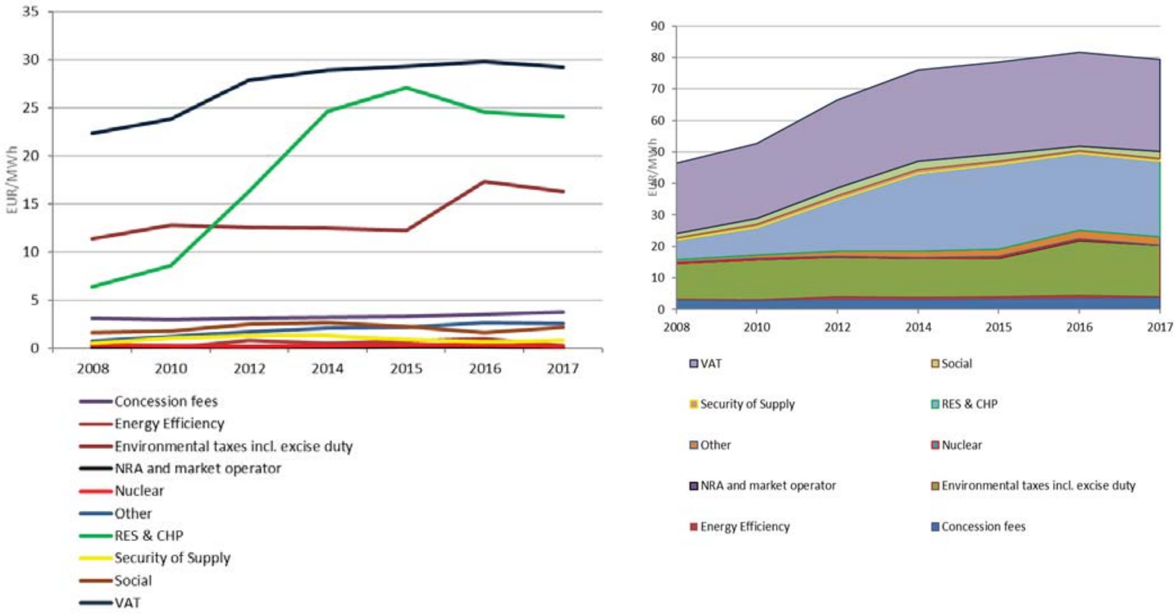

Figure 18 - Taxes, fees, levies and charges for EU households (DC)

Source: DG ENER in-house data collection

1.2.2 Industrial Electricity Prices

The following section analyses prices paid by non- household electricity consumers on EU and national levels. It examines prices of the Eurostat band ID, covering annual consumption of 2000 to 20 000 MWh. This band is often considered as the best indicator of economy wide non- household prices. It can be considered industrial as far as it might include prices paid by other non-household sectors, such as services, agriculture, fisheries and transport.[15]

Box - The role of households and industry in our energy consumption

Households account for about 22% of our energy consumption[16]. This has not changed significantly over the last decade as the share of household consumption fluctuates close to this figure. Improvements in energy efficient appliances however slowly dampen these fluctuations that no longer reach as high as around 2010.

Industries accounted for 25% of the EU's energy consumption in 2016, reflecting a 3 percentage point decrease since 2008, the beginning of the economic and financial crisis that dampened industrial production and thus energy consumption.

[15] According to Directive 2008/92/EC of the European Parliament and of the Council: Industrial end-user may include other non-residential users.

[16] Final Energy Consumption in 2016, ESTAT: nrg_110a

Evolution of Industrial Electricity Prices

Total prices grew at 1% annual rate from 2008 to 2017. In absolute terms the EU price grew from 94 to 103 EUR/MWh. This growth was slightly higher than inflation for industrial prices, which averaged at 0.5% annually during the same period.[17]

The evolution of the EU industrial (ID) price conceals two distinct periods. From 2008 to 2014 it steadily grew by 2% annually. Since 2015 it has been decreasing by 1% annually These EU figures are made up of relatively homogenous national developments, as ID prices grew only in one third of the reporting countries from 2016 to 2017.

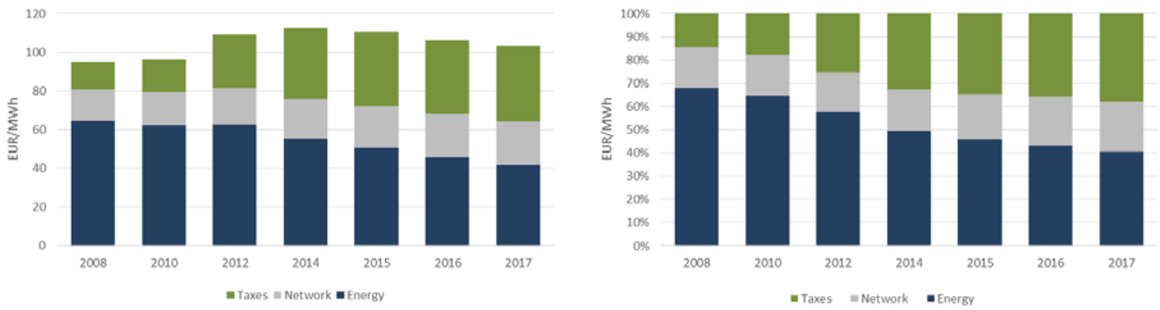

Figure 19 - Evolution and composition of the EU industrial price (ID)

Source: DG ENER in-house data collection

Composition of Industrial Electricity Prices

Over time, the composition of the EU industrial price changed even more significantly than the composition of the household price. The share of the energy component in the total price decreased by 28 percentage points from 68% to 40% in 2017. Still, unlike in the case of households, the energy component of industrial electricity prices remained the largest of the three components by a small margin. Its share in the total price was 2 p.p. higher than the share of taxes. In absolute terms, the energy component decreased at the annual rate of 5% and reached 41 EUR/MWh in 2017. The contraction of the energy component reflects falling wholesale prices which make up most of the component and can be linked to EU energy policies: increased competition resulting from market coupling and the growth of power generation capacity with low operating costs (such as wind and solar power, in addition to existing nuclear and hydro power). On country level, 9 countries reported actually higher energy components in 2017 than in 2016. In these countries wholesale prices either increased or their fall has not translated into a reduction of the energy component. Such results may imply that price competition in a number of retail markets is weak, allowing suppliers to avoid passing on wholesale price reductions to final consumers.

The share of the network component increased by 5p.p. from 17% to 22% in 2017. In absolute terms the network component grew at the annual rate of 4% and reached 22 EUR/MWh.

The share of the taxes component grew by 23 percentage points, taking over most part of the falling share of the energy component. It accounted for 15% of the EU price in 2008 and for 38% in 2017. In absolute terms, taxes grew at the annual rate of 12% and reached 39 EUR/MWh in 2017.

[17] Eurostat Producer Price Index, (sts_inppd_a)

In 2017 Germany reported the highest medium industrial price (142 EUR/MWh), followed by Italy (133 EUR/MWh) and Cyprus. Germany and Italy reported also the highest taxes across the EU, while in Cyprus a high energy component results in overall higher prices,[18] In Germany RES support costs made up 80% of all taxes while excise duties accounted for an additional 18%. The composition of Italian taxes is similar to those of Germany, with RES accounting for four-fifths of all taxes. Sweden reported the lowest price of 55 EUR/MWh among all EU and non- EU countries.

For medium industrial consumers, Latvia, Lithuania, Germany and Slovakia reported the highest network components (in descending order) ranging from 36 to 31 EUR/MWh. Belgium, where network charges for household consumers are double that of the EU average, reported the 6th smallest network component for industrial consumers (18 EUR/MWh).

The largest energy components were reported by the islands of Cyprus and Malta, followed by Ireland and the United Kingdom.

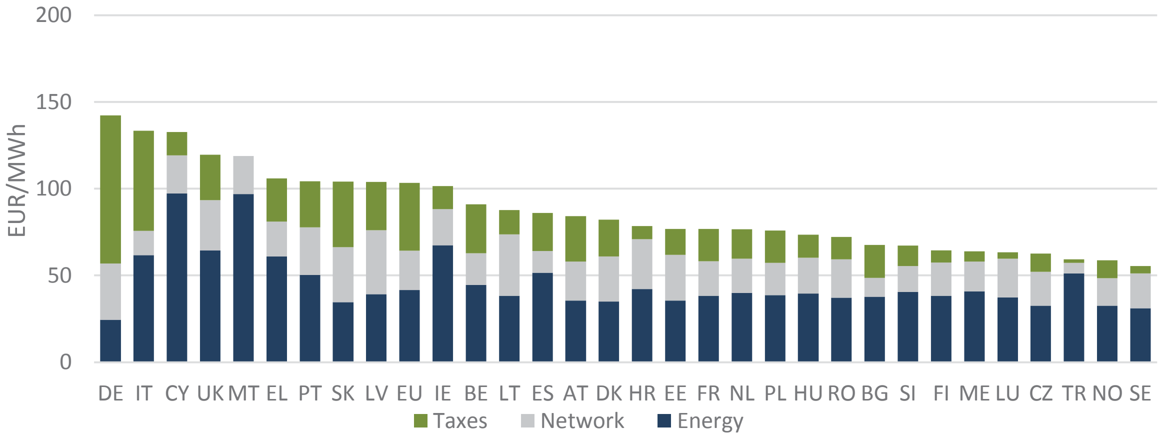

Figure 20 - Industrial (ID) electricity prices in 2017

Source: DG ENER in-house data collection

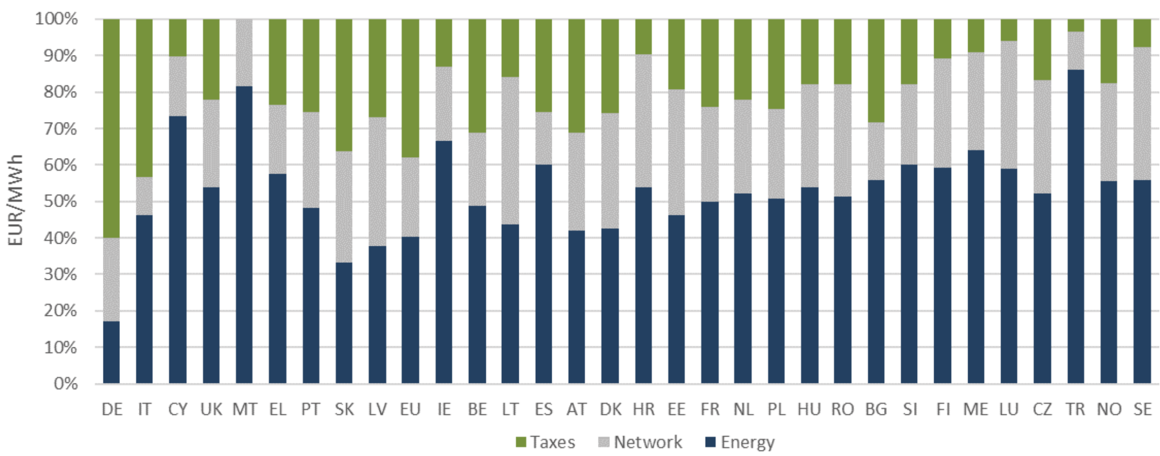

Figure 21 - Composition of industrial (ID) electricity prices in 2017

Source: DG ENER in-house data collection

[18] For more information on factors determining the energy component and on non- interconnected island systems, please consult the corresponding section of the household electricity chapter.

The previous graphs present medium consumption figures in each country. Several countries grant tax reductions to energy intensive industries. As energy intensity is not based on consumption volume, but on the share of energy related costs in total production, this median band can include enterprises that benefit from such reduced tax rates.

Drivers of Industrial Electricity Prices

The EU industrial price grew continuously from 2008 to 2015. This increase was driven by the combined impact of network charges and taxes, as both components were steadily increasing. At the same time, smaller decreases in the initially large energy component moderated the growth of total prices. A departure from this trend is to be observed in 2015 when the total EU price fell for the first time. This can be attributed entirely to the accelerated reduction of the energy component as the other two components kept increasing. From 2016 to 2017 the average industrial price further decreased from 106 to 103 EUR/MWh.

It is to be underlined that EU averages conceal divergent national developments. Total prices increased in one third of the reporting countries from 2016 to 2017. The energy component actually increased in 9 countries. On the national level network charges increased in 14 countries and taxes grew in 16 of the 28 EU Member States[19].

Composition of taxes, levies, fees and charges

The following section considers only policy support costs that directly impact retail prices.

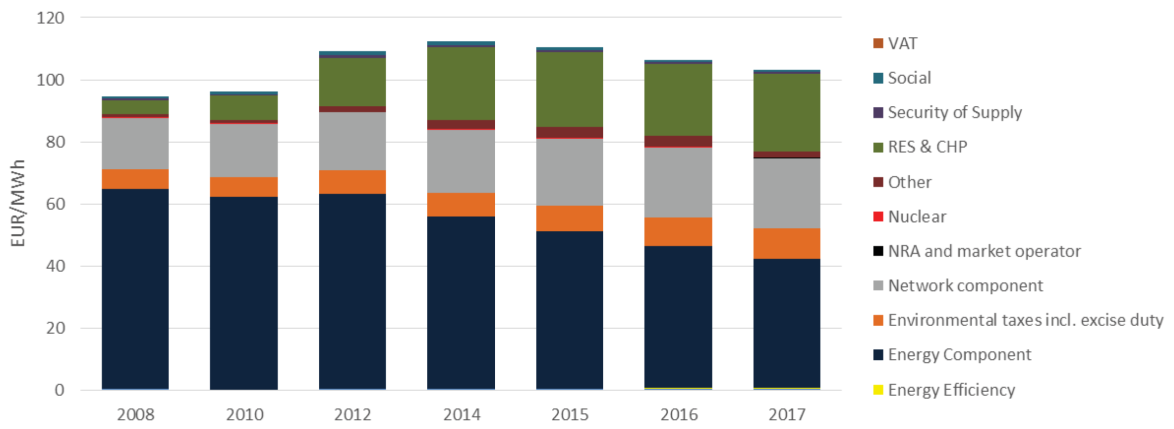

Figure 22 - Breakdown of EU prices in 2017 (ID)

Source: DG ENER in-house data collection

[19] No 2016 data available for Greece and the United Kingdom.

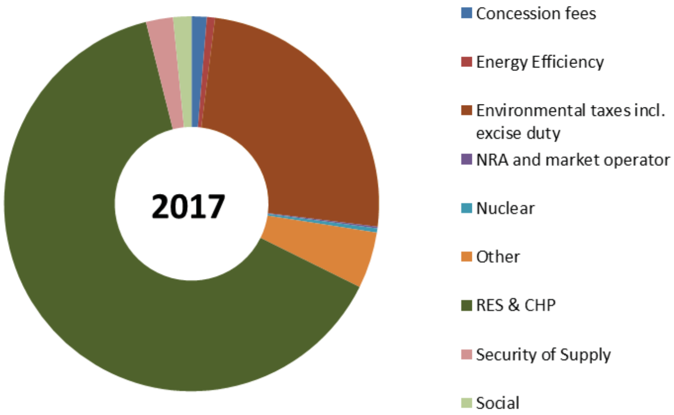

Figure 23 - Composition of taxes in 2017 (ID)

Source: DG ENER in-house data collection

Value Added Tax

VAT is recoverable for most industrial consumers in all reporting countries. Therefore this report analyses industrial prices excluding VAT. Other recoverable taxes are also excluded prom the price we report.

Environmental Taxes incl. excise duty (non- earmarked taxes)

Non- earmarked taxes grew from 6 EUR/MWh to 11 EUR/MWh in 2017. This reflects an annual growth rate of 3%, the third highest among the 10 different categories of taxes. Non-earmarked taxes made up 25% of the taxes component and 9% of the total price, representing the second largest sub-component after RES&CHP.

Renewable energy and Combined Heat and Power

This sub-component includes any support to renewable energy and combined heat and power generation. Explicit RES & CHP support costs are presented for 25 EU countries and Montenegro. In Finland and Malta the renewable energy support scheme is not financed from a levy on electricity consumption but from the central state budget. France has been following the same example since 2016. Therefore in these 3 countries the explicit cost of supporting renewable energy is zero for industrial consumers. It is important to note that consumers still pay for the support of renewable energy, albeit indirectly. In Hungary industrial consumers are subject to a RES levy while households are exempted. Data for the United Kingdom is estimated and includes support to energy efficiency. In several countries renewable energy is supported also from sources in addition to levies on electricity consumption.

RES & CHP accounted for 25 EUR/MWh in 2017 (up from 23.2 EUR/MWh in 201). This figure equals 64% of the taxes component and 24% of the total EU price. These relative shares are almost twice of the household figures. This is due to the fact that VAT, which accounts for a high share of household taxes, is recoverable for industrial consumers.

Social charges

Social charges include support to vulnerable consumers, social tariffs, last resort supplier, national tariff equalization, pension funds and support to sectorial employment policies. The impact of social charges on industrial prices diminished over time, as they decreased from 0.9 EUR/MWh to 0.6 EUR/MWH in 2017. They made up 2% of the taxes component and 0.6% of the total price (slightly less than for household consumers) in 2017.

Security of supply

Security of supply related levies were imposed by 10 countries in 2017, up from 6 in 2008. The impact of security of supply related charges remained limited, at below 1% of the EU price.

Concession fees

Concession fees for industrial consumers were much smaller than for their household counterparts. As a result, the impact of such fees remained insignificant (below half a percent of the total price).

Other energy policy relevant charges

The explicit impact of other energy policy relevant charges also remained limited. Cost elements imposed to support energy efficiency, the nuclear sector and national regulatory agency made up less than 1% of the average EU price. Charges for the financing of the National Regulatory Agency or a market operator are levied in 6 Member States (BE, ME, PT, SK, SI, ES). Nuclear sector levies are imposed by 4 Member States (BE, IT, SK, ES). The nuclear sub-component includes only levies that directly impact retail prices by supporting the sector. Taxes paid by generators of nuclear energy - imposed on the wholesale level - are therefore not included. Support to energy efficiency measures is explicitly levied in 4 Member States (BE, IT, SI, UK[20]). The residual sub-component "other" includes a limited number of elements such as, deficit annuities in Spain, public television fee in Turkey or R&D in Denmark.

[20] Data is available for the United Kingdom until 2015. From 2016 onwards Commission estimates are used as substitutes.

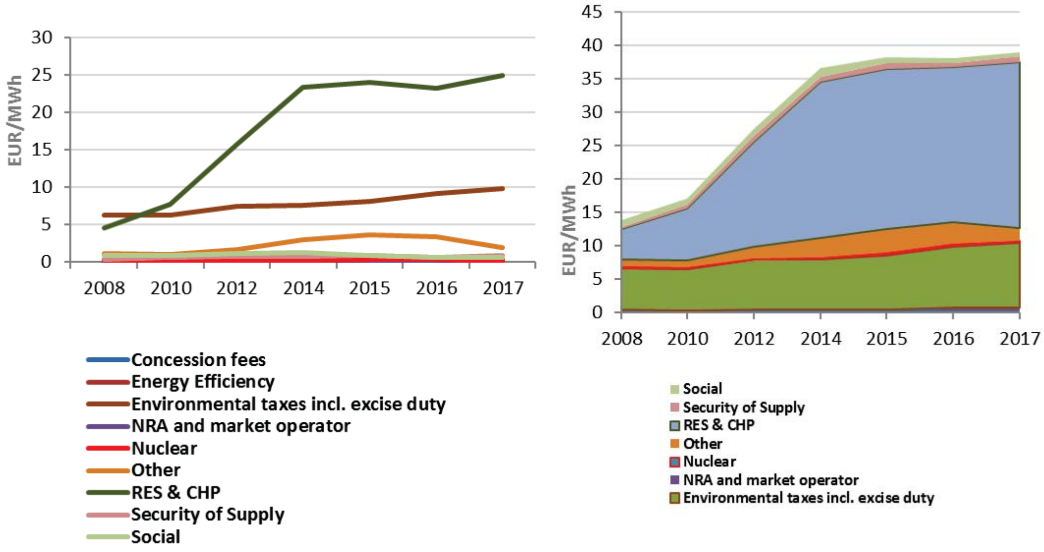

Figure 24 - Taxes, levies, fees and charges of industrial electricity prices

Source: DG ENER in-house data collection

1.2.3 Small vs. Large Industrial Electricity Prices

The following section compares prices paid by two types of non- household consumers: consumers with small volume of annual consumption (20 to 500 MWh defined as band IB) and consumers with large volume of annual consumption (70 000 to 150 000 MWh defined as IF). Band IB typically includes small enterprises and services. Band IF includes large industrial consumers such as the chemicals, metals and construction materials industries. Band IF covers many energy intensive industries, however not all of them. Energy intensity is not defined based on consumption volume but on the relative importance of energy costs in total production costs. As a result, an enterprise that consumes small amount of electricity can still be energy intensive. The opposite holds as well. There are enterprises consuming large amounts of electricity that are not considered energy intensive. An example is the automobile industry. Band IF is therefore a mixed band that covers prices paid by energy intensive and non-energy intensive industries. This is reflected in our data: large consumers pay lower taxes due to partial exemptions from levies according to the Energy and Environment State Aid Guidelines (EEAG). These partial exemptions apply to some, not all IF consumers.

Data for IB was reported by 26 EU member States (except the United Kingdom and Greece), Montenegro, Norway and Turkey. Data for the UK and Greece was estimated by DG Energy. IF data was reported by 25 EU Member States and Turkey. Data for the UK and Greece was also estimated by DG Energy for this band. In Luxembourg IF data is confidential (there are less than three consumers in the band).

Evolution of Small vs. Large Industrial Electricity Prices

Total prices grew at annual rate of 1.8% for IB consumers. IF prices experienced a different evolution as they fell slowly, by 0.3% a year. In absolute terms the IB price grew from 121 to

143 EUR/MWh and the IF price fell from 83 to 80 EUR/MWh. Inflation averaged at annual 0.5% during the same period.[21] The above figures cover the period 2008 to 2017, by 2015 year-on-year prices were falling for both consumer types. The EU averages conceal relatively homogenous evolutions across the reporting countries as IB and IF prices increased in 9 and 11 countries respectively from 2016 to 2017.

In 2017 Germany reported the highest (192 EUR/MWh) IB price while Sweden reported the smallest (78 EUR/MWh) across the EU. Both Norway and Turkey reported prices lower than any EU Member State. Cyprus reported the highest price for large industrial consumers (117 EUR/MWh) followed by Germany (114 EUR/MWh) and the United Kingdom (113 EUR/MWh). Also Sweden reported the smallest price for IF (40 EUR/MWh). Over the last decade the ratio of the largest to smallest price evolved differently for the two consumer types. For IB consumers the ratio decreased by 13% and the largest price was 2.7 times of the smallest. For IF consumers the ratio increased by 18% to 4.7.

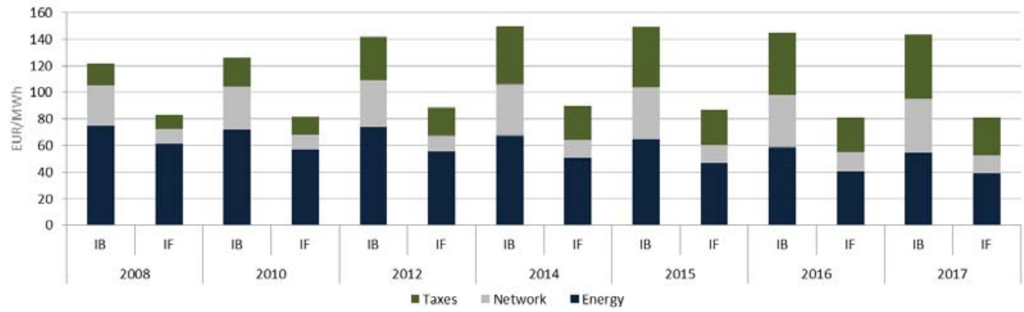

Figure 25 - Evolution of small (IB) and large (IF) industrial electricity prices

Source: DG ENER in-house data collection

Composition of Small vs. Large Industrial Electricity Prices

Albeit the two bands reflect prices for quite different consumer types, the composition of prices evolved in a notably similar fashion. For both consumer types the energy component lost about 25 p.p. of its share in the total price. Also for both consumer types taxes took over most of the decreasing share of the energy component, as they experienced around 20 p.p. increase. A smaller increase in the share of network charges accounted for the remaining changes.

Table 2 - Composition of small (IB) and large (IF) industrial prices

	IB		IF		IB	IF
	2008	2017	2008	2017	Change (p.p., 2008-2017)	
Energy	62%	38%	74%	49%	-24%	-25%
Network	25%	28%	13%	17%	3%	4%
Taxes	13%	34%	13%	34%	20%	21%

Source: DG ENER in-house data collection

In absolute terms, the energy component decreased at an annual rate of 3.5-5% for the two consumer types. By 2017 it reached 54 and 39 EUR/MWh for IB and IF consumers respectively. The contraction of the energy component reflects falling wholesale prices, which make up most of the component

[21] Eurostat Producer Price Index (sts_inpp_ma)

In absolute terms the network component grew at the annual rate of 2.7% (IB) and 3.3% (IF) for the two consumer types. For IB consumers the network component grew from 30 to 40 EUR/MWh from 208 to 2017. The IF network component grew from 10 to 13 EUR/MWh during the same period.

In 2008 taxes made up 34% of the total price for both consumer types. In absolute terms they grew from 16 to 48 EUR/MWh for IB consumers and from 10 to 27 EUR/MWh for IF consumers. Taxes grew 2 p.p. faster for large consumers (by 13% annually).

In 2017 the total IB price was 143 EUR/MWh, 62 EUR higher than the IF price. The reason for this difference lies in all three components. Some IF consumers are auto producers, who generate their own electricity or have over the counter, long term power purchase agreements which are reflected by lower energy components in our data (54 vs. 39 EUR/MWh). IF consumers are often connected directly to the high voltage transmission grid and therefore do not need to pay for using the distribution grid. This reduces the network component in our data set (40 vs. 13 EUR/MWh). Lastly, for IB consumers taxes at 48 EUR/MWh were 17 EUR higher than for IF consumers. The difference stems mostly from partial reductions in RES levies, according to the State Aid Guidelines and from reduced excise duty rates according to the Energy Tax Directive.

As all three components are proportionally smaller, taxes made up the exact same share of the total price for both consumers types: 34%. While relative shares for the two consumer types were equal, as we saw above, large consumers pay lower taxes. Reduced taxes reflect efforts to safeguard the competitiveness of EU industries. These reductions, which cannot exceed 85% of the applicable RES levy, qualify as aid compatible with the internal market. Reductions are partial, therefore no consumer is completely exempted. Qualifying industries are energy intensive, meaning that they face higher share of energy costs in their production (around 10% compared to 3% cross- industry average). Furthermore, due to the trade intensity of the goods they produce, they are exposed to competition with producers outside of the EU, who are not subject to comparable climate legislation. As a result of reductions in the applicable RES levies, not only the share of taxes in the total price is equal for the two consumer types, but also the subset of taxes supporting renewable energy. From 2008 to 2016 the share of RES support in the total price was equal in each year for IB and IF consumers. A difference appears only in 2017 when the RES levy for IB consumers was 20% of the total price, compared to 23% for IF consumers.

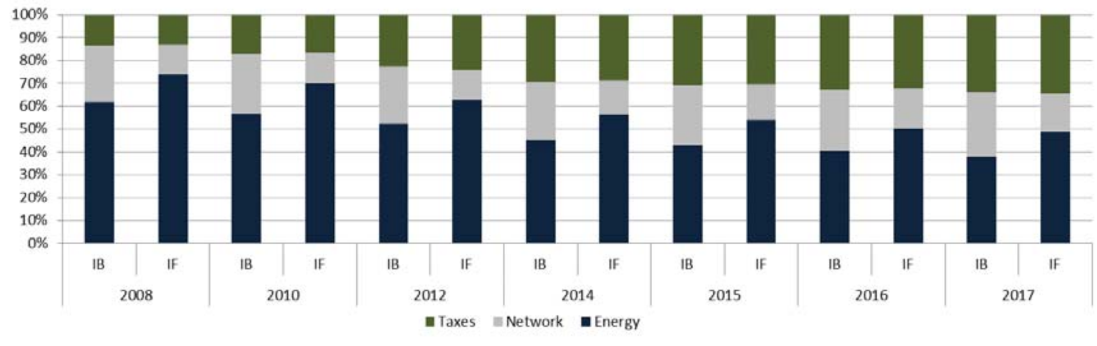

Figure 26 - Composition of small (IB) and large (IF) industrial electricity prices

Source: DG ENER in-house data collection

Drivers of Small vs. Large Industrial Electricity Prices

Both for small and large industrial consumers we observe the continuation of the trends of the last decade, with one exemption. The energy component continued to fall, taxes continued to increase. Both unbroken trends since 2008. The network component continued to slightly increase for IB consumers but fell for the first time for IF consumers from 2016 to 2017. This development represents the only new trend, however an important change lies in the speed of increases and decreases of the three components. We observe falling total prices for both consumer types since 2015, while the evolution of the three components mostly didn't change direction. Falling total prices result from the fact that the energy component kept decreasing at the same speed (4-7% year-on-year) while the increase of network charges and taxes slowed down to around 2% compared to double digit growth rates in the early years of our observation period. Since 2015 the decrease of the energy component was no longer only mitigating increases of the two other components but overtook them, resulting in overall falling prices both for small and large industrial consumers.

These EU level figures conceal relatively homogenous developments on national level. For IF consumers total prices increased in 9 countries and the energy component increased in 10 countries from 2016 to 2017. For IF consumers both total prices and the energy component increased in 11 countries. The list of countries where total prices increased and where the energy component increased is not identical but notably similar. This indicates, as also noted above, that in most countries the evolution of the network and taxes components slowed down so much that the overall price evolution is now set by the energy component.

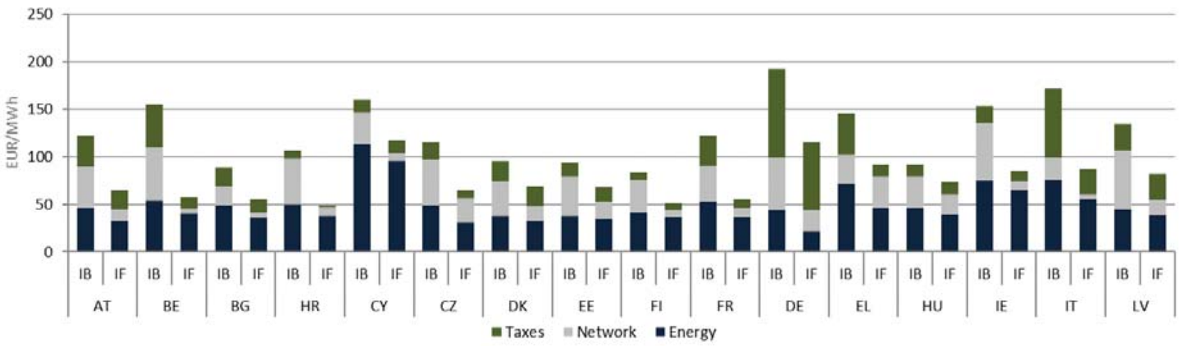

Figure 27- Composition of small (IB) and large (IF) industrial prices in 2017. First 16 countries alphabetically.

Source: DG ENER in-house data collection

In 2017 Germany reported the highest small industrial price of 192 EUR/MWh followed by Italy (172).

In Germany and Italy taxes are made up mostly of RES support (above 70% in both countries) and excise duty (17%), complemented with smaller elements, such as concession fees in Germany.

In 2017 Latvia, Ireland and Belgium reported the highest network components of 62, 59 and 56 EUR/MWh respectively for small industrial consumers (IB). While the lists of countries with highest level for taxation for small and large industrial consumers are very similar, we observe a difference in terms of network charges. For large industrial consumers the United Kingdom, the Czech Republic, Malta and Germany reported the highest network components in descending order. Belgium, where network charges for household consumers are double that of the EU average, reported the 3rd smallest network component in the EU for large industrial consumers.

The energy component was the highest in the same countries as in the case of household and medium industrial consumers. For further explanation, please consult the corresponding section of the chapter on household prices.

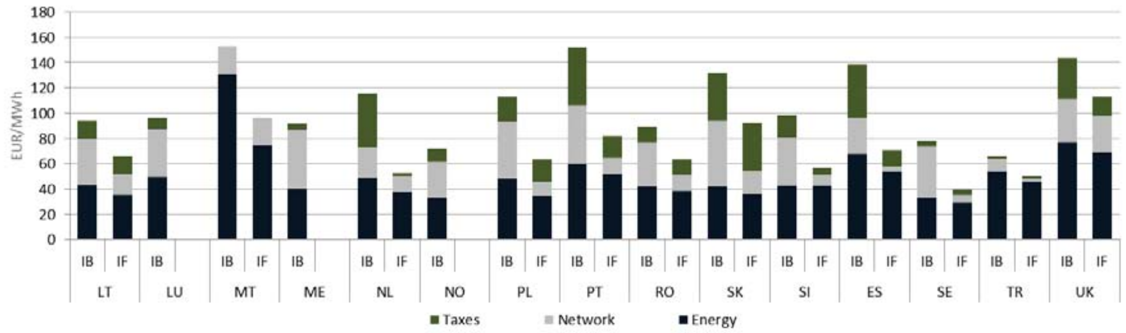

Figure 28 - Composition of small (IB) and large (IF) industrial prices in 2017. Last 15 countries alphabetically.

Source: DG ENER in-house data collection

Composition of taxes, levies, fees and charges

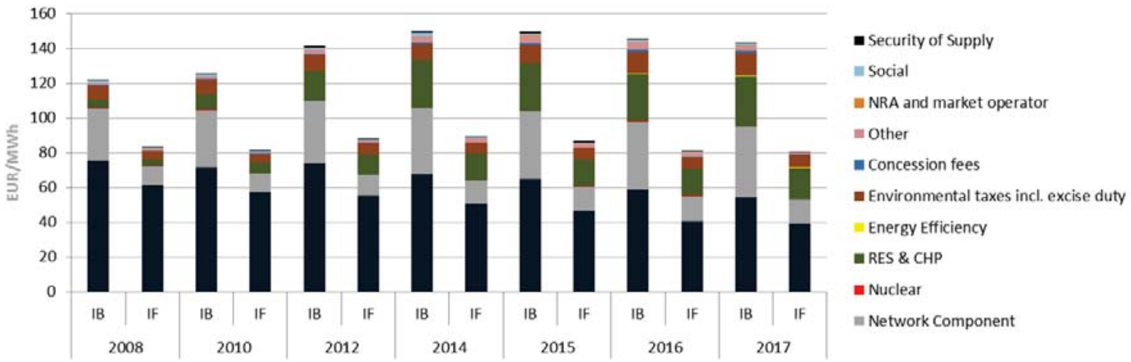

Figure 29 - Composition of taxes on prices for small (IB) and large (IF) industrial electricity prices (2008-2017)

Source: DG ENER in-house data collection

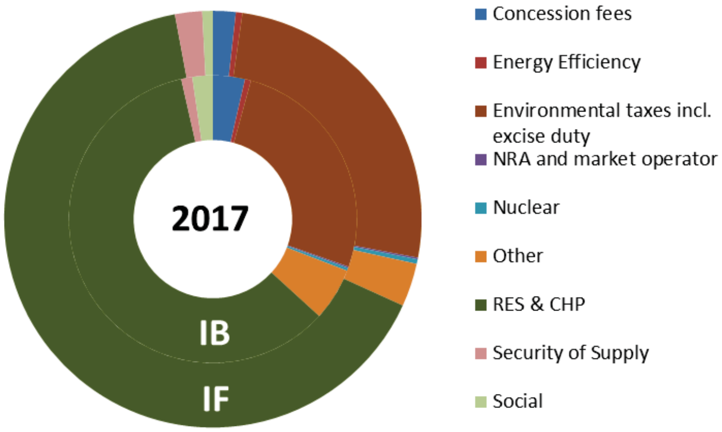

Figure 30 - Composition of taxes on prices for small (IB) and large (IF) industrial electricity consumers in 2017

Source: DG ENER in-house data collection

Value Added Tax

VAT is recoverable for most industrial consumers in all reporting countries. Therefore the analyses in this section focus on industrial prices excluding VAT. Other recoverable taxes are also excluded prom the price we report.

Other non- earmarked taxes

Non- earmarked taxes for small industrial consumers grew from 7 to 12 EUR/MWh by 2017. This reflects an annual growth rate of 2.4%, the third highest among the 10 different categories of taxes. Non- earmarked taxes made up 26% of the taxes component and 8% of the total IB price. For large industrial consumers, non- earmarked taxes grew even faster, at the annual rate of 3%, albeit from an initially lower level. They averaged at 7 EUR/MWh across the EU in 2017.

Renewable energy and Combined Heat and Power

This sub-component includes any support to renewable energy and combined heat and power generation. Explicit RES & CHP support costs were reported by 25 EU countries. In Finland and Malta, the renewable energy support scheme is not financed from a levy on electricity consumption but from the central state budget. France has been following the same example since 2016. Therefore in these 3 countries the cost of supporting renewable energy through electricity bills is zero. It is important to note that consumers still pay for the support of renewable energy, albeit in an implicit way. Data for the United Kingdom is estimated and includes support to energy efficiency.

RES& CHP support cost were 29 and 18 EUR/MWh for small and large consumers respectively in 2017. RES support made up 59% of all taxes and 20% of the total price for small industrial consumers. The same shares for large industrial consumers were slightly higher at 65% (of taxes) and 22% (of the total price). The RES sub-component grew at the annual rate of 16% and 18% for IB and IF respectively. These growth rates covering the period 2008 to 2017, conceal volatile sub- periods: after strong initial growth from 2008 to 2012 we observe almost stagnation from 2014 to 2016 for both consumer types. From 2016 to 2017 the cost of RES support grew again slightly faster.

The following graphs display the cost of supporting renewable energy for different consumer types. They reflect the extent to which Member States make use of the above described exemptions and reductions regulated by the State Aid Guidelines. Of the 26 countries that reported RES support costs for both consumer types, burden sharing is equal in 6. In 3 (HR, HU, IT) households pay less than small and medium industrial consumers (albeit more than large industrial consumers). In 17 countries the levy is degressive, it decreases as the consumption increases.

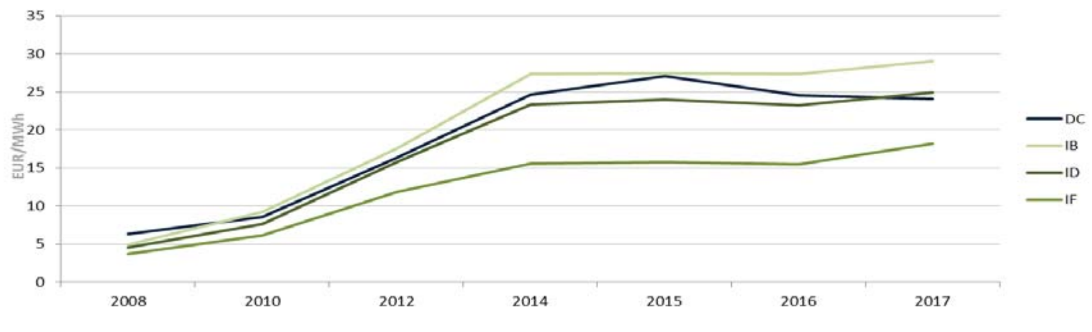

Figure 31 - RES support costs for electricity consumers (DC=Household, IB=small, ID=median, IF=large)

Source: DG ENER in-house data collection

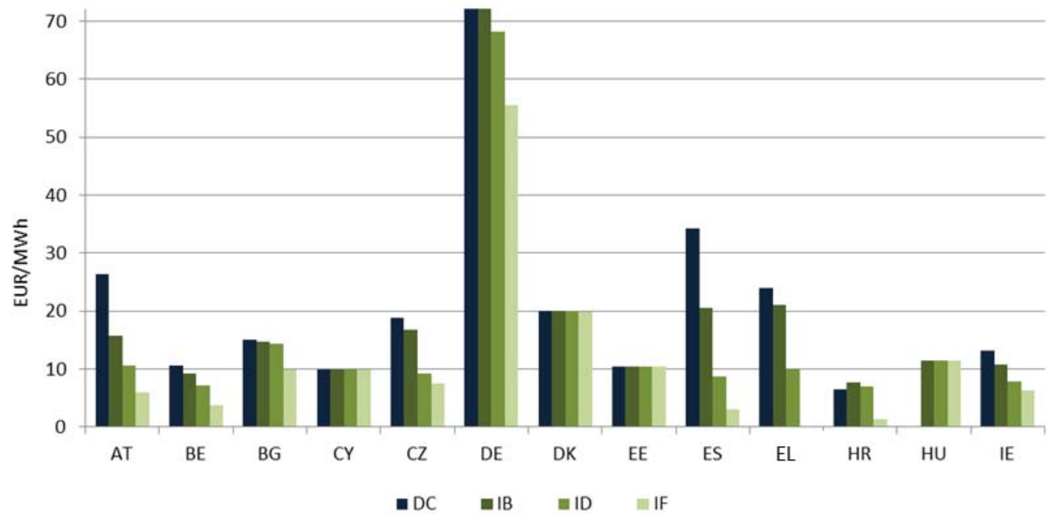

Figure 32 - RES support in 2017 by consumer type and country. First 13 countries alphabetically

Source: DG ENER in-house data collection

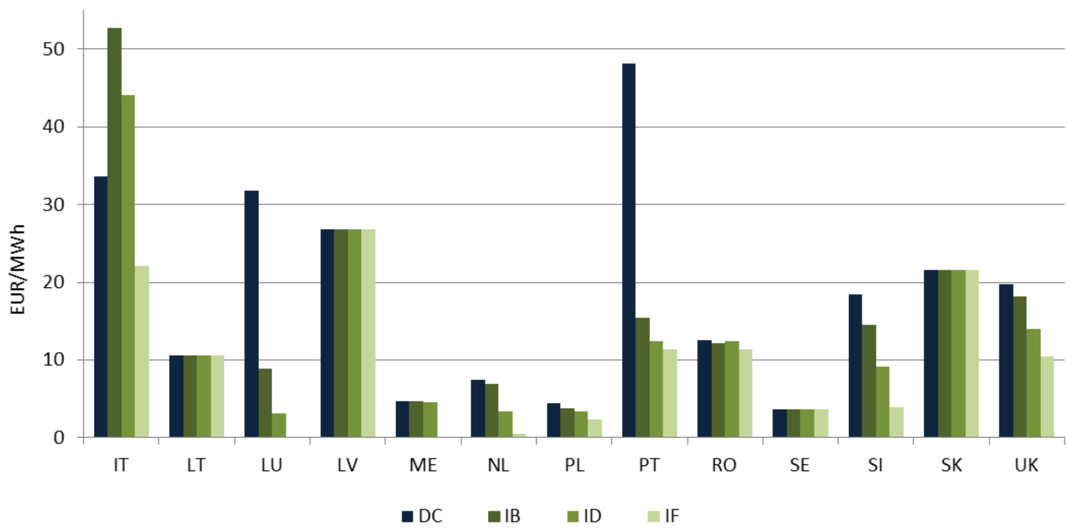

Figure 33 - RES support in 2017 by consumer type and country. Last 13 countries alphabetically

Source: DG ENER in-house data collection

The share of all other policy support costs, including energy efficiency, security of supply and nuclear sector policies, remained below 1% of the total price.

1.2.4 International comparisons

Component level data (energy, network, taxes) is not available for countries outside of the European Statistical System, which encompasses the 28 EU Member States, 4 EFTA members, 9 Energy Community contracting parties of the western- Balkans and Turkey. Consequently Turkey is the only G20 trading partner of the EU for which component level data is available.

Component level data enables the identification of price drivers. As this data is not available for G20 trading partners, the difference between wholesale and retail prices can serve as a proxy. The difference consists of network charges, taxes, levies as well as of the costs and profit margins of supply companies. Consequently, the difference includes elements from all three components. The non- regulated, supply related costs account for only a small share of the total difference in most countries.

We observe that the difference between wholesale and retail prices, therefore the impact of the regulated part, is larger in the EU than in its G20 trading partners. This holds for both electricity and natural gas and both households and industry. On average across the EU the non- regulated part of the [price has been contracting since 2008 while the regulated part kept growing until recently. At the same time we observe that retail prices are below wholesale prices in some trading partner countries, indicating that prices are subsidized and regulated at low levels. Consumers pay less than the actual cost of their energy use.

Electricity wholesale prices in the EU are often comparable to those in G20 countries. This however does not translate to retail prices as such are on average higher in the EU than in all G20 trading partners. This is a result of various taxes and levies that provide revenue to treasuries through excise taxes and finance policies, such as renewable energy and energy efficiency. These contributions result in higher prices but also allowed the EU to be a global driving force in combatting climate change and a leader in the development and deployment of sustainable energy technologies.

Household Electricity Prices

The EU28 average difference between household retail prices and wholesale prices has increased from around 100 EUR/MWh in 2008 to more than 160 EUR/MWh in 2017.

The difference in the US is lower than in the EU28 at around 80-90 EUR/MW, albeit it has been increasing since 2008. The same analysis using the wholesale proxy for China shows a negative outcome of 30-40 EUR/MWh, this highlights that household consumers in China are not paying the full cost of their electricity use. The difference in Japan varied considerably over the observation period, with the Fukushima effect on wholesale prices likely to have played an important role in the 2011 peak. For the other G20 countries the differences are significantly lower than for the EU28 average. In Mexico (MX), Indonesia (ID) and Russia (RF) the difference is small, indicating that retail prices are regulated and kept at low levels in these countries. In Canada (CA), Turkey (TR) and Brazil (BR) the difference is greater, but still significantly smaller than for the EU28 average.

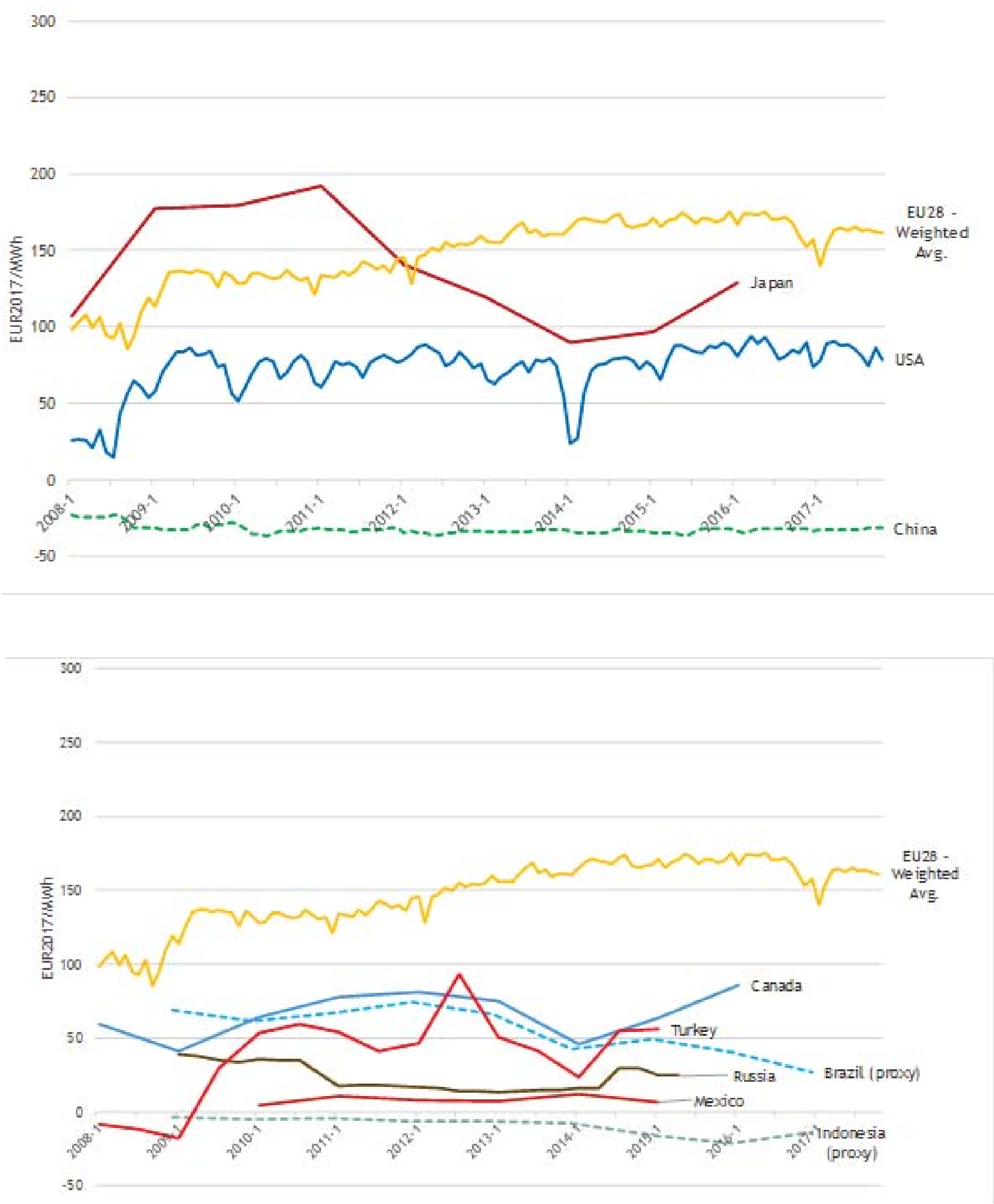

Figure 34 - Difference between household retail electricity prices and electricity wholesale prices 2008-2018, EUR_{2017}/MWh

Source: Trinomics et altri study

Industrial Electricity Prices

The EU28 average difference between household retail prices and wholesale prices has increased from around 30 EUR/MWh in 2008 to around 70 EUR/MWh in 2017. The difference in the US is lower than in the EU28 at around 15-40 EUR/MWh, albeit it has been slowly increasing since 2008. The difference in Japan is in the same order of magnitude as the EU28 average and US levels, but has varied considerably over the period, with the annual frequency of the data playing a role, and the Fukushima effect on wholesale prices likely to have played an important role in the 2011 peak. The same analysis using the wholesale proxy for China shows virtually no difference, likely due to the proxy being similar to the industrial price, it is an interesting contrast to household prices, pointing towards energy policy priorities and price interventions in favour of households rather than industry.

For the rest of the G20 countries the difference compared to the EU28 average is typically lower, although the difference in Canada (CA) has generally been similar to the EU. We can observe a small divergence in Mexican (ME) and Russian (RF) prices which remained mostly constant over time, while the difference in the EU increased. In Turkey (TR) the difference in prices was often negative highlighting that retail prices are regulated at levels below the cost of supplying electricity.

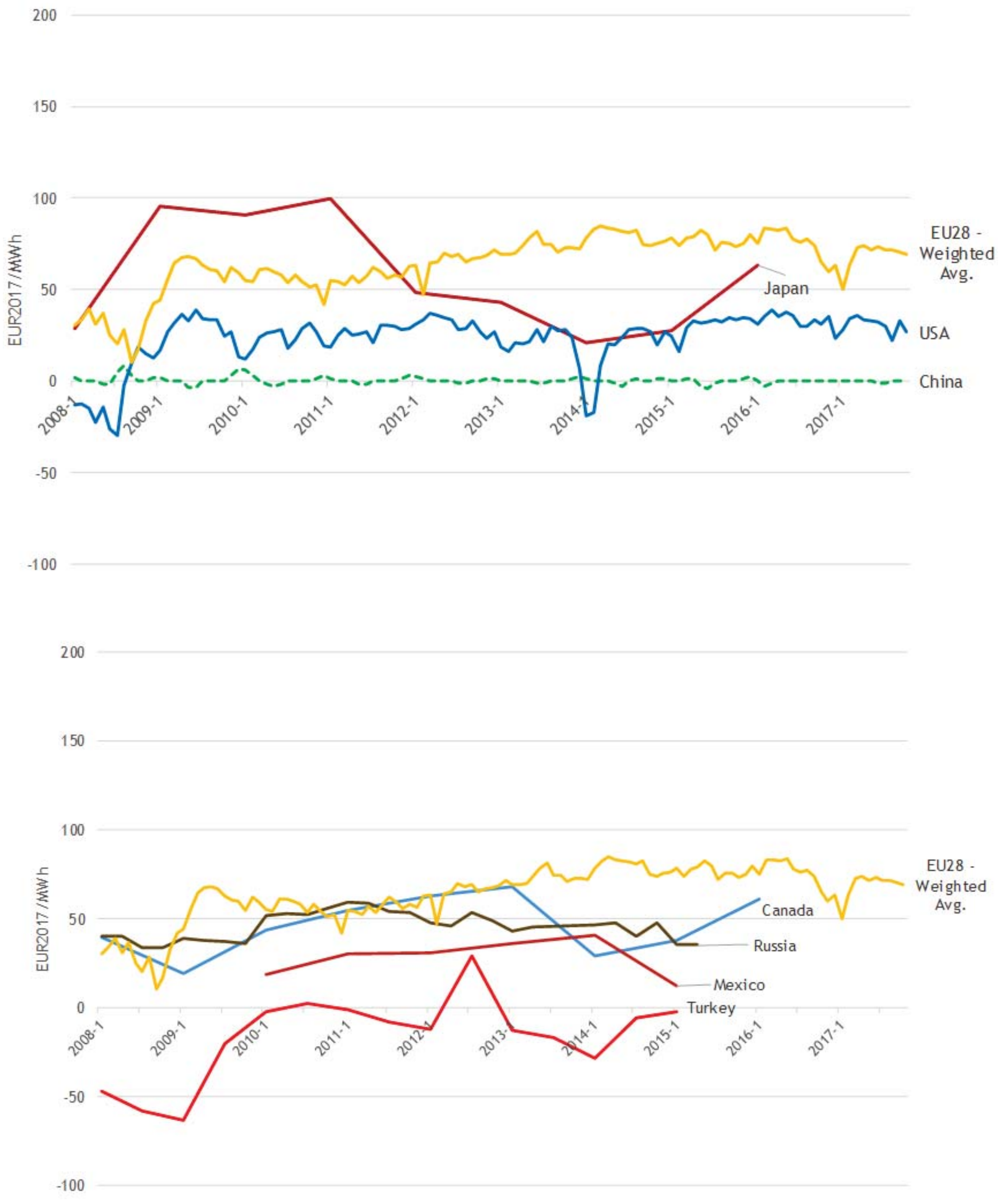

Figure 35 - Difference between industrial retail electricity prices and electricity wholesale prices, EU28 and other G20 countries, 2008-2018, EUR_{2017}/MWh

Source: Trinomics et altri study

2 Gas prices

2.1 Wholesale gas prices

Main findings

- European wholesale gas prices plummeted in the wake of the 2008-2009 financial crises but recovered by 2011-2013, helped by the economic recovery and the Fukushima accident which increased global LNG demand. This was followed by a period of declining prices as low oil prices and increasing global LNG supplies, coupled with weak demand put pressure on European gas prices. After bottoming out in 2016, wholesale gas prices have been on the rise, driven by the economic recovery, rising gas demand (both in Europe and globally) and increasing oil and coal prices.
- European wholesale prices move in a rather wide range, with regional price differences driven mainly by the level of competition: in general, markets with higher levels of competition show a lower price level than markets with only one supply source. Since 2015, falling oil prices, the decreasing role of oil-indexation and, in some cases the diversification of supply sources contributed to converging wholesale prices in Europe.
- Among the different pricing mechanism, oil-indexation is losing ground in the European market but continue to play an important role in certain regions, in particular in the Mediterranean, in Southeast Europe and the Baltics. On the other hand, hub prices gained significant ground in Central Europe: wholesale prices in this region are more and more aligned with Northwest European hub prices, rather than with oil-indexed prices.
- From time to time, daily prices can show extreme volatility, typically when cold snaps sharply increase demand while supply is limited by infrastructure constraints or other factors. Two such extreme periods occurred during the 2017-2018 winter, leading to unprecedented prices at certain gas hubs. On both occasions, rising prices provided the right signal to market participants and gas supplies were not interrupted but the extent of the price rise seems to point toward the inflexibility of demand.
- While oil-indexed prices have a diminishing role in the European market, European wholesale gas prices continue to be closely aligned with the oil price, reflecting the close relationship between the gas market and the wider energy complex. There is a strong correlation between oil and gas prices in the long term but during shorter periods the price trend of the two commodities can diverge. Compared to oil, the price of gas is more exposed to seasonality.
- EU gas demand shows a strong seasonality which is reflected in the development of wholesale gas prices: prices tend to be higher when temperatures are low. Periods of extremely cold temperatures often trigger price peaks.
- In international comparison, European wholesale gas prices are well above those in major gas producing countries (Canada, Russia, US) but in general lower than in other G20 economies, especially those which solely or largely rely on LNG imports (e.g. China, Japan, Korea). International prices have converged since 2015 which means that the absolute value of the regional differences decreased but, nevertheless, these differences proved persistent.

2.1.1 Evolution of wholesale gas prices

Gas prices, similarly to the price of most other commodities, peaked in 2008, driven by robust global economic growth and rising demand from emerging markets, particularly China. In the wake of the economic crisis, prices sharply decreased: in less than one year, European gas hub prices fell by around 70%. Prices gradually recovered between 2009 and 2013, helped by the economic recovery and the Fukushima accident which increased global LNG demand. In March 2013, hub prices exceeded the record levels reached in 2008.

In 2013-2016, wholesale gas prices were on a declining trajectory and, by 2016, European wholesale gas prices fell to the lowest levels since 2009. In this period, low oil prices and increasing global LNG supplies, coupled with weak demand put pressure on European gas prices.

Wholesale gas prices have bottomed out in 2016 and have been on the rise since then, driven by the economic recovery, rising gas demand (both in Europe and globally) and increasing oil and coal prices. Hub prices have nearly doubled since 2016 and, at the same time, they have been exhibiting strong seasonal volatility.

The Commission follows the development of a number of wholesale gas prices across the EU, including prices at trading hubs, estimated border prices calculated based on customs data and other prices reported by commercial data providers or other sources. Wholesale prices move in a rather broad band: in 2008-2014, the average difference between the highest and lowest price was close to 20 EUR/MWh. From 2015, prices have perceivably converged, with the widths of the band narrowing to around 10 EUR/MWh in 2015-2017. In case of extreme events (cold spells and/or supply disruptions) affecting specific regions, e.g. in the first quarter of 2018, the price band can become much wider.

Hub prices, especially those in the liquid Northwest European markets have been near to the lower border of the price range for most of the last decade, as demonstrated in **Figure 36** by the price at the Dutch (TTF) and the UK (NBP) hubs. Oil-indexed prices, on the other hand, have been typically closer to the upper border of the price band for most of the period, as indicated by the development of the Platts North West Europe Gas Contract Indicator (GCI), a theoretical index showing what a gas price linked 100% to oil would be.

Regional price differences are largely explained by the different pricing mechanisms and the different levels of competition. In general, markets with higher levels of competition show a lower price level than markets with only one supply source. Lower oil prices, the decreasing role of oil-indexation and, in some cases, new supply sources (e.g. LNG in Lithuania and Poland) contributed to converging wholesale prices in Europe in 2015-2017.

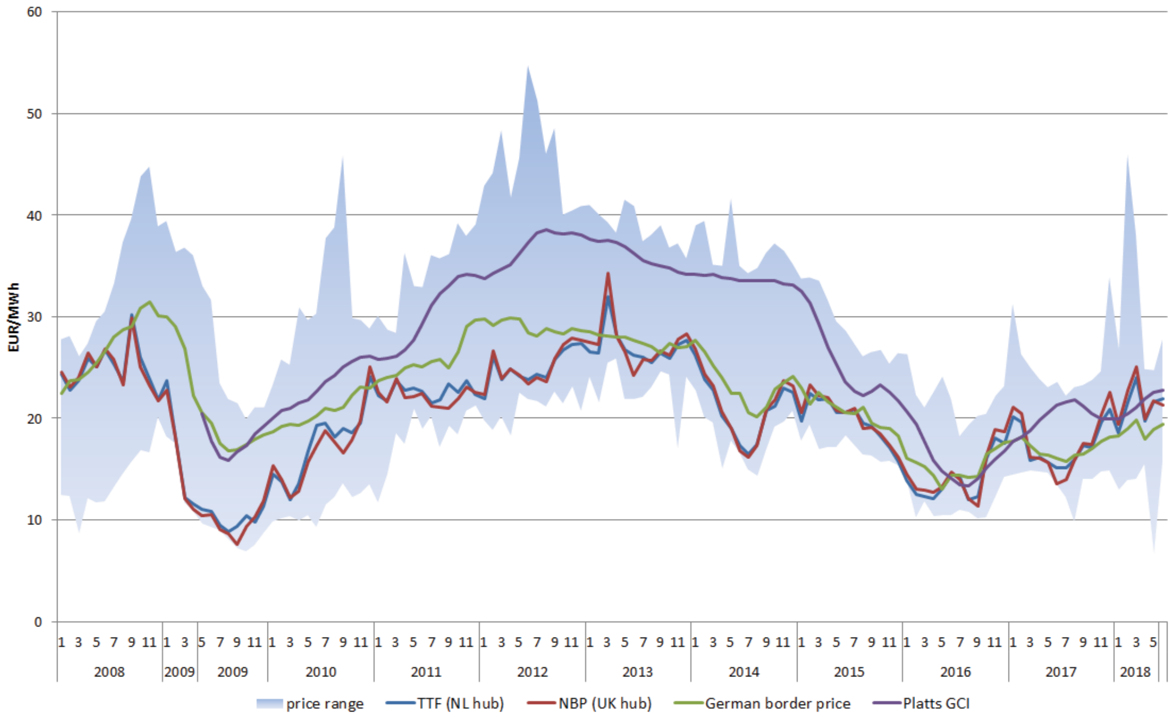

Figure 36 - Selected wholesale gas prices in Europe

Source: Platts, BAFA, Eurostat Comext

The difference between GCI and the price at the Dutch hub (TTF) averaged around 10 EUR/MWh in 2011-2014. In the wake of the oil price fall in 2014-2015, oil-indexed gas prices have significantly decreased, facilitating the convergence of European wholesale gas prices. In certain periods, oil-indexed prices were actually lower than the price at the most liquid gas hubs in Northwest Europe. This was the case during most of the 2016-2017 winter and in March 2018 when hub prices grew driven by high seasonal demand and supply disruptions.

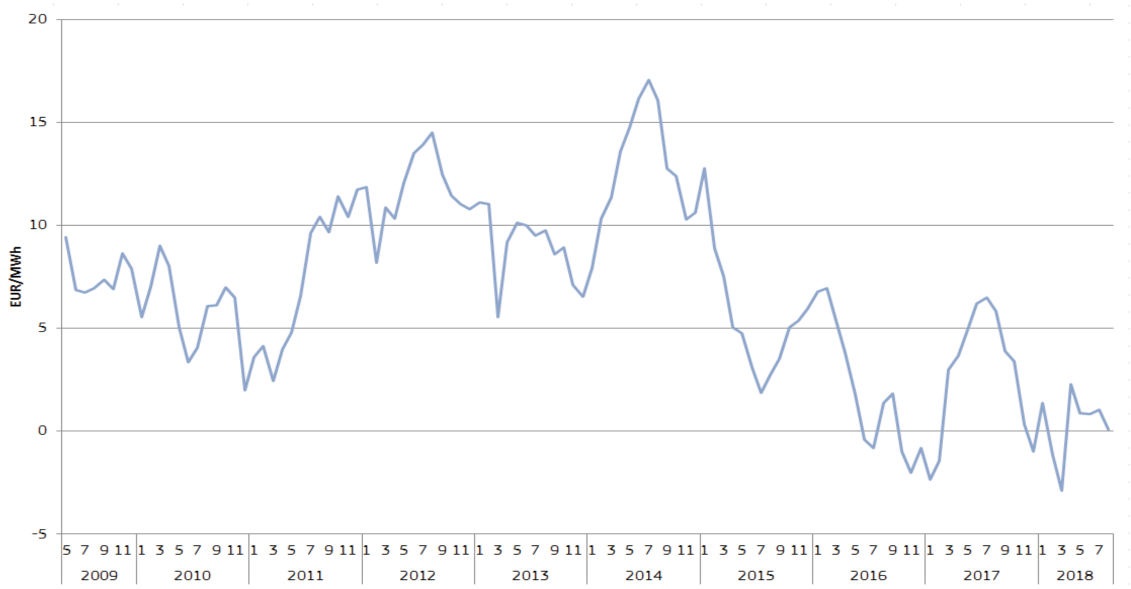

Figure 37 - The difference between the Platts North West Europe Gas Contract Indicator (GCI) and the Dutch hub price (TTF)

Source: Platts

Over the period, there has been a trend of moving from oil-indexed prices towards hub pricing. After years of a declining trend, the share of oil-indexation in Europe seems to have stabilised around 30% in 2014-2016 but there are significant regional differences.

The development of the German border price (a weighted average gas import price for the country) on **Figure 36** clearly demonstrates the trend of moving towards hub pricing: while in 2009 it was very close to the Platts GCI index, it gradually approximated the Dutch and UK hub prices, showing that the pricing of German imports, including those coming from Russia, is increasingly based on hub prices, rather than oil-indexation. As **Figure 38** shows, such a trend could be observed also in the countries of Central Europe (e.g. Czech Republic, Hungary, Slovakia) where wholesale prices are more and more aligned with Northwest European hub prices, rather than with oil-indexed prices. On the other hand, oil-indexation continued to have an important role in the Mediterranean, in Southeast Europe and the Baltics.

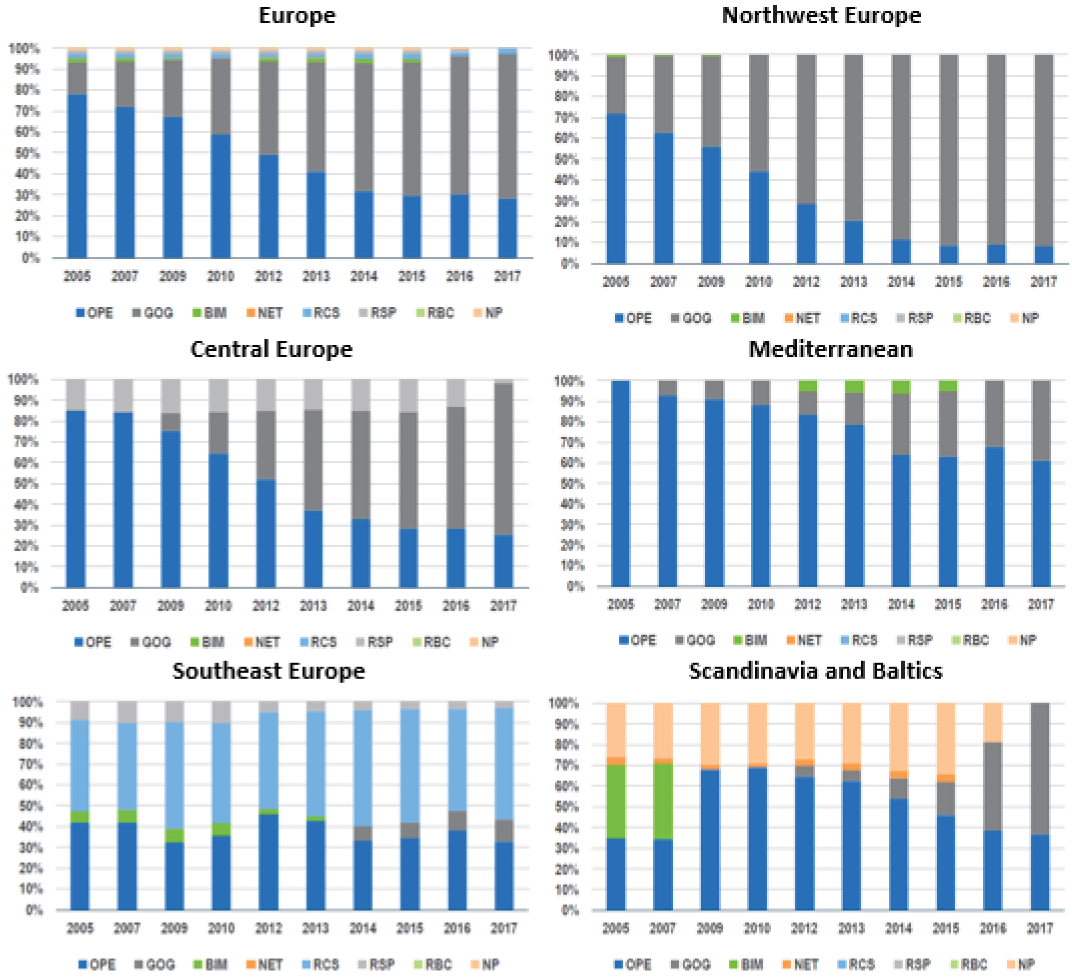

Figure 38 - Price formation in Europe

Source: IGU Wholesale Gas Price Survey, 2018 Edition
Northwest Europe: Belgium, Denmark, France, Germany, Ireland, Netherlands, UK
Central Europe: Austria, Czech Republic, Hungary, Poland, Slovakia, Switzerland
Mediterranean: Greece, Italy, Portugal, Spain, Turkey
Southeast Europe: Bosnia, Bulgaria, Croatia, FYROM, Romania, Serbia, Slovenia
Scandinavia & Baltics: Estonia, Finland, Latvia, Lithuania, Norway, Sweden
OPE: oil price escalation, GOG: gas-on-gas competition; BIM: bilateral monopoly, NET: netback from final product, RCS: regulated cost of service, RSP: regulated social and political, RBC: regulated below cost, NP: no price

The monthly average prices depicted in **Figure 36** often hide a high degree of daily volatility. For short periods, daily prices can reach exceptionally high levels, typically when cold naps sharply increase demand while supply is limited by infrastructure constraints or other factors. **Figure 39** shows that two such extreme periods occurred during the 2017-2018 winter, leading to unprecedented prices at certain gas hubs.

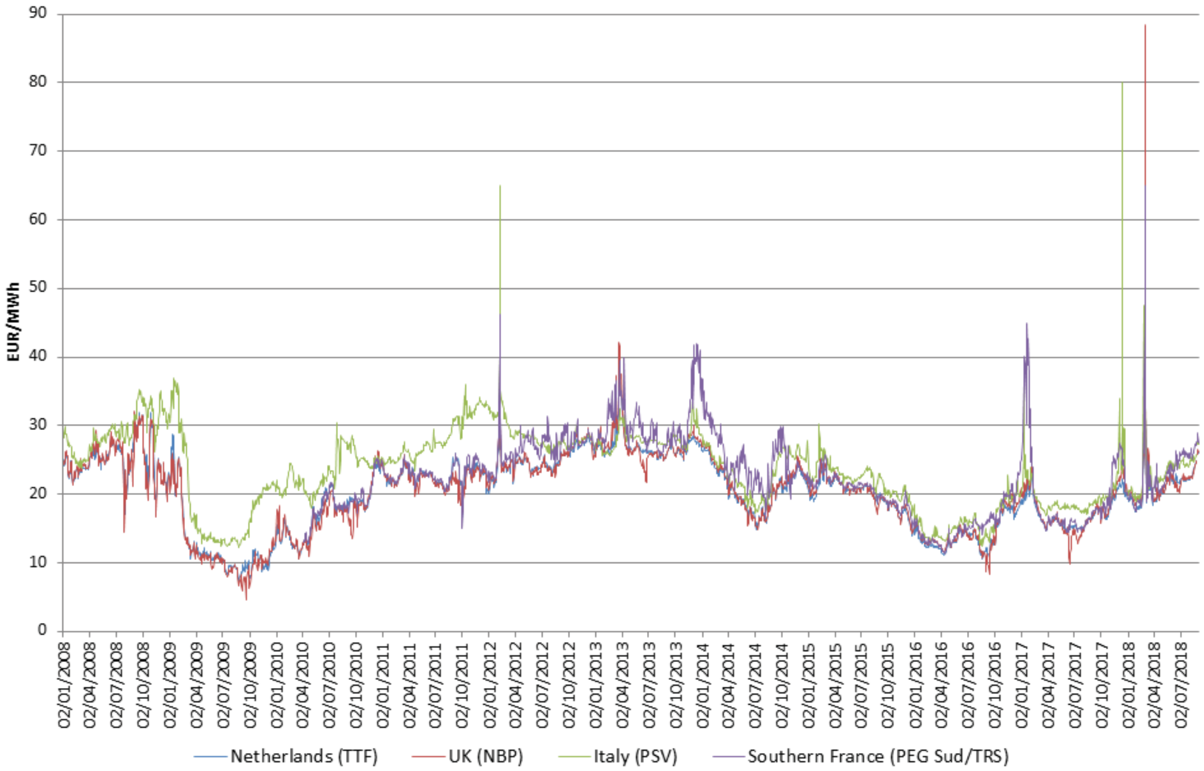

Figure 39 - Daily day-ahead prices at selected gas hubs from 2008 to mid-2018

Source: Platts

On 12 December 2017, an explosion at the Baumgarten facility in Austria cut Russian supplies to the country. In Austria, domestic supplies were secured from increased storage withdrawals. The accident also cut all Russian imports to Italy, the main source of supply to the country. In Italy, the supply-demand balance was rather tight already before the incident, because of strong winter demand and reduced import capacity through Switzerland. In the wake of the disruption, the Italian day-ahead price settled at a record 80 EUR/MWh on 12 December, up from 23.7 EUR/MWh the day before. The price spike allowed demand to fall and alternative supplies to grow. Italy has a number of import sources and, within hours, pipeline imports were ratcheted up on all supply routes, with the biggest additional volumes coming from Switzerland and Algeria. To a lesser extent, Libyan supplies also increased. In addition, LNG send-out from the Adriatic LNG facility was also stepped up. Growing imports were not sufficient to replace the missing volumes; increased withdrawals for domestic storages had to fill the gap. A longer-lasting disruption would have also attracted additional LNG cargoes. However, the outage was resolved in less than a day, with gas flows from Russia resuming before midnight and prices quickly receding to previous levels.

More or less at the same time, amid strong seasonal demand, supplies in Northwest Europe were constrained by the unplanned outage of the Forties pipeline system in the UK North Sea and a 2-day loss of output from Norway's Troll field. The outage of the Forties pipeline lasted from 11 to 30 December 2017 and triggered a reduction of UK gas production by 30-40 million cubic meters a day. As a result, UK prices also soared, reaching the highest level in nearly three years and incentivising additional imports. On 12 December, the NBP settled at 26.1 EUR/MWh, 3.9 EUR/MWh above the TTF and the premium remained around 2

EUR/MWh between 13 and 20 December. Increasing imports through the Interconnector (from Belgium) and the BBL pipeline (from the Netherlands) were instrumental in replacing missing volumes and, after 20 December, rising temperatures also contributed to the easing of the market tightness. On the other hand, the price signal was not strong enough to boost LNG imports.

During a late-winter cold snap in late February/early March 2018, temperatures dropped around 10°C below the seasonal average in most of Europe, causing a significant price spike. The cold spell triggered record gas consumption in a number of Member States and tightened the supply-demand balance in Europe. The cold spell arrived at a time when gas storage levels were already rather low (especially in Northwest Europe), increasing the impact on day-ahead prices. Hub prices in Western Europe reached unprecedented levels, with TTF and NBP closing at 79.0 Euro/MWh and 88.4 Euro/MWh, respectively on 1 March 2018. Storage withdrawals typically tail off in February but this was not the case in 2018. Skyrocketing spot prices provided a boost to withdrawals which was a key source of gas supply during the cold spell. On 28 February, withdrawals in the EU reached 11.4 TWh (nearly 1.1 bcm), the highest daily rate on record. On the other hand, the price spike did not last long enough to attract additional LNG supplies: LNG imports remained below 2017 levels in both February and March 2018.

On both occasions, rising prices provided the right signal to market participants and gas supplies were not interrupted but the extent of the price rise seems to point toward the inflexibility of demand.

Figure 39 also depicts the price in Southern France which, on certain occasions, well exceeds the price in the Northern part of the country. Northern France has access to the diverse supply sources available in Northwest Europe and, as a result, the price is typically very close to the price at the Dutch TTF hub. Southern France, however, is largely relying on the LNG terminals on its Mediterranean coast; constraints on the north-south link within France mean that prices can be quite divergent. For example, the premium of PEG Sud/TRS over PEG Nord reached a record 23.0 EUR/MWh on 20 January 2017 when high seasonal demand coupled with low LNG imports and the persistent capacity restrictions on the north-south link caused supply tightness in the Southern part of the country. In this period, LNG supplies from Algeria, France's main LNG supplier, were hindered by technical issues. Under such circumstances, prices had to increase substantially and for a sustained period in order to attract LNG cargoes from the high-priced Asian market. By early February, milder weather and additional LNG cargoes allowed the situation to ease and the premium of TRS over PEG Nord has practically disappeared. Ongoing infrastructure upgrade projects will help to debottleneck the north-south link; once these are completed, such big price differences are not likely to occur any more.

2.1.2 Factors impacting the evolution of wholesale gas prices

The development of wholesale gas prices is influenced by a number of factors. In this section we look into the impact of two important variables, the oil price and the weather.

There is a persistent strong correlation between oil and gas prices. By definition, this is the case for oil-indexed prices, as shown by **Figure 40** which depicts the movement of the Brent oil price and the Platts North West Europe Gas Contract Indicator (GCI), a theoretical index showing what a gas price linked 100% to oil would be. Typically there is a 6-9 month time lag in the pricing formulas used which means that oil-indexed gas prices react to changes in the oil price with a delay. For example, Brent started its steep fall in mid-2014 but this was reflected in the development of oil-indexed prices only from the beginning of 2015.

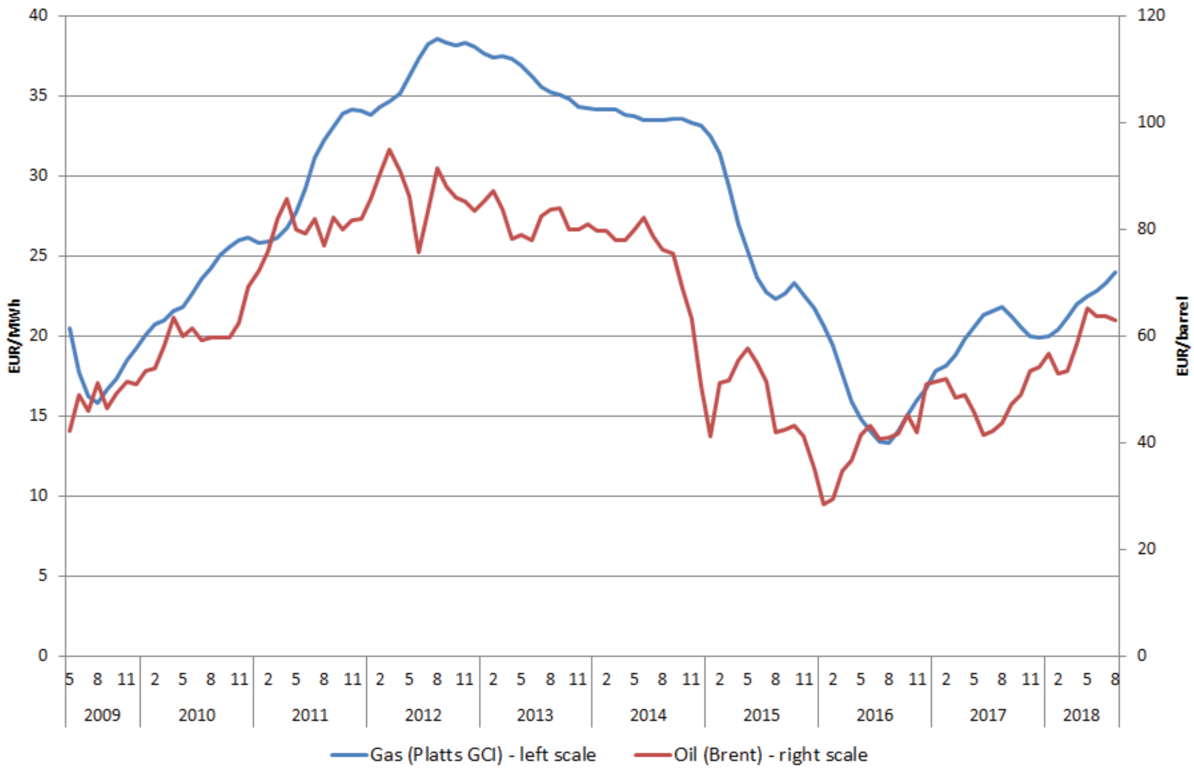

Figure 40 - The monthly average price of oil (Brent) and oil-indexed gas contracts (Platts GCI)

Source: Platts

The observation of a strong correlation between oil and gas prices also holds for European gas hub prices, as shown in **Figure 41** through the example of the Dutch TTF, Europe's most liquid hub. While oil-indexed prices have a diminishing role in the European market (see section 2.1.1), hub prices continue to be closely aligned with the oil price, reflecting the close relationship between the gas market and the wider energy complex.

Looking at the last decade, this correlation is apparent in the long term but in shorter periods the price trend of the two communities can diverge. For example, in the second half of 2014, when oil prices started to fall steeply, gas hub prices moved in the opposite direction. Also, the price of gas is more exposed to seasonality, as demonstrated lately by the distinct peaks during the 2016-2017 and the 2017-2018 winters.

In certain cases there seems to be a time gap between changes in oil and gas hub prices: in 2008-2009, TTF plunged a couple of months later than Brent while in 2014 the fall of TTF preceded the collapse of the oil price.

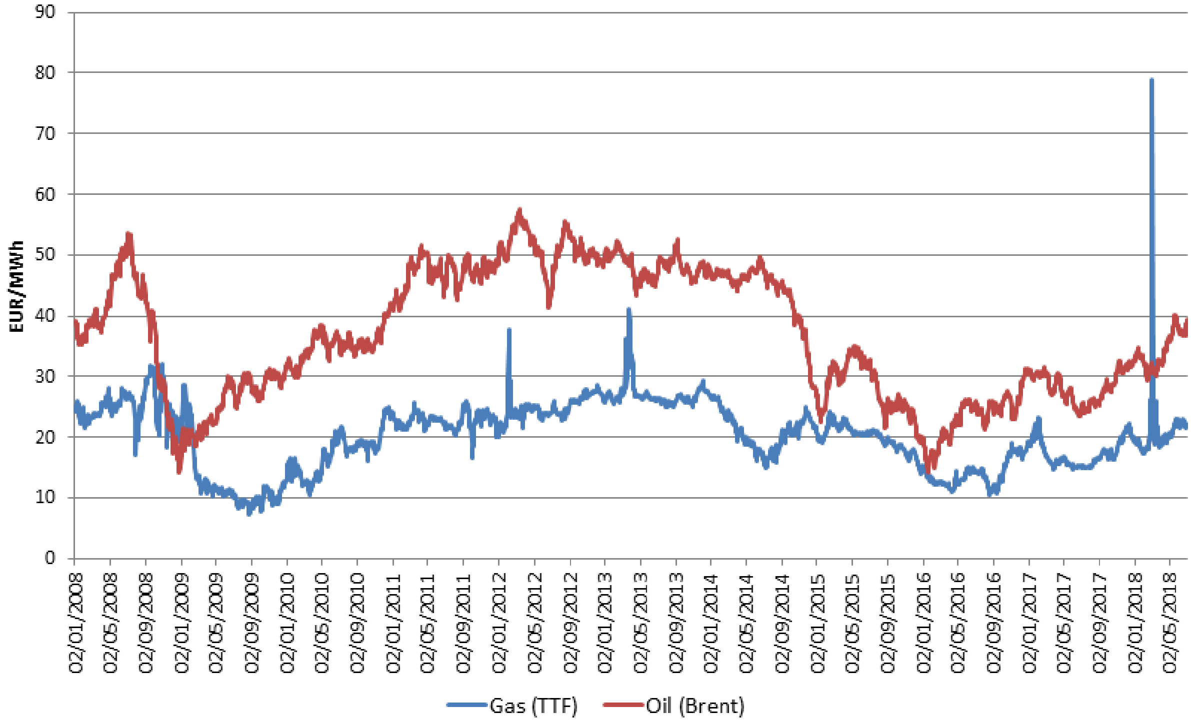

Figure 41 - Daily spot prices of oil (Brent) and gas (at the Dutch TTF hub)

Source: Platts

Figure 42 depicts daily changes of Brent and TTF. Dots represent individual days, showing the change of oil price (on the horizontal axis) and the gas price (on the vertical axis) compared to the previous day, expressed in percentage. While oil and gas prices do not necessarily change in the same direction every day, there is a weak positive correlation, particularly the increasing oil prices often coincide with increasing gas prices.

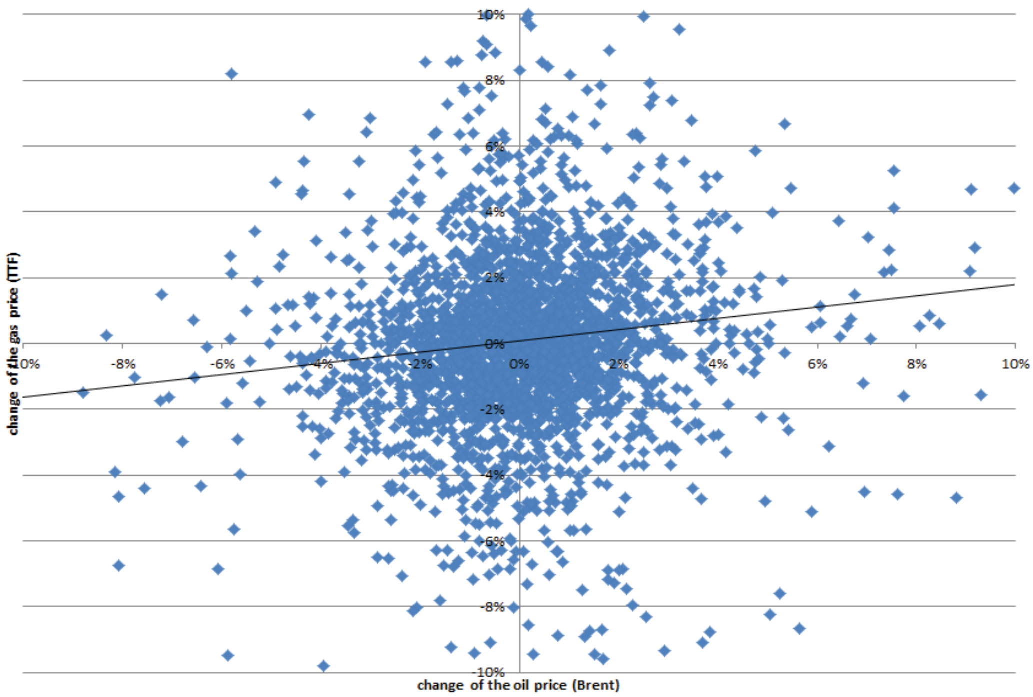

Figure 42 - Daily change of spot prices of oil (Brent) and gas (at the Dutch TTF hub)

Source: Platts

Measured in energy content, oil has traditionally been more expensive than natural gas. This was the case in the last decade, except for a short period at the end of 2008 and the beginning of 2009 when European gas hub prices followed the plunge of oil price with some delay. Between the beginning of 2008 and mid-2018, the price of Brent (measured in EUR/MWh) was on average 86% higher than the price of gas at the TTF hub. This ratio has gradually decreased over the period, meaning that the relative price of gas compared to oil increased. In the last three and a half years, the average "premium" of oil over gas was 58%.

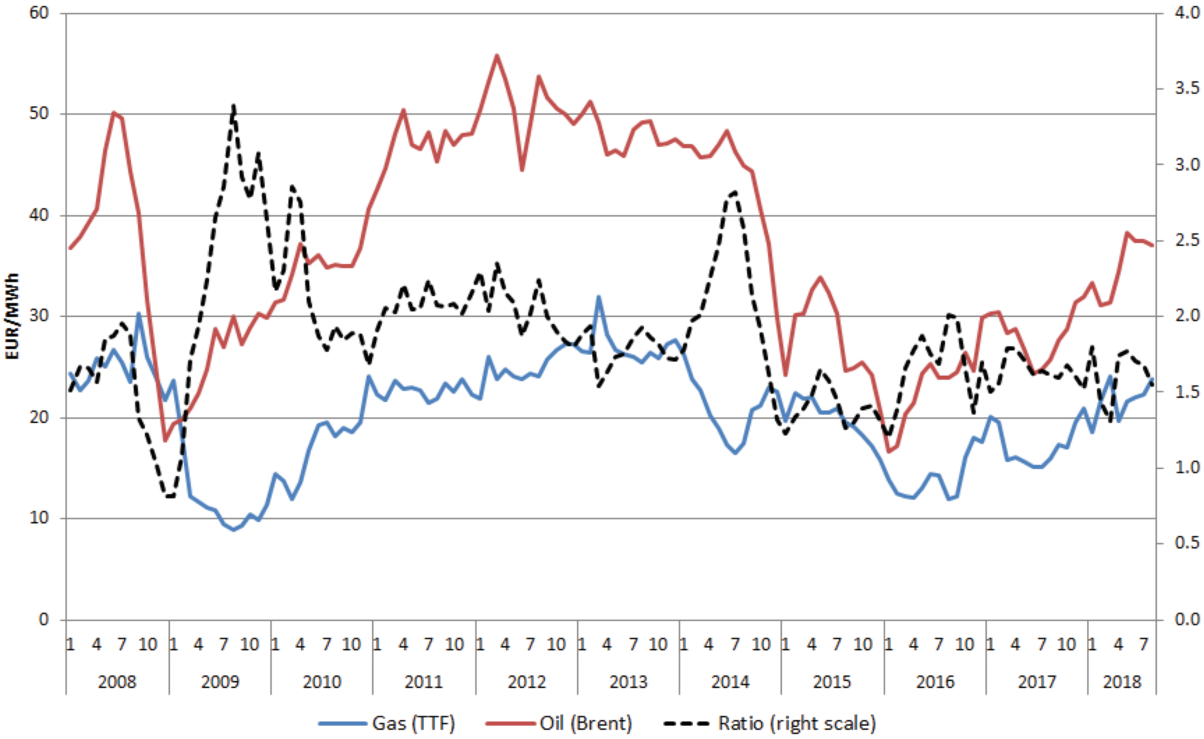

Figure 43 - The monthly average price of oil (Brent) and gas (at the Dutch TTF hub), measured in EUR/MWh

Source: Platts

Note: a conversion rate of 1.7 MWh/barrel was used for Brent

EU gas demand shows a strong seasonality, reflecting the fact that a large proportion of gas is used for space heating. According to 2016 data, the residential sector covered 27% of the gross inland consumption of gas in the EU; this is very close to the share of transformation input (gas used mainly in power stations and district heating plants) which was 33%.[22] Depending on temperatures, the level of gas consumption can be rather volatile during the winter months which can obviously have an impact on the price of gas.

Accordingly, one would expect a seasonality in prices reflecting the seasonality of demand, with lower temperatures associated with higher prices. Looking at the Netherlands, this is indeed the case in several years (in particular 2009, 2014, 2016 and 2017) with lower prices in summer and higher prices in winter. On the other hand, there are years when such a trend cannot be observed, indicating that gas prices are also impacted by other factors. But in general, periods of extremely cold temperatures (e.g. January 2009, January 2010, December 2010, January 2012, January 2017) trigger smaller or larger price peaks. Cold spells at the end of winter, when gas stocks are largely depleted (e.g. March 2013 and March 2018), can induce exceptionally high prices.

[22] Source: Eurostat (http://ec.europa.eu/eurostat/web/energy/data/energy-balances)

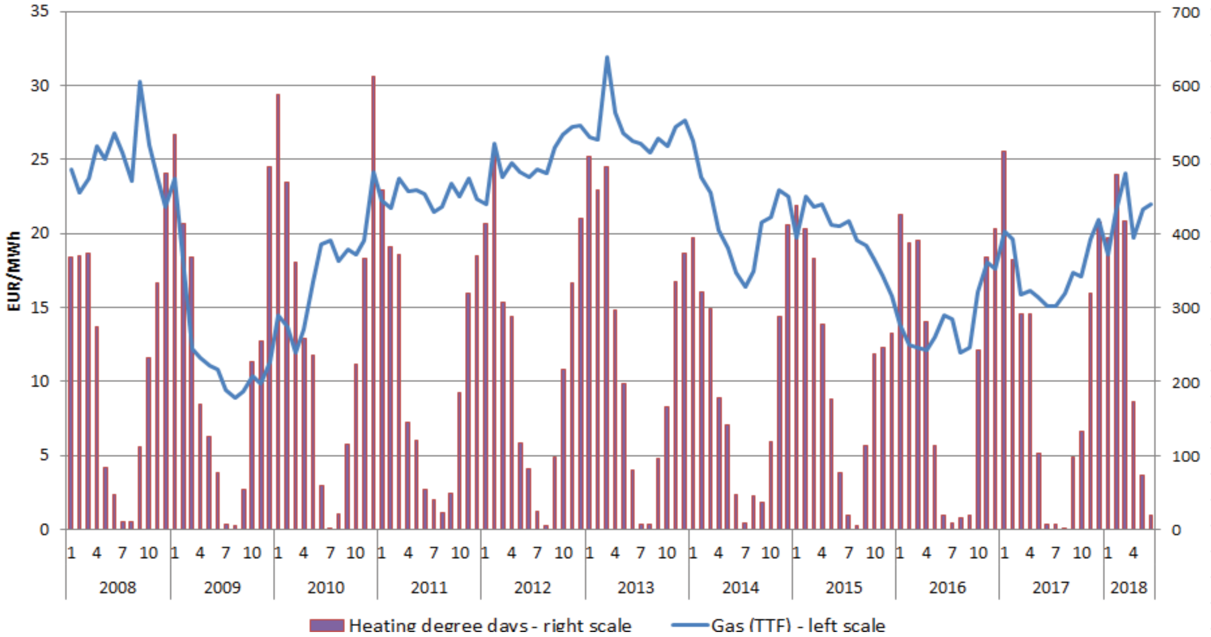

Figure 44 - Monthly average gas price at the Dutch TTF hub and heating degree days in the Netherlands

Source: Platts, Eurostat

On **Figure 45**, dots represent individual days, showing the daily average temperature in the Netherlands (on the horizontal axis) and the gas price at the TTF hub (on the vertical axis). The linear trendline confirms the negative correlation between temperatures and prices. It is also clearly visible that exceptionally high prices occur on days with low temperatures. Since 2013, the TTF price never exceeded 30 EUR/MWh on days with an average temperature of more than 4°C. The highest price was observed on 1 March 2018 when temperatures were 9°C below the seasonal average.

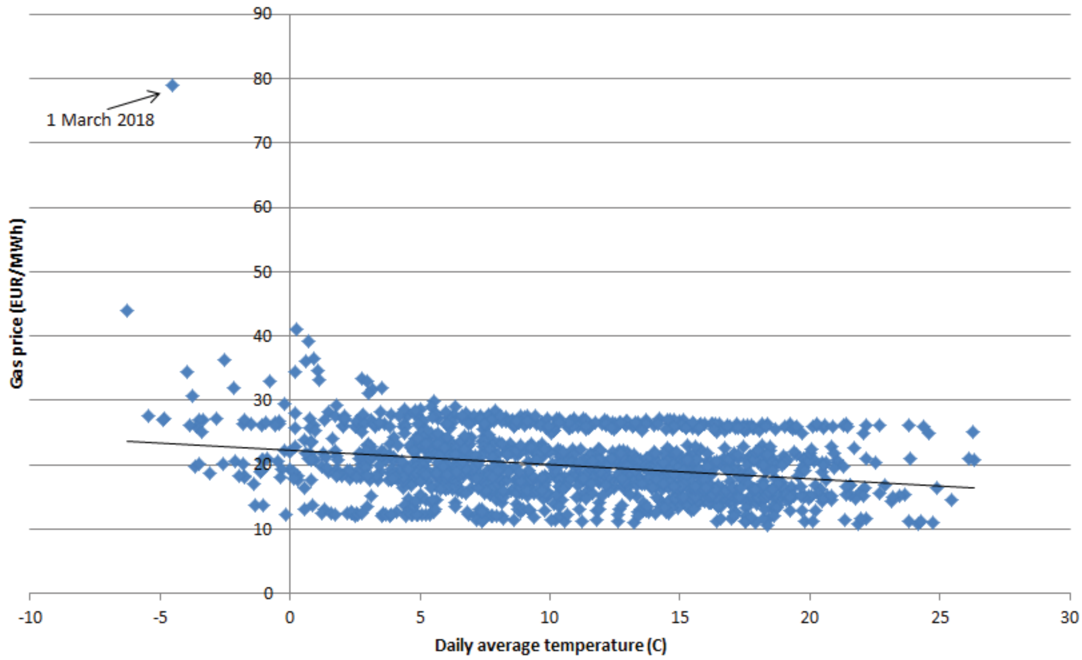

Figure 45 - Daily gas price at the Dutch TTF hub and average daily temperature in the Netherlands from the beginning of 2013 to mid-2018

Source: Platts, Thomson Reuters/Point Carbon

Note: only weekdays are depicted

2.1.3 International comparison

Comparing European gas wholesale prices with those in the EU's major trading partners provides an insight into how energy costs can impact the international competitiveness of energy intensive industries which are exposed to global trade.

After the 2011 Fukushima accident and the start of the US shale gas revolution, the three main regional benchmarks depicted in **Figure 46** had significantly diverged and price differences remained large through 2011-2014. Since the second half of 2014, there has been a convergence of international prices. Japanese LNG prices significantly decreased, facilitated by weak demand in Asia and the increasing global LNG supplies, and compounded by the fall of oil prices. These factors also contributed to the decrease of prices in Europe, thereby lowering the premium above the persistently low gas wholesale price in the US.

In the second quarter of 2017, the convergence among the key international gas prices reached the greatest level since the Fukushima accident. However, the trend of converging regional prices was interrupted during the last two winters (2016-2017 and 2017-2018) when Asian prices showed a steep rise due to strong seasonal demand. European and US prices also increased but to a lesser extent, resulting in a widening gap between regional benchmarks.

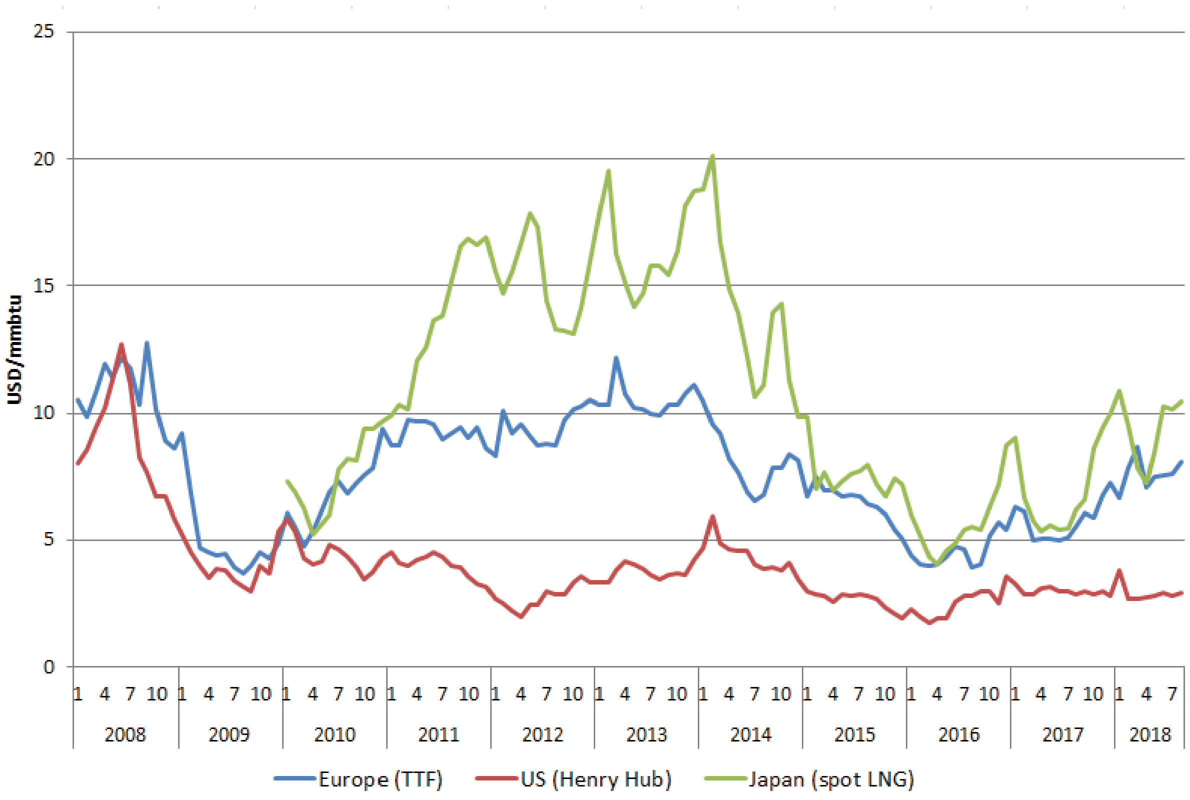

Figure 46 - Comparison of European, US and Japanese wholesale gas prices

Source: Platts, Thomson Reuters

There has been a slow convergence between US and European prices in 2012-2016, with the ratio of European and US prices dropping below 1.5 in the third quarter of 2016. Since then, however, European prices increased while US prices remained rather stable, leading to a diverging trend. European prices remain stubbornly high compared to those in the US: in 2017, the TTF price was on average almost two times higher than the US Henry Hub benchmark.

For most of 2011-2014, Japanese spot LNG prices were 40 to 100% higher than the Dutch TTF benchmark. In the last few years, during the summer months, the gap between European and Japanese prices has almost disappeared. However, during the winter months, driven by the strong seasonal demand in Asia, Japanese prices rise substantially and as a result show a distinctive premium over Europe. In 2017, the Japanese spot LNG price was on average 20% higher than the price at the Dutch TTF hub but in January 2018 the mark-up was well above this level, reaching 64%. In March, when TTF surged due to a late-winter cold spell, the Japanese spot LNG price was exceptionally lower than the Dutch benchmark.

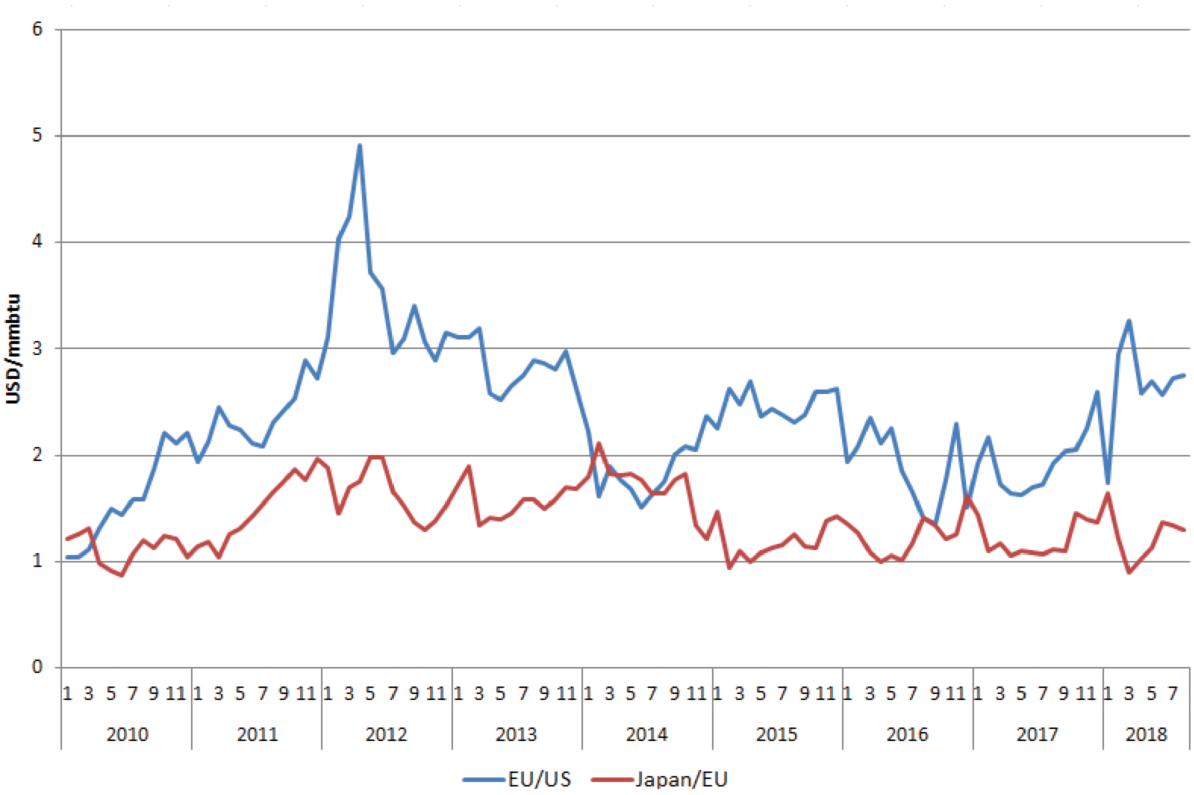

Figure 47 - The ratio of European, US and Japanese wholesale gas prices

Source: Platts, Thomson Reuters

Table 3 - The ratio of European, US and Japanese wholesale gas prices

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018*
EU/US	1.25	1.24	1.58	2.34	3.51	2.84	1.88	2.48	1.88	1.95	2.66
Japan/EU			1.12	1.49	1.62	1.57	1.71	1.18	1.23	1.20	1.24

Source: Platts, Thomson Reuters – The 2018 values refer to the period of January-August 2018

The study prepared by Trinomics[23] provides a more comprehensive international comparison of gas wholesale prices, covering most G20 economies, with the findings shown in **Figure 48** and **Figure 49**. Prices are expressed in constant (2017) euros. In case of the EU, a weighted average of national wholesale prices was calculated and depicted.

The analysis reveals a very large dispersion of prices in 2011-2011, followed by a noticeable convergence from 2015. Part of the gas wholesale prices is indexed to oil prices and hence the price convergence was largely driven by the lowering of the crude oil price.

[23] Energy prices, costs and subsidies and their impact on Industry and Households (2018) by Trinomics et altri (2018)

Major gas producing countries, including Canada, Russia and the US have the lowest gas wholesale prices in the G20. This was also the case in Australia until 2016 but then domestic supply shortages triggered a significant price rise.

Apart from the producing countries, wholesale prices in the G20 countries tend to be higher than the EU average, often showing a high degree of volatility.

Chinese wholesale prices follow a similar trend to the Japanese price but in 2011-2014, after the Fukushima accident, the absolute level of the price remained somewhat lower, probably because – unlike Japan– China is not fully reliant on LNG (the country also has indigenous production and pipeline imports from a couple of sources). In addition, Chinese prices exhibit less seasonality.

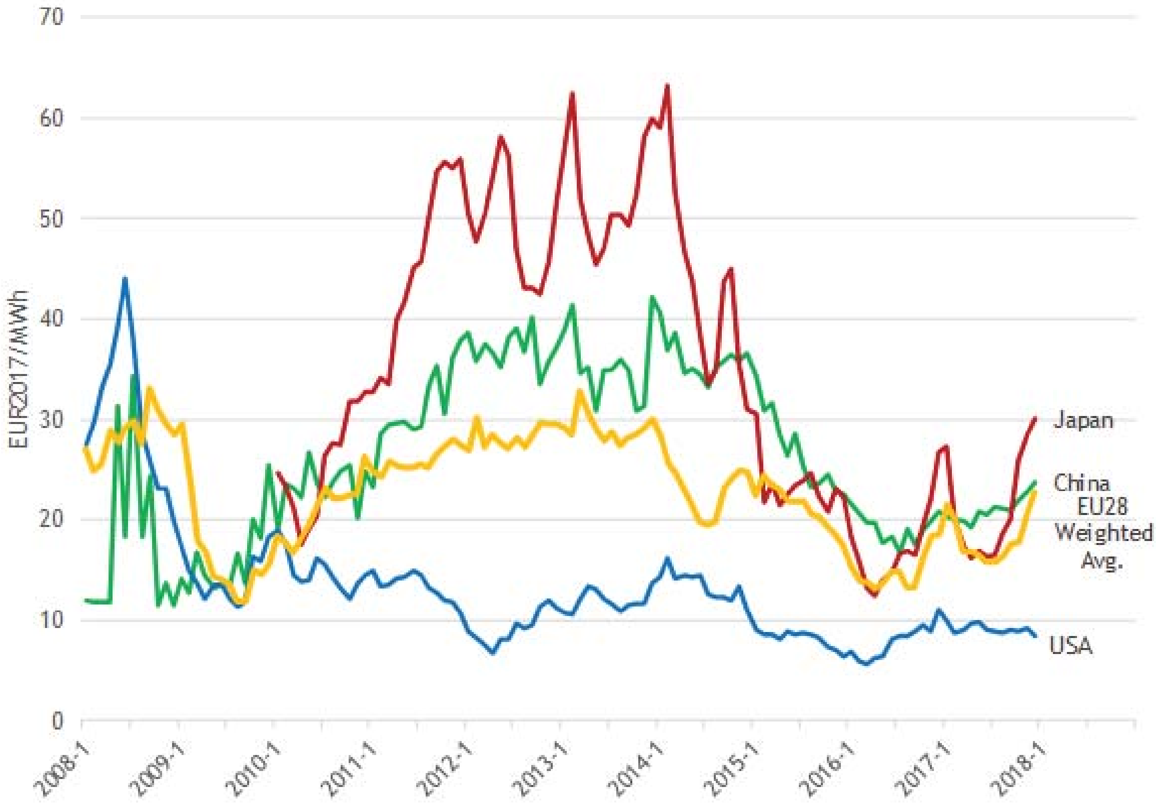

Figure 48 - Gas wholesale prices in the EU (weighted average), China, Japan and the US

Source: Platts, Thomson Reuters, Knoema (World Gas Intelligence; World Bank), World Bank Commodities Price Data (The Pink Sheet).

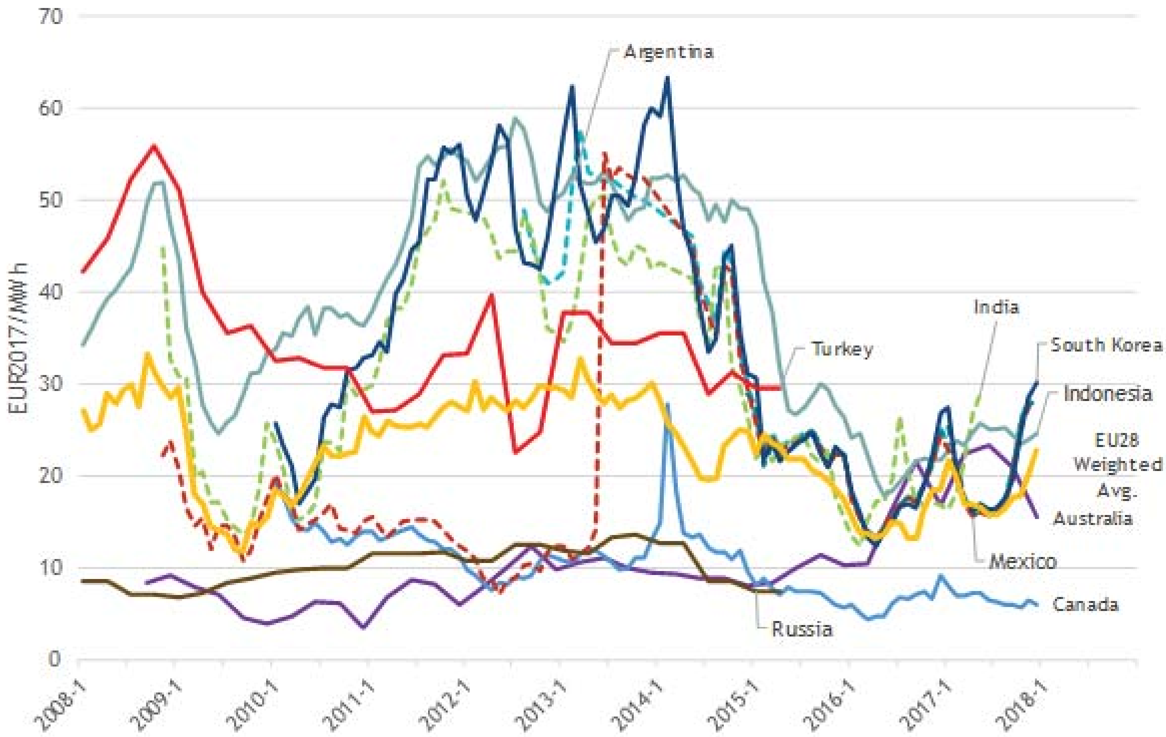

Figure 49 - Gas wholesale prices in the EU (weighted average) and selected markets

Source: Platts, Thomson Reuters, Knoema (World Gas Intelligence; World Bank), World Bank Commodities Price Data (The Pink Sheet).

2.2 Retail gas prices

Main findings

- Progress towards the completion of the single gas market continued. This is reflected by the fact that national energy components are gradually converging: they became 20%[24] less spread out over the last decade.
- Natural gas prices remained largely determined by the international wholesale price of the commodity and followed its evolution with a slight time lag. Consequently, the energy component - containing wholesale prices- retained its positions as the largest of the three components for all consumer types, with shares ranging from 50 to 80%.
- In absolute terms the energy component increased by half a percent annually for households but decreased at a faster pace for industrial consumers (by 1.75% annually[25]).
- Network charges continued to be on divergent trajectories for different gas consumer types. They increased annually by 4% for households and 5% medium industrial consumers but decreased by 1.6% annually for large industrial consumers.
- The impact of taxation on natural gas prices remained limited. Taxes made up 26% of household bills (compared to 40% for electricity) and only 10% of large industrial gas bills.
- The composition of taxes on natural gas bills also differs significantly from their electricity counterparts. Almost 90% of imposed additions are fiscal instruments generating revenue for the state budget and only a small portion are levies supporting specific policies. Non- harmonized taxes (other than VAT and excise duty) are more common compared to electricity bills.
- Support to renewable energy has played an insignificant role in gas price developments. By 2017 only 3 countries imposed a RES levy on gas.
- The EU household gas prices grew by 2.5% annually since 2008 and reached 60 EUR/MWh in 2017. Industrial gas prices evolved in the opposite direction as prices for both small and large consumers contracted over the same period and reached 29 EUR/MWH and 22 EUR/MWh respectively.

[24] Average of the 3 analysed natural gas consumption bands (D2,I3,I5).
[25] Average of the two analysed industrial bands (I3,I5).

Table 4 - Key figures on the evolution and drivers of retail gas prices

Consumer type	Household (D2)			Industrial (I3)			Large Industrial (I5)		
Component	Annual growth	Share 2017	Δ Share	Annual growth	Share 2017	Δ Share	Annual growth	Share 2017	Δ Share
Energy	0.5%	49%	- 10 p.p.	-2%	69%	- 14 p.p.	- 1.5%	81%	- 4 p.p.
Network	+ 4.1 %	24%	+ 3 p.p.	+ 4.8 %	18%	+ 7 p.p.	- 1.6%	8%	0
Taxes	+ 5.8 %	26%	+ 7 p.p.	+ 10%	13%	+7 p.p.	+ 5%	11%	+4 p.p.
Total	+ 2.5 %			- 0.4%			- 1%		

Source: DG ENER in-house data collection

Scope of the chapter

According to Regulation (EU) 2016/1952 the report analyses prices of natural gas sold to consumers who purchase gas for their own use. Therefore prices paid by consumers who purchase gas for electricity generation in power plants or for non-energy purposes (e.g. for use in the chemicals industry) are excluded.

Box - The role of electricity and natural gas in our energy consumption

This chapter analyses consumer prices of electricity and natural gas. What is the role of these two energy products in our economy and everyday lives? Electricity accounts for 22% of our energy consumption[26] across the whole economy. This share remained remarkably constant over the last decade as a combined result of progressive electrification and increasing energy efficiency at the same time. The share of electricity varies considerably across reporting countries. It ranges from 13% in Lithuania to 34% in Sweden. The highest shares of electricity in final energy consumption are recorded by 2 non- EU member countries: Montenegro and Norway with 34% and 51% respectively.

The high share of electricity in Norway's energy mix results from the abundance of available hydro power resources. About 96% of electricity in Norway is produced from hydro power and most of it is consumed domestically. Relatively low cost and low carbon electricity helped Norway to develop a large power intensive industry. The availability of hydro electricity also impacts household energy consumption: electric heating sector is more wide spread than in other EEA countries. In Montenegro the dominant role of electricity results partially from the fact that there is no natural gas consumption in the country. On the other hand, different end uses of electricity, such as space cooling or electro intensive industries are prevalent.

Natural gas accounted for the exact same share on average across the EU as electricity, namely 22%. The share of natural gas in our final energy consumption has also not changed over the last 10 years. The use of natural gas differs even more across countries than the use of electricity. No gas is used on the islands of Cyprus and Malta. This is reflected in our data. The share of natural gas in final energy consumption of households is the lowest in Sweden at 1 %, closely followed by Finland and Norway with 2% share in both countries. The relative importance of natural gas is the highest in Hungary at 31%, followed by Italy and the United Kingdom with 29% share in both countries. Our analysis of national energy components reflects on the high shares of natural gas in the energy mix of these countries.

Electricity and natural gas together account for less than half of our energy consumption. The rest is covered mainly by liquid fuels for transport and heating as well as biomass.

[26] Final Energy Consumption in 2016, ESTAT: nrg_110a

2.2.1 Household Natural Gas Prices

Household gas prices were reported by 23 EU Member States and Turkey. Natural gas is not used on the islands of Malta and Cyprus and in Montenegro. Regulation (EU) 2016/1952 lays down that reporting countries, where natural gas accounts only for an insignificant share of final energy consumption, are exempt from the obligation of providing price data. According to this Finland, where the share of household consumption of gas in final energy consumption is below 1.5%, is not reporting such data. Figures for Greece and the United Kingdom are estimates by DG energy as these two countries have not reported the breakdown of gas prices. No household gas data or estimates are available for Greece after 2015.

The following chapter analyses gas prices paid by household consumers whose annual consumption falls in the range of 20 to 200 GJ. This consumption band is defined by Eurostat as D2. It is the most representative consumption band in all but one reporting country.

Evolution Household Gas Prices

Total prices grew at 2.5% annual rate from 2008 to 2017. In absolute terms the EU price grew from 48 EUR/MWh to 60 EUR/MWh. This growth is faster than inflation, which averaged at 1.2% annually during the same period. The overall increase recorded throughout the period 2008 to 2017 however conceals two distinct periods. Prices steadily grew from 2008 to 2014 but have been increasing ever since. The EU average price peaked at 69 EUR/MWh in 2014 and decreased to 60 EUR/MWh by 2017. This EU average conceals relatively homogenous developments on national level as prices increased only in 10 countries in the last reporting year. In 2017 Romania reported the smallest and Sweden the largest price. The ratio of the largest to smallest price increased by 6% to around 4:1 over the last decade.

Composition of Household Gas Prices

Over time, the composition of prices changed albeit less significantly than in the case of electricity. In 2017 the energy component, which mainly consists of wholesale prices, still made up almost half of the price even after its share decreased by 10 percentage points from 59% to 49% by 2017.

In absolute terms, the energy component decreased at an annual rate of 0.5% and reached 29 EUR/MWh in 2017. This collides with developments on the national level, as the energy component increased in only 6 reporting countries from 2016 to 2017.

The share of the network component increased slightly from 21% to 24% of the total price. In absolute terms the network component grew at the annual rate of 4% and reached 14 EUR/MWh by 2017.

The share of the taxes component grew by almost 7 percentage points and reached 26% in 2017. In absolute terms, taxes grew at the annual rate of 6% and reached almost 15 EUR/MWh by 2017.

The impact of taxes was smaller on household gas prices than on their electricity counterparts as the energy component, driven mainly by international commodity prices, remained the dominant component.

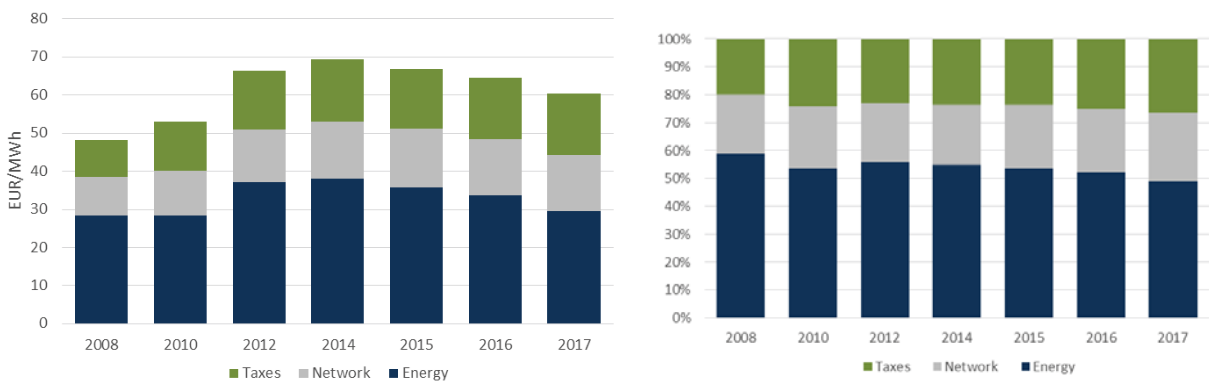

Figure 50 - Composition of the EU household gas price (DC)

Source: DG ENER in-house data collection

Drivers of Household Gas Prices

The EU natural gas price for household consumers peaked in 2014 and has been decreasing ever since. The trend results from a steady decline of the energy component, continued smaller increases in the network component and a volatile evolution of taxes. 2017 was the first year when all three components contracted, leading to the largest year-on-year fall of the total price in our observation period.

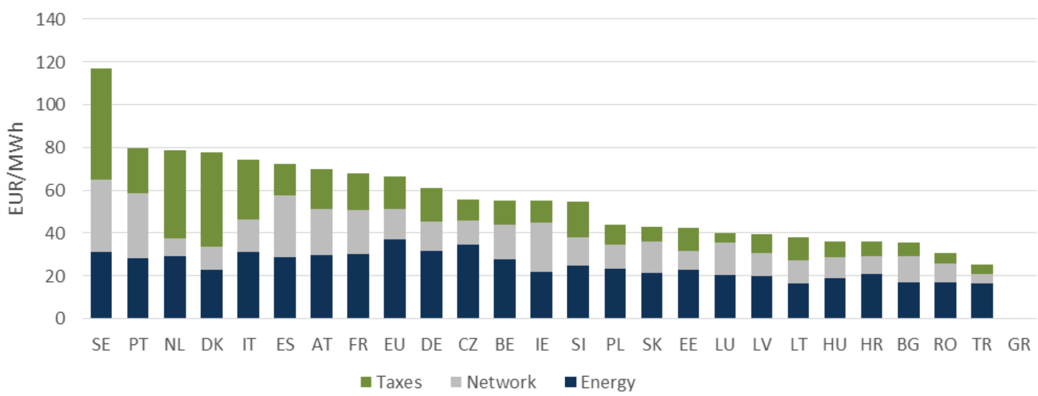

Figure 51 - Household gas prices in 2017

Source: DG ENER in-house data collection

Sweden's high gas prices stem from a carbon tax, which aims to curb greenhouse gas emissions. This holds both for households and industrial consumers. The tax was introduced as early as 1991 on all fossil fuels in proportion to their carbon content. Combustion of sustainable biofuels doesn't result in a net increase of carbon in the atmosphere and hence are not subject to the carbon tax.

Relatively high gas prices in Portugal result from a combination of factors, namely the very low unit consumption of households (mild climate), a modern network resulting in higher access tariffs (Portugal’s natural gas industry is only 20 years old), and a higher tax burden than in most other Member States. Additionally, natural gas has a CCGT backup role in Portugal, complementing the relevant, non-dispatchable and renewable-based electricity production. This balancing role led to access tariff volatility, affecting price convergence with other EU countries. This is reflected in our data: in other countries high prices typically stem from high taxes. In Portugal the network component of 30 EUR/MWh is more than double that of the EU average (13 EUR/MWh).

In the Netherlands relatively high prices stem also from taxation. 41 EUR/MWh taxes account for more than half of the total price and are significantly above the 13 EUR/MWh EU average. This tax policy aims to prevent gas field earthquakes at extraction sites through reducing demand. The Netherlands has significant gas resources in the Groningen area, located in north of the country. The extraction of these resources causes seismic activity which in turn causes significant damage to local businesses and homes.

90% of taxes imposed on natural gas bills across all reporting countries, including those in Sweden and the Netherlands, are non- earmarked taxes. Revenues from these taxes feed into the general budget and do not directly support energy or climate policies.

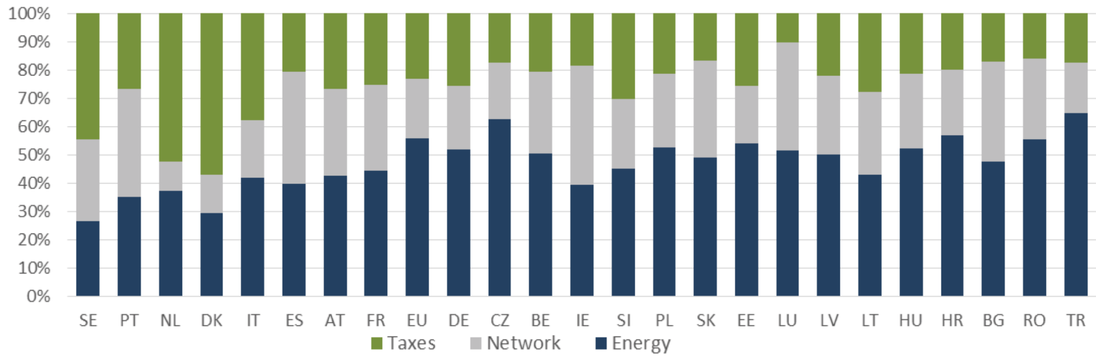

Figure 52 - Composition of household gas prices in 2017

Source: DG ENER in-house data collection

Composition of taxes, levies, fees and charges

Natural gas prices remained less impacted by taxation than their electricity counterparts. Taxes made up 26% of the total price compared to 41% of household electricity prices. The number and composition of taxes imposed on household gas prices also significantly differs from electricity taxation. While Member States add dozens of different policy support costs to electricity prices, the variety of taxes on gas prices is much more limited.

Taxation of household gas prices is dominated by excise duties. Such are imposed according to the Energy Tax Directive from 2003. Excise duties accounted for 40% of all taxes, twice as much as in the case of electricity (20%). Renewable energy support costs, which make up 30% of all taxes on electricity prices, have almost no impact on household gas prices as they account for less than a percent of the total price. Their 0.5% share almost equals the share of social charges and energy efficiency (both below half a percent share). In the case of electricity household prices RES support cost exceed energy efficiency related charges by a factor of 100. While until 2016 all but 3 Member States levied explicit RES support costs on household electricity prices, only 5 did so on household gas prices.

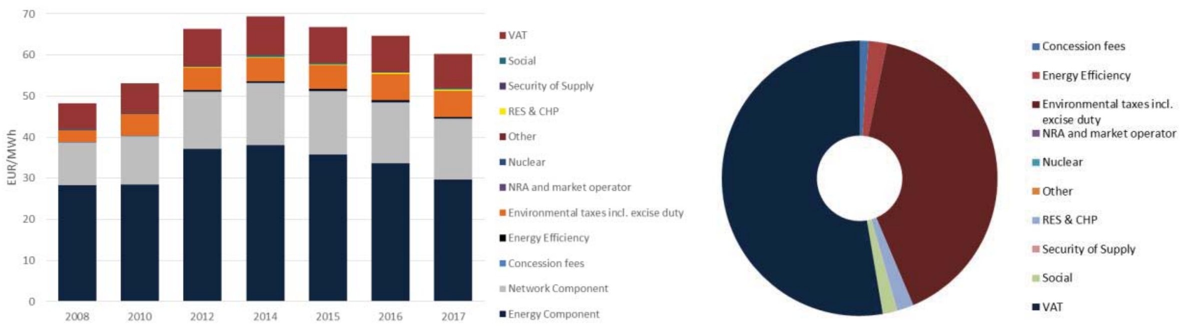

Figure 53 - Composition of EU taxes on household gas prices

Source: DG ENER in-house data collection

2.2.2 Industrial Natural Gas Prices

The following chapter compares gas prices paid by industrial consumers with medium versus large annual consumption. Medium industrial consumption is defined as band I3 covering annual consumption volumes between 10 000 and 100 000 GJ. Large consumption is defined as band I5 covering annual consumption between 1 million and 4 million GJ. Median industrial (I3) prices were reported by 24 EU Member States and Turkey. The breakdown of gas prices was not reported by Greece and the United Kingdom. Large industrial prices (I5) were reported by 19 EU Member States and Turkey (in other countries there are either no consumers in this consumption band or data is confidential). Figures for the United Kingdom are Commission estimates both for I3 and I5 prices.

Evolution Industrial Gas Prices

The observation period 2008 to 2017 conceals two distinct periods for both consumer types: Prices grew from 2008 to 2012 and have been on a decreasing trajectory ever since. Looking at the whole of the last decade, the median industrial price decreased at the annual rate of 0.4%. The large industrial price contracted even faster, by 1% annually. Inflation during the same period averaged at 0.5%[27]. In absolute terms the I3 price fell from 30 to 29 EUR/MWh by 2017. The I5 price decreased from 25 to 23 EUR/MWh. In 2017 Belgium reported the smallest I3 price and Sweden the largest. The ratio of the largest to smallest price across the EU increased by 22% since 2008 and reached almost 3:1 by 2017. The largest price for I5 consumers was also reported by Sweden, the smallest by Romania with a ratio of 3:1 in 2017. This ration decreased by 17% over the last decade. The convergence indicates progress towards the completion of the internal energy market.

Composition of Industrial Gas Prices

Over time the composition of industrial gas prices also changed, albeit to a different extent for the two consumer types. In 2008, the first year of our observation period, the energy component accounted for 82% of small and 85% of large industrial prices. The international price of the commodity, complemented by the commercial costs of suppliers, made up most of the final consumer price. The impact of network costs and taxes was limited. The share of

[27] Eurostat Producer Price Index (sts_inpp_a)

the energy component decreased to 68% for small and to 81% for large industrial consumers by 2017. The 13 percentage point decrease in the composition of the I3 price is more significant than the smaller change in the I5 price. In I3 prices, the diminishing share of the energy component was taken over equally by network charges, which grew by almost 5% annually and taxes, which grew by 10% annually. Taxes increased at a higher speed, albeit from an initially lower level, reaching 4 EUR/MWh by 2017. As a result, both components grew in absolute terms by about 2 EUR/MWh in the period 2008-2017. The share of the network and taxes components grew by 6.6% and 7.7% respectively.

The composition of I5 prices changed less significantly as the energy component maintained its dominance accounting for over four-fifths of the price, even as it decreased in absolute terms from 21 to 18 EUR/MWh by 2017. The network component also decreased in absolute terms: large industrial consumers payed 20 Eurocents/MWh less in 2017 than they did in 2008. These network developments hold uniquely for I5 consumers among all analysed electricity and gas bands. As the share of both the energy and network components decreased, the relative weight of taxes grew from 6% to 11%, and reached 2.5 EUR/MWH in absolute terms.

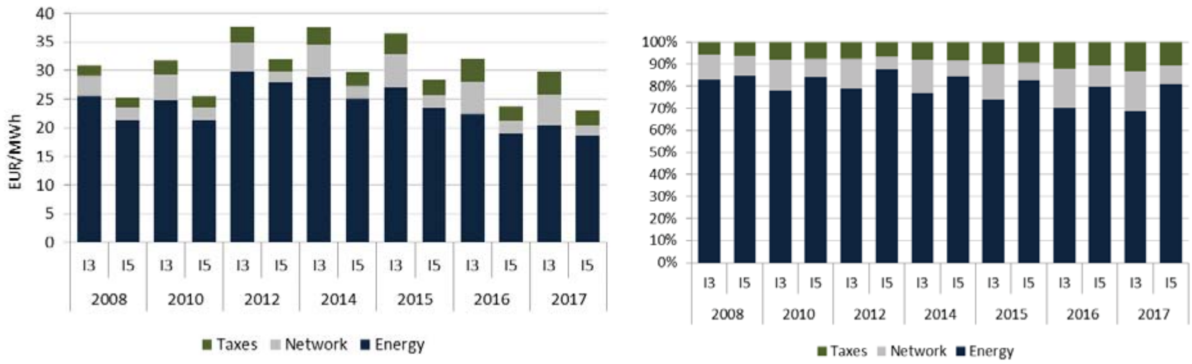

Figure 54 - Composition of EU prices for small (I3) and large (I5) industrial gas consumers

Source: DG ENER in-house data collection

Drivers of Industrial Gas Prices

Industrial gas prices remained dominated by the energy component, which mainly consists of the commodity price. Consequently, consumer prices followed the developments on international gas markets, albeit with a slight time lag. Between 2008 and 2010 the large energy component slightly decreased, while the initially small tax component grew by 25% for I3 consumers. From 2010 to 2012 international commodity prices gradually recovered. As a result, I3 and I5 consumer prices grew by 18% and 25% respectively. Since 2012, both prices have been on a downward trajectory. Decreases are driven by falling energy components complemented by moderate decreases in network components since 2015.

The evolution of the three components for the two consumer types (small and large industrial gas) is fairly similar. One difference is to be observed in the evolution of taxes: for small industrial gas consumers taxes kept increasing throughout the whole observation period while they started to decrease for large consumers in 2015. Price decreases are driven by the continued contraction of the energy component, in the last year accompanied by contractions in all three components for small industrial consumers.

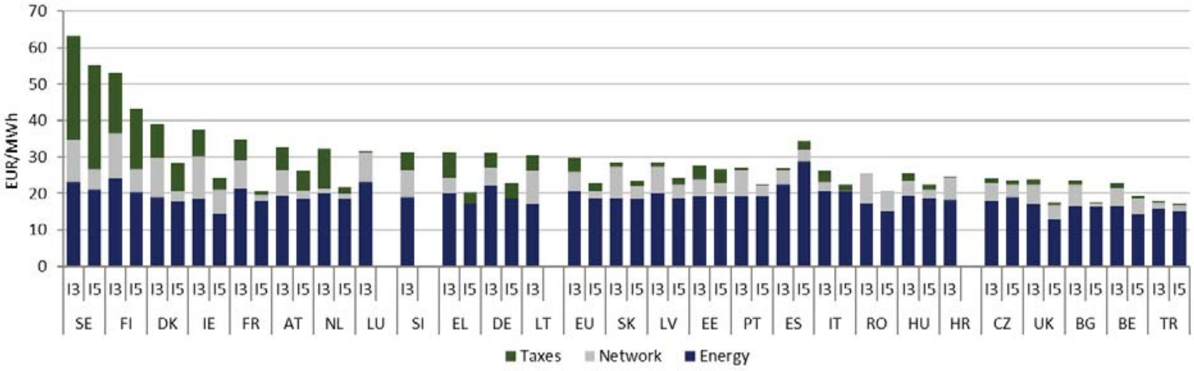

Figure 55 - Median (I3) and large (I5) industrial gas prices in 2017[28]

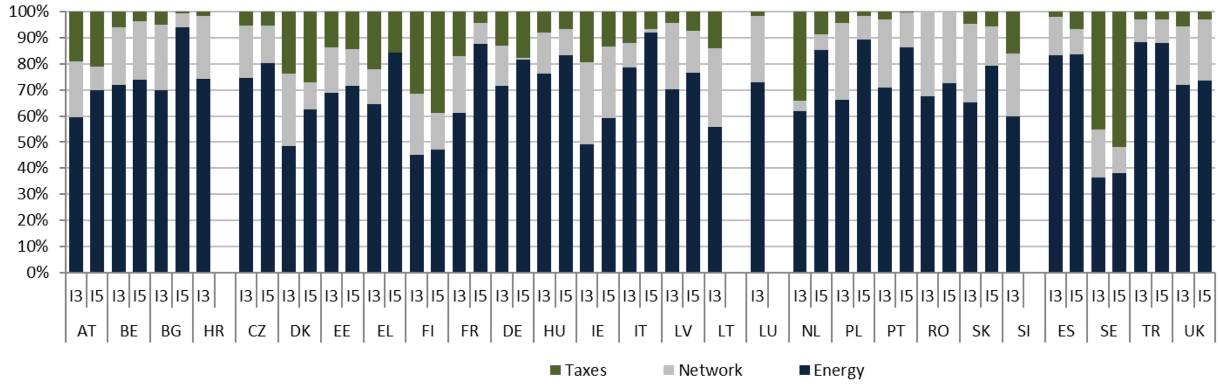

Figure 56 - Composition of median (I3) and large (I5) industrial gas prices in 2017[29]

Composition of taxes, levies, fees and charges

Gas prices are generally less impacted by policy support costs and fiscal instruments than electricity prices. Also, industrial consumers benefit from exemptions and reduced tax rates in most countries. As a result, taxes accounted for only 13% and 10% of the total price for medium and large consumers respectively. In comparison, taxes made up 26% of the household gas price and 40% of the household electricity price.

Taxes imposed on industrial gas prices consist mostly of excise duty and other non-earmarked taxes that do not support any specific policies (shown as environmental taxes incl. excise duty on our graphs). Non- earmarked taxes made up 89% and 86% of total prices for median and large consumers respectively. The impact of renewable energy support costs remained limited at 4% and 5% of all taxes. 3 countries imposed a levy on median industrial gas prices to support renewable energy and only 1 of all reporting countries (Italy) did so for large industrial consumers.

Several countries however impose taxes that are both non-earmarked and non-harmonized. These taxes are non- earmarked as their revenues do not support any specific policy and non-harmonized, as their minimum levels are not regulated on EU level (minimum levels of excise

[28] Energy Component for Greece includes also network charges
[29] Energy Component for Greece includes also network charges

duty and VAT are set by the Energy Tax Directive of 2003). Imposing non-harmonized taxes on gas prices is more common across the EU than imposing such taxes on electricity prices

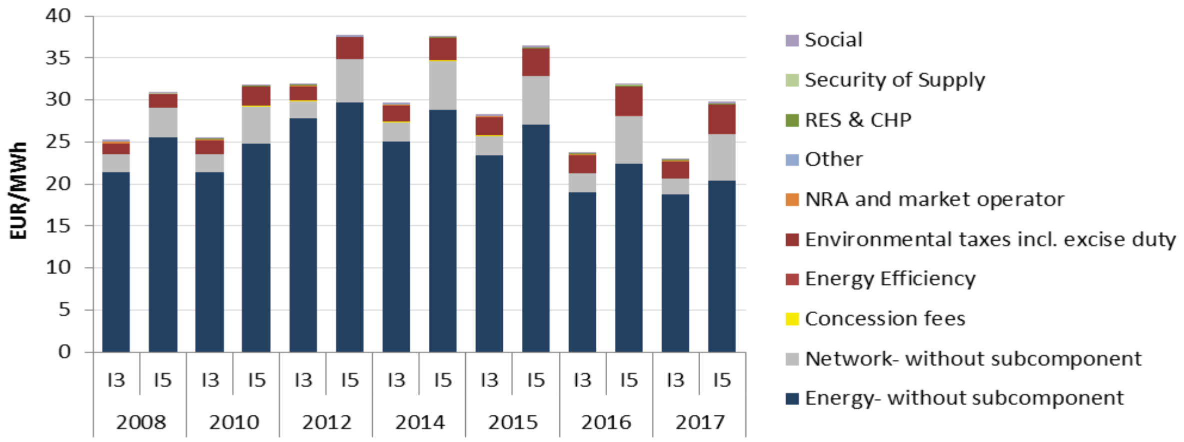

Figure 57 - Composition of EU gas prices for median (I3) and large (I5) consumers

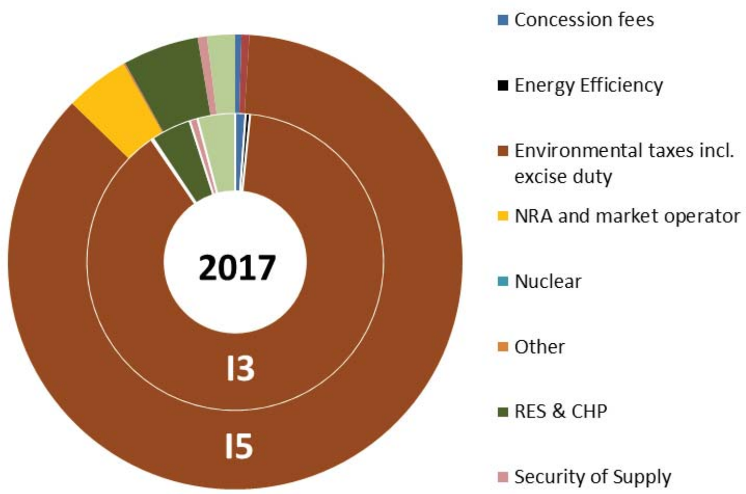

Figure 58 - Composition of taxes for median (I3) and large (I5) industrial gas consumers

2.2.3 International comparisons

For a detailed explanation on the purpose and methodology of this analysis, please consult the international comparison section of the electricity chapter.

Household Natural Gas Prices

The EU28 average difference between retail and wholesale prices increased from 30 EUR/MWh in 2008 to 40 EUR/MWh in 2017. The difference in the US is lower, at around 20 EUR/MWh and experienced only a small increase since 2008. The small difference however allows for important conclusions in terms of the role of the components. As US wholesale prices have declined significantly, the share of the other components in the total price must have increased.

The difference in Japan has declined over the period from more than 120 EUR/MWh to around 80 EUR/MWh but remains around twice as high as EU average levels. The price difference in China fluctuates between low and negative levels (+/- 10 EUR/MWh) indicating that Chinese households don't pay the full cost of their natural gas use. For all other G20 countries) the difference is lower than the EU28 average. In Mexico (MX) and Turkey (TR) there is only a very small difference, indicating that prices are regulated at low levels. The difference in Russia, Canada and Brazil is also lower, in the range of 20 EUR/MWh . Only in South Korea is the difference closer to the EU level. In Argentina the prices difference is negative, highlighting indicating that households pay subsidized prices that do not cover the full costs of their natural gas use.

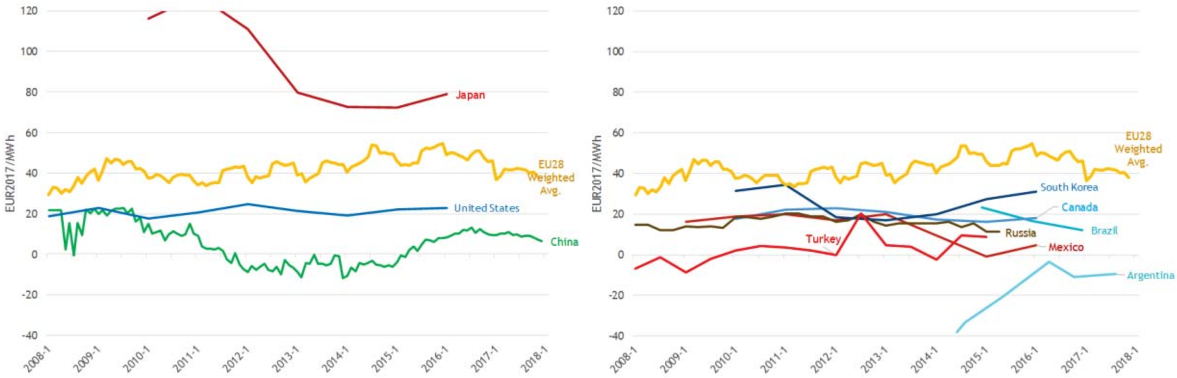

Figure 59 - Difference between household retail natural gas prices and wholesale prices, EU28 and trading partners

Source: Trinomics et altri study

Industrial Natural Gas Prices

The EU28 average difference between industrial retail and wholesale remained at 5 EUR/MWh between 2008 and 2017. The difference in the US is slightly lower than in the EU28 difference in Japan has been greater than EU, but has substantially converged since 2011. The price difference in China has been greater than in the EU and finished the period at around 15 EUR/MWh. In both Japan and China this reflects both wholesale and retail prices that are similar or higher than in the EU.

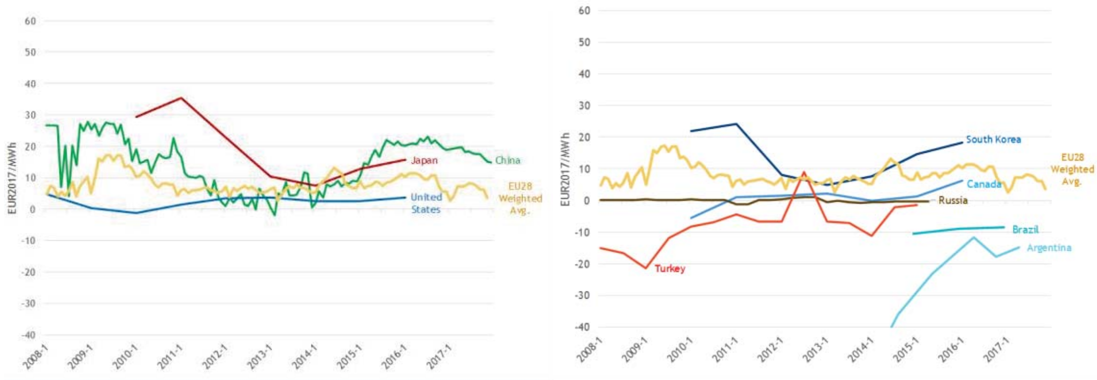

Figure 60 - Difference between industrial retail natural gas prices and wholesale prices, EU28 and trading partners

EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 2/11

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(2019) 1 final}

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3 Oil and oil product prices

Main findings

- After the dramatic fall seen in 2014-2016, crude oil prices have broadly been rising since mid-2017, driven by robust global demand growth, Middle East tensions, concerns over the impact of a return to US sanctions on Iranian oil, sliding output in Venezuela and the continued OPEC-led output cuts.
- The crude oil price is the main driver for the development of the wholesale prices of oil products although other factors, like the supply-demand situation in the specific oil product market, refinery maintenance or seasonality can also influence the prices.
- In addition to the crude oil price, the retail price of oil products is also influenced by the costs of refining and distribution, variations in exchange rates (crude oil is traded in US dollar but the finished products are sold at the pump in euros or other national currencies) and tax rates. In fact, the share of crude oil in the final price can be as low as 25% and, therefore, variations in the price of crude oil have a limited impact on the price at the pump. In contrast, the tax component (excise duty plus VAT) can reach up to 70% of the retail price
- The high share of taxes and exchange rate developments moderate the pass-through of falling/rising oil prices to the retail prices of oil products in Europe.
- In mid-2018, retail prices reached the highest levels since 2014-2015
- There has been some convergence of gasoline and diesel prices, helped by some convergence of the excise duty rates but in several Member States the tax advantage of diesel actually increased.

3.1 Crude oil prices

Crude oil prices reached unprecedented levels in 2008, with Brent exceeding 140 USD/bbl at the height of the "commodity super cycle" which was driven by the rising demand from emerging markets, particularly China. The price increase was interrupted by the financial crisis, with a sharp downturn in the second half of 2008. However, as demand recovered, prices began to rise and crossed the 100 USD/bbl level again in early 2011. This was followed by three and a half years of remarkable price stability, with Brent rarely leaving the 100-120 USD/bbl range.

Crude oil prices started to decline in mid-2014, driven by weak demand and robust supply growth, resulting in an oversupplied market. Global oil demand growth has significantly weakened in 2014, mainly because of lower than expected global economic growth and mild winter temperatures.

On the supply side, non-OPEC output showed a robust growth, driven by increasing unconventional oil production in North America. US light tight oil production proved to be rather resilient to low prices: improving efficiency and cost reductions allowed output to continue increasing in spite of the plummeting crude oil prices.

In spite of the falling prices, OPEC countries chose not to cut production in an attempt to maintain market share and to squeeze out high-cost producers. Furthermore, the lifting of the Iranian sanctions in January 2016 allowed Iran to increase its oil exports, adding to an already high OPEC output and further delaying the market rebalancing. OPEC and a few key non-OPEC producers finally agreed in November 2016 to limit their production, in order to accelerate the drawdown of the stock overhang and bring the rebalancing forward.

From a 115 USD/bbl peak in June 2014, Brent dropped to 26 USD/bbl on 20 January 2016, its lowest level since 2003. This means the price decreased by 77% in 19 months.

Despite the November 2016 agreement of OPEC and non-OPEC producers to reduce output, oil prices decreased in the first half of 2017 reflecting increasing production in the US, as well as growing output in Libya and Nigeria which were exempted from the OPEC cut. The rollover of the cut in May 2017 failed to reverse the trend: in the second half of June 2017, the price of Brent dropped below 45 USD/bbl, the lowest level since November 2016.

From mid-2017, however, oil prices have broadly been on the rise, driven by a combination of factors, including the robust growth of global demand, growing tensions in the Middle East, a number of actual supply disruptions (Northern Iraq, hurricanes in North America, closure of the Forties pipeline system in the UK North Sea, a sustained plunge of Venezuelan supply), the weakening of the dollar and a further extension of the OPEC cut in November 2017. In late December and early January, the protests in Iran provided support to prices.

Prices receded in early February 2018 as the market remained well supplied, but the price rise resumed afterwards as growing tensions in Syria and the expectation of the US withdrawal from the Joint Comprehensive Plan of Action (the Iran nuclear deal) raised concerns about future oil supplies. In mid-May 2018, after President Trump announced the re-imposition of US sanctions on Iran, Brent reached 80 USD/bbl, the highest level in three and a half years. Compared to the 44 USD/bbl low on 20 June 2017, Brent increased by more than 75%. Prices continued to rise despite the strengthening of the US dollar which in general is conducive to lower oil prices.

Brent receded to around 75 USD/bbl in late May/early June after Russia and Saudi Arabia indicated they would increase production in the second half of the year. On 22 June, OPEC and non-OPEC producers agreed to do away with the over-compliance with the cuts agreed back in 2016, implying a theoretical output increase of around 1 million barrels per day (mb/d) in the second half of the year. Despite the agreement, prices rose again in late June and early July, supported by production outages in Libya and Canada.

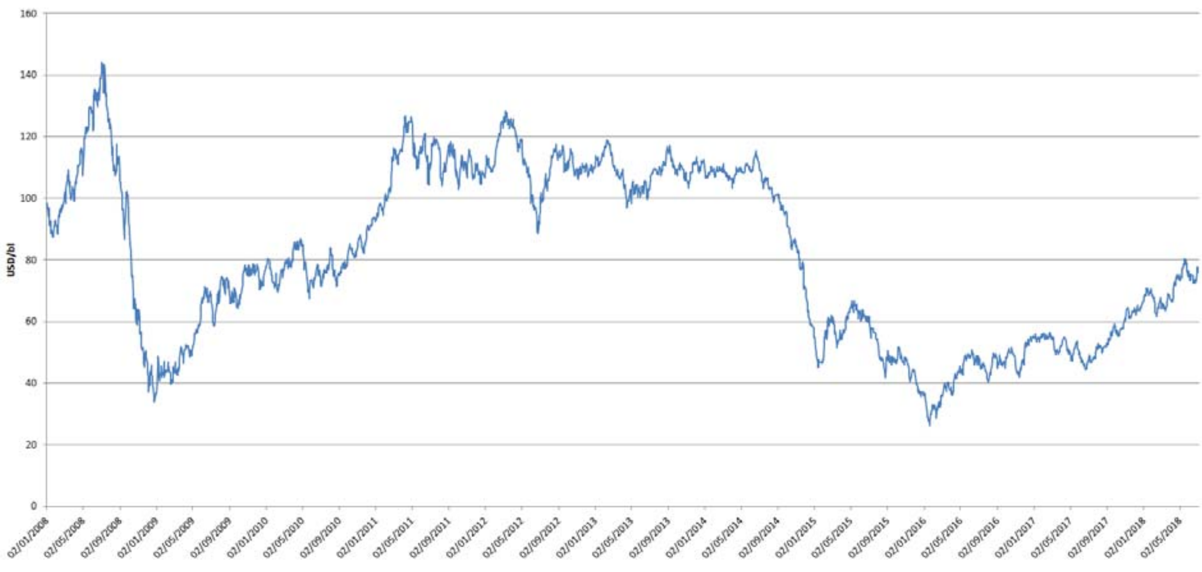

Figure 61 - The Brent crude oil price from 2008 to mid-2018

Source: Platts

The unilateral withdrawal of the US from the Iran nuclear deal casts doubt about the future of Iranian crude exports, at a time when we already see sliding output in Libya and Venezuela, as well as geopolitical risks in other parts of the world. This is expected to further tighten the global market, potentially leading to an additional price rise[30].

It is far from certain whether OPEC and Russia have the capacity to fill this gap. Even if they do, this will significantly reduce global spare capacity, making the market exposed to any supply disruptions.

3.2 Wholesale prices of oil products

Crude oil is the main feedstock to produce oil products and oil product prices closely follow the development of the crude oil price. This is clearly visible if we compare the Brent oil price with the representative wholesale prices of the main oil products in Western Europe.

Figure 62 - Crude oil (Brent) and European wholesale gasoline, diesel and heating oil prices from 2008 to mid-2018

Source: Platts, ECB

The following oil product prices were used: Gasoline Prem Unleaded 10ppmS FOB AR Barge (gasoline), ULSD 10ppmS FOB ARA Barge (diesel) and Gasoil 0.1%S FOB ARA Barge (heating oil)
The following conversion rates were used: crude oil 159 litre/barrel, gasoline 1350 litre/ton, diesel and heating oil 1186 litre/ton.

Looking at the crack spreads (i.e. the differential between the wholesale price of oil products and crude oil), one can see that these spreads are however rather volatile and often follow different paths for different products.

[30] However, oil market is very volatile; since the beginning of October 2018 crude oil prices fell and at the end of November 2018 the Brent crude oil price was slightly below 60 USD/bbl.

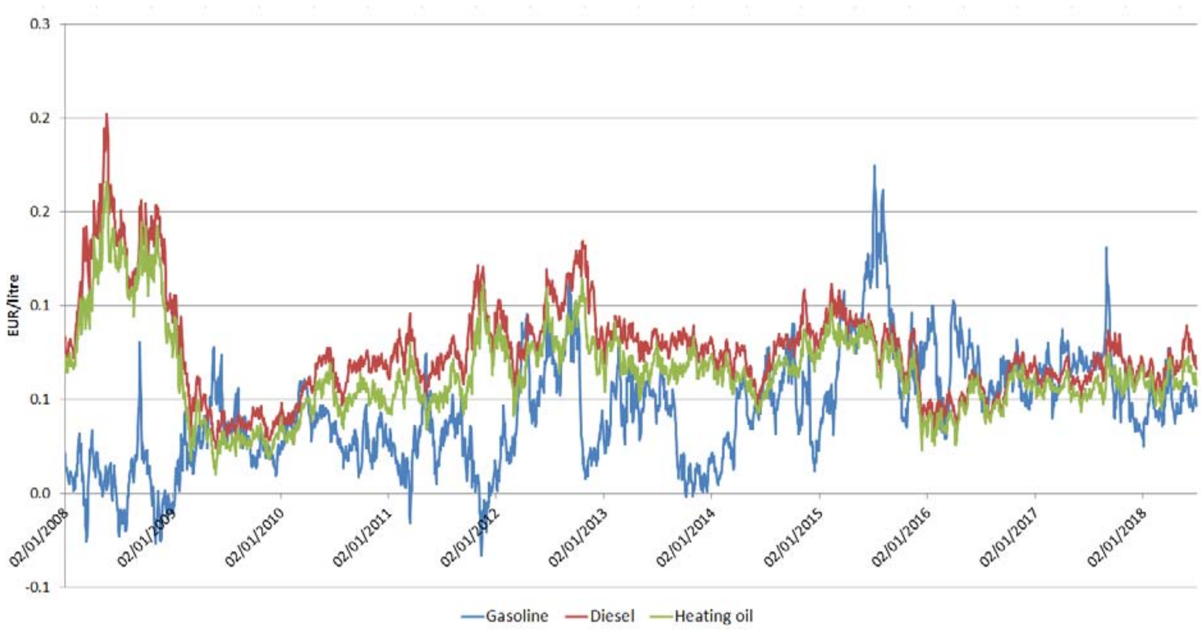

Figure 63 - Crack spreads of gasoline, diesel and heating oil from 2008 to mid-2018

Source: Platts, ECB

Crack spreads are calculated as the difference between the Brent crude oil price and the price of the following products: Gasoline Prem Unleaded 10ppmS FOB AR Barge (gasoline), ULSD 10ppmS FOB ARA Barge (diesel) and Gasoil 0.1%S FOB ARA Barge (heating oil)
The following conversion rates were used: crude oil 159 litre/barrel, gasoline 1350 litre/ton, diesel and heating oil 1186 litre/ton.

The supply-demand conditions of the different products are divergent (both from crude oil and from each other) which will affect their crack spreads. For example, the 2008 oil price rise was very much driven by industrial growth in China, leading to a big increase in the demand of middle distillates which is reflected in the high crack spreads of these products. There are also seasonal differences in demand, for example, gasoline demand is higher in the summer, typically resulting in a relatively high crack spread during that period while in times of low demand crack spreads can even turn negative (implying the gasoline is cheaper than crude oil). In the summer of 2015, gasoline crack spreads reached unusually high levels as low prices boosted gasoline demand.

Oil product supply can also fluctuate, for example as a result of refinery maintenance or natural disasters affecting refinery operations; this will also affect crack spreads. For example, Hurricane Harvey in the US triggered the spike of European gasoline crack spreads in late August 2017.

On **Figure 63** one can see that European crack spreads have been relatively high in 2015, averaging 0.08 EUR/litre (around 13 EUR/barrel) for both gasoline and diesel. Afterwards, crack spreads diminished: in the period from the beginning of 2016 to mid-2018, both gasoline and diesel crack spreads averaged 0.06 EUR/litre (less than 10 EUR/barrel).

3.3 Retail prices of oil products

In addition to electricity and gas, oil products constitute an important part of the energy costs of both households and industry. Oil products have a dominant role in transport where they have limited alternatives, particularly in road freight, maritime and air transport. In case of space heating, the share of oil products is on a declining trend but in certain Member States they still have an important role in this sector.

The retail price of oil products depends on several factors. Variations in the price of crude oil will obviously have an impact on retail prices but crude oil costs constitute just a part, often a relatively small part, of the final price paid by the consumer. Crude oil is traded in US dollar but the finished products are sold at the pump in euros or other national currencies. Therefore, variations in exchange rates will also influence the crude oil component.

Crude oil has to be refined to produce fuels which can be used in transportation, heating or other uses. After refining, the finished products have to be distributed and sold, typically at petrol stations. Refining and distribution costs are relatively stable and are not proportional to the crude oil price.

A significant part of the price goes to taxes: excise duties, other indirect taxes and VAT. These taxes make an important contribution to the tax revenue of Member States (see Chapter 8.1). In case of motor fuels (gasoline and diesel), taxes typically cover more than half of the final price.

Excise duties are generally a fixed amount per quantity (usually litre or kg), i.e. not influenced by the price of crude oil. VAT, on the other hand, is set as a percentage of the price of the product (including the excise duty) and, therefore, changes in the crude oil price will have an impact on the absolute value of the VAT component.

Rates of both the excise duty and VAT vary by product and by Member State, resulting in significant price differences across Europe. Nevertheless, Member States have no complete freedom when setting the tax rates. The Energy Tax Directive (2003/96/EC) sets minimum excise duty rates for gasoline, gasoil, kerosene, LPG and heavy fuel oil. New Member States were often granted a transition period to reach the minimum level; today, all Member States comply with minimum level.

In case of VAT, the VAT Directive (2006/112/EC) requires that the standard VAT rate must be at least 15%; currently the standard VAT rates applied by Member States range from 17% (in Luxembourg) to 27% (in Hungary). In case of oil products, Member States typically apply the standard VAT rate. Under certain conditions, however, Member States can set a lower VAT rate for specific products and services; for example, a few Member States apply a reduced rate for heating oil.

As the share of crude oil in the final price can be as low as 25%, variations in the price of crude oil will have a limited impact on the price at the pump. In fact, the high share of fixed taxes in the price acts as a buffer: fluctuations in the retail price of oil products (particularly motor fuels) are significantly lower than the fluctuation of the crude oil price. Variations in the exchange rate have a similar effect: the oil price and the value of the US dollar usually move in the opposite direction: a strengthening dollar typically coincides with decreasing oil prices and vice versa. This means that changes in the oil price, whether upwards or downwards, are mitigated by the exchange rate and the volatility of the oil price expressed in euros is smaller than the volatility of the price expressed in dollar.

During the decline of crude oil prices in 2014-2016, the above factors moderated the pass-through to oil product prices in the EU: while crude oil prices (expressed in USD) fell by 77% between mid-2014 and early 2016, in the same period[31] the average EU consumer price of gasoline and diesel decreased by 24% and 28%, respectively. In case of heating oil, the decrease was 45%.

[31] Between 30 June 2014 and 15 February 2016

Similarly, the comparably high taxes in the EU mitigated the feed-through of the recent oil price rise: between 3 July 2017 and 11 June 2018, retail prices of gasoline and diesel (including taxes and duties) increased by 12% and 18%, respectively, as compared to a more than 50% increase in international crude oil prices in the same period (measured in USD). In case of heating oil, where the tax component is smaller, the price increase was 32%.

Finally, although their current use is limited, alternative fuels provide an increasing share of the energy mix in transport and their importance is expected to grow in the future. At the same time, as shown by Trinomics et al. (2018), data on retail prices for compressed natural gas (CNG), liquefied natural gas (LNG), liquefied petroleum gas (LPG) and biofuels is not widely available. The growing importance of the market for alternative fuels shows the need of further efforts in collecting such retail prices in the future.

3.3.1 Methodology

The analysis in this section is based on the data of the weekly Oil Bulletin. Pursuant to the Council Decision on Crude Oil Supply Costs and the Consumer Prices of Petroleum Products (1999/280/EC), Member States have to report to the Commission the retail prices of the main petroleum products on a weekly basis. Member States also have to report any changes in the tax rates (VAT, excise duty, other indirect taxes) applicable to these products, allowing us to break down the final price to three main components: the net price, excise duty[32] and VAT. The reported data are published on the website of DG Energy.[33]

The analysis covers the three main petroleum products sold in the retail sector: gasoline (Euro-super 95), diesel (automotive gas oil) and heating oil (heating gas oil). The time horizon is from 2008 to the first half of 2018. All Member States are covered but data for Croatia is available only from 2013. In case of heating oil, Slovakia does not report prices since October 2011 while, from 2015, Greece does not report prices for the period from May to mid-October.

Prices reported in currencies other than the euro were converted into euro, using the ECB exchange rate of the day for which the price applies.

For each year and each Member State an average price was calculated as an arithmetic average of the weekly prices and an EU average price was calculated as the weighted average of these. In the absence of 2017 and 2018 consumption figures, for these years we used the 2016 consumption data as the weight.

3.3.2 General findings

While the absolute level of the prices of the three oil products are different, their development over the last 10 and half years is very similar and basically reflects the evolution of the crude oil price in the same period. The price of all three products decreased significantly in 2009 when oil prices plummeted in the wake of the financial crisis. This was followed by years of gradual increase, with prices peaking in 2012. Prices decreased afterwards, with the decrease

[32] In this section, other indirect taxes are reported in the excise duty component
[33] https://ec.europa.eu/energy/en/statistics/weekly-oil-bulletin

accelerating in 2015-2016. As crude oil prices recovered from 2016, oil product prices have been also rising in the last two years.

For comparison, **Figure 64** also depicts the evolution of the Brent crude oil price (recalculated into EUR/litre).

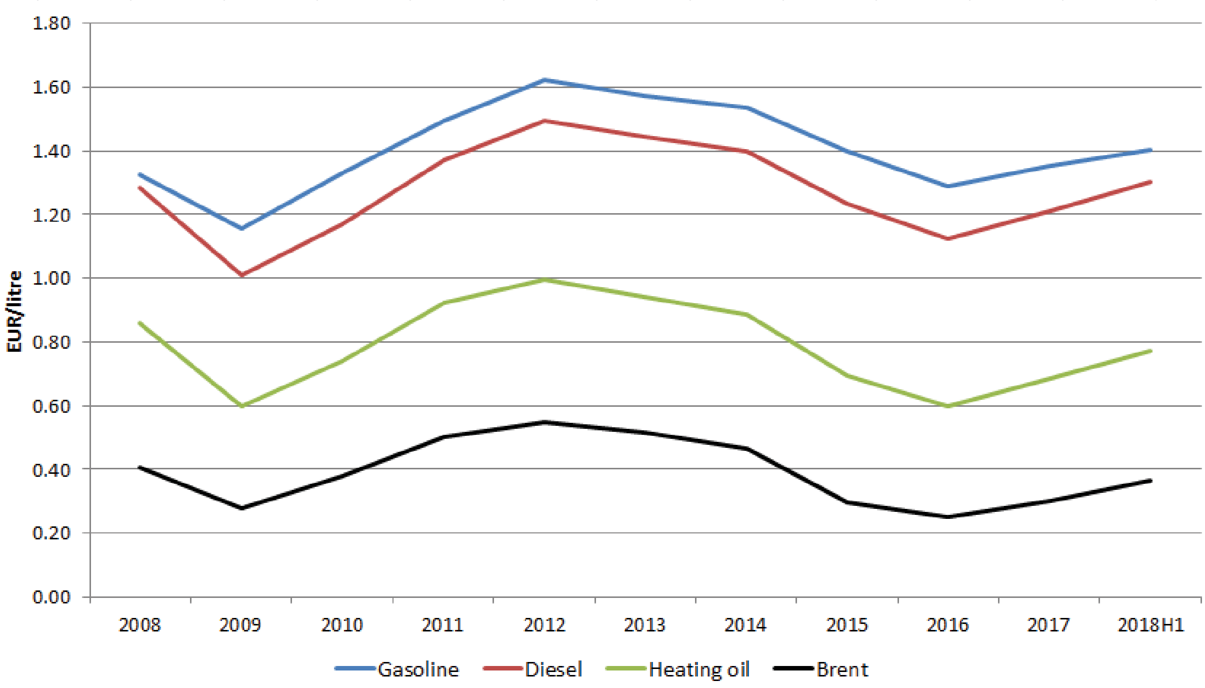

Figure 64 - Average retail price of oil products in the EU

Source: Oil Bulletin, DG Energy, Platts

The difference in the absolute price of the three products can be mostly attributed to the diverging tax rates. In practically all Member States, the excise duty rate of gasoline is higher than that of diesel. The Energy Tax Directive also sets a higher minimum rate for gasoline (0.359 EUR/litre) compared to diesel (0.33 EUR/litre). The UK is the only Member State where the two motor fuels are taxed at the same level.

In case of heating oil, a few Member States (Bulgaria, the Czech Republic, Hungary and the Netherlands) apply practically the same excise duty rates than for diesel. In most Member States, however, heating oil is taxed at a lower level. The minimum rate established by the Energy Tax Directive (0.021 EUR/litre) is much lower than those for motor fuels. Ireland, Luxembourg and the UK also apply a reduced VAT rate for heating oil.

Although excise duty rates are set in absolute values, i.e. as a fixed amount per quantity of the product, several Member States increased the tax rates over the period, resulting in a gradually increasing (weighted) average tax rate. According to the Energy Tax Directive, the minimum excise duty rate for diesel increased from 0.302 EUR/litre to 0.33 EUR/litre on 1 January 2010, requiring some Member States to adjust their rates.

Contrary to the general trend, the weighted average excise duty rate for gasoline slightly decreased in 2016 and 2017. While a few Member States indeed reduced the excise duty rate for gasoline in this period, the decrease was driven mainly by exchange rate developments, in particular the depreciation of the pound sterling which made the UK excise duty (unchanged in the local currency) significantly lower when expressed in euros.

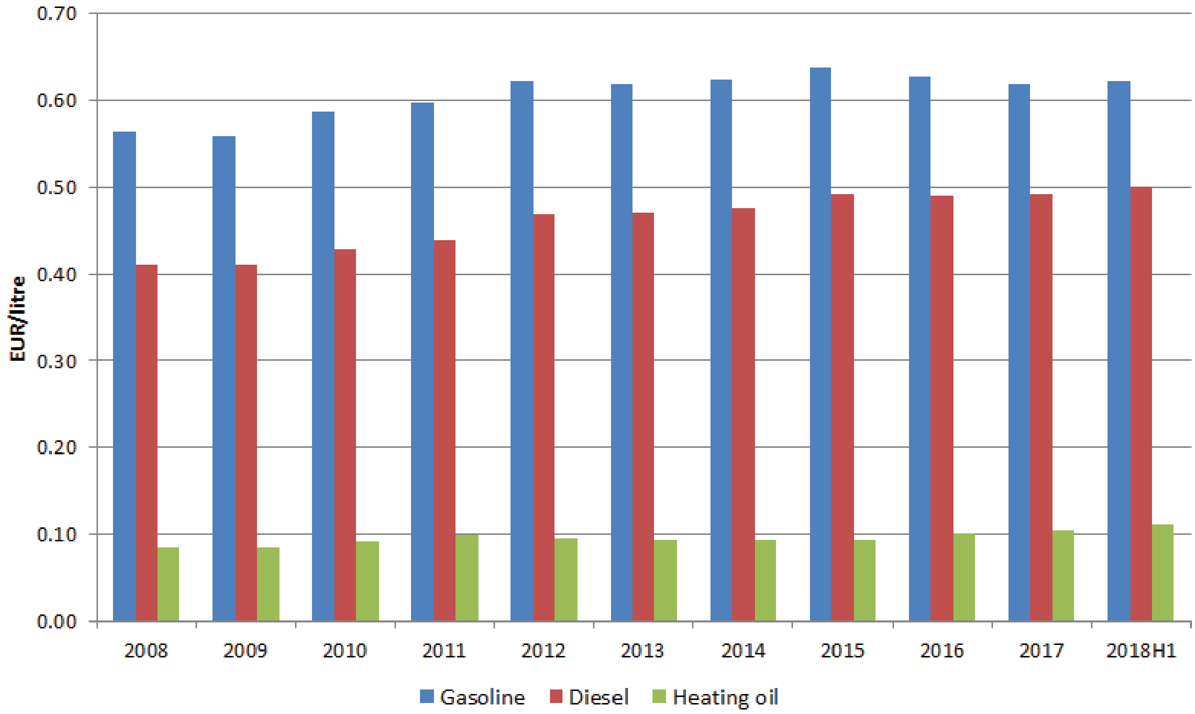

Figure 65 - Average excise duty rates for oil products in the EU

Source: Oil Bulletin, DG Energy

If the net price of the three products is compared, the difference is significantly lower. In fact, during the whole period the net price of diesel is slightly higher than that of gasoline.

Figure 66 also depicts the evolution of the Brent crude oil price (recalculated into EUR/litre), showing that crude oil is clearly the main component of the net price. Over the period, crude oil price represented on average 65-70% of the net price of gasoline and diesel but in 2015-2016, as crude oil prices dropped significantly, this share dropped below 60%.

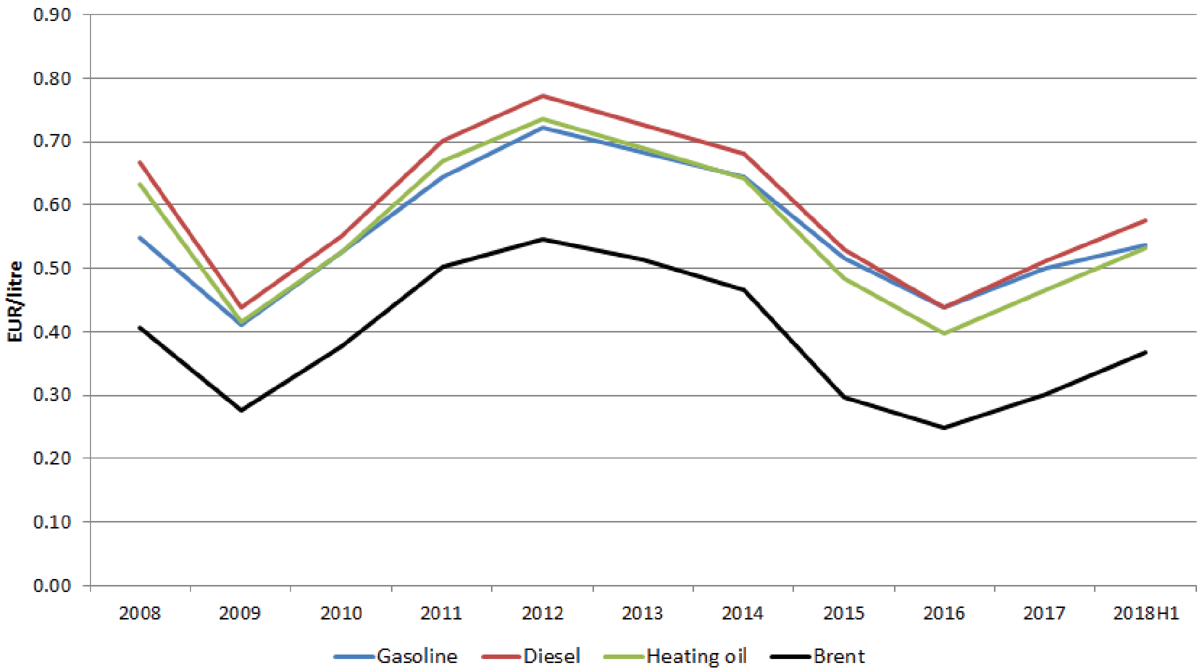

Figure 66 - Average retail price of oil products in the EU, without taxes

Source: Oil Bulletin, DG Energy

3.3.3 Gasoline

In most Member States, the evolution of gasoline prices clearly followed the trend of the crude oil price but there have been considerable differences in the absolute level, mainly explained by the diverging excise duty and VAT rates. Average prices moved in a relatively wide range, with the difference between the highest and lowest price being about 0.5 EUR/litre. This range has slightly narrowed between 2008 and 2014, from 0.52 EUR/litre to 0.45 EUR/litre, indicating some degree of price convergence. However, the range widened afterwards, reaching 0.54 EUR/litre in the first half of 2018.

Greece showcased the biggest relative increase in gasoline prices: while in 2008-2009 Greek prices were well below the EU average, since 2011 they are among the highest, mainly as a result of the sharp increase of the excise duty rate. In the first half of 2018, the EU average gasoline price was 6% higher than in 2008; in case of Greece, the increase was 39%. At the other end of the spectrum, prices in Poland decreased by 8%, mainly because of the depreciation of the national currency in the second half of 2008 (measured in Polish zloty, the average price increased).

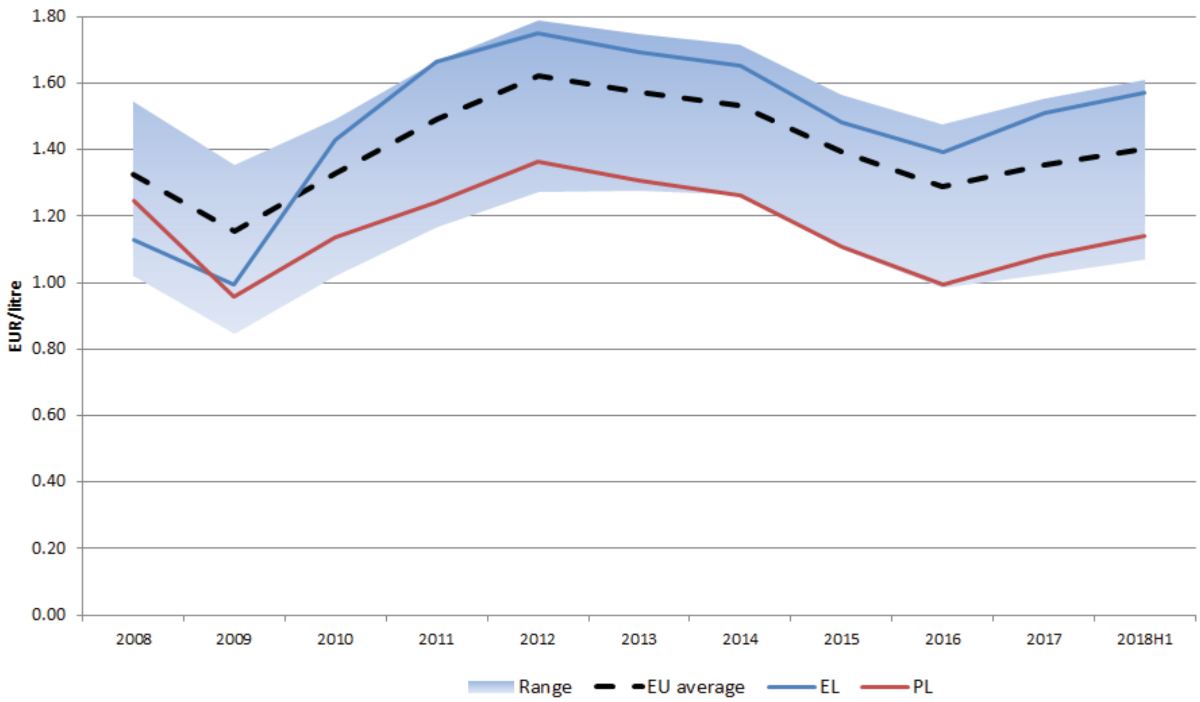

Figure 67 - The retail price of gasoline in the EU

Source: Oil Bulletin, DG Energy

Looking at net prices, the dispersion is smaller, the difference between the highest and the lowest price is typically between 0.10 and 0.15 EUR/litre. The net price depends on a number of factors, including the source of supply (local refinery or import), industry structure and competition. In the first half of 2018, the highest net price was reported by Denmark while the lowest by the UK. Comparing the average net price with a representative wholesale price (Platts Gasoline Prem Unleaded 10ppmS FOB AR Barge), the difference is relatively stable, averaging 0.13 EUR/litre over the period.

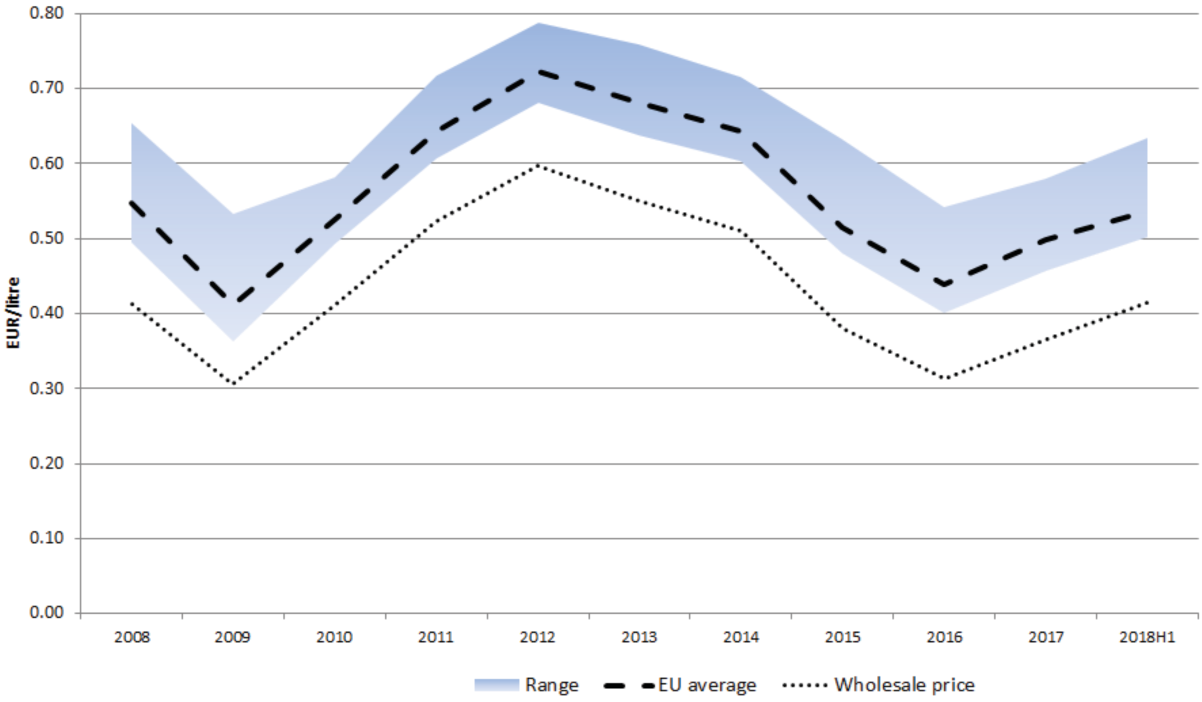

Figure 68 - The retail price of gasoline in the EU, without taxes

Source: Oil Bulletin, DG Energy, Platts

The wholesale price is Gasoline Prem Unleaded 10ppmS FOB AR Barge reported by Platts

Excise duty is an important component of the retail gasoline price; in the first half of 2018, in half of the Member State it actually exceeded the net price. Over the years, we see a gradual increase of the average excise duty rate, with a slight decrease in 2016 and 2017. While in 2008 the average excise duty rate was 0.56 EUR/litre, by 2015 it increased to 0.64 EUR/litre. In the first half of 2018 the average rate was 0.62 EUR/litre.

The average VAT rate also increased during this period, from 19.3% in 2005 to 21.0% in 2014. Since then, the average VAT rate has not changed.

In most Member States, excise duty rates increased between 2008 and the first half of 2018, with the biggest increases in Greece (98%), Latvia (63%) and Cyprus (58%). Germany and Luxembourg are notable exceptions: in these countries, the excise duty rate for gasoline has not changed since 2003 and 2007, respectively. In Hungary and Poland, the excise duty rate measured in euro was lower in the first half of 2018 than in 2008, mainly because of exchange rate developments (in national currencies, the excise duty rates increased over this period). In 2015, the UK had the highest excise duty in the EU but since then, due to the depreciation of the pound sterling, the excise duty measured in euro has significantly decreased.

For most of the study period, the Netherlands applied the highest excise duty rate for gasoline while Bulgaria had the lowest rate, just above the minimum level prescribed by the Energy Tax Directive.

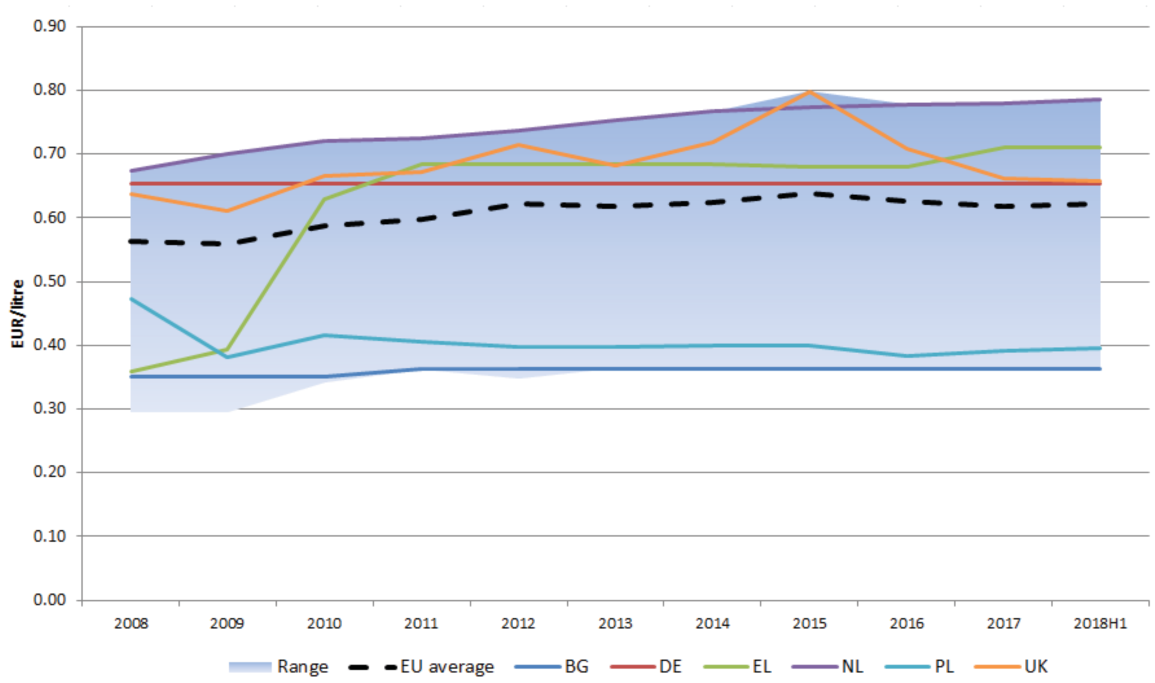

Figure 69 - The exercise duty rate of gasoline in the EU

Source: Oil Bulletin, DG EnergyIn 2014-2016, in line with the decreasing oil prices, the average retail price of gasoline decreased. However, because of the fixed (or, in case of several member States, increasing) excise duty rates, the share of the tax component gradually increased, from 55% in 2012 to 66% in 2016. In absolute terms, the tax component decreased from 0.90 EUR/litre in 2012 to 0.85 EUR/litre in 2016.

The average gasoline price increased in both 2017 and the first half of 2018 but remained well below the record level reached in 2012. In the first half of 2018, the average price was 1.40 EUR/litre, composed of a 0.54 EUR/litre net price (38%), 0.62 EUR/litre excise duty (44%) and 0.24 EUR/litre (17%) VAT.

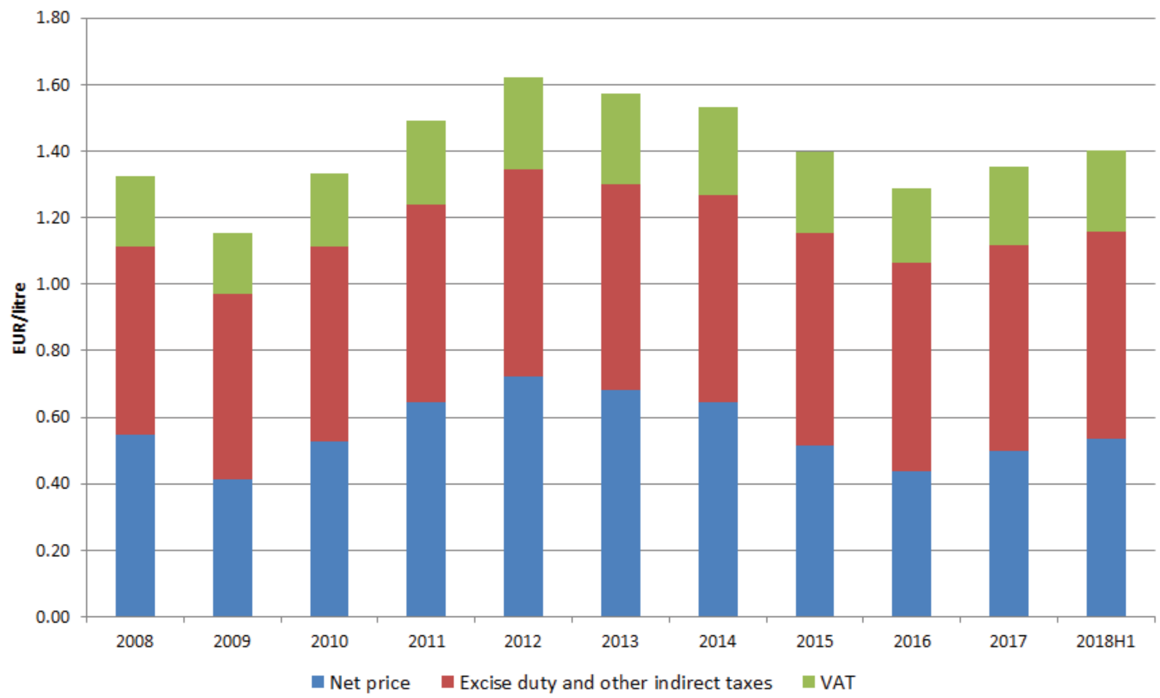

Figure 70 - Average retail price of gasoline in the EU by price component

Source: Oil Bulletin, DG Energy

The next graph shows the composition of the average gasoline price by Member State in the first half of 2018.

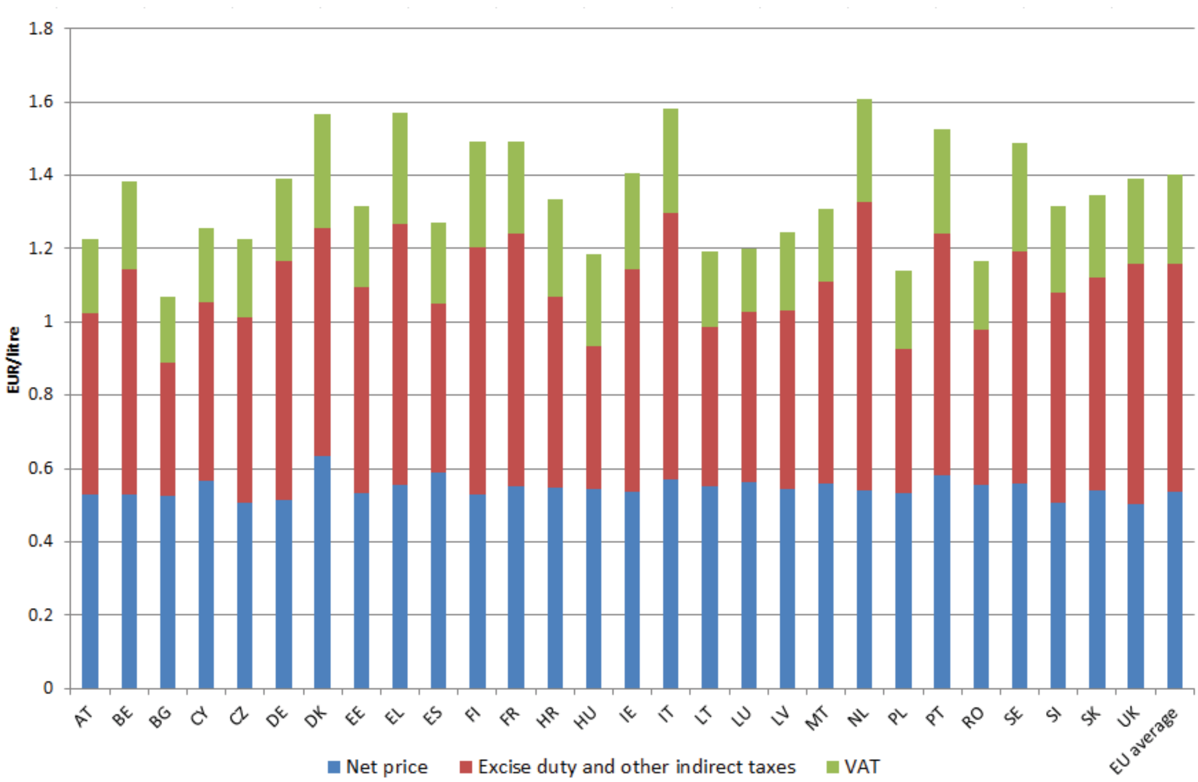

Figure 71 - Average retail price of gasoline in the first half of 2018 by Member State and price component

Source: Oil Bulletin, DG Energy

3.3.4 Diesel

Similarly to gasoline, the evolution of diesel prices clearly followed the trend of the crude oil price, with considerable differences in the absolute level, mainly explained by the diverging excise duty and VAT rates. Average prices moved in a relatively wide range and, contrary to gasoline, this range has widened between 2008 and 2015: it was 0.40 EUR/litre in 2008 but grew to 0.56 EUR/litre in 2015. In 2016-2018, the range has significantly narrowed, mainly because of the decrease of UK prices measured in euros.

If the three most expensive countries (Italy, Sweden and the UK) were disregarded, the range would be considerably narrower. In 2015, the UK was by far the most expensive, 0.18 EUR/litre above the second most expensive country, Italy. However, the depreciation of the pound sterling in 2016-2017 had a negative impact on UK prices measured in euros and, as a result, it was "only" the third most expensive country in the first half of 2018.

Cyprus experienced the biggest relative increase in diesel prices: in 2008 it had the lowest price in the EU but after significant increases in the excise duty rate the price reached the EU average by 2013. In the first half of 2018, EU average diesel prices were 1% higher than in 2008; in case of Cyprus, the price increased by 16%. In Slovakia, in turn, the price fell by 9% in this period, helped by a reduction of the excise duty rate introduced in 2010.

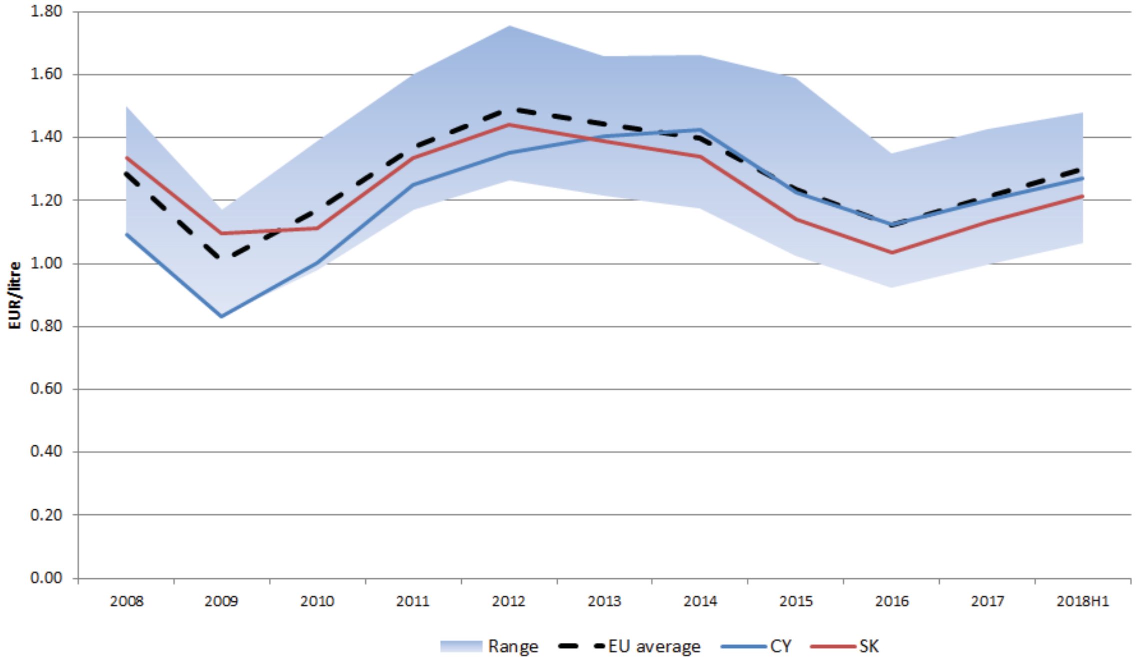

Figure 72 - The retail price of diesel in the EU

Source: Oil Bulletin, DG Energy

In case of net prices, the difference between the highest and the lowest price has been 0.10-0.12 EUR/litre in 2008-2014 but significantly increased afterwards, reaching 0.20 EUR/litre in the first half of 2018. The widening range was largely driven by a robust price increase in Sweden which is now by fare the most expensive country in terms of net prices. In the first half of 2018, somewhat surprisingly, the lowest net price was reported in Malta which in 2015 was the country with the highest net price. Comparing the EU average net price with a representative wholesale price (Platts ULSD 10ppmS FOB ARA Barge), the difference has increased from 0.11 EUR/litre in 2010 to 0.14 EUR/litre in the first half of 2018.

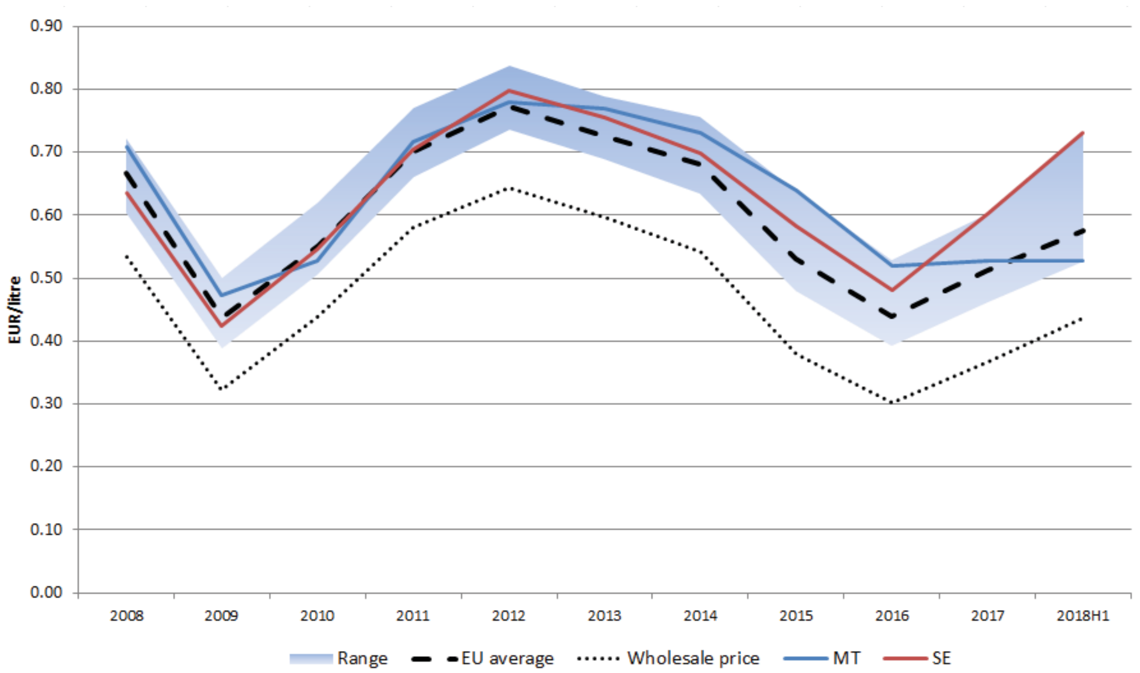

Figure 73 - The retail price of diesel in the EU, without taxes

Source: Oil Bulletin, DG Energy, Platts**.** The wholesale price is Gasoline Prem Unleaded 10ppmS FOB AR Barge reported by Platts

The average excise duty rate of diesel increased from 0.41 EUR/litre in 2008 to 0.50 EUR/litre in the first half of 2018 (an increase of 22% in 10 years). This increase is faster than in case of gasoline and, as a result, the difference between average excise duty rate of gasoline and diesel slightly narrowed: from 0.16 EUR/lire in 2010-2011, it decreased to 0.12 EUR/litre in the first half of 2018.

The average VAT rate of diesel also increased during the study period, from 19.1% in 2008 to 20.9% in 2014. Between 2014 and the first half of 2018, the average VAT rate for diesel has not changed.

With two exceptions, excise duty rates increased in all Member States between 2008 and the first half of 2018, with the biggest increases in Cyprus (80%), Belgium (76%) and Slovenia (64%). In Germany, the excise duty rate for diesel has not changed since 2003 (similarly to the excise duty of gasoline). Slovakia is the only country where the excise duty was lower in the first half of 2018 than in 2008, as a result of a cut in the rate in 2010.

The excise duty rate applied by the UK and Italy is significantly higher than in the rest of the countries. Even after the depreciation of the pound sterling in 2016-2017, the UK excise duty rate remained the highest in the EU. In contrast, Bulgaria imposes a rate at the minimum level prescribed by the Energy Tax Directive.

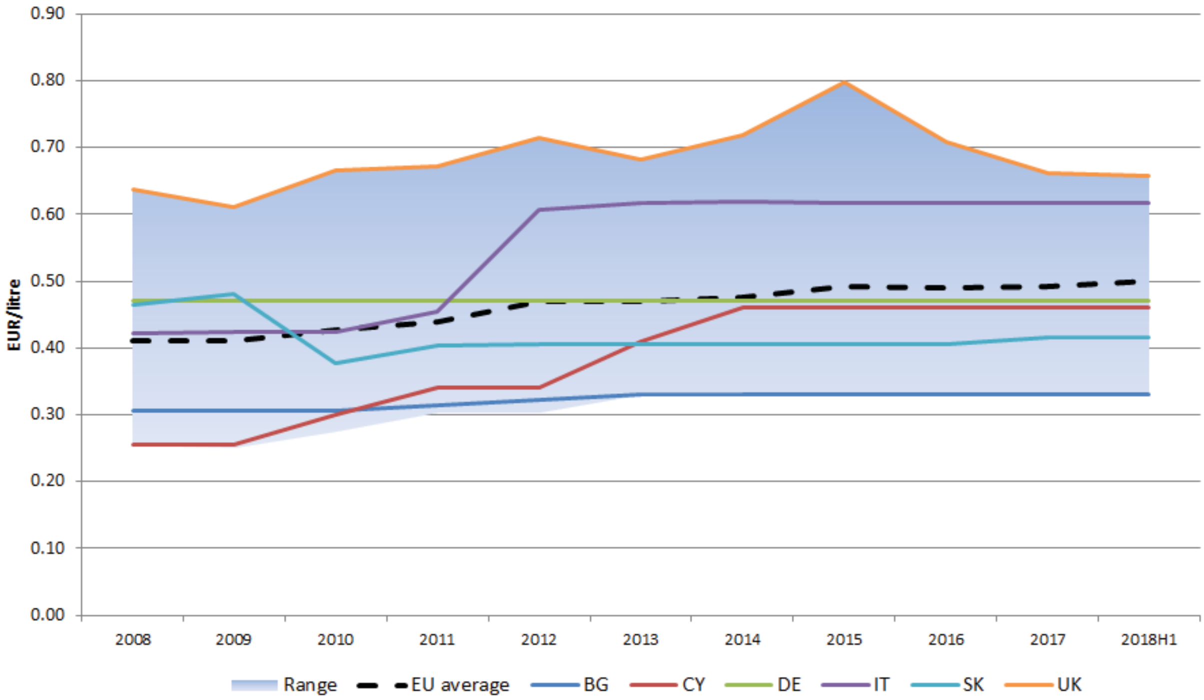

Figure 74 - The exercise duty rate of diesel in the EU

Source: Oil Bulletin, DG Energy

In 2012-2016, the average retail price of diesel decreased, with the share of the tax component increasing from 48% in 2012 to 61% in 2016. In absolute terms, the tax component decreased from 0.72 EUR/litre in 2012 to 0.68 EUR/litre in 2016.

Since 2016, the average retail price of diesel has been on the rise but remained well below the record level reached in 2012. In the first half of 2018, the average price was 1.30 EUR/litre, composed of a 0.57 EUR/litre net price (44%), 0.50 EUR/litre excise duty (39%) and 0.22 EUR/litre (17%) VAT. Compared to 2016, the absolute value of the tax component increased to 0.73 EUR/litre but its share in the total price fell to 56%.

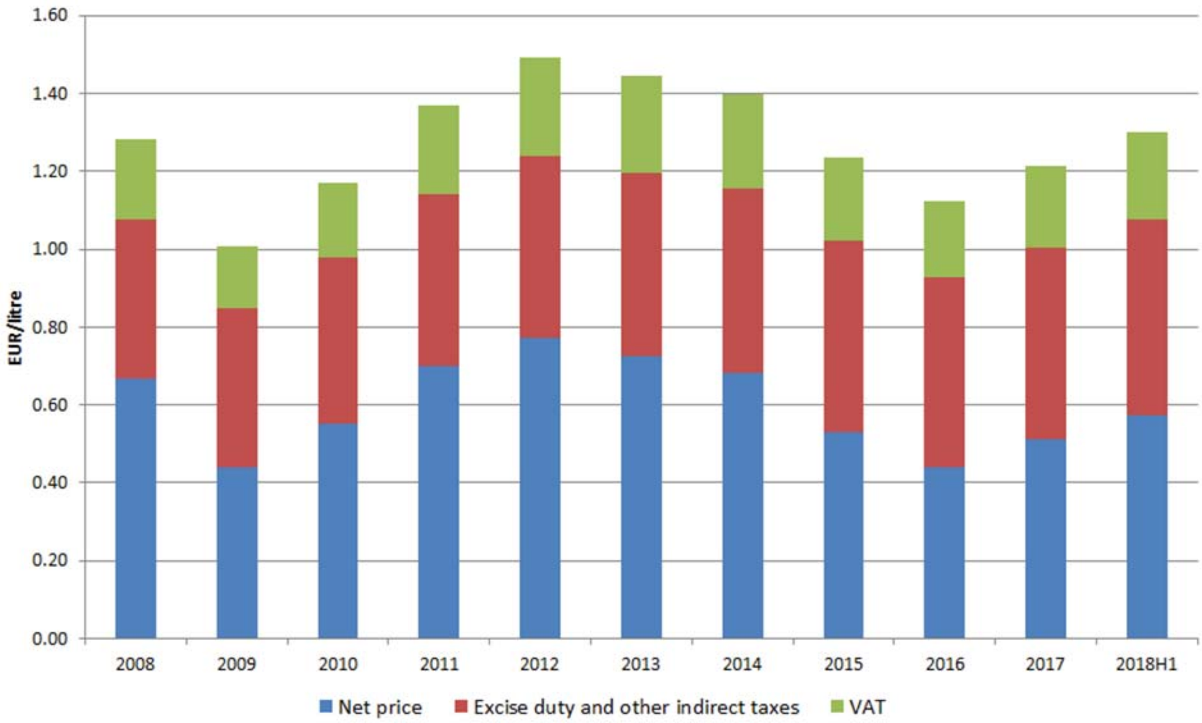

Figure 75 - Average retail price of diesel in the EU by price component

Source: Oil Bulletin, DG Energy

The next graph shows the composition of the average diesel price by Member State in the first half of 2018.

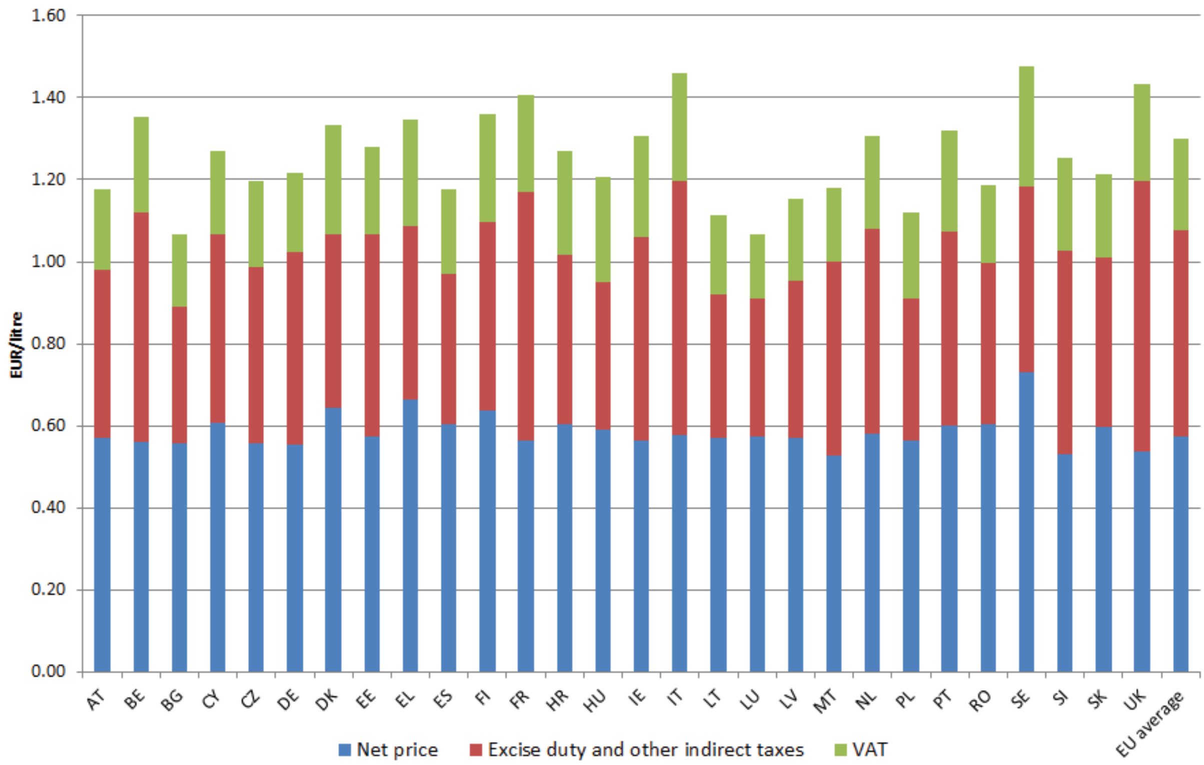

Figure 76 - Average retail price of diesel in the first half of 2018 by Member State and price component

Source: Oil Bulletin, DG Energy

3.3.5 Heating oil

The large differences in the excise duty rates result in a wide dispersion of heating oil prices across the EU. The difference between the highest and lowest price increased from 0.60 EUR/litre in 2008 to 0.79 EUR/litre in 2014 but decreased to 0.67 EUR/litre in the first half of 2018. In the most expensive Member State, Denmark, the price in the first half of 2018 was 109% higher than in the cheapest Member State, Luxembourg. Many of the most expensive countries have a rather low level of heating oil consumption. Germany is by far the biggest consumer of heating oil in the EU and its price has been consistently below the EU average.

Bulgaria experienced the biggest relative increase in heating oil prices: in 2008 its price was well below the EU average but today it is considerably higher. In the first half of 2018, the EU average heating oil price was 9% lower than in 2008; in case of Bulgaria, the price increased by 33%. Ireland experienced the biggest price drop between 2008 and the first half of 2018, 23%.

During most of the study period, Denmark had the highest heating oil prices in the EU, driven by a high excise duty.

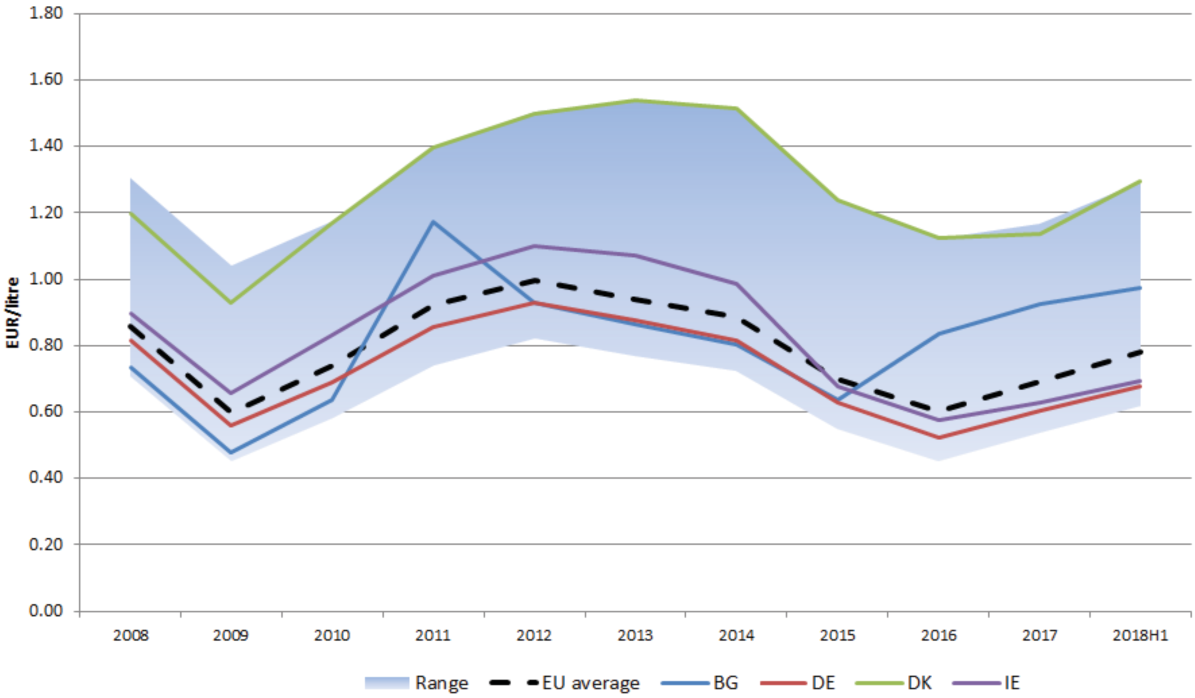

Figure 77 - The retail price of heating oil in the EU

Source: Oil Bulletin, DG Energy

The difference between the highest and the lowest price is rather high also in case of net prices (0.21-0.43 EUR/litre), significantly higher than for motor fuels. The gap significantly increased until 2014 but narrowed afterwards.

Denmark had the highest net price of heating oil in the first half of 2018; the lowest net price was reported in the Netherlands. Comparing the EU average net price with a representative wholesale price (Platts Gasoil 0.1%S FOB ARA Barge), the difference has been stable in the 0.10-0.12 EUR/litre range. Curiously, the Dutch price is lower than the wholesale price.

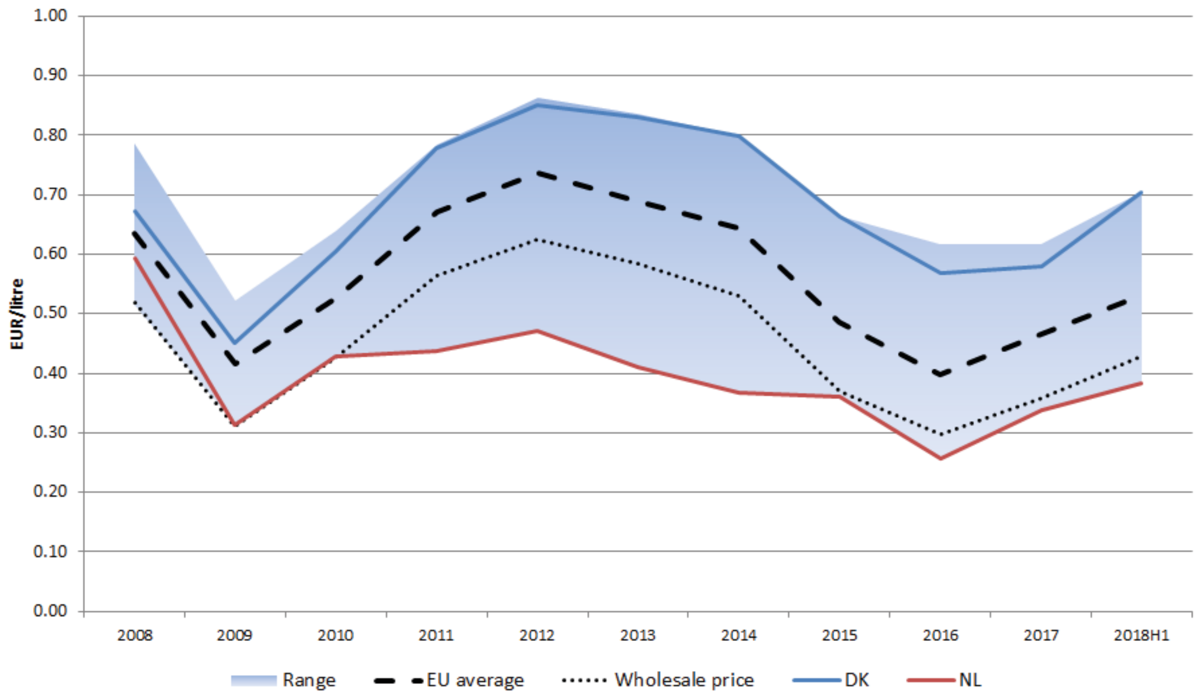

Figure 78 - The retail price of heating oil in the EU, without taxes

Source: Oil Bulletin, DG Energy, Platts

The wholesale price is Gasoline Prem Unleaded 10ppmS FOB AR Barge reported by Platts

The average excise duty rate of heating oil increased from 0.08 EUR/litre in 2008 to 0.12 EUR/litre in the first half of 2018. Although most Member States apply a higher rate, the main consumer of heating oil, Germany, has an excise duty of only 0.06 EUR/litre.

The average VAT rate of heating oil also increased during this period, from 19.3% to 20.1%.

Several Member States increased the excise duty rate between 2008 and the first half of 2018, but in a couple of countries (Austria, Germany, Italy, Lithuania and Luxembourg) it remained unchanged. Bulgaria significantly increased the excise duty rate in 2011 but returned to the previous, lower rate the following year; the rate was increased again in 2016. The Netherlands has the highest excise duty rate (0.50 EUR/litre in the first half of 2018) – it is one of the few countries that apply the same rate for diesel and heating oil. Luxembourg reports the lowest excise duty rate, 0.01 EUR/litre. The rates applied by Belgium and Luxembourg are lower than the minimum level set by the Energy Tax Directive (0.021 EUR/litre); Lithuania uses the minimum level.

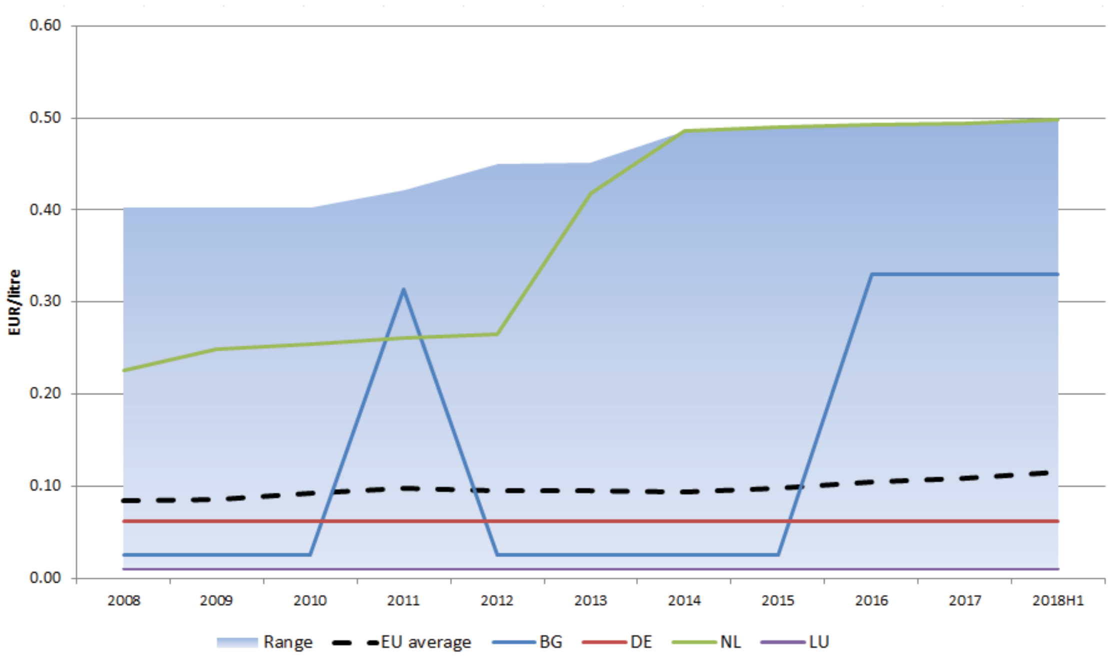

Figure 79 - The exercise duty rate of heating oil in the EU

Source: Oil Bulletin, DG Energy

The average retail price of heating oil significantly decreased between 2012-2016, with the tax component increasing from 26% in 2012 to 34% in 2016. In absolute terms, the tax component decreased from 0.26 EUR/litre in 2012 to 0.21 EUR/litre in 2016.

Prices have been rising since 2016 but remain well below the levels seen in 2012. In the first half of 2018, the average price was 0.78 EUR/litre, composed of a 0.53 EUR/litre net price (68%), 0.12 EUR/litre excise duty (15%) and 0.13 EUR/litre (17%) VAT.

Because of the low average level of the excise duty, the tax component of the average heating oil price is much lower than for gasoline and diesel.

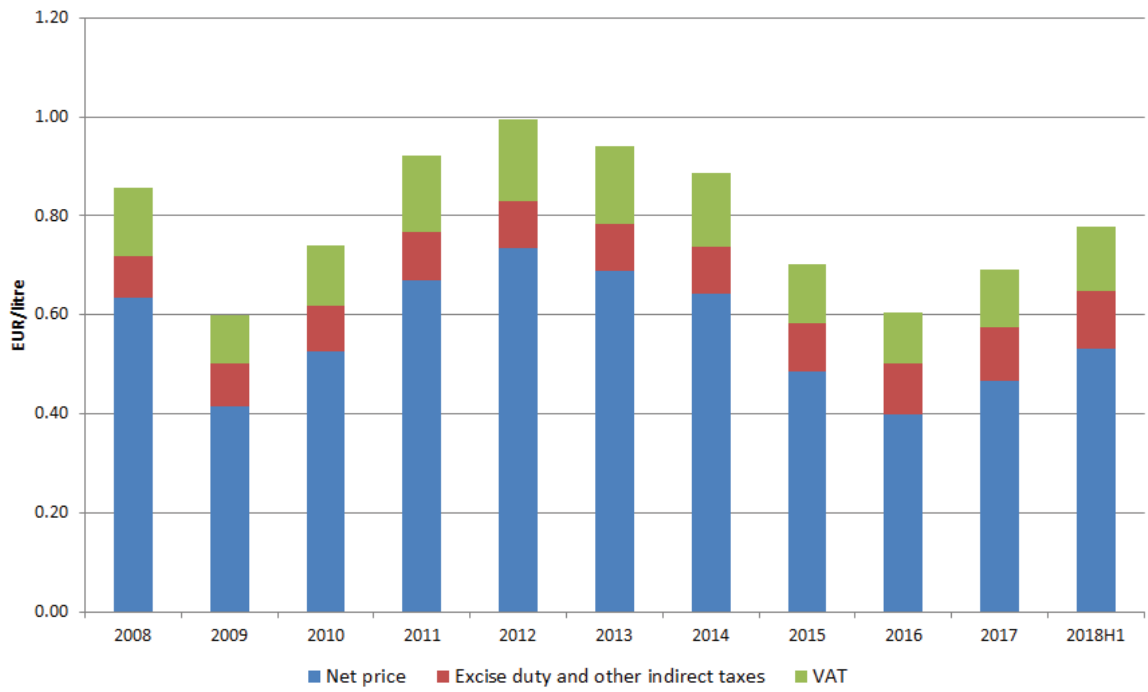

Figure 80 - Average retail price of heating oil in the EU by price component

Source: Oil Bulletin, DG Energy

The next graph shows the composition of the average heating oil price by Member State in the first half of 2018.

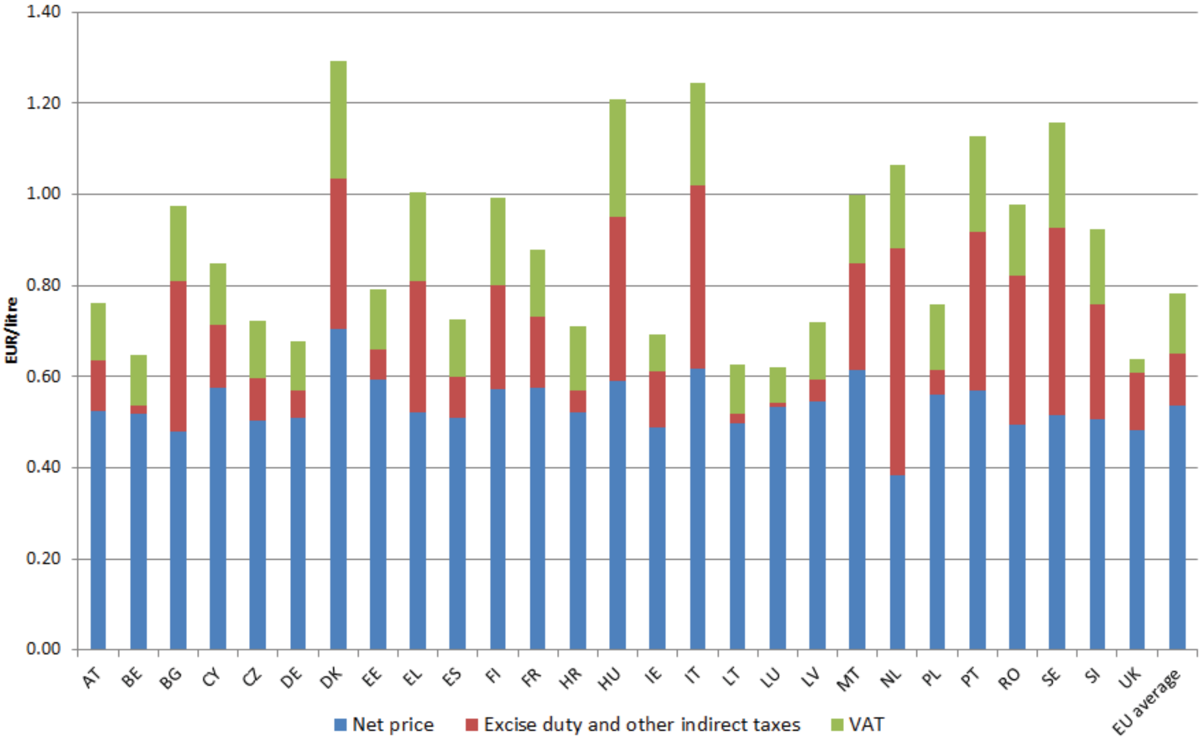

Figure 81 - Average retail price of heating oil in the first half of 2018 by Member State and price component

Source: Oil Bulletin, DG Energy

3.3.6 Gasoline vs diesel

The unequal tax treatment of the main motor fuels, gasoline and diesel, has been a contentious policy issue and was often blamed for the "dieselisation" of the European vehicle fleet. Most Member States impose a lower level of excise duty for diesel than for gasoil, resulting in a lower retail price, in spite of the fact that the wholesale price of diesel is typically slightly higher than that of gasoline. The price advantage of diesel, coupled with the improving fuel economy of diesel engines, made diesel cars increasingly popular in the passenger car and light duty vehicle segments, with their share from new registration reaching up to 70-80% in certain Member States. In contrast, in other regions of the world gasoline-engine cars continued to have a dominant role in the passenger car fleet. The dieselisation significantly contributed to the gasoline/diesel imbalance: European refineries produce too much gasoline which has to be exported while diesel output is insufficient to meet demand is Europe has to rely on imports.

More recently, the Volkswagen emission scandal which broke out in September 2015 put diesel-engine cars in the spotlight and raised renewed questions about the tax advantage of diesel.

Back in 2011, the Commission made an attempt to remove the distortive tax treatment of the two fuels in the proposed revision of the Energy Taxation Directive.[34] According to the proposal, the minimum tax rates of energy products would have been based on the energy content and the CO2 content of the fuel, resulting in a lower minimum rate for gasoline (diesel has a higher energy and CO2 content per litre). However, following the unsuccessful negotiations between Member States in the Council, the proposal was withdrawn.

In this section we compare the development gasoline and diesel prices in the EU and try to investigate whether there has been an approximation of excise duty rates imposed on the two fuels.

Over the last ten years, the average retail price of gasoline has been consistently above the price of diesel, with the difference averaging 0.13 EUR/litre in this period. The difference peaked in 2016 at 0.17 EUR/litre but, since then, has noticeably decreased: in the first half of 2018 it averaged 0.10 EUR/litre, the lowest level since 2018.

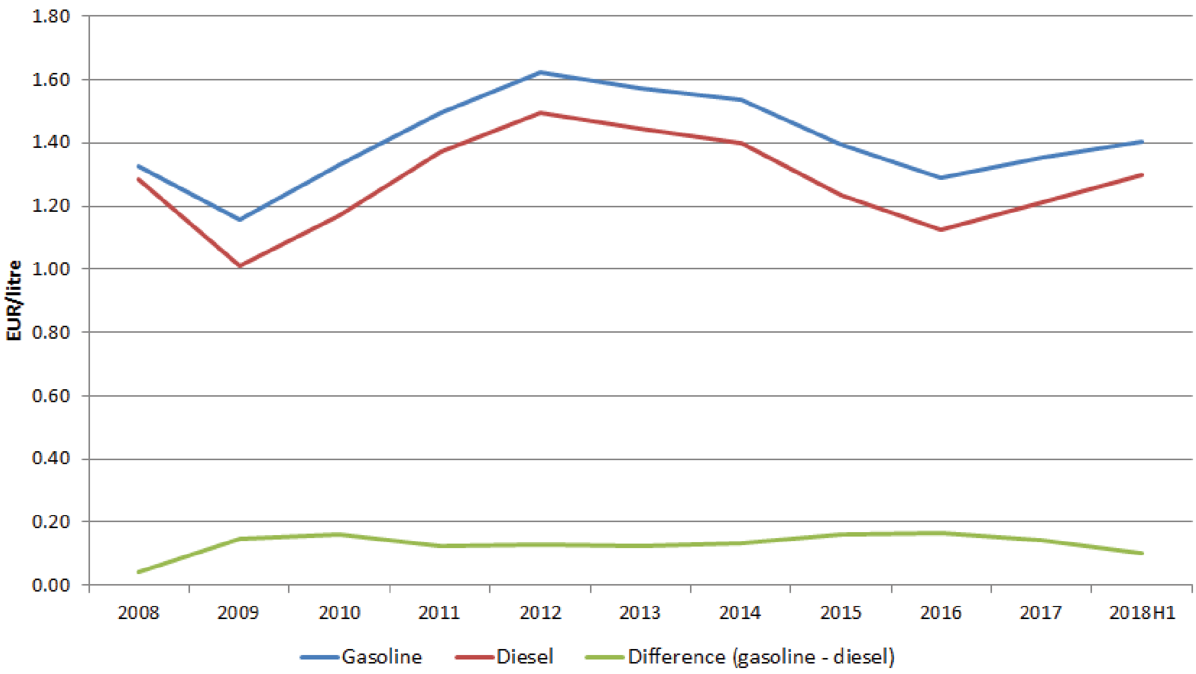

Figure 82 - Average retail price of gasoline and diesel in the EU

Source: Oil Bulletin, DG Energy

When comparing the prices without taxes, it is striking that diesel prices are actually higher than gasoline prices. The only exception is 2016 when the average gasoline and diesel price was practically identical. In this year, global gasoline demand was supported by record-low oil prices, resulting in a relatively high gasoline price. Over the ten and half year period, the net price of diesel was on average 0.04 EUR/litre higher.

[34] http://europa.eu/rapid/press-release_IP-11-468_en.htm?locale=en

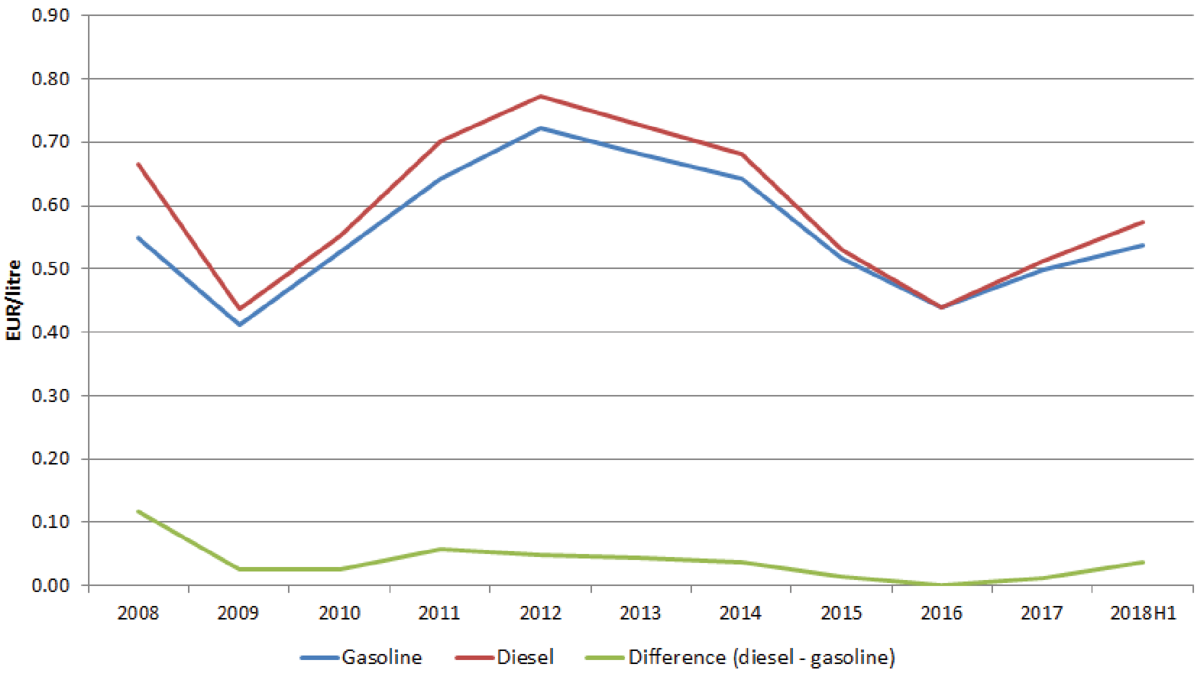

Figure 83 - Average retail price of gasoline and diesel in the EU, without taxes

Source: Oil Bulletin, DG Energy, Platts

The average excise duty rate for gasoline has been 0.15 EUR/litre over the period, more than offsetting the lower net price of gasoline. The difference was largest in 2010 (0.16 EUR/litre) but since then there has been a clear declining trend, with the average difference dropping to 0.12 EUR/litre in the first half of 2018.

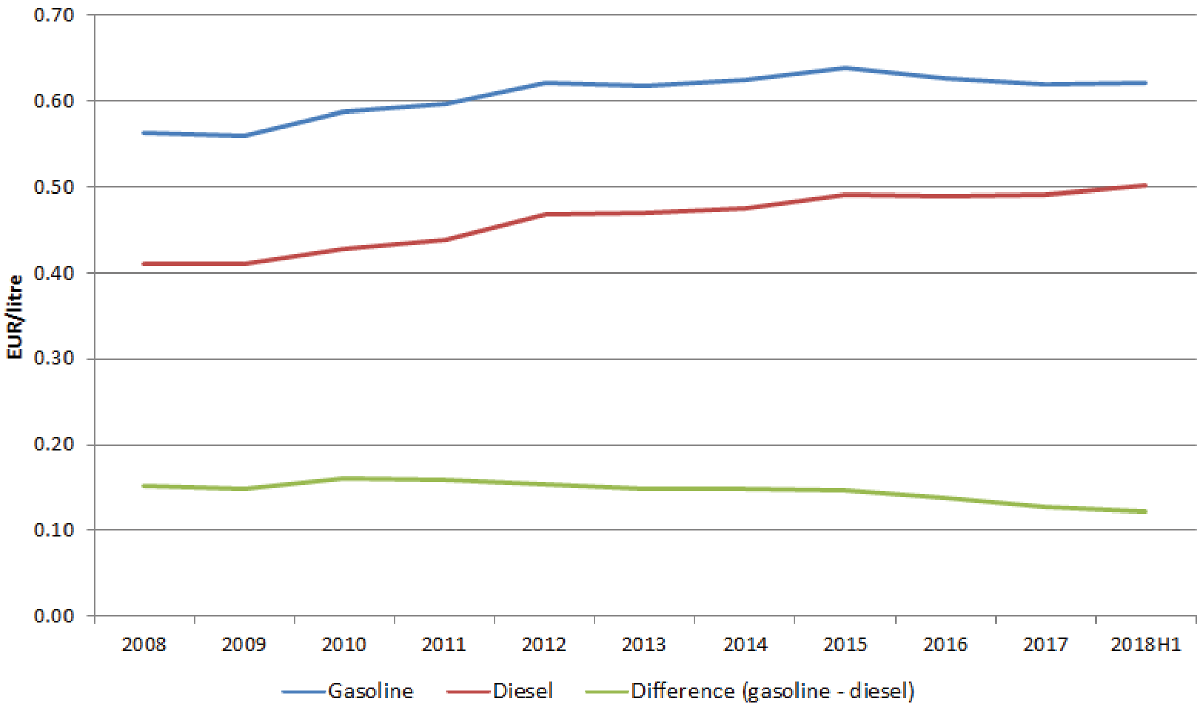

Figure 84 - Average excise duty rates for gasoline and diesel in the EU

Source: Oil Bulletin, DG Energy

In addition to the absolute difference, the relative (percentage) difference between gasoline and diesel excise duty rates also shows a decreasing trend: while in 2010 the excise duty on gasoline was on average 37% higher, by the first half of 2018 this difference decreased to 24%.

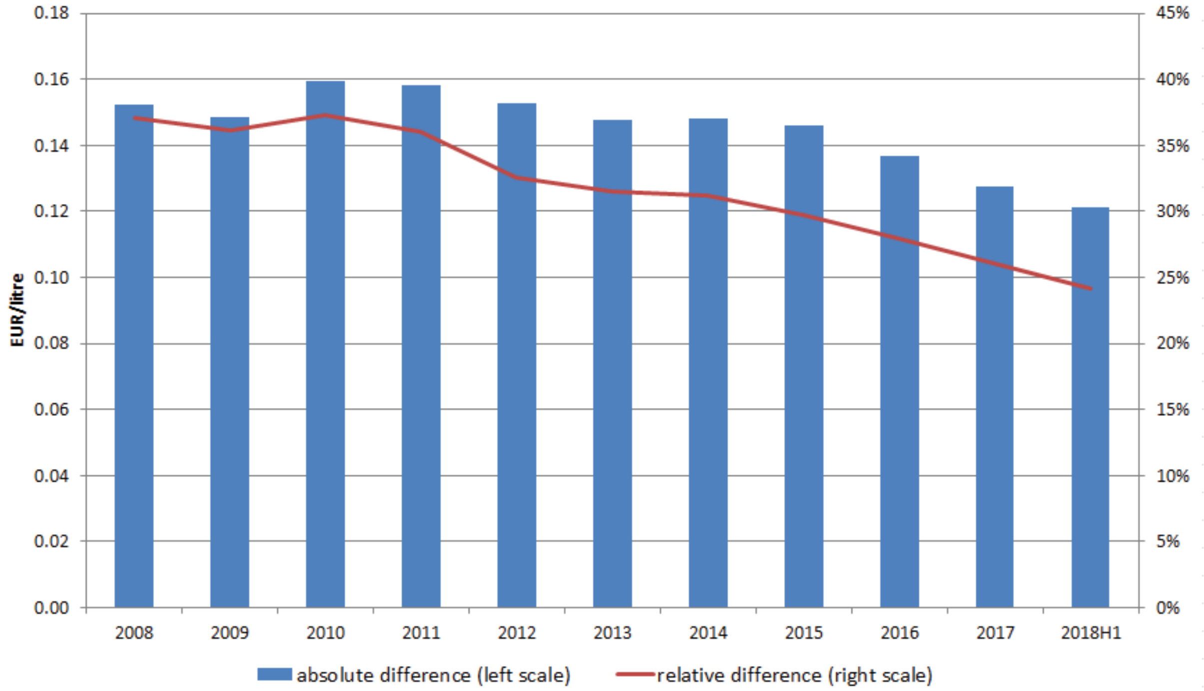

Figure 85 - The difference between the average excise duty rate on gasoline and diesel

Source: Oil Bulletin, DG Energy

In most Member States, excise duty rates increased for both gasoline and diesel in the last ten years. In case of gasoline, the average EU rate grew from 0.56 EUR/litre to 0.62 EUR/litre (+10%) while for diesel the average rate increased from 0.41 EUR/litre to 0.50 EUR/litre between 2008 and the first half of 2018. The faster growth of the diesel rate means that the difference has gradually diminished. Nevertheless, there is still only one Member State, the UK, which applies the same rate for the two fuels.

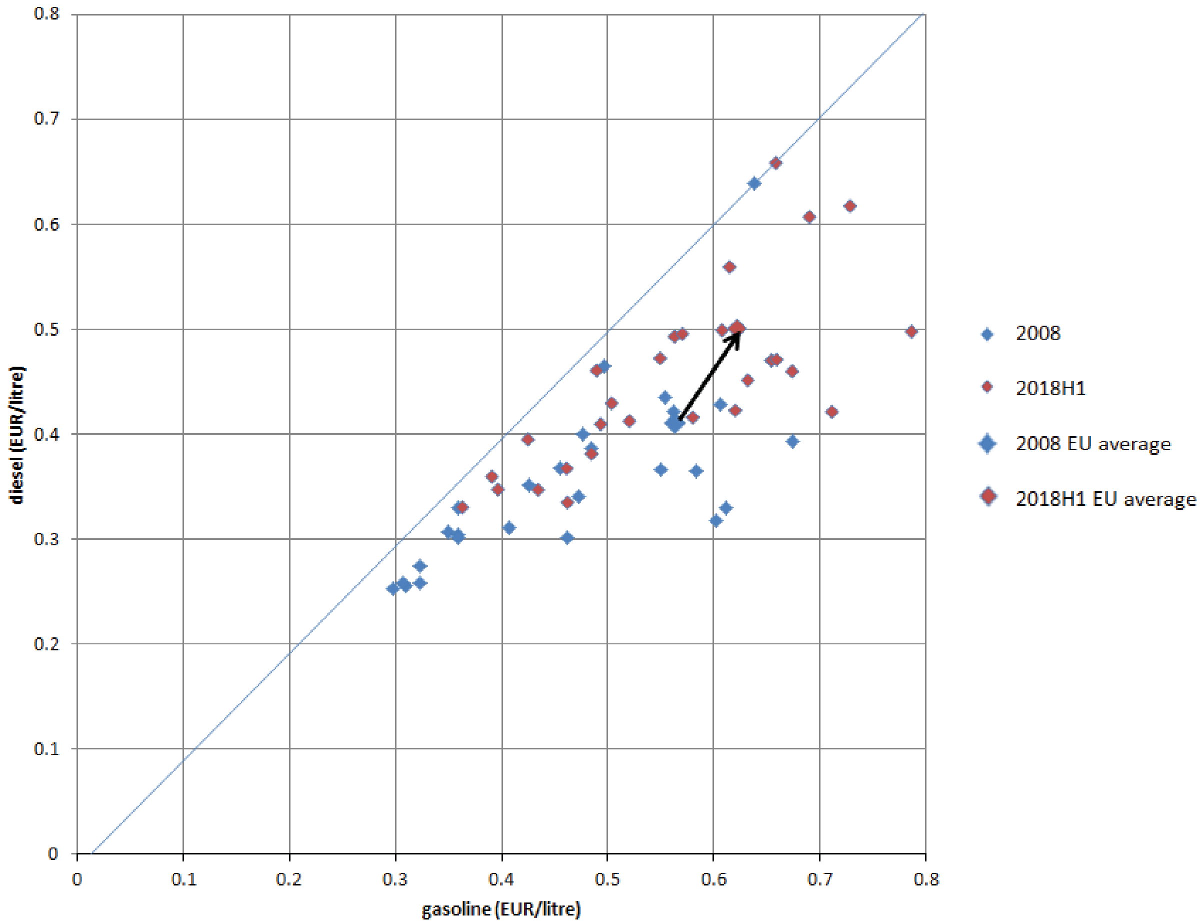

Figure 86 - Excise duty rates in individual Member States in 2008 and the first half of 2018

Source: Oil Bulletin, DG Energy

At EU level, the difference between the average gasoline and diesel excise duty rates decreased from 0.15 EUR/litre in 2008 to 0.12 EUR/litre in the first half of 2018. Looking at Member States, we can see that the difference decreased in only half of the Member States. In 12 Member States the absolute difference has actually increased, implying a growing tax advantage for diesel. For example, in Greece the gasoline excise duty rate has almost doubled (+98%) in this period while that of diesel grew by "only" 39%.

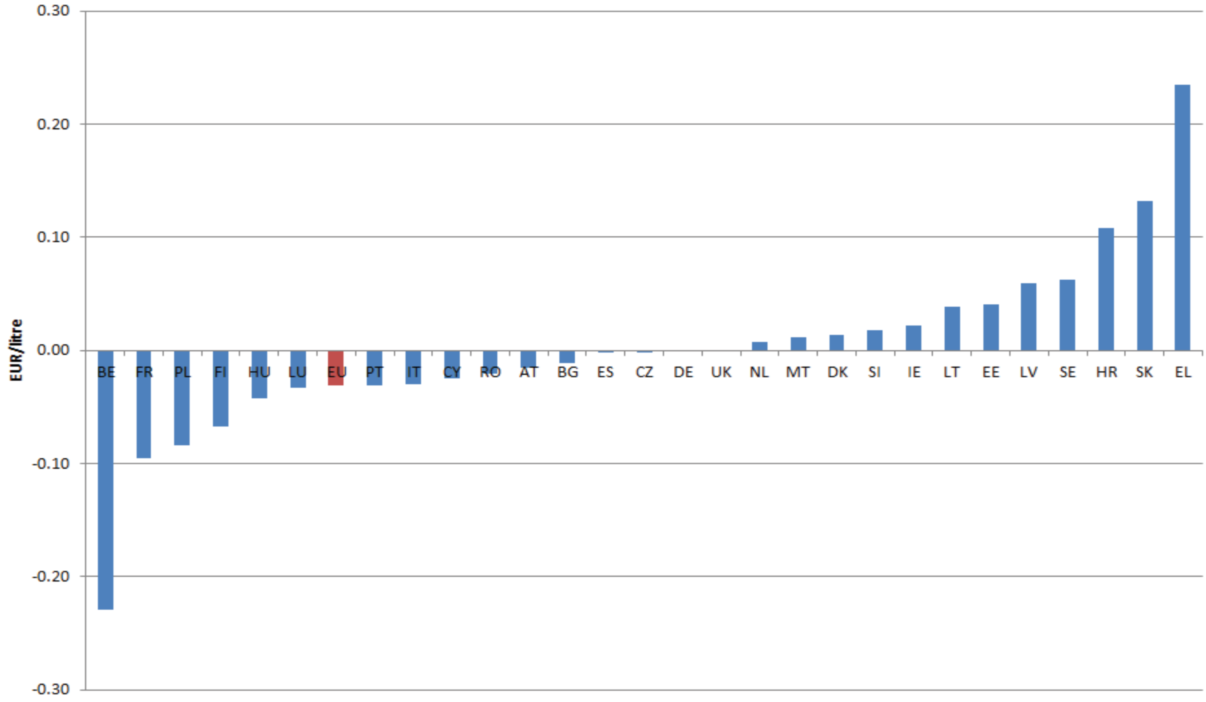

Figure 87 - the change of the difference between the gasoline and diesel excise duty rates between 2008 and the first half of 2018

Source: Oil Bulletin, DG Energy

In recent years, Belgium made the biggest step to remove the tax advantage of diesel: since 2016, the excise duty rate for diel has been gradually raised and by mid-2018 the difference between the gasoline and diesel rate dropped to 0.03 EUR/litre. As a result the difference between the retail price of the two fuels has practically disappeared.

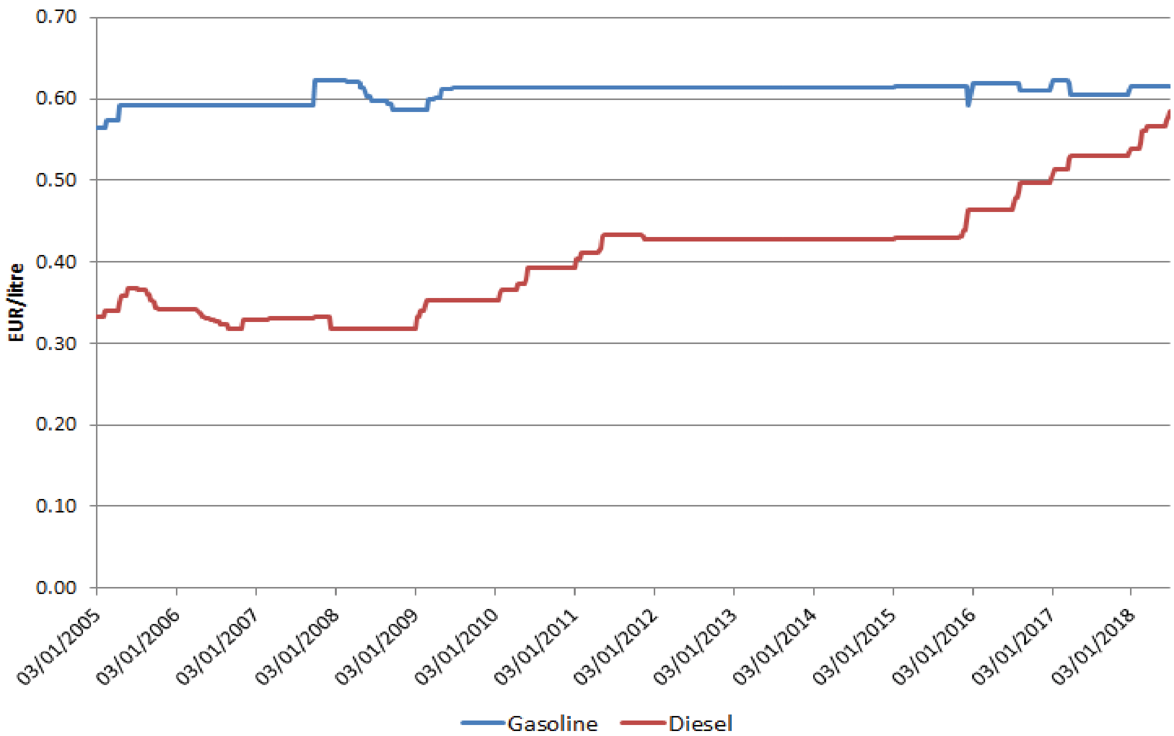

Figure 88 - Excise duty rates for motor fuels in Belgium

Source: Oil Bulletin, DG Energy

3.3.7 International comparison

This section is relying on the price data collected by Trinomics and covering G20 economies.[35]

Comparing the average retail price of motor fuels in the EU with prices in other G20 countries reveals that the trajectory of prices is in general very similar, basically following the development of crude oil prices. However, there can be significant differences in the absolute level of prices which are largely affected by taxes.

In case of gasoline, retail prices in most G20 countries are lower than the EU average. The retail price in the US is typically less than half of the EU average level. While in the EU the tax component is on average about 60% of the final price, this share in the US is only around 25%. Excluding taxes, EU and US prices are comparable. A few G20 countries had higher prices than the EU average for most of the period, in particular Korea and Turkey, but even these have converged to the EU average level over the last decade.

To sum up, differences in tax treatment are instrumental in explaining the price differences across G20 countries. EU taxes on fuels are among the highest globally, resulting in a high retail price compared to most G20 countries.

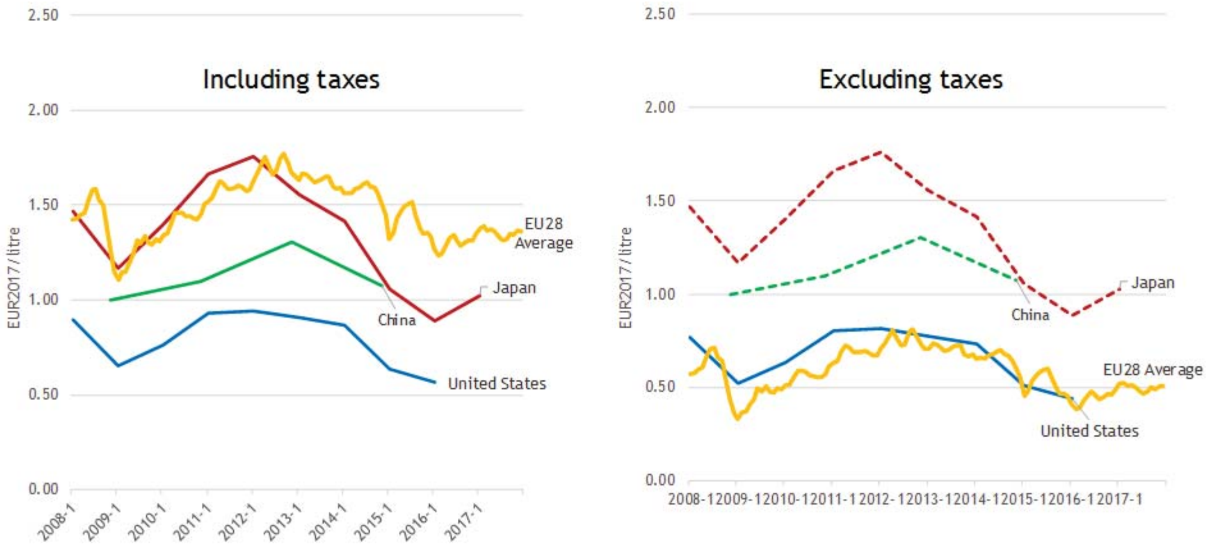

Figure 89 - International comparison of retail gasoline prices

Source: Oil Bulletin, DG Energy; IEA, GIZ

Note: prices are expressed in real (2017) euros; dotted line highlights that it is unclear if the excluding taxes price actually excludes relevant taxes

[35] Trinomics et altri (2018)

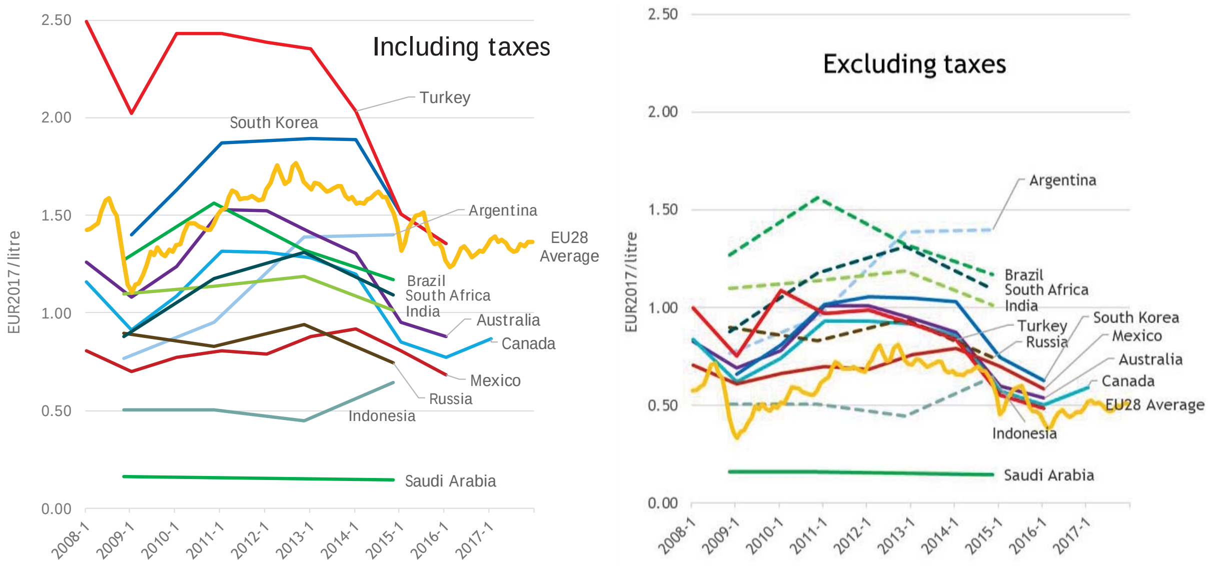

Figure 90 - International comparison of retail gasoline prices

Source: Oil Bulletin, DG Energy; IEA, GIZ
Note: prices are expressed in real (2017) euros; dotted line highlights that it is unclear if the excluding taxes price actually excludes relevant taxes

For diesel, the price is similar: the EU average price is one of the highest among the G20 countries. This is explained by a high tax component which on average constitutes about 50% of the final price. The retail price in the US, where the share of the tax component is only about 25%, is less than half of the EU average. Excluding taxes, EU prices are very similar to those in the US and lower than those in the majority of G20 countries. Turkey is the country which had a consistently higher price than the EU average for most of the period but the difference has largely disappeared by 2015-2016.

Similarly to gasoline, differences in tax treatment are instrumental in explaining the price differences across G20 countries. EU taxes on fuels are among the highest globally, resulting in a high retail price compared to most G20 countries, in spite of the relatively low net price.

The EU is not the only region with gasoline retail prices exceeding diesel prices. This is the case in practically all G20 economies.

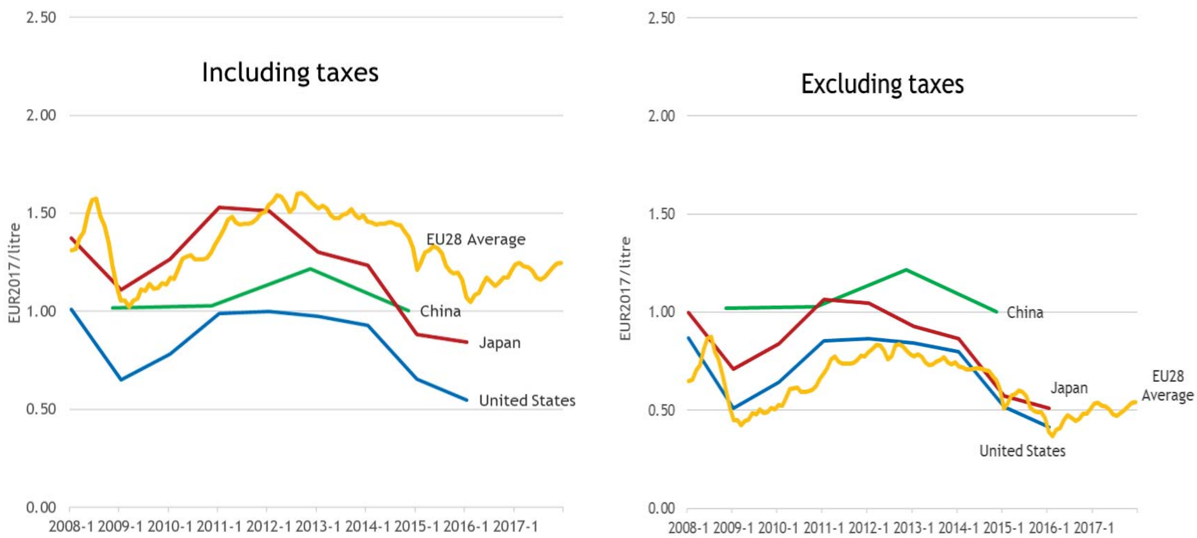

Figure 91 - International comparison of retail diesel prices

Source: Oil Bulletin, DG Energy; IEA, GIZ

Note: prices are expressed in real (2017) euros

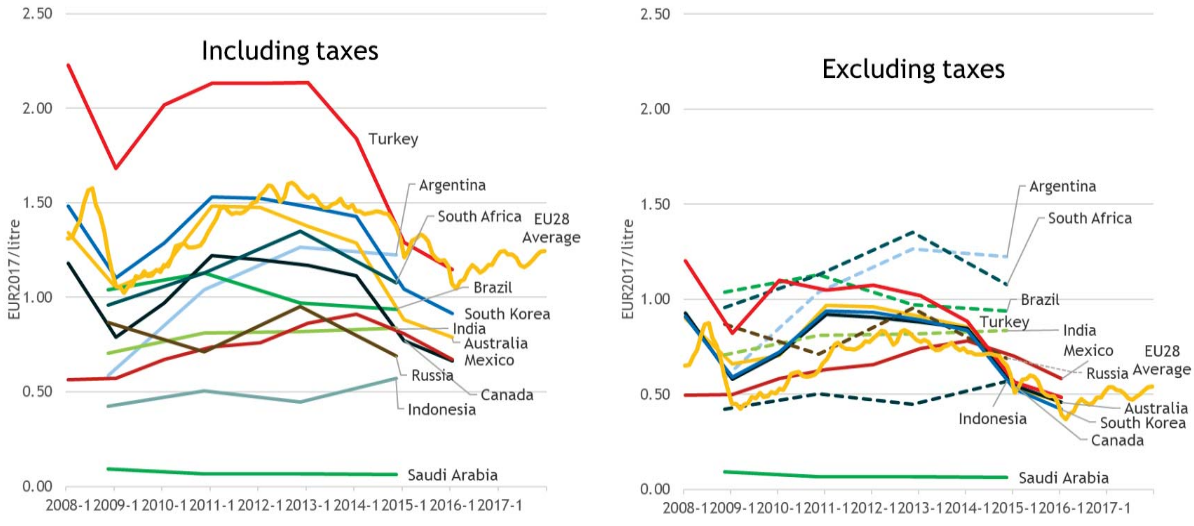

Figure 92 - International comparison of retail diesel prices

Source: Oil Bulletin, DG Energy; IEA, GIZ

Note: prices are expressed in real (2017) euros; dotted line highlights that it is unclear if the excluding taxes price actually excludes relevant taxes

PART II

ENERGY COSTS for the economy, households and industry

4 The EU energy bill

In this chapter we outline the main drivers of the import bill and estimate its size in the last couple of years.

Main findings

- High import dependency means that the EU faces an important energy import bill.
- The price of oil, gas and coal decreased significantly in 2014-2016, resulting in a decreasing import bill. After bottoming out in 2016, energy commodity prices and the import bill have been on the rise
- In 2013, the EU's estimated import bill reached EUR 400 billion. In 2013-2016, falling energy prices allowed the import bill to decrease significantly, although the weakening of the euro has partly offset this effect. In 3 years, the import bill has almost halved, thereby giving a boost to the economy.
- The prices of all three fuels increased in 2017, resulting in a growing import bill, but still well below the 2013 level: in 2017, the estimated import bill amounted to EUR 266 billion, 26% more than in 2016 but 34% less than in 2013.
- The increase in crude oil prices in 2018 could result in lower growth and higher inflation. Crude oil prices assumed at 75$/bbl on average in 2018 would result in an economic growth being 0.4% lower in the EU and an inflation rate higher by 0.6% than the baseline assumption with oil prices remaining at the level of 2017.
- Crude oil is by far the main component of the import bill, making up 68% of the total in 2017. The share of gas and hard coal was 28% and 4%, respectively.

4.1 Introduction

The EU is a net importer of energy: in 2016, the import dependency[36] stood at 53.6%, practically the same as two years earlier. This means that the EU needs to import just over half of the energy it consumes. Import dependency is particularly high in case of fossil fuels: in 2016, it was 87.4% for crude oil and NGL, 70.4% for natural gas and 40.2% for solid fuels (from which 61.2% for hard coal).

Between 2014 and 2016, import dependency increased for gas (because of rising consumption and falling indigenous production) but decreased for solid fuels (the consumption of which decreased to a larger extent than production). The import dependency for oil has not changed significantly.

EU energy import dependency seems to have stabilised in recent years: since 2005, it has been fluctuating between 52% and 55%. While the import dependency of fossil fuels shows a

[36] Import dependency is calculated as net imports divided by gross inland consumption

long-term increasing trend, their share within the energy mix is gradually decreasing. The share of renewables, on the other hand, is steadily growing and these are typically produced within the EU.

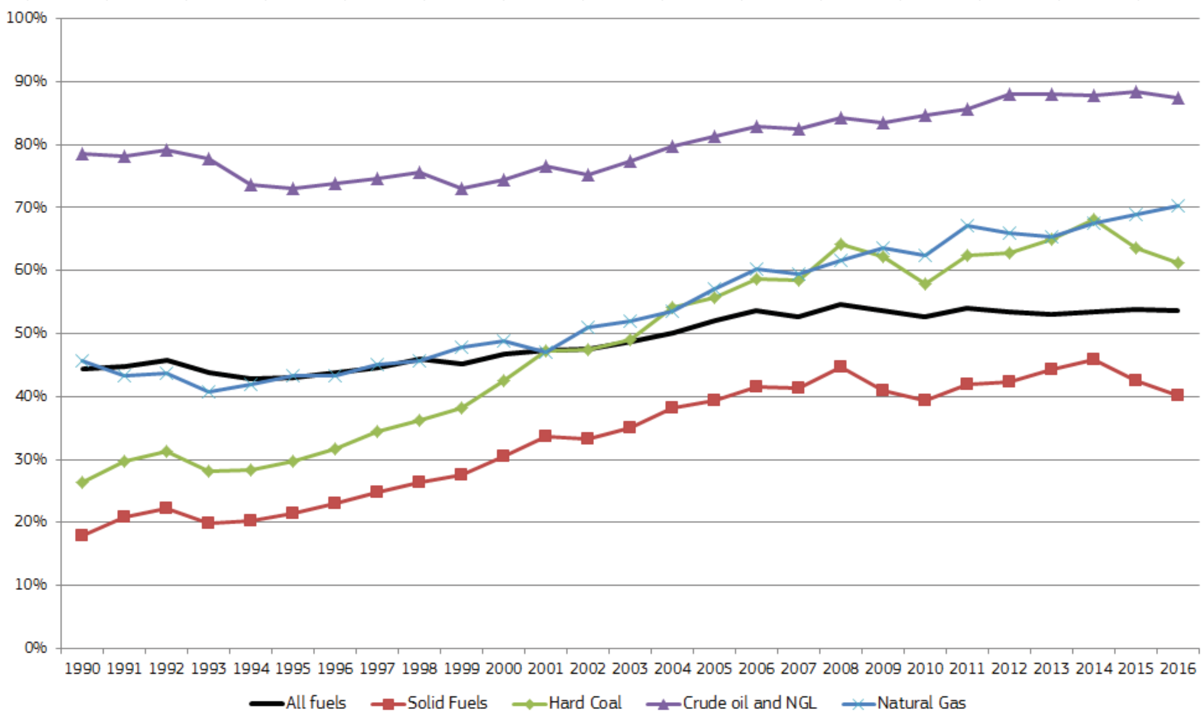

Figure 93 - EU import dependency by fuel

Source: Eurostat

The high import dependency poses significant challenges in terms of energy security and the diversification of suppliers and supply routes but, in addition, it also means that the EU is facing an important energy import bill.

4.2 Methodology

Scope

In this analysis, we focus on the import bill of the EU as a whole, therefore only extra-EU imports are considered. (When the import bill of an individual Member State is looked at, it is of course reasonable to take all imports into account, including those coming from other Member States.)

The analysis covers the main fossil fuels: crude oil, natural gas and solid fuels. These fuels still cover nearly three-quarters of the EU's gross inland energy consumption and the overwhelming majority (98% in 2016) of net energy imports. Crude oil alone makes up well over half of the EU's net energy imports while gas accounts for 30%.

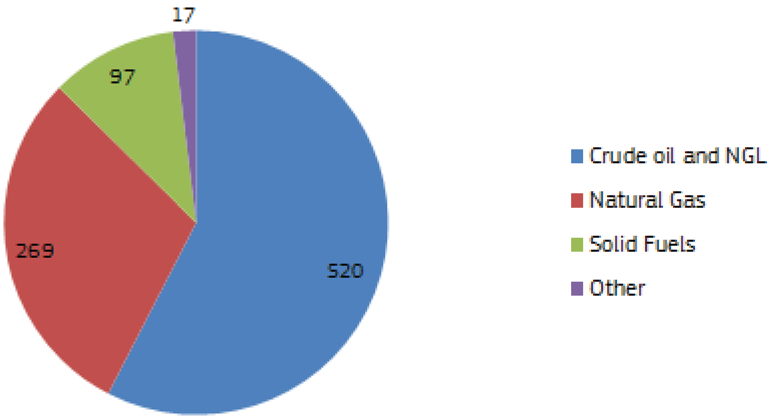

Figure 94 - EU net imports of energy in 2016 (mtoe)

Source: Eurostat

In addition to crude oil, the EU is also an importer of petroleum products. However, considering the practical difficulties of finding reliable volume and price data for a multitude of products with different specifications and the fact that the EU is also exporting petroleum products and exports and imports are of a similar magnitude (the EU typically exports motor gasoline and imports middle distillates), petroleum products were not included in the calculation of the import bill.

Lignite/brown coal is typically not traded internationally and the imports arriving to the EU are negligible. Therefore, the analysis of solid fuels was restricted to hard coal.

In terms of time horizon, we provide import bill estimates for the period 2013-2017.

Data sources

In case of oil, we are in comfortable position as Member States report on a monthly basis the volume and the average CIF price[37] of imported oil under Regulation (EC) No 2964/95 of 20 December 1995 introducing registration for crude oil imports and deliveries in the Community.[38] Every year, the collected and aggregated information is published on the website of DG Energy.[39]

For gas, the import volumes used are from the Transparency Platform of the European Network of Transmission System Operators for Gas (ENTSO-G)[40] which is based on the gas flows reported by gas transmission system operators. Gas imports arrive to the EU from Russia, Norway, Algeria and Libya through several pipelines while, in 2017, LNG was arriving from 12 supplying countries to around 25 terminals in 13 Member States.[41] Volumes were calculated by adding the gas flows at the relevant entry points to the EU gas network.

Gas import prices can vary across Member States depending on the supplier, the supply route, the type of contracts (spot or long-term), the way of pricing (hub-based or oil-indexed) and the level of competition. Based on available sources, including customs data, national agencies (e.g. BAFA in Germany) and commercial data providers, for each supplier (Russia,

[37] The CIF price includes the FOB price (the price actually invoiced at the port of loading), the cost of transport, insurance and certain charges linked to crude oil transfer operations.
[38] http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31995R2964
[39] https://ec.europa.eu/energy/en/statistics/eu-crude-oil-imports
[40] https://transparency.entsog.eu/
[41] Including small-scale terminals in Finland and Sweden.

Norway, Algeria, Libya and LNG) and for each year an estimated average price was established.

Table 5 - Estimated average gas import prices by supplier (€/MWh)

Year	Russia	Norway	Algeria	Libya	LNG
2013	30.0	25.0	30.0	31.0	28.5
2014	25.5	20.0	27.5	29.5	25.5
2015	22.0	19.5	23.5	23.5	20.5
2016	16.0	14.0	16.0	14.5	15.5
2017	17.5	17.5	18.0	15.5	18.5

Source: DG Energy estimation

In case of coal, volumes are the imports of hard coal[42], reported in Eurostat annual (2013-2016) and monthly (2017) statistics. For price, the CIF ARA spot price reported by Platts was used; this is deemed to be representative for most of the hard coal imports arriving to the EU.

For the conversion from US dollars to euros, we used the annual average of the daily official exchange rates published by the European Central Bank[43]: 1.3281 in 2013, 1.3285 in 2014, 1.1095 in 2015, 1.1069 in 2016 and 1.1297 in 2017.

4.3 Drivers

The import bill basically depends on the volume and the average price of imports. Like most commodities, energy sources are typically traded in US dollars and therefore the development of the USD/EUR exchange rate will also influence the import bill (if expressed in euros).

Volumes

Import volumes will depend mainly on the level of consumption. In addition, the development of indigenous production (falling production results in increasing import dependency even if consumption is unchanged) and, to a smaller extent, stock changes can also affect import volumes. In principle, exports can also influence import volumes (higher exports has to be offset by higher imports) but extra-EU exports of crude oil, natural gas and coal are negligible.

[42] This includes anthracite, coking coal, other bituminous coal and sub-bituminous coal
[43] http://www.ecb.europa.eu/stats/exchange/eurofxref/html/index.en.html

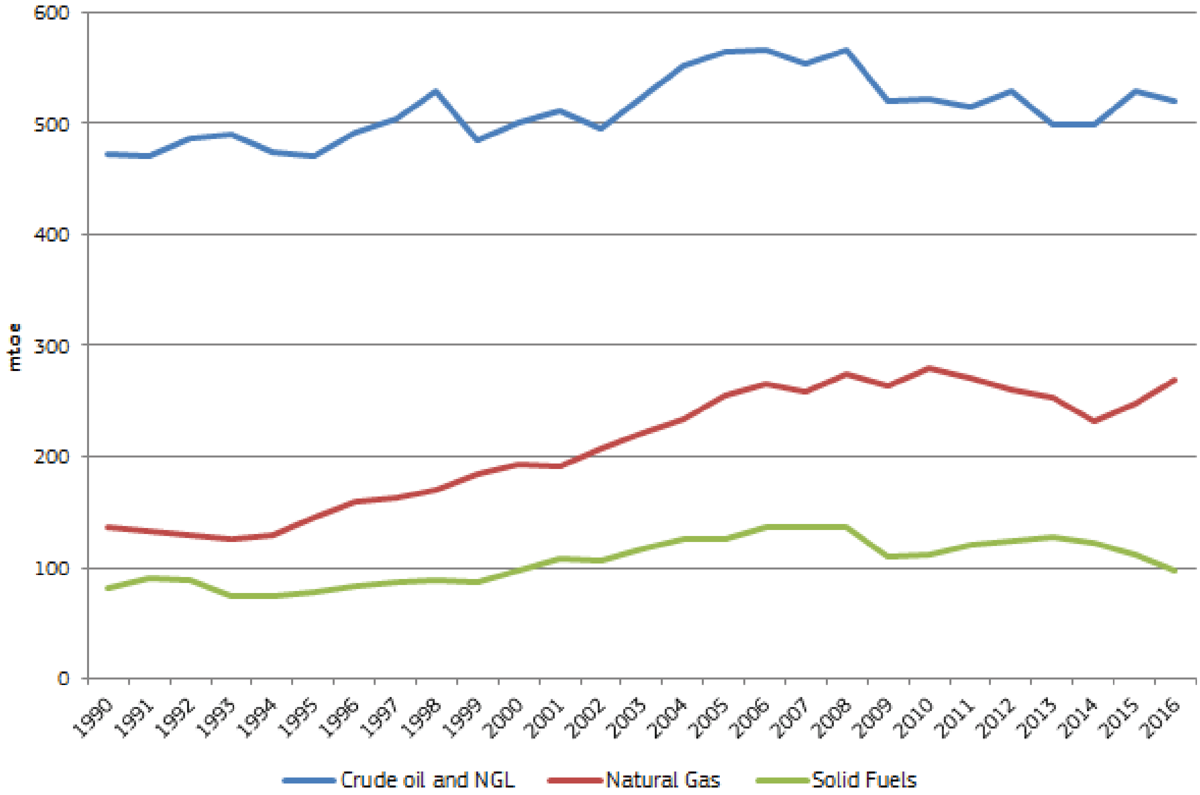

Figure 95 - EU net imports

Source: Eurostat

EU imports of fossil fuels showed a marked increasing trend during the 1990s and for most of the 2000s. Since then, the tendencies of the different fuels are diverging.

In case of oil, imports have been decreasing since 2008 but bounced back in 2015, as the significant fall of oil prices triggered an increase in fuel demand.

Gas imports decreased in 2010-2014 when this fuel lost ground in the electricity sector where it had to face increasing competition from renewables and coal. The trend turned after 2014 as increasing gas consumption and the ongoing fall of indigenous production increased import needs.

In case of hard coal, imports increased from 2009-2010, helped by low prices (cheap shale gas squeezed out the fuel from the US power sector), coupled with the low carbon prices. In 2013-2014, the trend reversed and coal imports started to fall again. The competitiveness of gas has improved compared to coal and, in addition, many Member States announced plans to phase out coals.

Prices

International commodity prices generally decreased in 2014-2016 and have been rising since 2016. There is a strong correlation between international commodity prices; in particular, one can observe a strong correlation between Brent and TTF (the Dutch gas benchmark) since 2015.

In the short run, changes in the import volumes are usually moderate but prices can be rather volatile. For example, the price of oil fell by more than 70% between mid-2014 and early 2016, whereas coal prices have more than doubled between the beginning and the end of 2016.

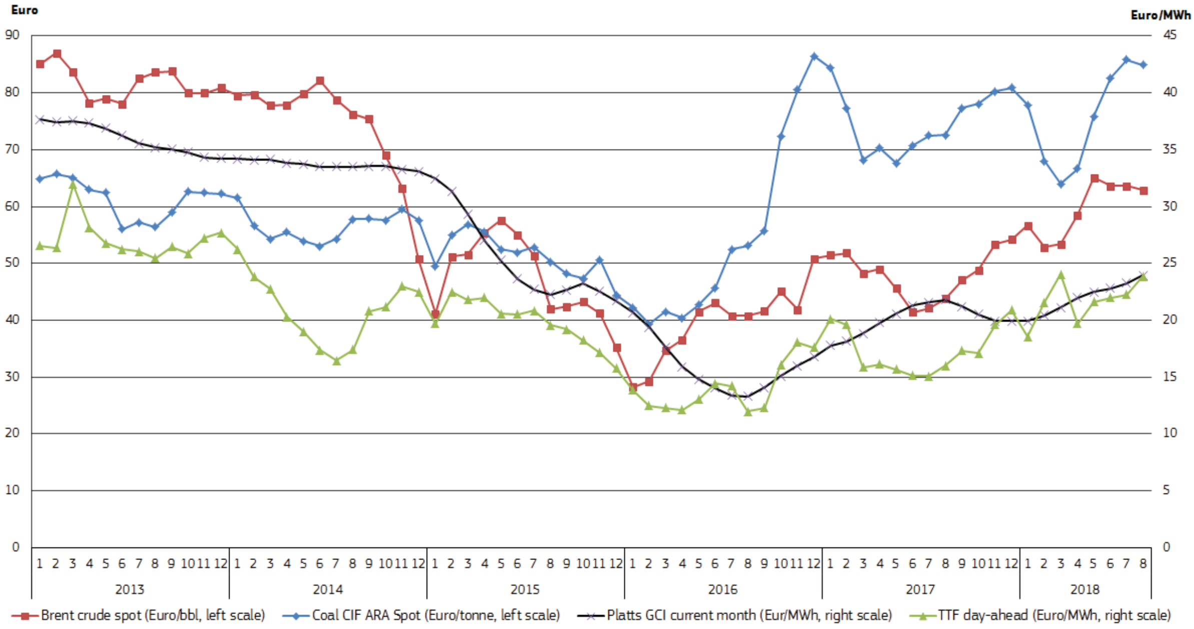

Figure 96 - Comparison of European oil, gas and coal prices

Source: Platts; GCI is the North West Europe Gas Contract Indicator, a theoretical index showing what a gas price linked 100% to oil would be

As the EU is net crude oil importer, price volatility impacts the energy expenditure of EU consumers and at macroeconomic level the impact can be tracked in economic growth and in the inflation. According to an analysis carried out by the European Commission, in 2015 and 2016 decreasing oil prices resulted in an additional GDP growth of 0.8% and 0.5%, respectively. As since crude oil prices started to rise again, an opposite impact is anticipated.

If prices are estimated to be 75 USD/barrel on average in 2018, being measurably higher than the average of 2017 (54 USD/barrel), real GDP in 2018 is predicted to be 0.4% below a baseline reflecting constant 2017 oil prices. Compared to the baseline, rising production costs together with the direct effect of higher oil prices on consumer prices are expected to translate into an overall increase in the consumer price index (CPI) inflation by 0.6 percentage points in 2018.

Exchange rates

Most energy is traded in US dollars. Accordingly, the fluctuations of the USD/EUR exchange rate can directly affect the prices and the import bill when these are measured in euros.

Historically, there has been a consistently negative correlation between oil prices and the US dollar, although recently, with the decline of US oil imports, the relationship has weakened. In other words, it can be observed that the price of oil and the value of the US dollar generally move in an opposite direction: a strengthening dollar typically coincides with decreasing oil prices and vice versa. This means that changes in the oil price, whether upwards or downwards, are mitigated by the exchange rate and the volatility of the oil price expressed in euros is smaller than the volatility of the price expressed in dollars. In view of the correlation between oil, gas and coal prices, to a certain extent this is true for coal and gas prices, too.

The euro has considerably weakened compared to the US dollar in the second half of 2014: the exchange rate went down from nearly 1.40 USD/EUR in early May 2014 to 1.06 in March

2015, a depreciation of 24% in 10 months. In spite of the weakening of the euro in the second half of 2014, the 2014 average exchange rate was practically the same as in 2013, 1.33, but in 2015 it decreased to 1.11.

In 2015-2016, the exchange rate had been rather stable, moving in the 1.05-1.15 range during most of this period. The annual average was 1.11 in both 2015 and 2016.

Throughout 2017, the Euro strengthened compared to the US dollar but the annual average exchange rate was only slightly higher (1.13) than in the previous two years.

Figure 97 - The USD/EUR exchange rate since 2013

Source: ECB

The red dotted lines represent the annual average in 2013, 2014, 2015, 2016 and 2017

The European Union has a strong intention to "do more to allow the euro to play its full role on the international scene"[44]. As the EU is a net importer of petroleum products, gas and coal, broader deployment of euro in the international trade of these energy products could eliminate the risk of price volatility stemming from the fluctuation of euro against other major currencies, such as the US Dollar.

[44] See Commission President Juncker's speech on the State of the Union, 2018. https://ec.europa.eu/commission/sites/beta-political/files/soteu2018-speech_en_0.pdf

4.4 Import bill calculation

Oil

Table 6 - EU crude oil import bill in 2013-2017

	2013	2014	2015*	2016*	2017*
Volume (million bbl/day)	9.83	10.01	10.48	10.29	10.53
Average Brent price (USD/bbl)	108.66	98.95	52.39	43.73	54.19
Average CIF import price (USD/bbl)	108.83	98.65	51.72	42.11	53.16
EUR/USD exchange rate	1.3281	1.3285	1.1095	1.1069	1.1297
Import bill (bn USD)	390.6	360.4	197.8	158.6	204.3
Import bill (bn EUR)	294.1	271.3	178.3	143.2	180.8

Source: DG Energy, based on Member State reports under Regulation (EC) No 2964/95, Platts, ECB

*for confidentiality reason, from 2015 figures do not include the Czech Republic (in 2014, imports by the Czech Republic made up around 1.5% of total EU imports, implying an estimated annual import bill of 2-3 billion euros in 2015-2017)

In spite of the growing import volumes, the EU oil import bill significantly decreased in 2014-2016 as a result of the oil price fall. While in 2013 the oil import bill was close to USD 400 billion, in 2016 it dropped below USD 160 billion, a decrease of almost 60% within three years. The depreciation of the euro in the same period mitigated this trend: measured in euros, the import bill decreased from EUR 294 billion in 2013 to EUR 143 billion euros in 2016, a decrease of 51%.

2017 was the first year since 2012 when the average Brent price increased: it was 54 USD/bbl, 24% more than in 2016. The volume of daily imports also rose (by 2.3%), helped by falling indigenous production, rising fuel consumption and a relatively good refining environment. Driven mainly by the increasing oil prices, the EU's oil import bill increased from EUR 143 billion in 2016 to EUR 181 billion in 2017 (an increase of around 26%) but remained well below the level observed in 2013, the last year before the oil price fall. The euro slightly strengthened in 2017, which moderated the increase of the oil price bill.

Gas

Table 7 - EU gas import bill in 2013-2017

	2013	2014	2015	2016	2017
Volume (TWh)	3 390	3 113	3 445	3 853	4 238
Estimated average import price (€/MWh)	28.1	23.6	21.0	15.2	17.7
Import bill (bn EUR)	95.4	73.5	72.4	58.7	74.8

Source: ENTSO-G, DG Energy estimations

Gas imports showed a robust increase in 2015, 2016 and 2017 but prices had been on the decline, bottoming out in 2016 and increasing in 2017. In spite of the rising volumes, the estimated import bill decreased in 2014, 2015 and 2016 (as a result of the falling prices) but bounced back in 2017 when both import volumes and prices increased.

Between 2013 and 2016, the estimated gas import bill decreased by 38%, from EUR 95.4 billion to EUR 58.7 billion. In 2017, the gas import bill increased by 27%, reaching EUR 74.8 billion.

Coal

Table 8 - EU hard coal import bill in 2013-2017

	2013	2014	2015	2016	2017
Volume (million tons)	230.0	226.6	210.8	183.4	140.0
CIF ARA spot price (USD/ton)	81.57	75.20	56.84	60.18	84.73
EUR/USD exchange rate	1.3281	1.3285	1.1095	1.1069	1.1297
CIF ARA spot price (EUR/ton)	61.41	56.63	51.25	54.37	75.00
Import bill (bn USD)	18.8	17.1	12.0	11.0	11.9
Import bill (bn EUR)	14.1	12.8	10.8	10.0	10.5

Source: Eurostat, Platts, ECB

Similarly to oil and gas, the coal import bill also decreased between 2013 and 2016 although the absolute values are significantly lower. The estimated coal import bill decreased by 29%, from EUR 14.1 billion in 2013 to EUR 10.0 billion in 2016. International coal prices significantly increased in 2017 which offset the decrease of the imported volumes, resulting in a 5% increase of the import bill to EUR 10.5 billion.

Total

In 2013, the total import bill was about EUR 400 billion, more than EUR 1 billion per day. Falling prices allowed the EU to decrease its estimated import bill to EUR 358 billion in 2014 (-11%), EUR 262 billion in 2015 (-27%) and EUR 211 billion in 2016 (-19%). The cumulative decrease between 2013 and 2016 was 47%.

In 2017, however, the import bill increased by 26%, reaching EUR 266 billion.

When expressed as a percentage of EU GDP (at current prices), the share of the estimated import bill decreased from 3.0% in 2013 to 1.4% in 2016. This saving gave a significant boost to GDP growth in 2015-2016: lower energy prices meant more disposable income for households, lower energy costs for businesses and increasing activity of oil intensive sectors (e.g. transport, refining and chemicals). In 2017, the estimated import bill was equivalent to 1.7% of the GDP.

The per capita import bill decreased from around 800 euros in 2013 to 415 euros in 2016 and bounced back to around 520 euros in 2017.

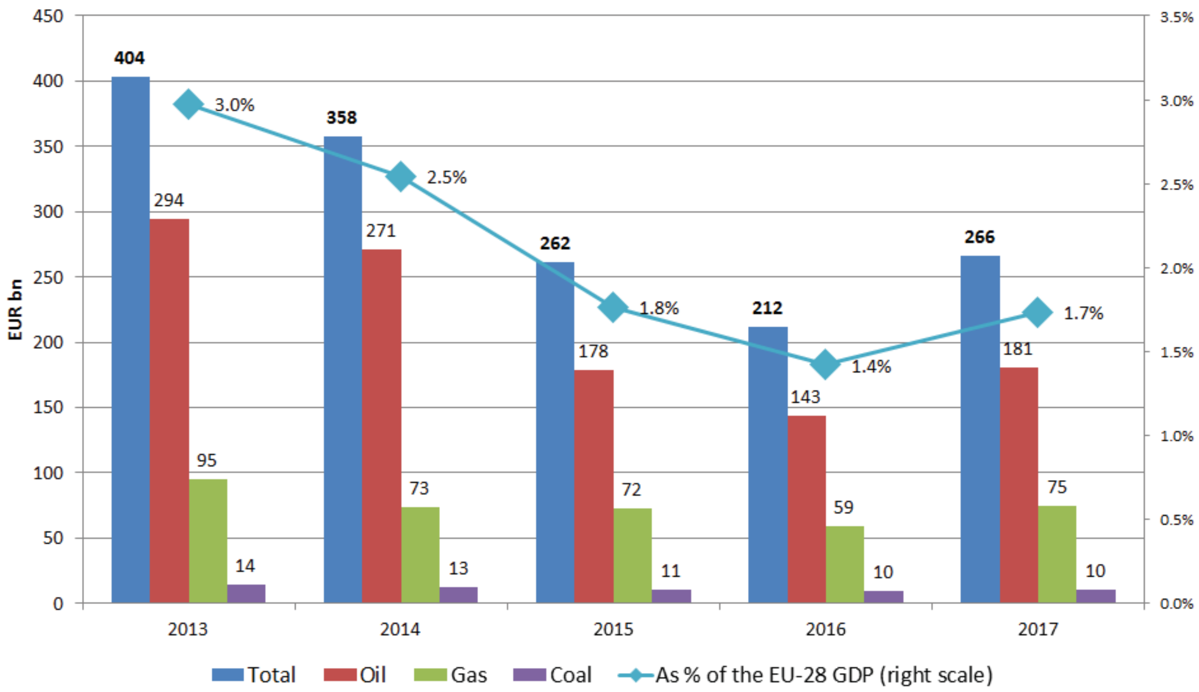

Figure 98 - The estimated EU import bill

Source: DG Energy calculation

5 Household energy expenditure and energy poverty

Introduction

Energy poverty became an ever more important issue in the last decade, as retail energy prices underwent a significant increase and in the consequence of economic crisis that began in 2008 the income of many households, especially in the case of the poor, fell measurably, leading to an increasing burden of paying their energy bills, as the share of energy rose in their consumption expenditure. As energy as basic need cannot be replaced, at least not on the short run, increasing energy related expenditures imply less spending on other consumer purposes.

In its Clean Energy for All Europeans legislative package, the European Commission has proposed to include the concept of energy poverty, explicitly mentioning it in the proposal of the new Electricity Directive. This would foresee that all Member States measure energy poverty. Recently, the project on European Energy Poverty Observatory (EPOV) has been launched, aiming at collecting data, developing indicators and presenting best practices to tackle energy poverty in the EU Member States. In this chapter an analysis is provided on the importance of energy products and transport fuels for households with different income across the EU Member States.

Main findings

- In 2015 the poorest households spent € 870 on energy products (electricity, gas, liquid and solid fuels, central heating) in the EU on average, representing around 10.4% of their total consumption expenditure. There were huge differences across the EU Member states, energy expenditures ranging from € 500 to € 2,300 per household.
- When compared to the total expenditure, the poorest households in Sweden spent only 3% on energy, while in Slovakia this share was more than 23%.
- Households with middle income, though spending higher amounts on energy products, spent proportionally less on energy within their total expenditure, only 7.1% on EU average, as opposed to the aforementioned 10.4% in the case of the poorest.
- However, even middle income households in Central and Eastern Europe spent around 10-15% of their expenditure on energy, owing to lower income compared to North and Western Europe, where this share was typically around 4-8% in 2015.
- The share of households being unable to keep their home adequately warm serves as a good complementary indicator on energy poverty, showing a positive correlation with the share of energy products within the total household expenditure. In 2017 around 19% of lower middle income households in the EU could not keep their home adequately warm, ranging from 2% in Finland to 60% in Bulgaria.
- Expenditures on transport fuels (petrol and diesel) represented € 370 (3.1% of the total expenditure) on EU average in the case of the poorest, while for middle income households it reached € 980 (4.3% of the total expenditure).
- Households with higher income spent proportionally more on transport fuels within their total expenditure than the poorer, and diesel had an increasing importance in their fuel spending compared to lower income households.

5.1 Energy products in household budgets

In this chapter we primarily rely on data provided by national statistical authorities (NSIs) on expenditure on energy products of households in the twenty-eight EU Member States. Energy expenditure of the residential sector usually covers heating, lighting, cooking needs, and the operation of electrical appliances. Household Budget Survey (HBS) and Standard Income and Living Conditions (SILC) data, available in both Eurostat and NSI databases provide information on expenditures on products and services and the quality of living conditions. In order to analyse the burden energy expenditures mean to households, it is reasonable to take into account the major energy products households spend resources on (electricity, gas, solid fuels, liquid fuels and heating – mainly district heating), and to look at how much households with different income conditions spend on these products, in absolute figures and in the share of their total expenditure on products and services.

In the 2016 edition of the Energy prices and costs report, detailed data were provided on energy expenditures in each income quintiles (one fifth of the population regarding their income), in this report for most of the EU countries we have more refined data, detailed expenditures in each decile (one tenth of the population, arranged into income strata). Furthermore, detailed data are available on expenditures on transport fuels (fuels total, expenditures on petrol and diesel). The analysis in this report primarily focuses on the latest available data, as opposed to the 2016 report, which looked at the timely evolution of energy expenditures over a ten-year long period.

5.1.1 Energy expenditure (excluding transport) in households with low income

The next chart (**Figure 99**) shows energy expenditure of households in the lowest decile (the poorest ten per cent of the population) in the EU countries[45]. In the EU € 870 was spent on energy on average by the poorest household according to the latest data[46], which represented 10.4% of their total consumption expenditure. There were huge differences across the EU on both absolute expenditures and the share of energy in the total household expenditure. In Bulgaria and Romania the annual energy expenditure remained below € 500[47], in contrast, in Denmark it was above € 2300 in 2014-2015. This nearly five-fold difference in energy expenditures reflect mainly differences in average household incomes in different EU Member States, however, differences between household energy prices also play a role. In the case of heating related expenditure the quality of residential building stock also has of particular importance, as energy expenditure can be reduced if buildings are more energy efficient.

[45] For some countries (Germany, Denmark and Poland) data of the lowest quintile (the poorest 20% of the population) was used for the computations as we did not receive decile data from the national authorities or there were issues with the data quality.

[46] EU average is calculated as weighted average from Member States' expenditure data, using the number of households as weight. Latest available data in most cases mean 2015 or 2014 data, however, due to different data collection in different countries, in some cases data might be of earlier time period.

[47] In this chapter expenditures are expressed per household

Looking at the shares of energy products in the households' budget[48], in Sweden the poorest households spent only 3% of their total expenditure on energy, whereas in Slovakia this share was higher than 23%. Countries in Central and Eastern Europe, primarily owing to lower incomes compared Northern and Western Europe, spent significantly higher share on energy within their household expenditure.

The role of different household energy products may also differ across the EU. A good example for this is the high share of district heating in Denmark, representing more than half of the total energy-related household expenditures[49]. In Estonia, Lithuania, the Czech Republic and Slovakia district heating also had an important share in household energy.

Electricity had high share in Sweden, Finland and France; in these countries this energy source is dominant not only in residential lighting but in heating as well. Natural gas had high share in the Netherlands, Italy, UK and Malta, and liquid fuels, mainly in the form of heating oil, are of importance within household energy in Slovenia, Belgium, Ireland and Luxembourg. Solid fuels only represented a fraction in the total energy expenditure in the EU, however, in Ireland, and in some Central and East European countries they still had a measurable share.

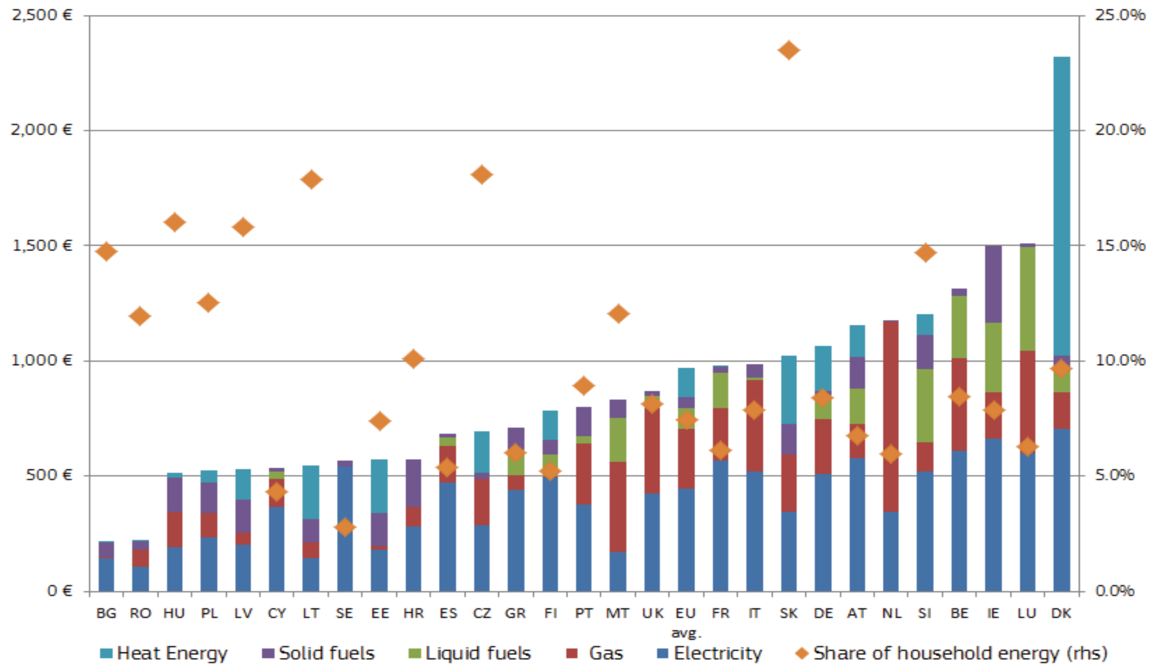

Figure 99 - Expenditures on household energy products for the poorest households in the EU Member States), and the share of energy in the total household consumption expenditure

Source: DG ENER ad-hoc data collection on household consumption expenditures

[48] As HBS data are not fully harmonised in the EU, the actual shares might differ from the result of this analysis. In some countries the share of energy is low in the total expenditure, as energy bills are "hidden" in the rental payments in the housing sector.

[49] According to the Danish District Heating Association, around 64% of all Danish households were connected in 2017 to the district heating grid, and district heating companies were legally bound to run on a non-profit basis. Otherwise saying, the high expenditures on district heating in Denmark was rather due to the broad deployment of district heating, not to the costs of this technology.

5.1.2 Energy expenditure (excluding transport) in households with middle income

Beside the poorest households, it is reasonable to analyse the situation of the lower-middle income and middle-income households, which are represented by the third and the fifth income decile (or in the case of some countries, the second and the third quintile) in the expenditure data. As both **Figure 100** and **Figure 101** show, the order of the countries regarding the absolute spending on energy products and the distribution of the individual energy sources within the total spending on energy is similar in all income deciles, however, the higher income a given household has, the higher is the usual amount it spends on energy products.

On the contrary, households with higher income spend proportionally less on energy products, compared to their total consumption expenditure, than poorer households. In the third decile (lower-middle income households) the average share of energy in total spending was only 7.2% (as opposed to 10.4% in the case of the poorest), and in the fifth decile (middle income households it was 7.1%. However, even for middle income households differences across Europe are perceivable regarding the share of energy in total spending, as households in Northern and Western Europe spent typically between 4% and 8% of their expenditure on energy, in Central and East Europe this share was 10-15% in recent times, implying that amid current income levels energy represents a significant burden for households in these latter countries.

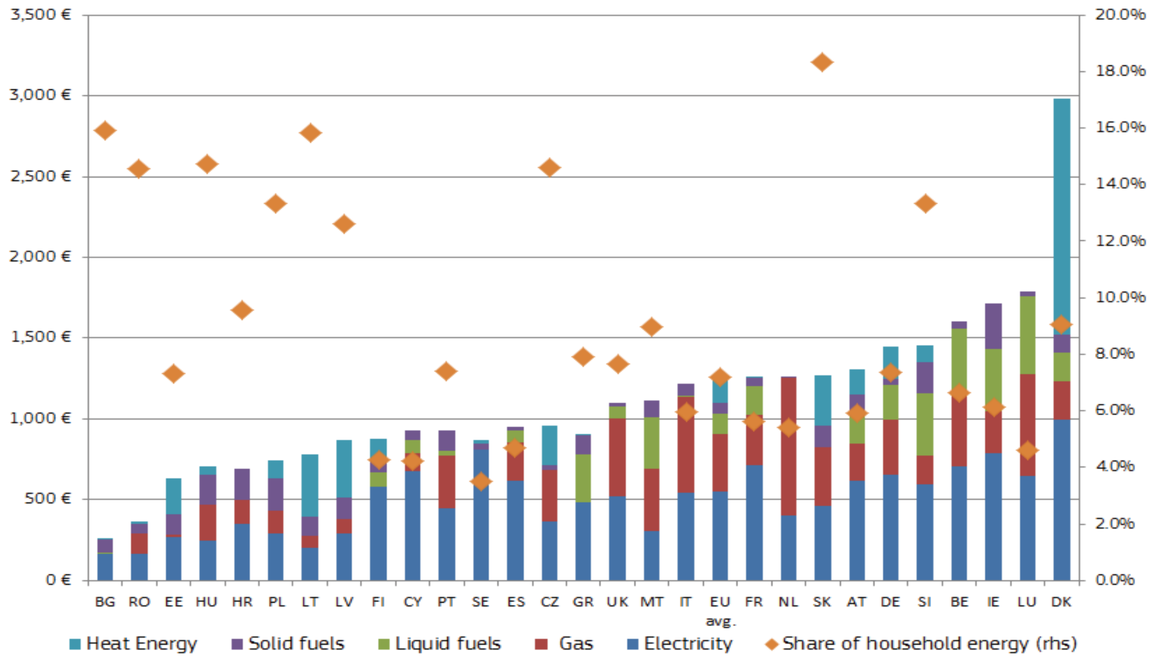

Figure 100 - Expenditures on household energy products for the lower-middle income households in the EU Member States, and the share of energy in the total household consumption expenditure

Source: DG ENER ad-hoc data collection on household consumption expenditures

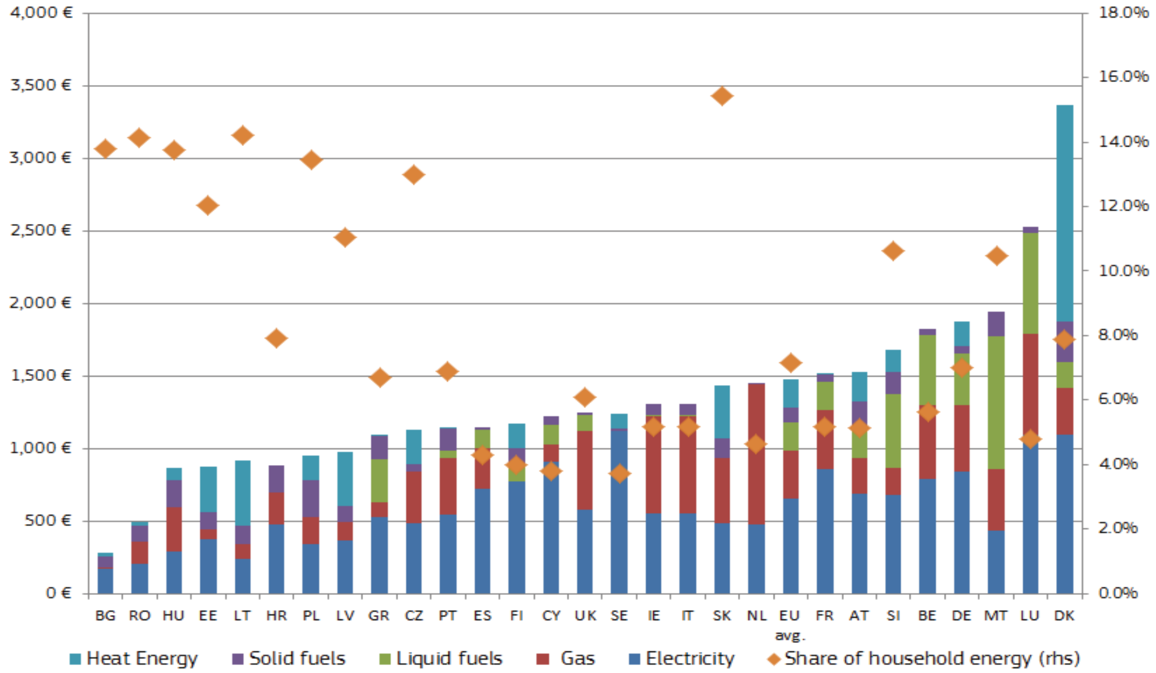

Figure 101 - Expenditures on household energy products for households with middle income in the EU Member States, and the share of energy in the total household consumption expenditure

Source: DG ENER ad-hoc data collection on household consumption expenditures

There exist a few other indicators providing information on the burden of household relating to paying their energy bills and/or keeping their home sufficiently warm. **Figure 102** shows the relation between spending on energy (in the share of the total) for lower-middle income households and the share of those being unable to warm up their home sufficiently.

Whereas in Finland only 2% of the households being under 60% of the median income were not able to keep their home adequately warm, in Bulgaria this share was more than 60% in 2017. The share of homes non-adequately warm shows a positive correlation (though not very strong, having a coefficient around 0.25) with the share of energy in total expenditures. The correlation is weakened by the data in some Mediterranean EU Member States, owing to lower energy expenditure amid warmer climate; however, this is not reflected in the perception of households on having a sufficiently warm home.

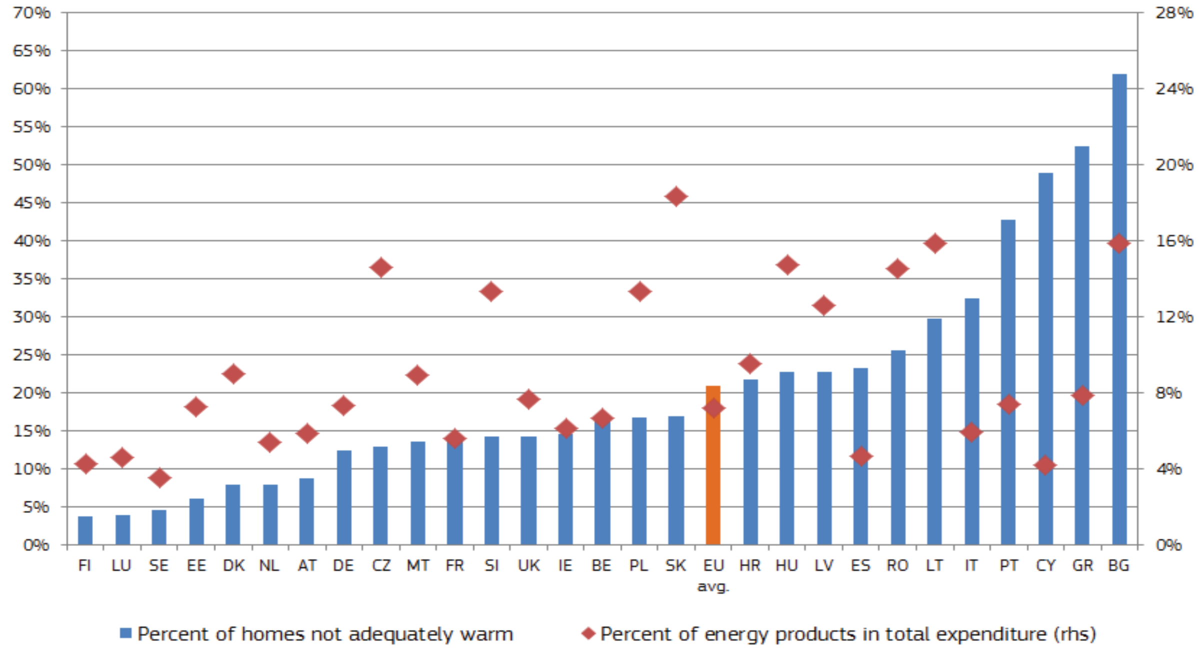

Figure 102 - The ratio of homes being not adequately warm for households being below the 60% of the median income and the share of energy products within the total expenditure for households in the third decile (lower-middle income)

Source: DG ENER ad-hoc data collection on household consumption expenditures and Eurostat

Box –Energy efficiency of the household sector

Energy consumption in the residential sector is impacted by several factors. Higher number of households, higher floor area of buildings, higher disposable household income all result in higher energy consumption (though as regards income proportionally less expenditure on energy products, as it was presented before, than in the case of poorer households). Increasing energy prices also result in decreasing consumption, however, energy is a price-inelastic product and necessary to living conditions. Energy consumption also shows strong correlation with climate conditions and has a strong intra-annual seasonality therefore, as two thirds of total energy consumed by households is related to heating needs.

Energy efficiency measures can mitigate the impact of these factors on the total residential energy consumption. Consumption of energy in the EU residential sector, accounting for around a quarter of total final energy use, rose by 7.4% between 2014 and 2016, largely owing to colder weather conditions in 2016 compared to the mild winter in 2014. Weather-corrected heating energy consumption has been relatively flat since 2010, following a decade of reductions. Non-heating related energy use, accounting for one third of the household energy consumption, went up by 3% a year between 2014 and 2016. This was related to large household appliances, such as refrigerators and televisions, in spite of their improving energy efficiency. For better understanding the reasons behind household energy consumption, the attention should be more focused on electricity, which seems to be driving up the total residential energy consumption in recent years.

In earlier periods significant decreases could be observed in EU household energy consumption (by 5.7 between 2008 and 2016), largely owing to decreasing heating related consumption, due to building refurbishments and more efficient heating systems (e.g.: replacement of boilers with low energy efficiency). However, over the last few years these factors could not any longer contribute to the decrease in energy consumption up to such extent as before, pointing to the need of seeking new sources of efficiency improvements in other areas, such as the aforementioned electricity use of appliances.

5.1.3 Energy expenditures in the transport sector

Figure 103 and **Figure 104** show the expenditures on transport fuels (petrol and diesel, or in the case of some Member States where detailed data were not available, fuels and lubricants total). Similarly to household energy products, there were significant differences across the Member States, both in absolute spending on fuels and in their share in the total household expenditure.

There were six Member States (Romania, Bulgaria, Slovakia, Lithuania, Czech Republic and Latvia) where spending on transport fuels remained below € 100 per household in 2015, whereas in France and Italy it was above € 600. In the EU the poorest households spent € 370 on average on transport fuels, representing 3.1% of the total consumption expenditure. The lowest share of transport fuels within the total expenditure could be observed in Romania (2%), whereas in Malta the poorest households spent almost 8% on transport fuels of their total expenditure.

The share of petrol and diesel within transport fuels was different across the EU. In countries like the Netherlands, Sweden, Belgium, UK and most of the countries in Central and Eastern Europe expenditures on petrol dominated the transport fuel bill, whereas in France, Italy, Luxembourg or Austria diesel had a significant share (though with the exception of France it was lower than the share of petrol).

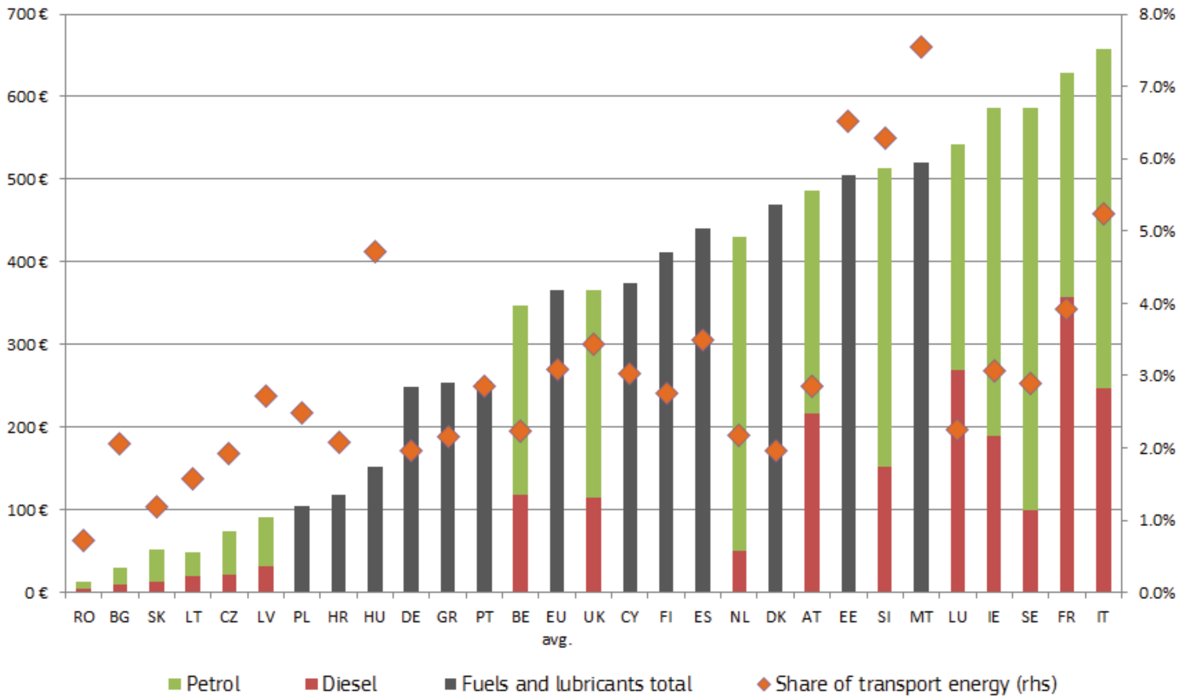

Figure 103 - Expenditures on transport energy products for the poorest households in the EU Member States, and the share of transport energy in the total household consumption expenditure

Source: DG ENER ad-hoc data collection on household consumption expenditures

Note: "Fuels and lubricants total" cover diesel, petrol and other fuels and lubricants. A split is not available by fuel in these EU Member States

In contrast to household energy products, the share of transport fuels within the total expenditure proportionally increases with the income of households, otherwise saying richer households tend to spend more on transport fuels within their total expenditure. As it was mentioned before, the poorest households spent 3.1% on transport energy on EU average, while those in the third income decile (lower-middle income) and in the fifth decile (middle income) respectively spent 3.9% and 4.3%. Expenditures on transport fuels reached €980 in the case of middle income households in 2015 in the EU.

Comparing the details of transport fuel expenditures of the poorest and middle income households, it seems that the share of diesel fuel is higher in the case of middle income households than for the poorest. Diesel engine cars are more popular among those who use their car more frequently, or having a higher annual mileage, as in many countries taxation of diesel fuels is more favourable (or at least it used to be in the past) compared to petrol.

As households with higher income rely more on private transport, they spend proportionally more on diesel than the poorer. However, in the future this might change as difference in taxation of petrol and diesel (mainly excise duties) will diminish and due to the changing environmental rules and public acceptance; thus diesel may not be as attractive alternative to petrol cars as in the past.

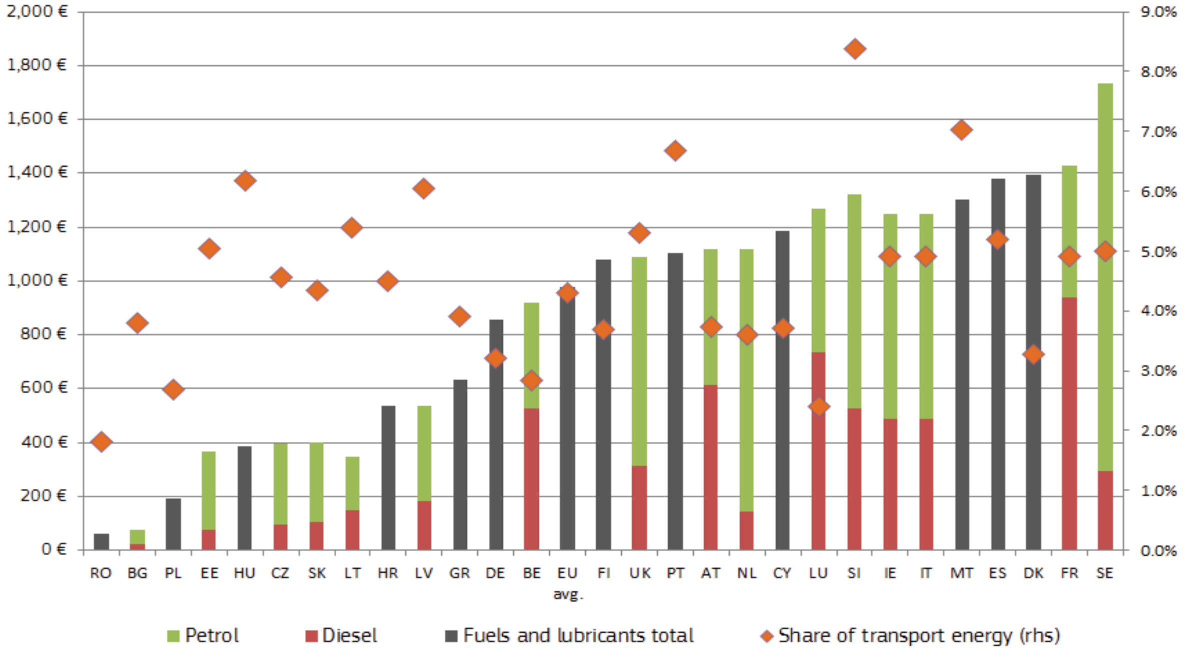

Figure 104 - Expenditures on transport energy products for households with middle income in the EU Member States, and the share of transport energy in the total household consumption expenditure

Source: DG ENER ad-hoc data collection on household consumption expenditures

EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 3/11

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(2019) 1 final}

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6 Industry energy costs

Introduction

The chapter mainly looks at the impact of energy prices and energy costs on the cost-competitiveness of selected European industrial sectors. In the following pages we first look at the context of the general competitiveness of the EU and the importance of energy costs for the overall industry and services. Energy costs are then mapped across several manufacturing, services and agricultural sectors. Emphasis is put in analysing energy intensive sectors which by nature are sensitive to energy costs fluctuations. The evolution of energy costs in the various sectors are assessed as well as the factors driving these costs like changes on energy prices, output and energy intensity. Finally the available international data is used to establish international comparisons of energy costs with third countries.

Main findings

On the overall impact of energy on the EU competitiveness

- 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 around 2% of the total production value of manufacturing and around 1% of the combined group of industry and services in 2016.

- The economic performance and the overall competitiveness of the EU Member States has remained stable compared to that of our main trading partners.

- The macroeconomic effects of the wide variations of the global energy commodity prices (oil, gas and coal) in recent years are yet to unravel. It seems that up to 2017 the impact on the overall competitiveness of the EU economy was limited and the real unit energy costs of large industrial subsectors remained stable.

- Yet, energy is at the very fabric of almost all products and services used in everyday life. In addition, several important manufacturing sectors (see section 6.2) also rely on energy as the biggest or the most critical factor of production.

Energy costs shares

- Energy costs shares in production costs fell for the vast majority of the sectors studied between 2008 and 2015, with the most significant declines appearing in some of the most energy intensive sectors.
- Energy costs for the selected manufacturing sectors accounted for around 1-10% of total (operational) production costs. For some sectors of the most energy intensive sectors energy costs accounted for more than 10% of production costs in at least one year like for *paper*, *clay building materials*, *iron and steel* and *cement* (on the latter sector the energy costs share was consistently above 10%).
- Amongst the less energy intensive manufacturing sectors studied, energy costs are typically 1-3% of operational (production) costs. For *computers and electronics*, *motor vehicles* and *other transport equipment* costs do not reach 1% of total production costs

- Amongst the non-manufacturing sectors studied, energy cost shares are comparable to or higher to those in the highly energy intensive manufacturing sectors for *land transport*, *air transport*, *mining of metal ores*, e*lectricity-gas* and o*ther mining*. It is notable that energy cost shares in *waste management* and *accommodation and restaurants* are 3-5%, while negligible in *construction* and *trade*.

Drivers of energy costs for industry

- The aggregated energy costs of the sectors studied at EU level fell by 8% over 2010-2015. The decomposition analysis shows that this was the result of increasing prices of energy (that induced +7% increase in energy costs), reduced energy intensity (-4% in energy costs) and almost close to zero impact from changes in output. Due to data limitations, a large part of the decrease in energy costs over the period could not be specifically identified and is behind the important reduction in energy costs over the period (the residual explains -10% of reduction in energy costs). The low quality of the energy consumption data may have prompted an underestimation on the reduction of energy intensity, which could come from the intense industry restructuring that follows economic crises and international competitive pressures in energy intensive sectors.

- Energy costs have a zero or negative impact on the Total Production Costs in the vast majority of manufacturing sectors analysed over the period of study.

- Energy costs shares in total production costs have fallen among nearly all the manufacturing sectors over the period of study (27 out of 30 sectors). Although half of the sectors experienced increases in energy costs, these costs have not increased by as much as other non-energy costs of production resulting in lower energy costs shares. For most of the less energy-intensity industries, the energy costs share fell by *-0.1pp to -0.6pp* while for the more energy intensive sectors, reductions were larger, between *-5.8pp and -1.5pp.*

Energy intensity

- Energy intensity (energy consumption/GVA) varies considerably across the sectors studied in accordance to the various production processes (the highest values are displayed in *steel, cement, refineries, paper and basic chemicals,* in manufacturing, and *land transport*, *electricity-gas*, in non-manufacturing,)

- Energy intensity fell in most of the highly energy intensive sectors in *manufacturing*, including *steel*, *refineries* and *paper.* There were, however, manufacturing sectors in which energy intensity increased (i.e. *cement*, *grain products*, *sawmills* and *chemicals*). In *non-manufacturing*, energy intensity decreased in sectors like *land transport* and *other mining* although increased in *electricity-gas* and *agriculture.* Energy intensity remained overall decreased or remained relatively stable in the less energy intensive sectors (manufacturing and non-manufacturing)

International comparisons

- Energy costs shares in production costs in the EU are usually higher than in Asian partners (Japan, South Korea). EU costs shares are in most of the cases comparable to those in the US sectors, with the exception of sectors like *non-ferrous metals (aluminium)* or *steel*, which display lower energy costs shares in the US.

- Energy intensity (proxy of energy efficiency)[50] in the sectors studied is systematically lower in the EU than those in China and Turkey. Energy intensity in the EU sectors is comparable to those in the US, although with a considerable variation per sector (EU sectors being more energy efficient (less energy intensive) in *beverages*, *glass*, *fabricated metal products*; and the less energy efficient (more energy intensive) in *chemicals*, *man-made fibres* and *computers and electronics*).

- EU industrial prices for electricity are lower or comparable to Asian countries (lower than Japan, comparable to China) and higher than US prices (US prices are half the EU levels). Most other G20 countries (Canada, India, Russia, Mexico, South Korea, Saudi Arabia, and Turkey) also have lower prices than in the EU. Only Brazil has higher prices.

- Industrial prices for electricity increased over the period (from 100 EUR/MWh in 2008 to 110 EUR/MWh in 2017). The price gap with the US and China (which was favourable for these two countries) has widened, slightly with the US and more significantly with China (where prices have declined since 2011). The gap with Japan (which was favourable for the EU) has shrunk as prices have converged in 2015-2016 to EU levels. Prices South Korea are increasing and converging to EU levels, whilst prices in Mexico (already below cost) are decreasing since 2014.

- Industrial gas prices in the EU are overall lower than those in Asia (Japan, South Korea, China) but higher than the rest of G20, particularly gas producers (e.g. US, Canada, Russia, Brazil display price levels around half of those in the EU).

- EU industrial gas prices have declined in nominal and real terms between 2008-2017 (to reach below 25 EUR/MWh in 2016) but prices declined even further in most of the other G20 countries. The price gap deteriorated with regard to the US and Canada (where prices reached 10 EUR/MWh in 2016) and Japan and South Korea (where after peaking around 2014 prices decreased to get closer to EU prices). Conversely, price gaps with China, Russia, Mexico and Australia improved for the EU as prices in these countries remained roughly constant at the end of period or increased.

- Inflation and exchange rate changes played a significant role in the evolution of nominal prices. High inflation pushed up prices in countries like Brazil and Indonesia while in Russia and Turkey the inflationary effects were mitigated or offset by exchange rates depreciations. Exchange rate appreciations pushed up Chinese and US prices.

[50] Data available across sectors and countries is rather limited

6.1 Energy costs and competitiveness at macroeconomic level

To properly asses the cost-competitiveness of the various industrial sectors it is important to know more about the international competitiveness context of the EU. Competitiveness is a complex matter which depends not only on prices and costs (cost competitiveness) but also on aspects like the quality of the products produced and the institutional background (economy stability, legal certainty, etc.). All these different factors are weighed by investors and producers when taking decisions on where (in which country) to produce or invest.

This introductory section provides an overview of the competitiveness context of the EU and precedes the more detailed analyses on the sectorial competitiveness (section 6.2). In this section we first assess how the EU competitiveness is placed internationally by looking at international competitiveness indexes. Second, we assess the overall impact of energy costs in the cost competitiveness of the EU and its Member States. We do so by calculating the shares of energy costs in the total production value of the whole industry and services sectors in each Member State.

Defining competitiveness and the factors affecting it

The competitive positions of companies, industries and economies are impacted by a set of factors that go beyond prices, costs and factor productivity. The country risk, the political stability, the regulatory environment, the presence or absence of barriers to trade and investment and taxation policy (among others) are weighing heavily on economic decisions to invest or do business in a given area of the world.

The purpose of the current and the next section of the chapter is to position the energy-related aspects as a subset of the complex group of interdependent factors that impact competitiveness, productivity and economic decisions to invest. Seen from the macro-economic perspective, the importance of the energy compound might appear modest when compared to total production value. Yet, as energy is at the very fabric of almost all products and services used in everyday life its role is crucial for the entire economy.

Several 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) [51], the *World Competitiveness Scoreboard* of the International Institute for Management Development (IMD)[52] and the *Economic Freedom of the World Index* of Fraser Institute (FI)[53] are using similar bottom-up approaches to measure economic performance and assess the competitive position of a country. A wide range of parameters are first collected and quantified, to be later regrouped in main themes which will then feed into global, composite indices. A methodological note at the end of section 6.1.2 presents the structure, the parameters and the factors of competitiveness used in the global indices of WEF, IMD and FI.

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[51] World Economic Forum; Global Competitiveness Report 2017-2018. The Global Competitiveness Indicator of the World Economic Forum (WEF) https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018

[52] The World Competitiveness Scoreboard of the International Institute for Management Development (IMD), https://www.imd.org/wcc/world-competitiveness-center-rankings/world-competitiveness-ranking-2018/

[53] Economic Freedom of the World indicator, Fraser institute, https://www.fraserinstitute.org/studies/economic-freedom

WEF defines[54] the competitiveness on a national level as "*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*"

6.1.1 Competitiveness drivers: EU vs G20

From 2008 to 2018, the EU economy has followed a pathway that is broadly comparable to that of its main trading partners, proxied here as the non-EU group of G20 countries[55]. Starting from 2014, the EU economy as a whole was actually improving its overall competitiveness and performance, as shown by the aggregate indices in **Figure 105**.

The focus of this section is on general trends that are driving competitiveness; as such the use and comparison of groups of countries to track evolution is justified. It should nevertheless be pointed out that the EU and the non-EU G20 are far from being homogenous groups. They are rather composed of countries that are at undergoing different stages of their economic development. Caution should be used when general conclusions are applied to specific countries of the two groups. The charts that follow try to capture group diversity by reporting data for averages and dispersion (outliers and middle quartiles).

[54] World Economic Forum; Global Competitiveness Report 2017-2018, p. ix.
[55] The non-EU countries members of the G20 are Argentina, Australia, Brazil, Canada, China, India, Indonesia, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey and the United States.

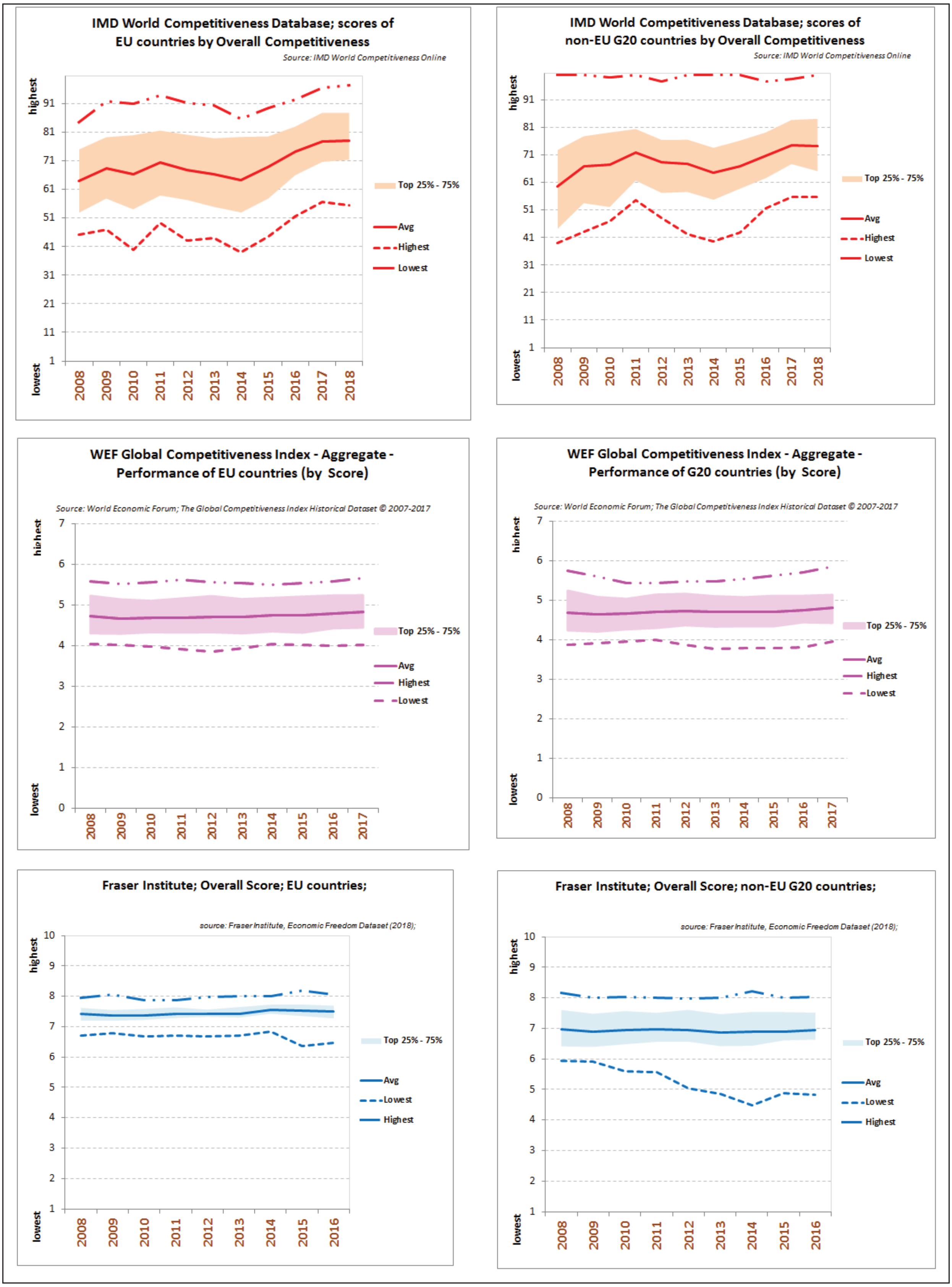

Figure 105 - Overall competitiveness in EU and non-EU G20

This finding on gradual improvement of competitiveness of the EU holds when the economic performance of the two groups is measured by **actual score** or by the **ranking position** of the countries that are being analysed.

Figure 106 and **Figure 107** report on a set of components and factors of competitiveness where EU Member States and the non-EU G20 countries show a relative divergence in terms of performance. Those factors could also explain possible differences of the level of macroeconomic competitiveness of the two groups of countries.

The indices of WEF, IMD and FI 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[56]; freedom to trade internationally[57]; prices[58]; public finance[59]; institutional framework[60]; sound money[61]; business legislation[62]; infrastructure – including electricity supply; security; 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.

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[56] Metrics measuring country performance of international trade include elements from the current account balance, balance of trade, exports and imports of goods and services, etc.

[57] Metrics measuring country's freedom to trade internationally include: tariffs, regulatory trade barriers, black market exchange rates and controls of movement of capital and people.

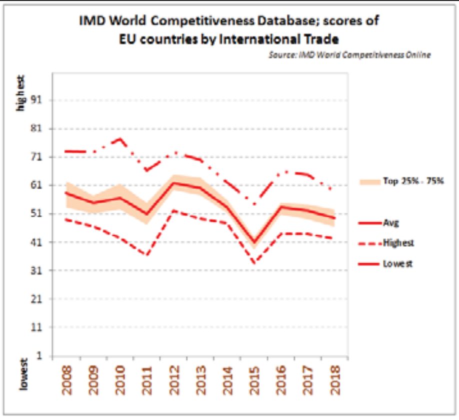
[58] Metrics measuring country performance of prices include: consumer price indices, cost of living, rents, food costs and gasoline prices

[59] Metrics measuring country performance of public finance include: government budget surplus/deficit, total government debt, management of public finances, tax evasion, pension funding, general government expenditure, etc.

[60] Metrics measuring country performance of institutional framework include: interest rate, credit rating, central bank policy; foreign currency reserves, legal and regulatory framework, adaptability of government policy, transparency, bureaucracy, bribery and corruption, rule of law, etc.

[61] Metrics measuring country performance in terms of sound money include: money growth, inflation, freedom to own foreign currency bank accounts, etc.

[62] Metrics measuring country performance of business legislation include: tariff barriers, protectionism, public sector contracts, state ownership of enterprises, ease of doing business, start-up days, etc.


IMD World Competitiveness Database; scores of
EU countries by International Trade
Source: IMD World Competitiveness Online
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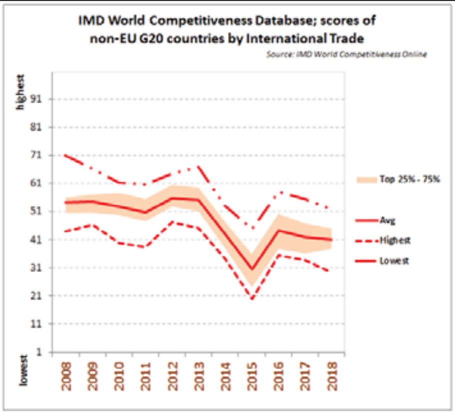
IMD World Competitiveness Database; scores of
non-EU G20 countries by International Trade
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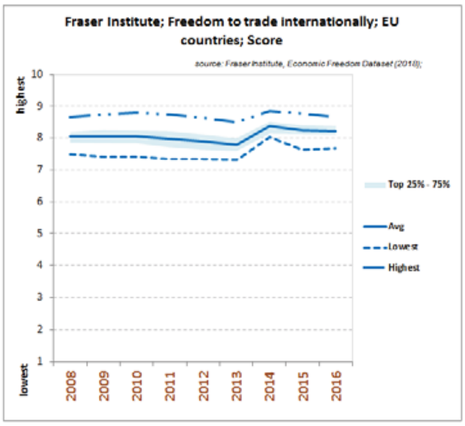
Fraser Institute; Freedom to trade internationally; EU
countries; Score
source: Fraser Institute, Economic Freedom Dataset (2018);
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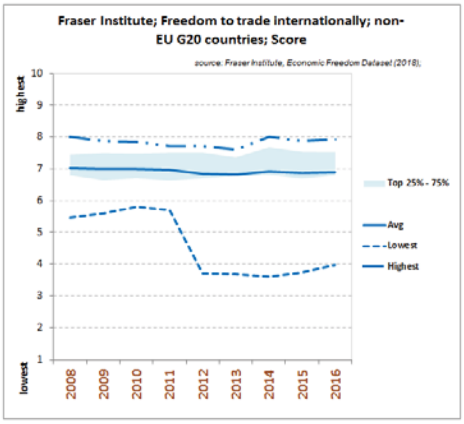
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EU G20 countries; Score
source: Fraser Institute, Economic Freedom Dataset (2018);
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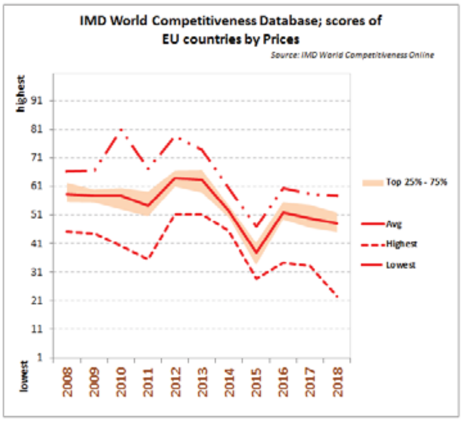
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EU countries by Prices
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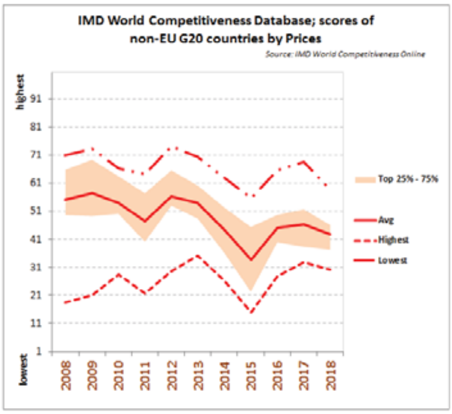
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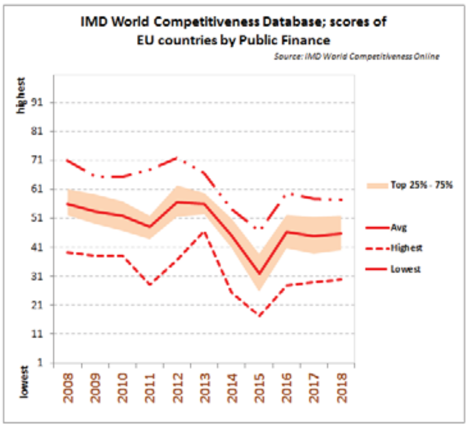
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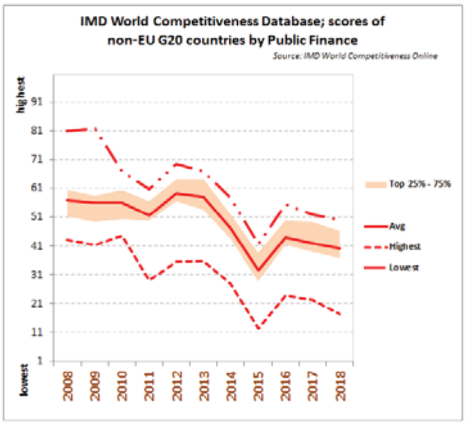
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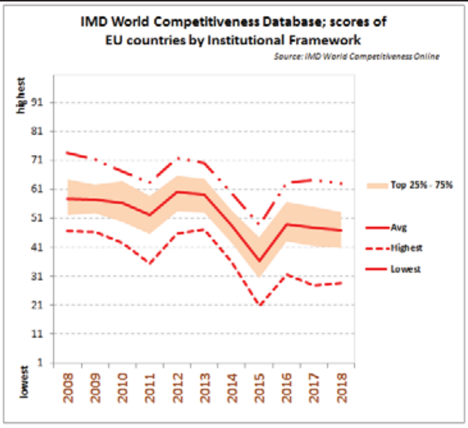
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EU countries by Institutional Framework
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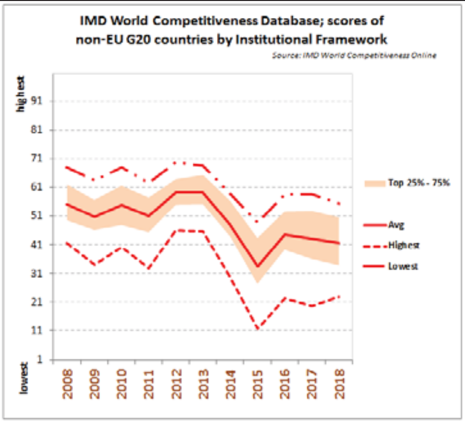
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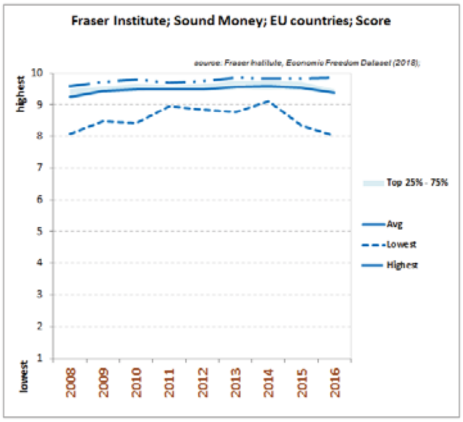
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source: Fraser Institute, Economic Freedom Dataset (2018);
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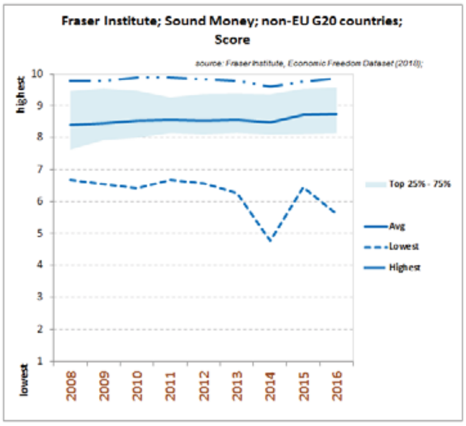
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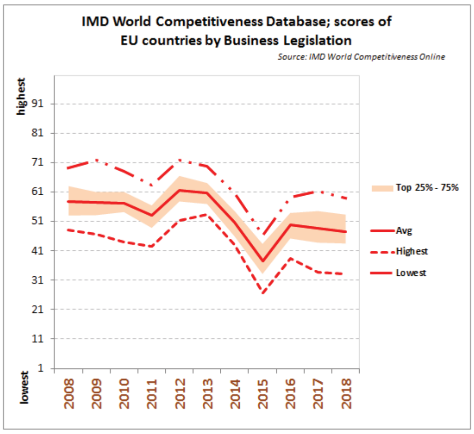
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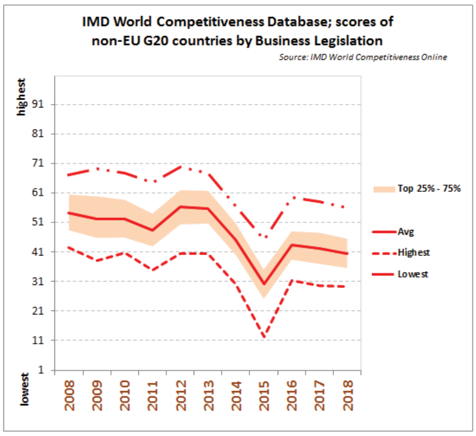
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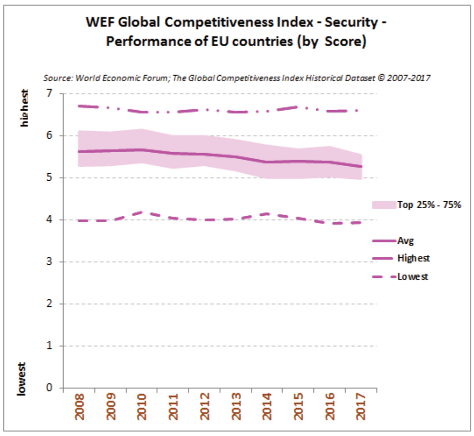
WEF Global Competitiveness Index - Security -
Performance of EU countries (by Score)
Source: World Economic Forum; The Global Competitiveness Index Historical Dataset © 2007-2017
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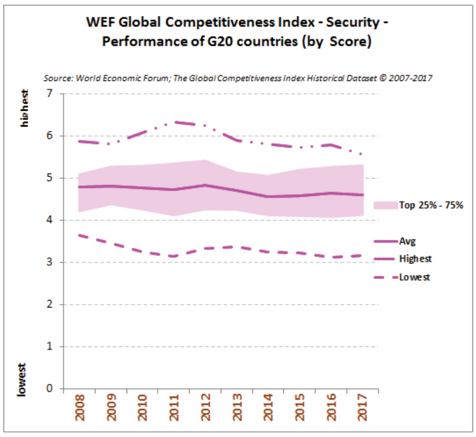
WEF Global Competitiveness Index - Security -
Performance of G20 countries (by Score)
Source: World Economic Forum; The Global Competitiveness Index Historical Dataset © 2007-2017
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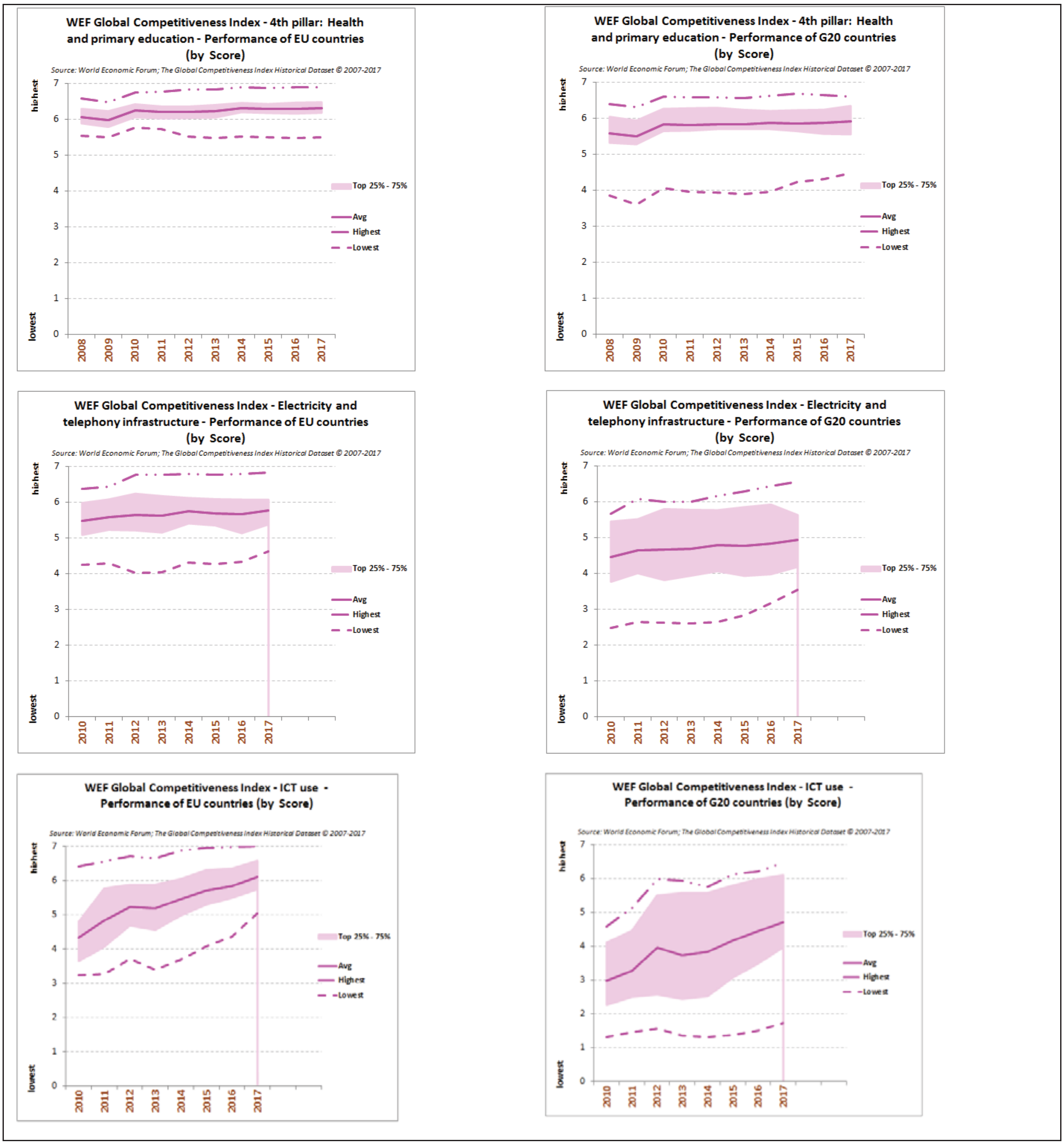

Figure 106 - Results for selected favourable factors of competitiveness

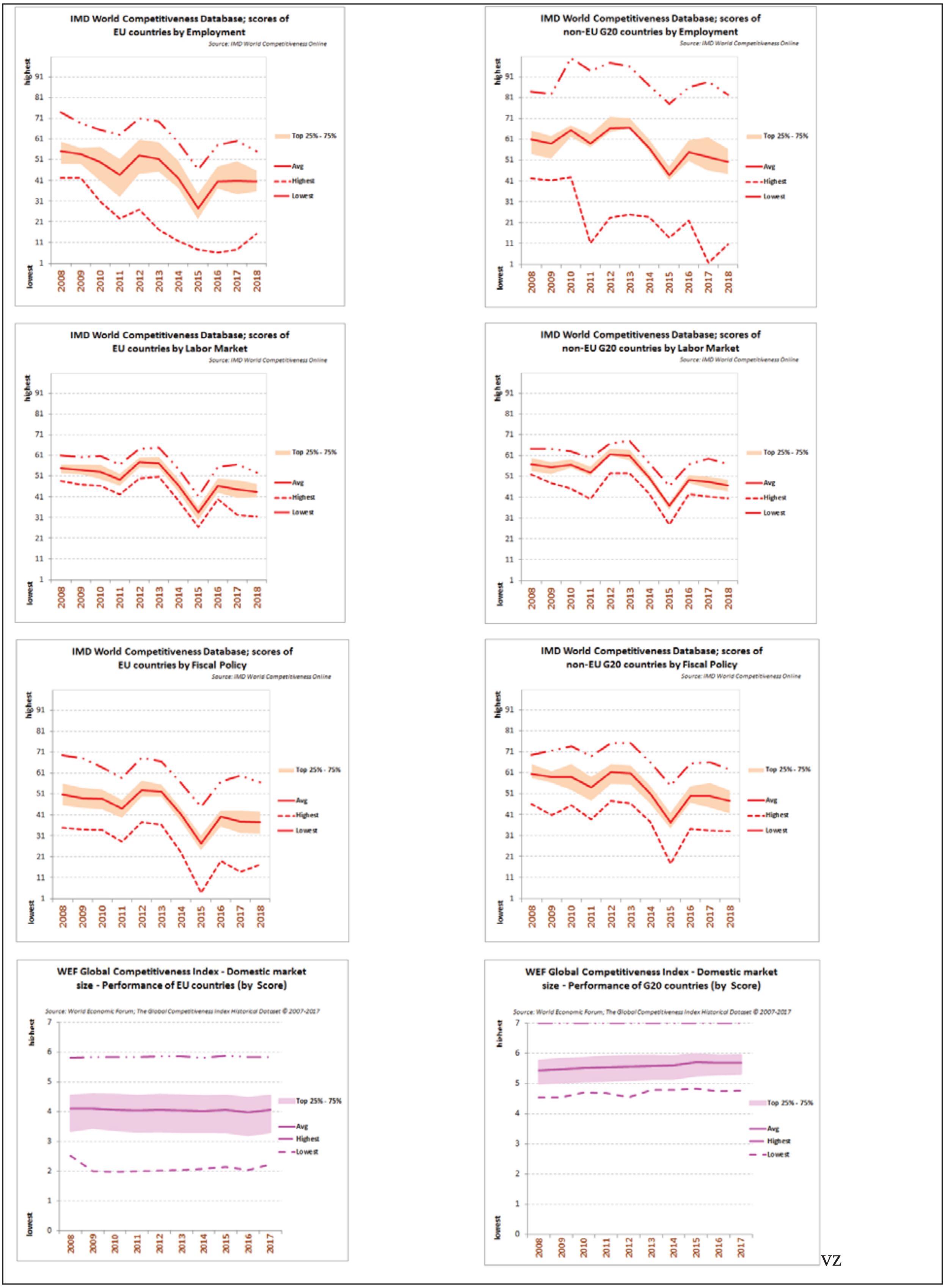

Figure 107 - Results for selected unfavourable factors of competitiveness

The recent improvement of EU economic performance is also confirmed by the European Commission reports on Single Market Integration and Competitiveness[63].

In terms of overall productivity, the majority of EU MS are competing with the high-income members of the non-EU G20 group, as shown in **Figure 108**.

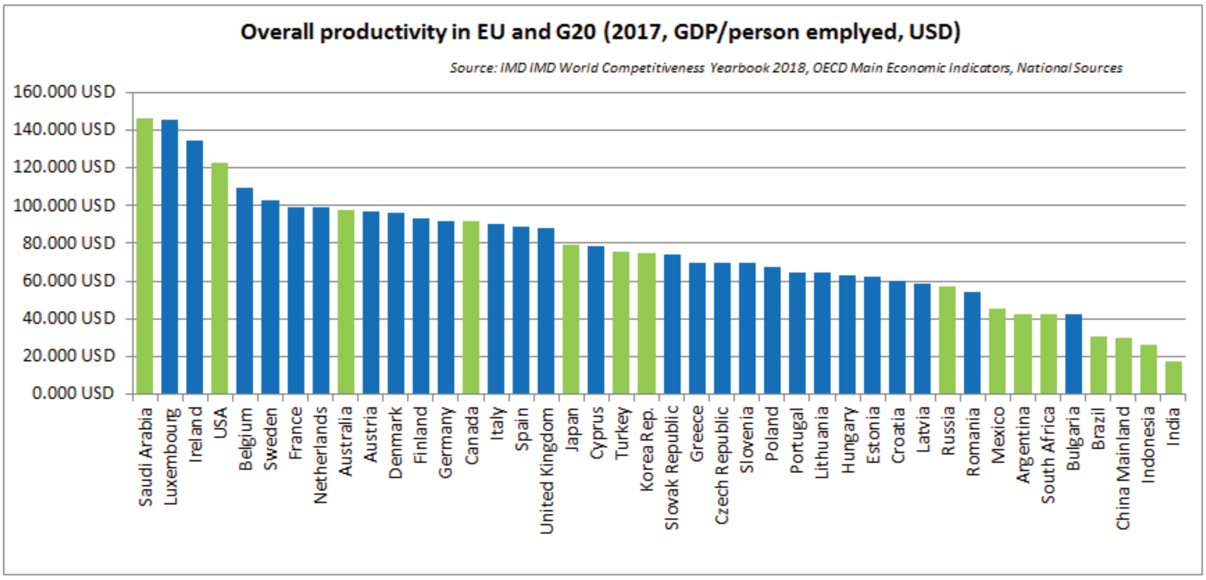

Figure 108 - Overall productivity in the EU and G20

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 Malta is not available

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 109**), the 2016 Single Market Integration and Competitiveness report mentioned above, as well as its 2015 version, point out that many EU Member States face a generalised fall in productivity growth rates and that productivity gaps are accumulating with respect to high income G20 countries. Reforms enhancing the labour and total factor productivity of European companies at both national and EU level are further discussed in separate reports of the European Commission[64].

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[63] Report on Single Market Integration and Competitiveness in the EU and its Member States, 2016 DG GROW, https://ec.europa.eu/growth/content/single-market-integration-and-competitiveness-eu-and-its-member-states-2016_en
[64] 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

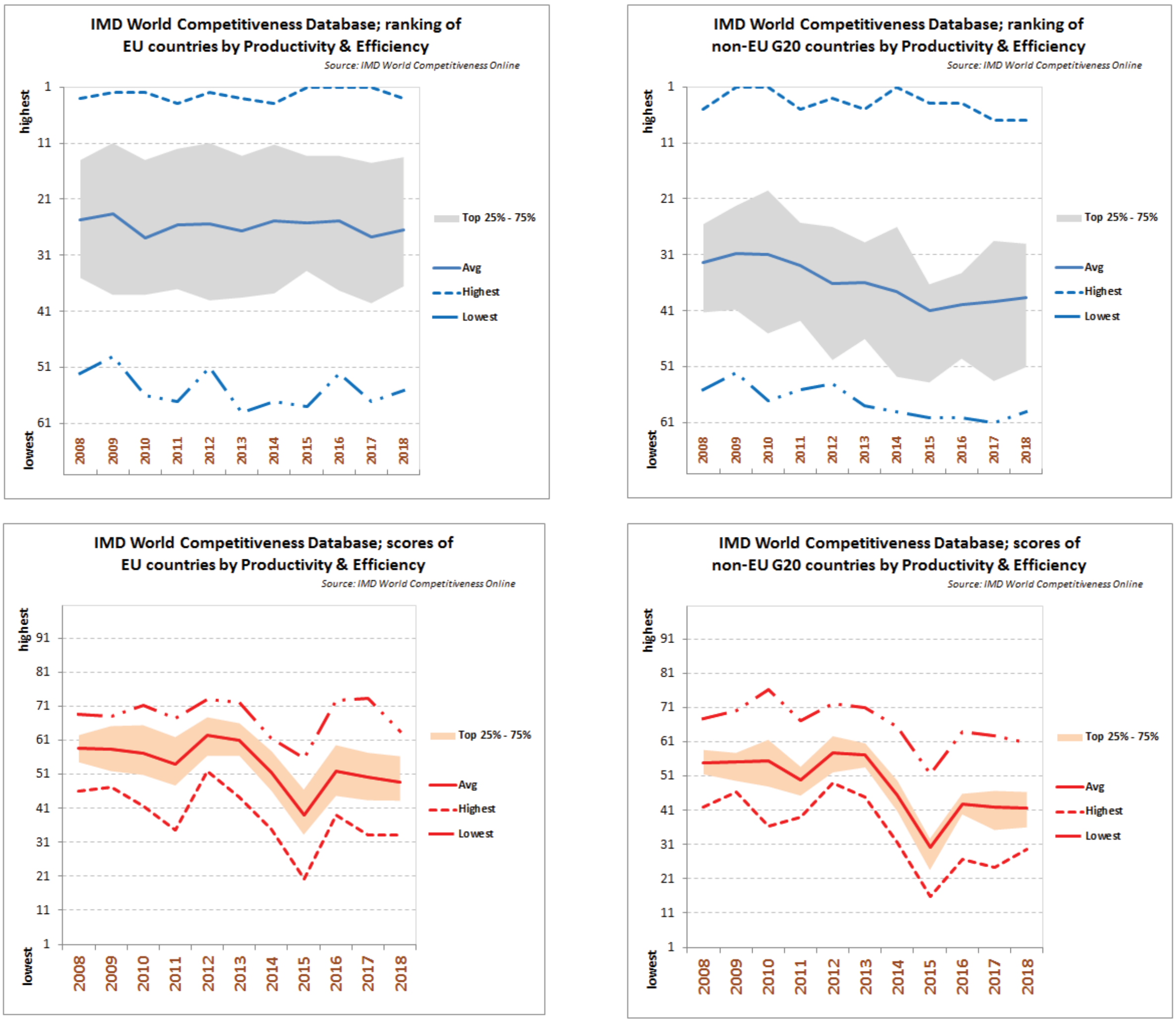


Figure 109 - Productivity and Efficiency of EU and non-EU G20

Whereas the underlying trends driving productivity remain the same, the productivity spread across high- and low- income countries is less pronounced when the monetary value used is switched from US Dollars to Purchasing Power Parities[65]. This is confirmed both for the industrial and services sectors, as shown in **Figure 110** and **Figure 111.**

[65] 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 buy the same basket of goods. PPP are currency conversion rates that eliminate the differences in price level across countries.

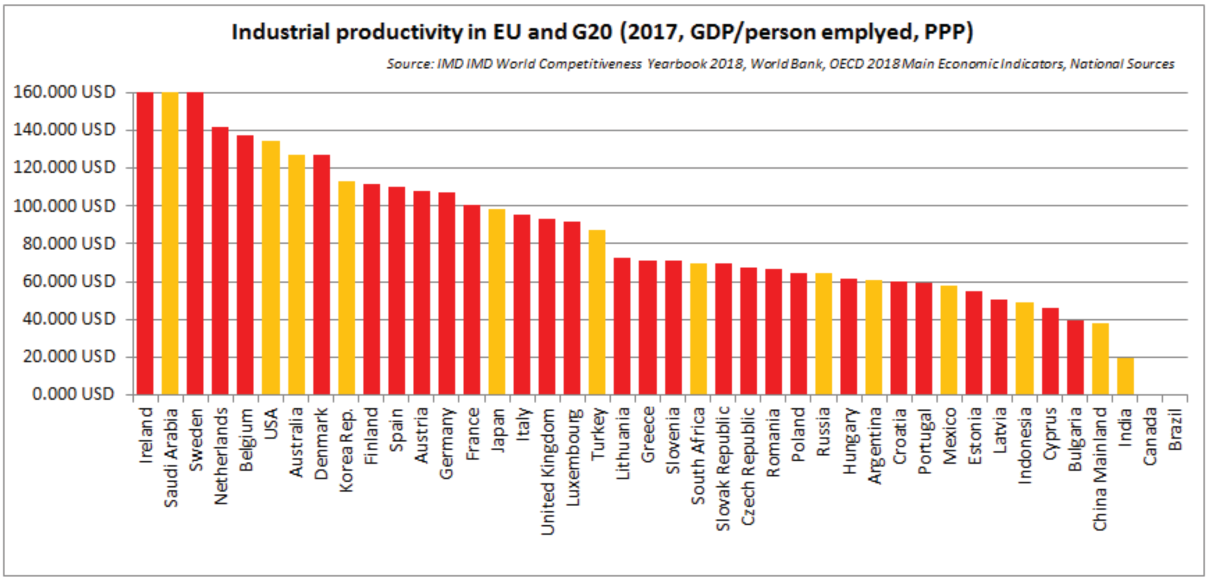


Figure 110 - Labour productivity in industry in EU and G20

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 Canada and Brazil is not available

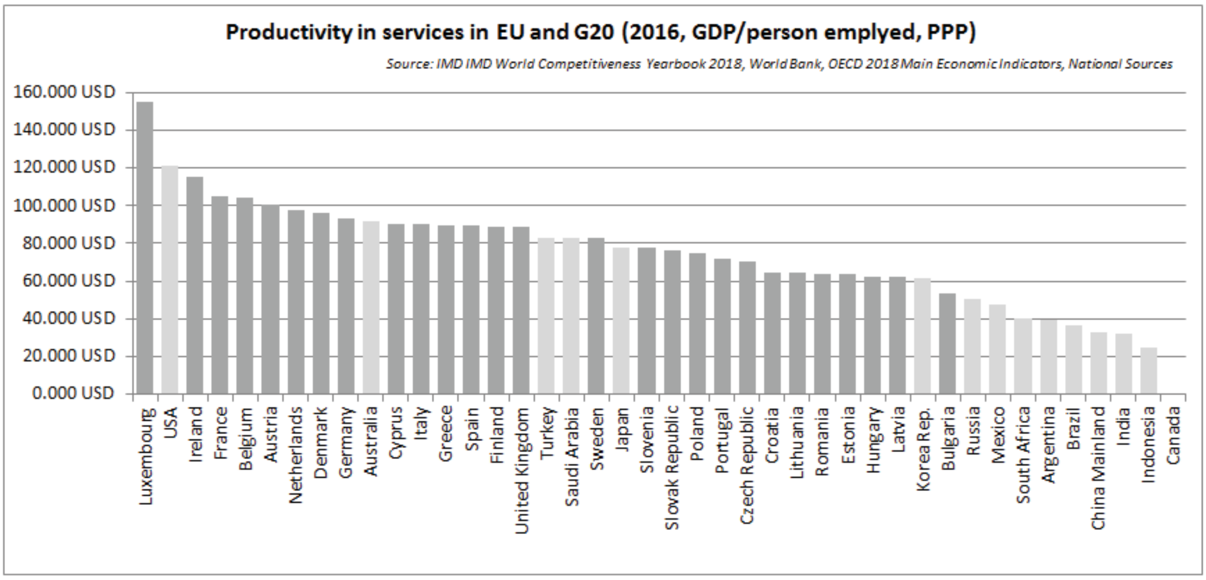


Figure 111 - Labor productivity in Services in EU and G20

Notes:
1. Productivity in services is defined as the ratio of related GDP (PPP) per person employed in services; employment data are estimates and are provisional for the most recent period
2. Data for Canada and Brazil is not available

6.1.2 Impact of energy on the economy's competitiveness

Figure 112 reports on the results from the user satisfaction survey on the adequacy and efficiency of energy infrastructure. As a group, EU clearly outperforms the non-EU G20 countries, as EU users of energy grids tend to be more satisfied on average with the overall operation, reliability and quality of service of dispatching of energy than their counterparts from G20 countries.

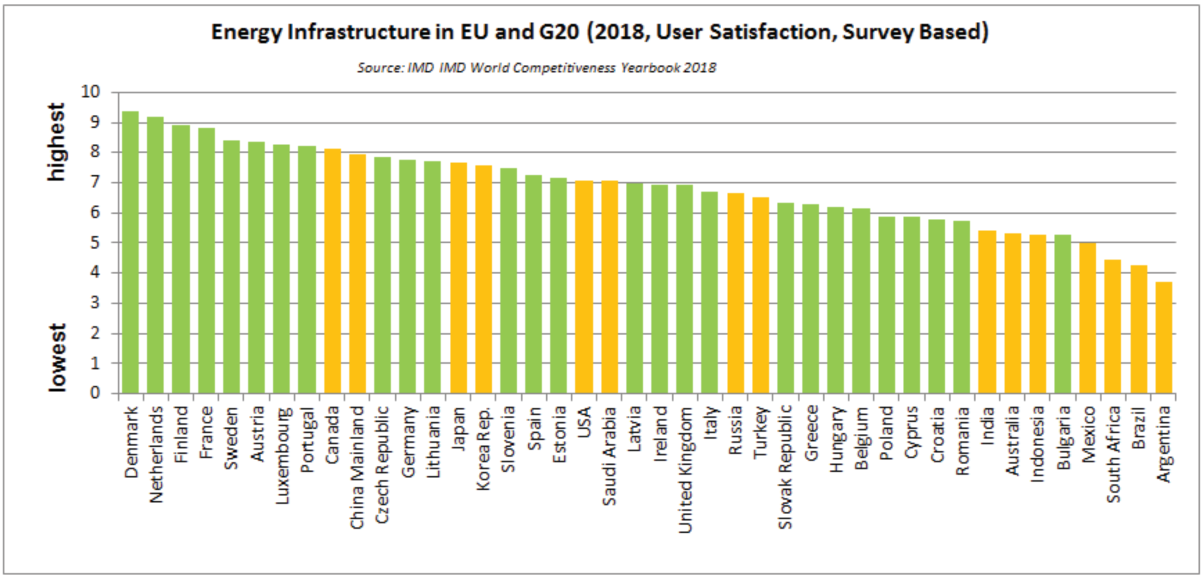


Figure 112 - User satisfaction on Energy infrastructure in EU and G20

Looking at recent prices for electricity for industrial users, both the EU and the non-EU G20 country groups appear as quite dispersed. Within non-EU G20, and compared to prices from 10 years ago, Mexico and Turkey register decreases in the range of 10% - 20% whereas the highest increases were recorded in Indonesia and Korea, both above 30%, as shown on **Figure 113**. **Section 6.5.3** provides a comprehensive international comparison on the evolution industrial prices, using a richer data sources.

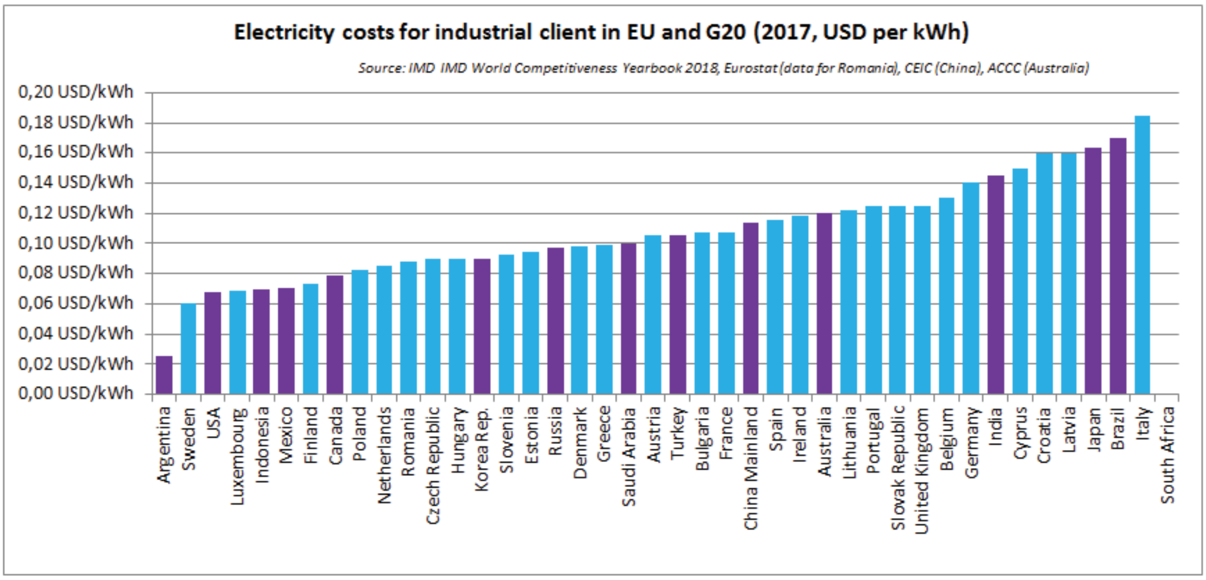


Figure 113 - Elecriticity prices for industry in the EU and G20 in 2017

Notes:
1. Prices refer to the simple average of the domestic monthly reference with tax for electricity for industry; data may be different
2. US prices are net of taxes;
3. Data for India is for 2013, data for Saudi Arabia is for 2014 data for South Africa 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 its main trading partners is not straightforward, with serious data availability and methodological issues.

In terms of the **absolute value of energy costs**, a report[66] from the European Commission estimated that the EU manufacturing sector had some of the lowest **Real Unit Energy Costs (RUEC)** [67] together with Japan and the US. While the USA is constantly performing better than the EU, looking at updated data[68], Japan has recently decoupled from the EU and increased its RUEC, mainly on the back of rising energy prices. China and Russia, on the other hand, score worse than the EU on a permanent basis (see **Figure 114**).

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

[67] 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.

[68] Corsatea, T. D., Lindner, S., Rueda-Cantuche, J. M., Velázquez, A., Amores, A.F. and Neuwahl, F. (2018 – to be published) World Input-Output Database (WIOD) Energy and Emission Accounts. Update 2000-2016. JRC Technical Reports. Publications Office of the European Union, Luxembourg.

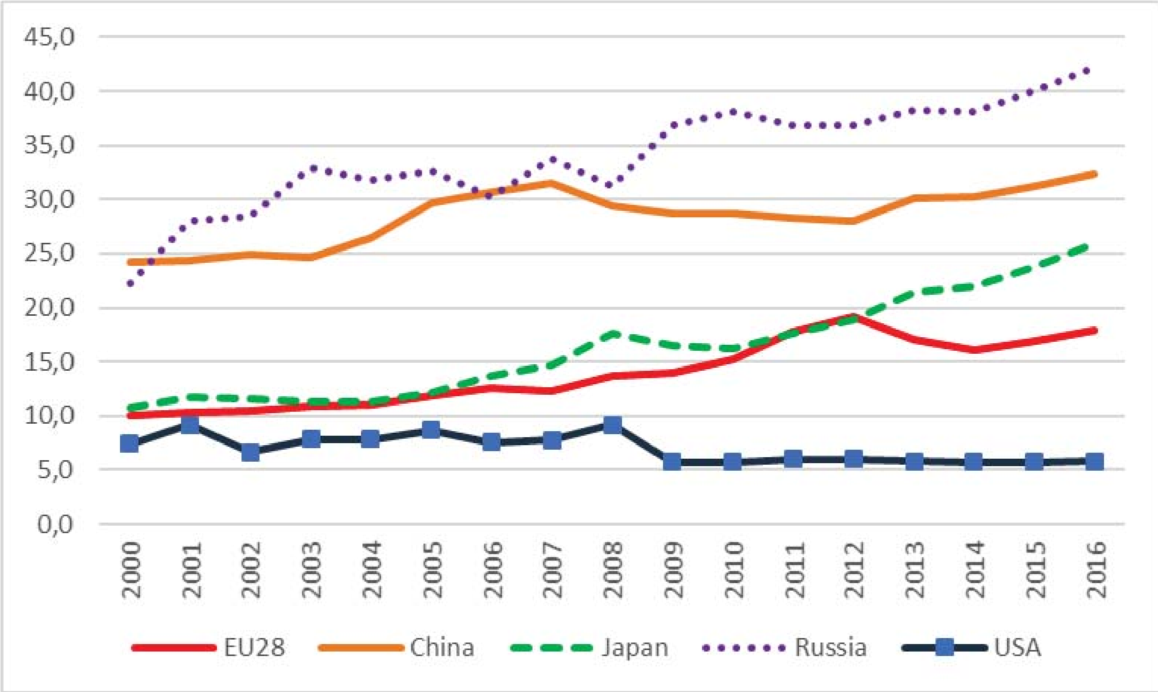


Figure 114 - Real Unit Energy Cost - manufacturing excluding refining

Source: DG JRC (own calculations based on WIOD) and DG ECFIN

The Real Unit Energy Costs of the EU has remained broadly stable over the last 5 years. However, a slight increase was recorded recently, especially due to higher energy prices. To a large extent these were offset by decreasing energy intensity of the European manufacturing sectors (**Figure 115**).

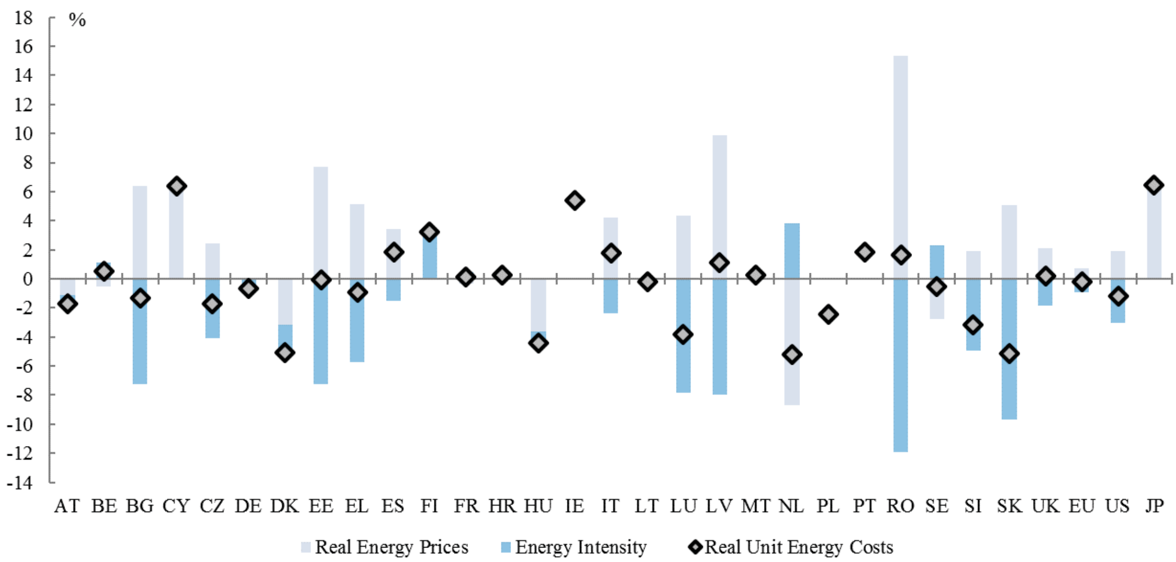


Figure 115 - Contribution to growth of RUEC by Real Prices and Energy Intensity

Source: DG JRC (own calculations based on WIOD) and DG ECFIN

The improvements of the EU industry in terms of energy intensity have helped to offset the increase in real energy prices. Compared to its world peers, EU manufacturers have developed best-of-class industrial processes in terms of energy efficiency and have continued to steadily improve their energy intensity levels.

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 the Box at the end of this section, but remains the only viable one in terms of harmonised and publically available data.

Figure 116 shows the evolution of the share of energy-related costs in total production value in the broad classes of industry and services[69]. On EU level, and for the last decade of observed data, this share has decreased from 1.5-1.7% to around 1.0%-1.3%.

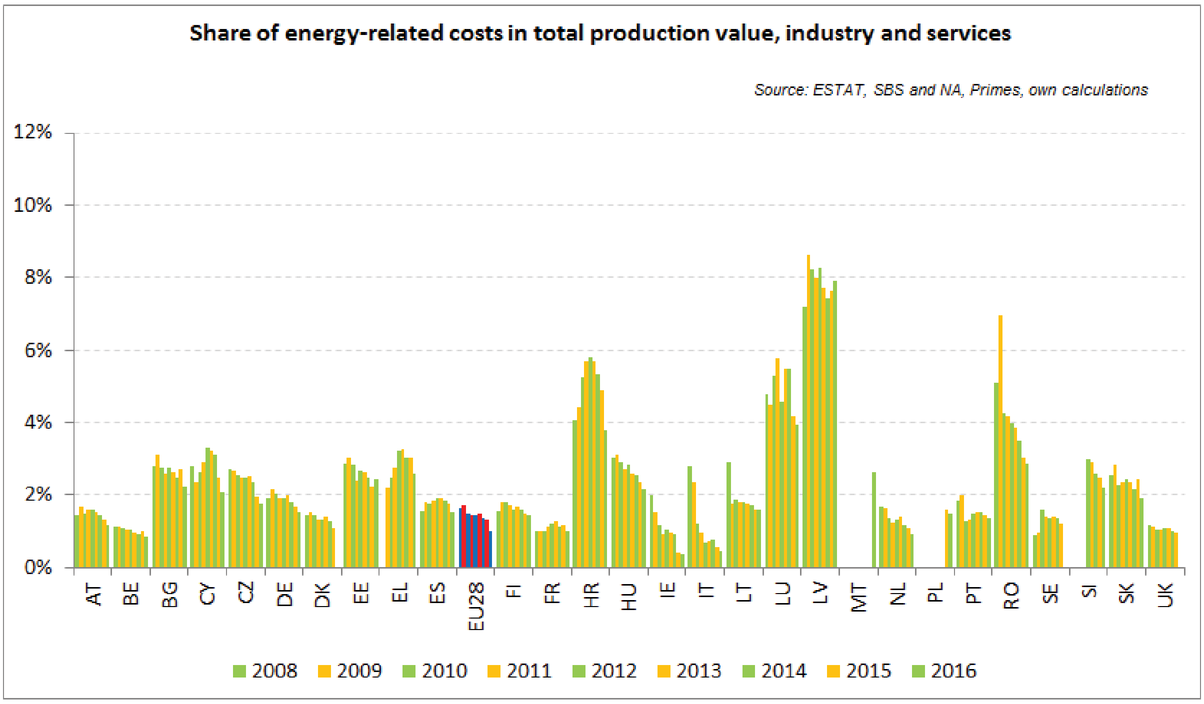


Figure 116 - Evolution of energy costs shares in production value

Notes:
1. Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Figure 117 represents the share of energy-related costs for the manufacturing sector and across the EU Member States. Throughout the 2008-2016 period, and where data is available,

[69] Industry defined as the combination of 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) of NACE Rev. 2, the Statistical classification of economic activities. Services defined as the grouping of NACE Rev. 2 sections A (Agriculture, forestry and fishing), G (Wholesale and retail trade; repair of motor vehicles and motorcycles), H (Transportation and storage), I(Accommodation and food service activities), J(Information and communication), K(Financial and insurance activities), L(Real estate activities), M(Professional, scientific and technical activities) and N(Administrative and support service activities).

the energy share has gradually decreased for the majority of Member States. On EU level, it went from 2.2%-2.5% at the beginning of the period to 1.5%-2.0% at the end. Member States with relatively smaller size would typically present a higher and more oscillating share than average; probably pointing to the fact that these economies have a relatively less diversified portfolio of manufacturing industries centred mainly on more energy-intensive sectors.

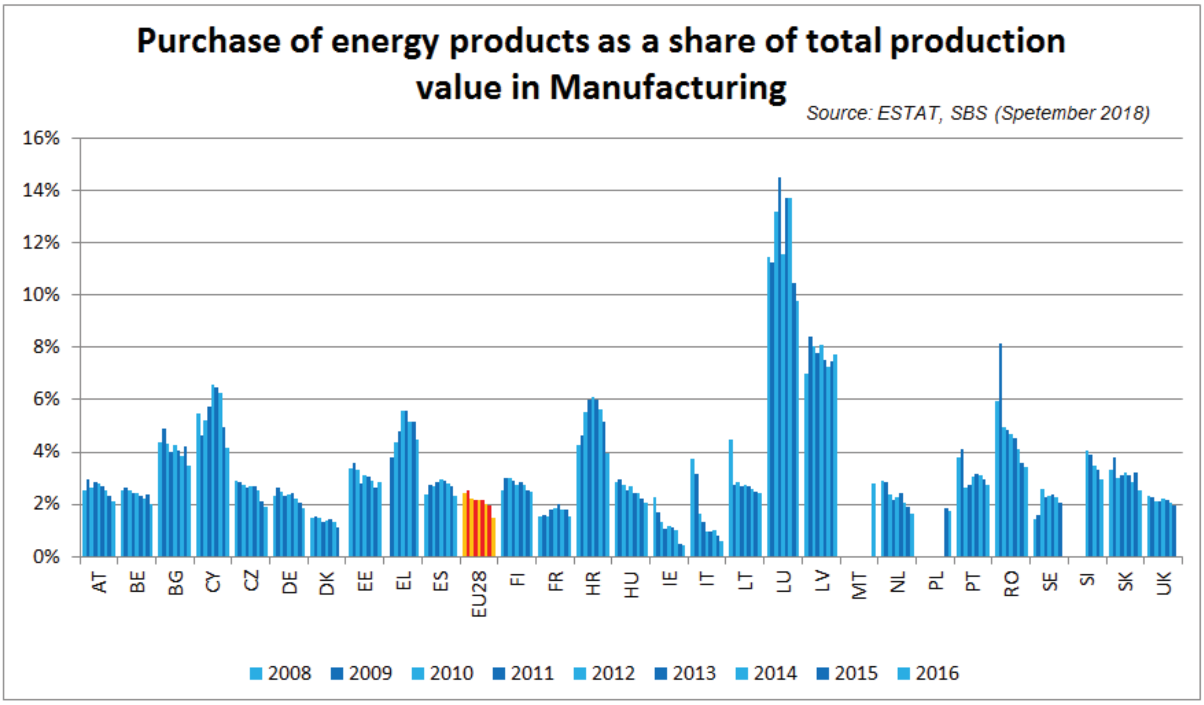


Figure 117 - Evolution of energy costs shars in production value for Manufacturing

Notes:
1. Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Box- Data limitations

- 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 such as Section F (Construction) and energy intensive sections such as H (Transportation and storage). More importantly, it is not available for all services sectors. According to the 2015 Commission report on single market integration and competitiveness, 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 (such as crude oil) are excluded.

Methodological note

Structure, parameters and factors of competitiveness in WEF, IMD and FI indices

WEF Global Competitiveness Index		IMD World Competitivneess Scoreboard		Fraser Institute, Economic Freedom of the World Index
Basic requirements		Competitiveness Sub-Factors (CSF)		
1st pillar: Institutions	1	**Economic Performance (83 criteria)**	**Area 1**	**Size of Government**
A. Public institutions	1.1	Domestic Economy	1A	Government Consumption
1. Property rights	1.2	International Trade	1B	Transfers and subsidies
2. Ethics and corruption	1.3	International Investment	1C	Government enterprises and investment
3. Undue influence	1.4	Employment	1D	Top marginal tax rate
4. Government efficiency	1.5	Prices	**Area 2**	**Legal System & Property Rights**
5. Security	2	**Government Efficiency (70 criteria)**	2A	Judicial independence
B. Private institutions	2.1	Public Finance	2B	Impartial courts
1. Corporate ethics	2.2	Fiscal Policy	2C	Protection of property rights
2. Accountability	2.3	Institutional Framework	2D	Military interference in rule of law and politics
2nd pillar: Infrastructure	2.4	Business Legislation	2E	Integrity of the legal system
A. Transport infrastructure	2.5	Societal Framework	2F	Legal enforcement of
B. Electricity and telephony infrastructure	3	**Business Efficiency (71 criteria)**	2G	Regulatory restrictions on the sale of real property
3rd pillar: Macroeconomic environment	3.1	Productivity & Efficiency	2H	Reliability of police
4th pillar: Health and primary education	3.2	Labor Market	2I	Business costs of crime
A. Health	3.3	Finance	**Area 3**	**Sound Money**
B. Primary education	3.4	Management Practices	3A	Money growth
Efficiency enhancers	3.5	Attitudes and Values	3B	Standard deviation of inflation
5th pillar: Higher education and training	4	**Infrastructure (114 criteria)**	3C	Inflation: Most recent year
A. Quantity of education	4.1	Basic Infrastructure	3D	Freedom to own foreign currency bank accounts
B. Quality of education	4.2	Technological Infrastructure	**Area 4**	**Freedom to trade internationally**
C. On-the-job training	4.3	Scientific Infrastructure	4A	Tariffs
6th pillar: Goods market efficiency	4.4	Health and Environment	4B	Regulatory trade barriers
A. Competition	4.5	Education	4C	Black market exchange rates
1. Domestic competition			4D	Controls of the movement of capital and people
2. Foreign competition			**Area 5**	**Regulation**
B. Quality of demand conditions			5A	Credit market regulations
7th pillar: Labor market efficiency			5B	Labor market regulations
A. Flexibility			5C	Business regulations
B. Efficient use of talent				
8th pillar: Financial market development				
A. Efficiency				
B. Trustworthiness and confidence				
9th pillar: Technological readiness				
A. Technological adoption				
B. ICT use				
10th pillar: Market size				
A. Domestic market size				
B. Foreign market size				
Innovation and sophistication factors				
11th pillar: Business sophistication				
12th pillar: Innovation				

6.2 Energy costs for industry

Sources, scope and methodology

The following sections of this chapter mainly rely on findings from studies commissioned by the European Commission to external consultants. The main source for this chapter is the study on *'Energy prices, costs and subsidies and their impact on industry and households'* by Trinomics et altri[70] (2018), onwards *study by Trinomics*, which provides data and analyses on a wide range of manufacturing sectors and other relevant economic sectors (30 manufacturing sectors, including 15 energy intensive industries *plus* 14 sectors from agriculture, extractive and services). The study on *'Composition and drivers of Energy: case studies in selected Energy Intensive Industries'* by CEPS and Ecofys (2018)[71], onwards the *study by CEPS*, is the other main source for this chapter and focuses on case studies of 8 energy intensive subsectors.

The **methodology** of both studies is different but complementary. The *study by Trinomics et altri* follows a *top-down approach* using highly aggregated statistical data in particular for non-manufacturing sectors (30 manufacturing sectors at NACE 3 level, 7 non-manufacturing level at NACE 2 level and 7 other non-manufacturing at NACE level 1). Statistical data and estimates based on that data are used to understand the role of energy prices and costs in the competitiveness of these sectors. The CEPS study follows a *bottom-up* approach. CEPS calculations are based on direct collection of price and costs data at plant level via a questionnaire which allows analysing samples of varying representativeness.

These two approaches are complementary and provide a broader vision of the energy prices and energy costs paid by European industries. Highly aggregated data (used in a top down approach) usually is easily available in official statistics with well-established methodologies that cover long-time spans that makes it good for identifying long term trends. But aggregated information within one sector contains individual companies which may have rather heterogeneous industrial processes and products. Plant data or highly disaggregated data (used in bottom up approach) can be better for identifying targeted sub-groups of individuals and therefore represent better the analysed characteristics of these groups. But plant data is however scarce, normally based on ad-hoc methodologies which make comparisons of each studies or sources difficult and most importantly the actual effectiveness of the data sample for describing the targeted sub-groups of individuals depends critically on how large and how well the sample represents that group of individuals (something which is difficult to achieve).

Approach for the selection of sectors

The study commissioned by the European Commission to *Trinomics et altri* analysed energy costs and other indicators across 44 sectors of different levels of aggregation. Sectors were selected by looking at three aspects:

[70] Consortium is made up by Trinomics B.V. in association with Enerdata, Cambridge Econometrics and Ludwig Bölkow systemtechnik.
[71] Consortium composed by CEPS and Ecofys

— *Importance of energy costs for the sector* usually *proxied* by the energy cost per production value, calculated by dividing purchases of energy by the total production value of each sector[72];

— *Economic importance of the sector* proxied by the share of sectoral value added in GDP of the country and by the assessment of the general economic or strategic relevance of the sector;

— *The trade exposure of the sector* which was proxied by the trade intensity of the sector which was calculated by dividing the sum of imports and exports of a product to and from the EU in total, by the size of the market which is represented by the sum of production value and imports.

The selection resulted in 30 manufacturing sectors[73]. The first 15 sectors are the most intensive energy sectors and were already the object of a study in the 2016 energy prices and costs report (shaded sectors in **Table 9**). In addition to those sectors, 15 more manufacturing sectors were selected in order to be able to *map* energy costs in manufacturing (non-shaded sectors in **Table 9**). The mapping of energy costs was completed by selecting the other non-manufacturing sectors.

Table 9 - Coverage of manufacturing sectors

Coverage of Manufacturing			
Study by Trinomics et altri		*Study by CEPS et altri*	
Sector	Level of aggregation (NACE code)	Sector	Level of aggregation (NACE code)
Grain mill and starch products	C106		
Weaving of **textiles**	C132		
Sawmilling and planing of **wood**	C161		
Pulp, paper and paperboard	C171		
Refined petroleum products	C192	**Refineries**	C1920
Basic chemicals and fertilisers	C201	**Nitrogen fertilisers**	C2015*
Man-made fibres	C206		
Glass and glass products	C231	**Packaging glass**	C2313*
		Glass tableware	C2313*
Refractory products	C232		
Clay building materials	C233	**Wall and floor tiles**	C2331
		Bricks and roof tiles	C2332
Porcelain and ceramic products	C234		
Cement, lime and plaster	C235		
Cutting **stone**	C237		
Basic **iron and steel** and of ferro-alloys	C241	**Iron and steel**	C2410
Non-ferrous metals	C244	**Aluminium**	C2442

[72] Due to a lack of energy cost data at EU level for divisions A and G to S, indicator 1) could not be calculated. For these divisions the importance of energy costs was estimated by assessing the energy intensity level (energy consumption/value added) instead.

[73] Methodological details of the selection criteria can be found in the *Trinomics et altri* study.

Fruit and vegetables	C103		
Articles of paper and paperboard	C172		
Plastics products	C222		
Abrasive products and non-metallic	C239		
Casting of metals	C245		
Beverages	C11		
Basic pharmaceutical products	C21		
Fabricated metal products (except	C25		
Computer, electronic and optical	C26		
Electrical equipment	C27		
Machinery and equipment n.e.c.	C28-		
Motor vehicles, trailers and semi-trailers	C29		
Other transport equipment	C30-		
Other manufacturing	C32		
Repair, installation of machinery	C33		

* The sector analysed is a subsector of the NACE code mentioned.
Source: European Commission Services

Note: Shaded Sectors are those most intensive

Table 10 - Coverage of other sectors, excluding manufacturing

Coverage of other agriculture, mining, construction and services *Study by Trinomics et altri*	
Sector	Level of aggregation (NACE code)
Agriculture, forestry and fishing	A
Extraction of crude petroleum and natural gas	B06
Mining of **metal ores**	B07
Other mining and quarrying	B08
Electricity, gas, steam and air-conditioning supply	D35
Water supply, sewerage, water management and remediation activities	E38
Construction	F
Wholesale and retail **trade**	G
Land Transport	H49
Air Transport	H51
Accommodation and food service activities	I
Information and communication	J
Professional, scientific and technical **activities**	M
Administrative and support service **activities**	N

Source: European Commission Services

Energy costs shares

This section focuses in assessing the cost-competitiveness of the various industrial sectors. The share of energy costs in the total production cost is a good indicator of the impact that energy costs can have on the price competitiveness of the various industrial sectors. Using Eurostat SBS as the main data source, 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)[74] plus personnel costs.

Before looking at the results we should bear in mind that the heterogeneity of the energy intensity of the industries aggregated in each sector makes that the results for the total sector usually underestimates the impact of energy costs on the industrial segments with the highest energy intensity. This is particularly true for sectors like chemicals, cement, non-ferrous metals, steel and paper which include companies producing high energy intensive primary products alongside companies producing low energy intensive secondary products. It is also important to be aware that the consumption of self-generated energy is not captured by the indicator analysed (energy costs shares using SBS data) and that self-consumption is not uncommon in the industrial segments with a high energy intensity. This is why the analysis in this section is complemented by a more exhaustive analysis of all the factors affecting the energy costs (self-consumption of self-generated energy, exemptions to energy taxes, etc.) at a more disaggregated level (NACE 4) on the basis of the results of the CEPS study[75] (see 6.6.4 and Annex 1)

Results on energy costs shares

and **Figure 120** (see below) look at the main developments on energy costs shares the selected manufacturing sectors in the period 2008-2015 showing that:

- Energy costs for the selected manufacturing sectors typically accounted for around 1-10% of total (operational) production costs, although for some sectors the costs significantly exceed 10% (e.g. *Cement, lime and plaster* and *Clay building materials*)

- Amongst the 15 most energy intensive manufacturing sectors energy costs accounted for more than 10% of production costs in at least one year in the *pulp and paper*, *clay building materials*, *iron and steel* and in particular, the *cement, lime and plaster* sectors.

- Amongst the 15 less energy intensive manufacturing sectors energy costs are typically 1-3% of operational (production) costs. For *computers and electronics, motor vehicles* and *other transport equipment* costs do not reach 1% of total production costs

- Over the period 2008-2015, energy cost shares have fallen in almost every sector (except for the *refineries* sector) The largest declines in cost share were observed in

[74] 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.

[75] Study on Composition and Drivers of Energy Prices and Costs: Case Studies in Selected Energy Intensive Industries, CEPS and Ecofys, 2018

the most energy intensive sectors like *cement, lime and plaster* (-7%). *clay building materials* (-4%), *pulp and paper* (-4%), *glass* (-1.7%) and *iron and steel* (-1.7%). Other sectors with smaller declines nevertheless see proportionally significant decreases like in *non-ferrous metals, textiles* and *pharmaceutical products*.

— While the overall trend is for decline in energy cost shares across all sectors over the full period there are few exceptions (although more frequent in the second part of the period, 2011-2015) such as the *refractory products*, *clay building materials*, *abrasive products*, *fabricated metal products* and *computer and electronics* for which the cost shares increased by approximately 1-3%.

An account of the available data from MS to estimate the sector's energy cost share in production costs can be found in Annex D of the study by Trinomics et altri study (2018).

Box - Energy costs and the sector's fuel mix

Energy costs are determined by the price of energy products and the quantities of consumed for each product. Prices usually show high volatility while energy consumption volumes tend to more stable (as it depends on factors like the consumption patterns, the economic situation and energy efficiency). This makes that prices changes explain most of the changes in energy costs in the short term. The consumption fuel mix is thus very relevant for energy costs as it determines how much will be affected the energy costs by price changes in each energy product. It is also important to note that the sector's fuel mix tends to be rather stable (as it depend inter alia on the fuel requirements of the specific production process and the availability of the energy product (e.g. gas is not always available) which usually limit fuel switching)

Figure 118 displays the average importance of fuels in terms of energy consumption by sector and **Figure 119** shows the importance of fuels in terms of their energy costs shares in total energy costs related to each sector.

These figures show that electricity and gas (this varies across sectors) are generally the most important energy products in terms of consumption. Electricity is the energy product having the biggest impact on energy costs shares (e.g. > 80% for *Pharmaceuticals, non-ferrous metals* and *computers and electronics)*. This can be explained by its relatively high price compared to the other fuels. Natural gas has a major impact on the energy costs in *glass, beverages* and *steel*. Oil and coal have a relatively small impact on energy costs even when consumption is high. Oil costs are relevant for *refineries*, *cement* and *chemicals* while coal costs are for *steel*, *abrasive products, cement* and *casting of metals*. “Other energies”, in particular biomass, represent an important consumption share in some sectors like *sawmills* (>80% of consumption), *man-made fibres* (57%), *stone* (38%) and *paper* (29%) and can thus significantly impact their energy costs.

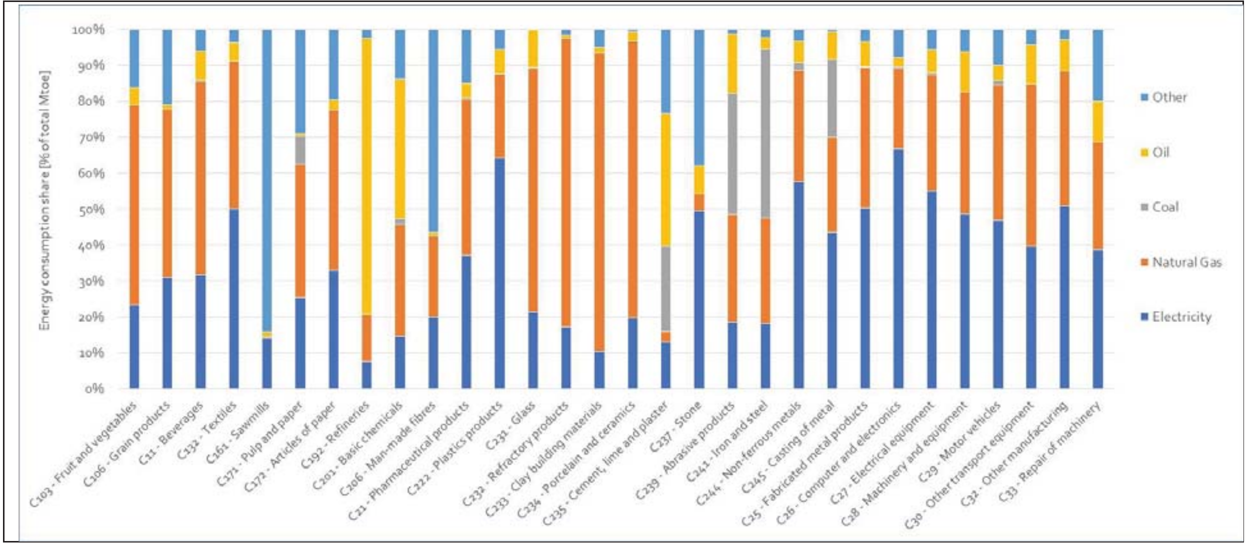


Figure 118 - Breakdown of the energy consumption per energy carrier, EU, 2008-2015 averages

Source: Trinomics et altri study

Note: "other" combines biomass and heat energy consumption

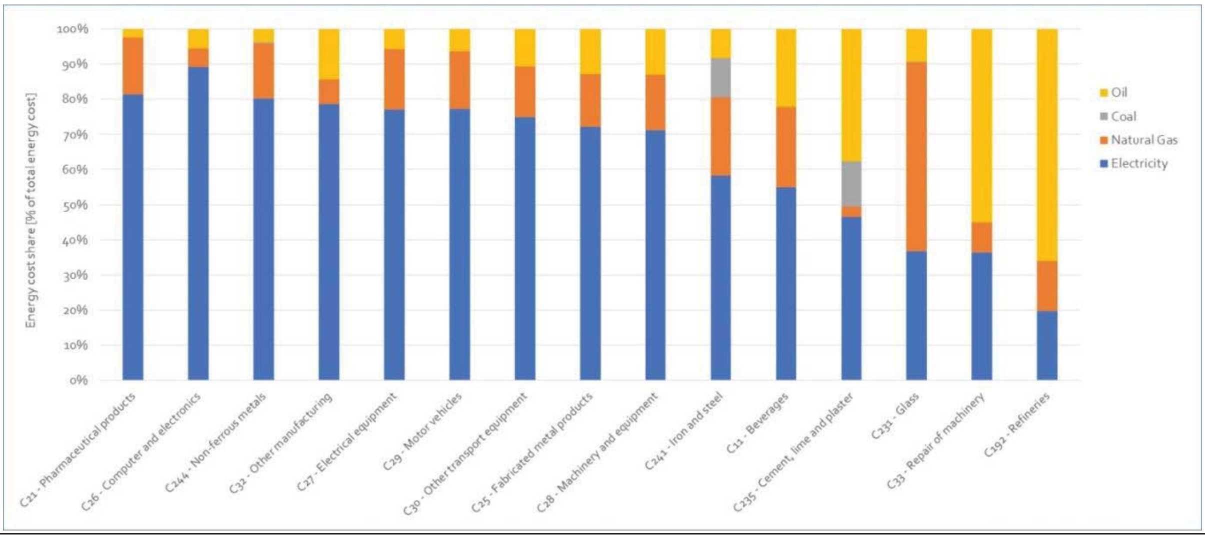


Figure 119 - Average energy cost shares per sector – based on available data points, split by energy carrier, 2008-2015 averages

Source: Trinomics et altri study

Table 11 - Energy costs shares in total production costs for manufacturing and non-manufacturing, 2008-2015

	2008	2009	2010	2011	2012	2013	2014	2015	Changes 2008-2015	Changes 2008-2011	Changes 2011-2015	Level 2015	Average	Max. level	Low. level	Diff max-low level
Section C																
C103 - Fruit and vegetables	3,6%	3,5%	2,8%	2,8%	3,0%	2,8%	2,9%	2,5%	-1,1%	-0,8%	-0,3%	2,5%	3,0%	3,6%	2,5%	1,1%
C106 - Grain products	3,8%	3,8%	3,3%	3,1%	3,3%	3,1%	3,3%	3,0%	-0,8%	-0,6%	-0,1%	3,0%	3,3%	3,8%	3,0%	0,8%
C132 - Textiles	4,3%	6,4%	3,6%	2,5%	2,7%	2,4%	2,3%	2,1%	-2,2%	-1,8%	-0,4%	2,1%	3,3%	6,4%	2,1%	4,3%
C161 - Sawmills	3,7%	4,1%	3,6%	4,1%	3,7%	3,6%	3,4%	3,1%	-0,6%	0,4%	-1,0%	3,1%	3,7%	4,1%	3,1%	1,0%
C171 - Pulp and paper	12,2%	13,0%	11,1%	11,2%	10,7%	9,9%	9,1%	8,4%	-3,9%	-1,1%	-2,8%	8,4%	10,7%	13,0%	8,4%	4,6%
C172 - Articles of paper	3,6%	3,7%	3,1%	2,8%	3,0%	3,0%	2,7%	2,5%	-1,0%	-0,8%	-0,3%	2,5%	3,0%	3,7%	2,5%	1,2%
C192 - Refineries	3,2%	2,4%	2,5%	2,0%	2,8%	3,1%	3,1%	3,7%	0,6%	-1,2%	1,7%	3,7%	2,8%	3,7%	2,0%	1,7%
C201 - Basic chemicals	7,1%	7,7%	6,8%	7,0%	6,7%	6,7%	6,1%	5,7%	-1,4%	-0,1%	-1,3%	5,7%	6,7%	7,7%	5,7%	2,0%
C206 - Man-made fibres	8,6%	12,4%	7,8%	7,1%	6,7%	8,5%	6,5%	6,2%	-2,4%	-1,6%	-0,9%	6,2%	8,0%	12,4%	6,2%	6,2%
C222 - Plastics products	3,5%	3,5%	2,9%	2,9%	2,8%	2,9%	2,7%	2,6%	-0,9%	-0,6%	-0,3%	2,6%	3,0%	3,5%	2,6%	0,9%
C231 - Glass	9,8%	10,1%	8,9%	9,1%	10,3%	10,1%	9,3%	8,2%	-1,7%	-0,7%	-0,9%	8,2%	9,5%	10,3%	8,2%	2,1%
C232 - Refractory products	6,9%	6,5%	6,2%	5,9%	6,5%	6,6%	5,8%	6,1%	-0,8%	-1,0%	0,1%	6,1%	6,3%	6,9%	5,8%	1,1%
C233 - Clay building materials	15,4%	14,1%	11,8%	11,0%	12,4%	12,4%	11,3%	11,1%	-4,3%	-4,4%	0,1%	11,1%	12,4%	15,4%	11,0%	4,4%
C234 - Porcelain and ceramics	6,0%	5,7%	4,8%	5,0%	5,3%	5,4%	5,0%	4,3%	-1,7%	-1,0%	-0,8%	4,3%	5,2%	6,0%	4,3%	1,7%
C235 - Cement, lime and plaster	22,1%	22,9%	22,1%	23,5%	21,4%	21,8%	20,9%	16,3%	-5,8%	1,5%	-7,3%	16,3%	21,4%	23,5%	16,3%	7,3%
C237 - Stone	4,8%	4,4%	3,3%	3,4%	2,6%	4,3%	3,1%	3,2%	-1,5%	-1,4%	-0,1%	3,2%	3,6%	4,8%	2,6%	2,1%
C239 - Abrasive products	5,8%	5,3%	4,9%	4,9%	5,0%	5,2%	4,8%	5,1%	-0,7%	-0,9%	0,1%	5,1%	5,1%	5,8%	4,8%	1,0%
C241 - Iron and steel	9,2%	11,9%	9,5%	7,7%	8,5%	8,5%	7,3%	7,5%	-1,7%	-1,4%	-0,3%	7,5%	8,8%	11,9%	7,3%	4,6%
C244 - Non-ferrous metals	4,6%	6,0%	4,2%	4,0%	3,9%	4,0%	3,6%	3,5%	-1,1%	-0,5%	-0,6%	3,5%	4,2%	6,0%	3,5%	2,5%
C245 - Casting of metal	6,4%	7,1%	6,0%	5,2%	5,4%	5,5%	5,3%	4,9%	-1,4%	-1,1%	-0,3%	4,9%	5,7%	7,1%	4,9%	2,2%

	2008	2009	2010	2011	2012	2013	2014	2015	Changes 2008-2015	Changes 2008-2011	Changes 2011-2015	Level 2015	Average	Max. level	Low. level	Diff max-low level
C11 - Beverages	2,6%	2,6%	2,6%	2,7%	2,6%	2,6%	2,5%	2,4%	-0,2%	0,1%	-0,2%	2,4%	2,6%	2,7%	2,4%	0,2%
C21 - Pharmaceutical products	2,8%	1,7%	1,2%	1,2%	1,3%	1,3%	1,2%	1,1%	-1,7%	-1,6%	-0,1%	1,1%	1,5%	2,8%	1,1%	1,7%
C25 - Fabricated metal products	2,2%	2,4%	2,3%	1,9%	2,0%	2,1%	2,1%	1,9%	-0,2%	-0,3%	0,0%	1,9%	2,1%	2,4%	1,9%	0,5%
C26 - Computer and electronics	0,9%	0,9%	0,7%	0,8%	0,8%	0,8%	0,8%	0,8%	-0,2%	-0,2%	0,0%	0,8%	0,8%	0,9%	0,7%	0,2%
C27 - Electrical equipment	1,1%	1,3%	1,0%	1,0%	1,0%	1,0%	1,1%	0,9%	-0,3%	-0,2%	-0,1%	0,9%	1,0%	1,3%	0,9%	0,5%
C28 - Machinery and equipment	1,1%	1,2%	1,0%	0,9%	0,9%	1,0%	0,9%	0,8%	-0,3%	-0,2%	-0,1%	0,8%	1,0%	1,2%	0,8%	0,4%
C29 - Motor vehicles	1,0%	1,0%	0,8%	0,8%	0,8%	0,8%	0,7%	0,7%	-0,3%	-0,2%	-0,1%	0,7%	0,8%	1,0%	0,7%	0,3%
C30 - Other transport equipment	1,1%	1,0%	0,9%	0,8%	0,8%	0,9%	0,7%	0,8%	-0,3%	-0,3%	-0,1%	0,8%	0,9%	1,1%	0,7%	0,4%
C32 - Other manufacturing	1,3%	1,4%	1,3%	1,1%	1,1%	1,1%	1,1%	1,0%	-0,3%	-0,2%	-0,1%	1,0%	1,2%	1,4%	1,0%	0,4%
C33 - Repair of machinery	1,3%	1,2%	1,1%	1,1%	1,1%	1,2%	1,1%	0,9%	-0,4%	-0,2%	-0,2%	0,9%	1,1%	1,3%	0,9%	0,4%
Other sections																
B - Mining and quarrying	3,4%	2,9%	2,9%	2,7%	2,8%	2,8%	2,7%	3,1%	-0,3%	-0,8%	0,5%	3,1%	2,9%	3,4%	2,7%	0,8%
B06 - Oil and gas	1,6%	0,6%	0,6%	0,5%	0,6%	0,7%	0,7%	0,7%	-0,9%	-1,1%	0,2%	0,7%	0,7%	1,6%	0,5%	1,1%
B07 - Mining of metal ores	15,8%	16,6%	19,7%	20,8%	19,6%	19,4%	17,7%	18,4%	2,6%	5,0%	-2,4%	18,4%	18,5%	20,8%	15,8%	5,0%
B08 - Other mining	10,3%	9,8%	10,4%	10,4%	10,9%	10,2%	9,6%	9,4%	-0,9%	0,1%	-1,0%	9,4%	10,1%	10,9%	9,4%	1,5%
D35 - Electricity, gas and steam	17,0%	16,8%	16,9%	16,4%	14,3%	12,3%	11,4%	11,5%	-5,5%	-0,6%	-4,9%	11,5%	14,6%	17,0%	11,4%	5,6%
E38 - Waste management	4,0%	3,0%	3,1%	3,5%	4,2%	4,3%	4,8%	4,3%	0,3%	-0,5%	0,8%	4,3%	3,9%	4,8%	3,0%	1,8%
F - Construction	1,5%	1,5%	1,5%	1,7%	1,7%	1,7%	1,6%	1,4%	0,0%	0,2%	-0,3%	1,4%	1,6%	1,7%	1,4%	0,3%
G - Wholesale and retail trade	0,7%	0,8%	0,7%	0,6%	0,7%	0,6%	0,6%	0,6%	-0,1%	0,0%	0,0%	0,6%	0,7%	0,8%	0,6%	0,2%
H49 - Land transport	36,3%	31,0%	33,2%	40,6%	37,0%	34,4%	32,1%	27,0%	-9,3%	4,3%	-13,6%	27,0%	33,9%	40,6%	27,0%	13,6%
H51 - Air transport	19,5%	16,7%	21,6%	20,1%	23,3%	20,0%	24,4%	20,2%	0,7%	0,6%	0,1%	20,2%	20,7%	24,4%	16,7%	7,8%
I - Accomodation and restaurants	3,9%	4,2%	4,7%	4,2%	4,5%	4,3%	3,7%	3,9%	0,0%	0,3%	-0,3%	3,9%	4,2%	4,7%	3,7%	1,1%

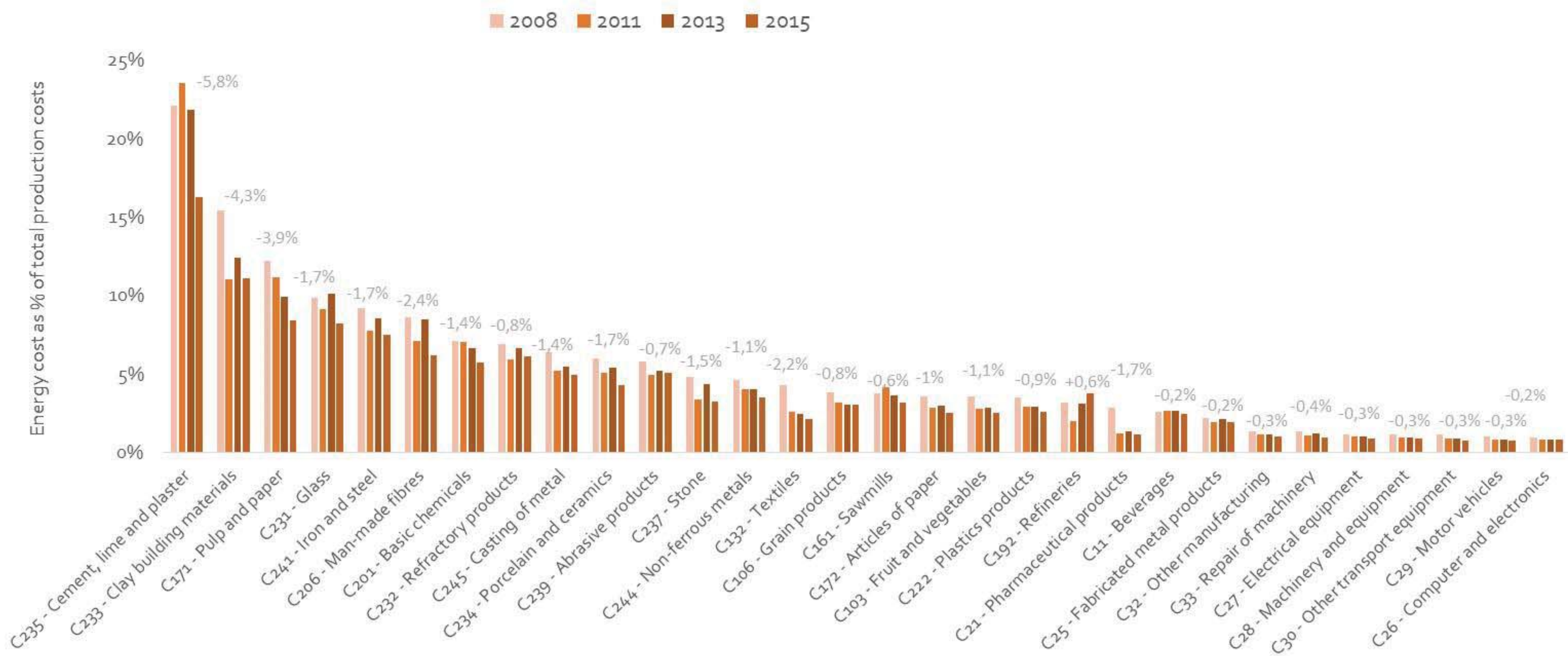


Figure 120 - Energy costs shares in total production costs in manufacturing sectors, 2008-2015

Source: Trinomics et altri study

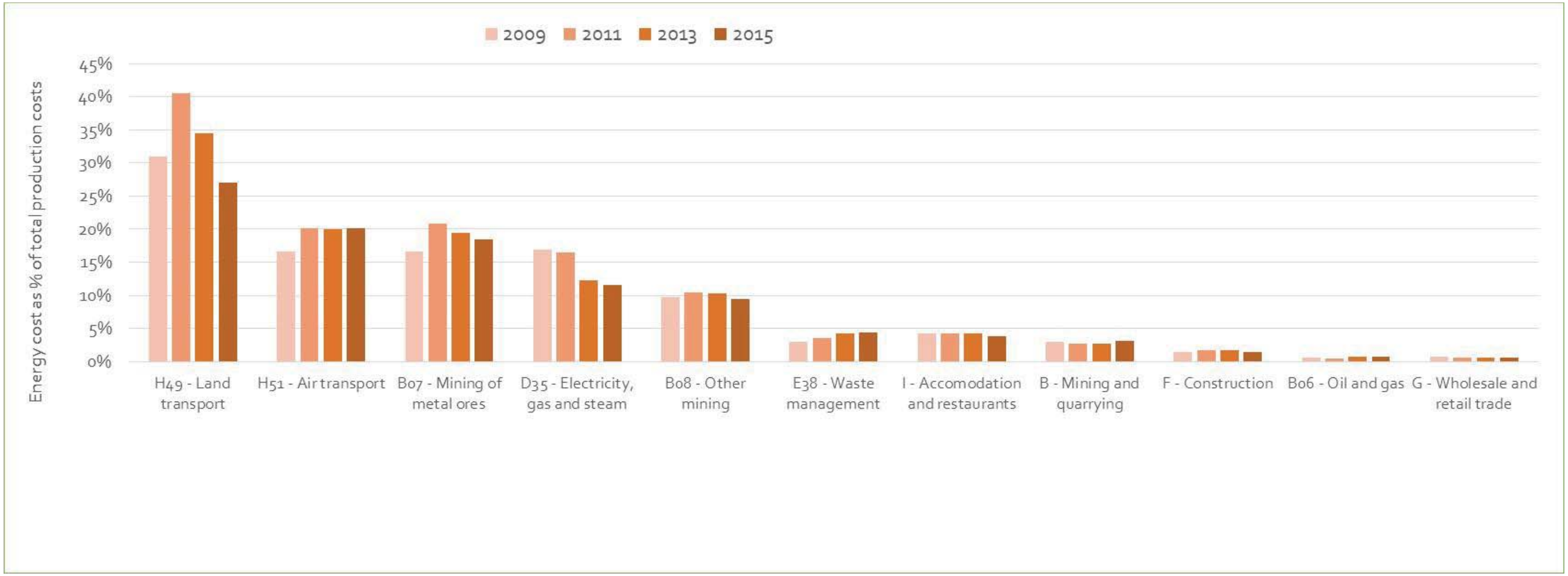


Figure 121 - Energy costs shares in total production costs in non-manufacturing sectors

Source: Trinomics et altri study

Amongst the non-manufacturing sectors for which data was available energy cost shares are particularly high in 5 sectors, being comparable to or higher than cost shares in the most energy intensive manufacturing sectors. These 5 sectors are H49 Land transport (H49), Air transport (H51), Mining of metal ores (B07), Electricity, gas and steam (D36) and other mining (B08). Clearly fuel costs are important drivers of costs in the transport and electricity and gas sectors, whilst mining is also an energy intensive activity. It is notable that energy cost shares in Waste management (E38) and Accommodation and restaurants (I) also have cost shares of 3-5%, which is comparable to many of the energy intensive manufacturing sectors. Energy cost shares are negligible in the construction (F) and Wholesale and retail (G) sectors.

Box - Energy costs for refineries

In sectors like refineries (also chemicals) the impact of energy products on production costs goes beyond the purchases of electricity and gas from external energy suppliers. In refineries energy products are also used as feedstocks (e.g. crude oil) in the industrial process. Moreover, some energy products are also self-produced and self-consumed in the industrial process. Energy costs have thus a key relevance for refineries.

Estimating the importance of all energy costs for the refinery sector is complex due to the limited or confidential data. The 'purchases of energy' from Eurostat statistics (SBS) represented on average bit less than 3% of the production costs over the last years (Trinomics et altri, 2018). However, the SBS 'purchases of energy' does not include crude oil expenses. These crude oil expenses were estimated to account for more than 80% of the production costs of refineries (CEPS and Ecofys, 2018).

Finally, refineries also consume petroleum products, refinery gas and petroleum coke for its own use. Such products are self-consumed. The estimation of the monetary amounts from self-generated and self-consumed products (Trinomics et altri) signals that these amounts would represent a small share of total energy costs (few percentage points) which would tend to be smaller where products of the prices are lower (particularly as regards gas).

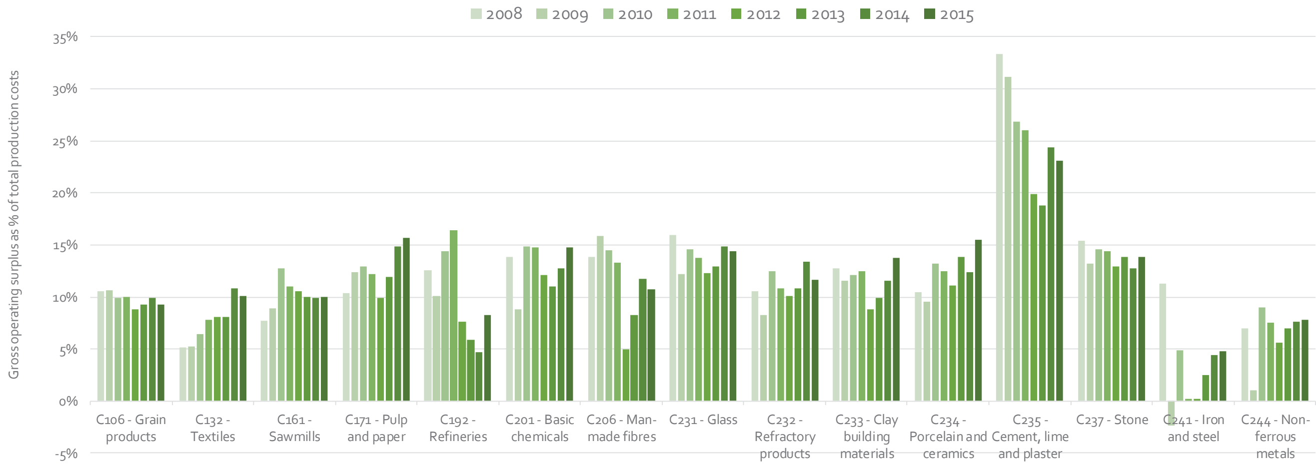
Results on Gross Operating Surpluses shares

Profit margins together with production costs make up the final sales price. Profits therefore play an important role in the cost-competitiveness of firms in the short term (when setting prices). But profits are also relevant for the competitiveness in the long term as they are necessary to attract and enable investment.

It is thus interesting to analyse the trends on Gross operating surplus[76] (GOS, a proxy for profits) for the sectors studied (see the two graphs below in **Figure 122)** shows the average GOS share in production costs for the manufacturing sectors between 2008 and 2015. For most of those sectors, the share was between 5-15%, higher for sectors like *pharmaceuticals*; *cement*, *beverages* and particularly lower for *steel* (only 3.2% and even negative in one year, in 2009).

The GOS shares in production costs increased and decreased across for some sectors alike. The proportionally higher increases were in *textiles* (+94%), *casting of metal*, *paper*, *porcelain* and *ceramics* (all the latter around 50%). The most significant declines were in *steel* (-57%) and *refineries*, *cement*, and *motor vehicles* (all the latter around minus 30%).

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



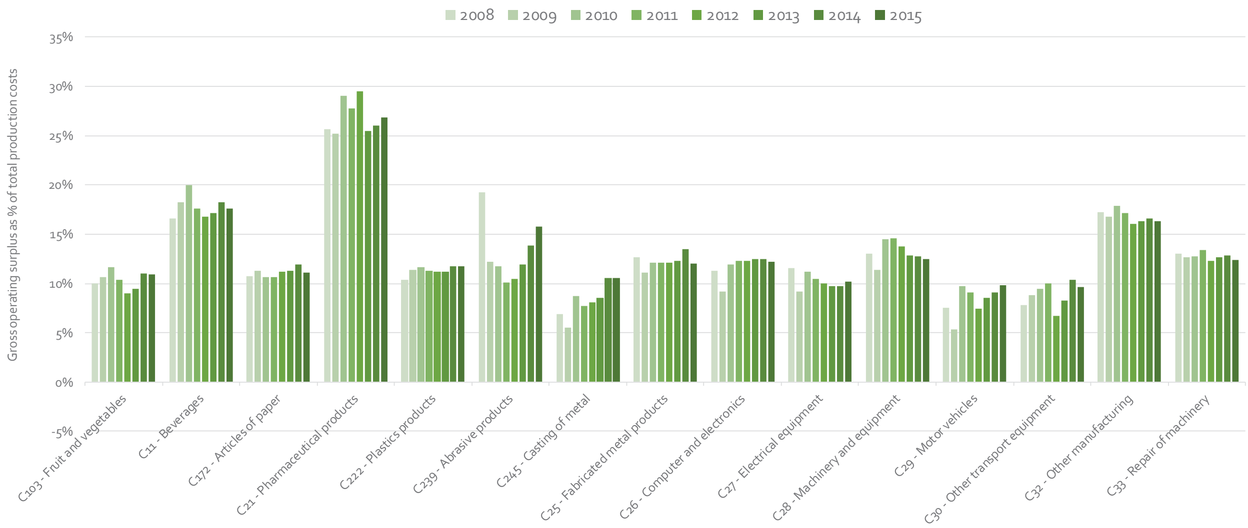


Figure 122 - Gross Operating Surplus in manufacturing sectors (average 2008-2015)

Source: Trinomics et altri study

Note: Average of for the sector based on the MS for which total production cost and GOS data available for all years

For the EU as a whole (see **Figure 123**), GOS shares in production costs oscillated in the range of 11-13%/year between 2008 and 2015, with significant differences between Member States. Poland, the UK and Ireland have the highest surpluses (over 16%) and are closely followed by Greece, Cyprus, Bulgaria and Romania. The lowest surpluses are found in France, Italy, Belgium and Sweden.

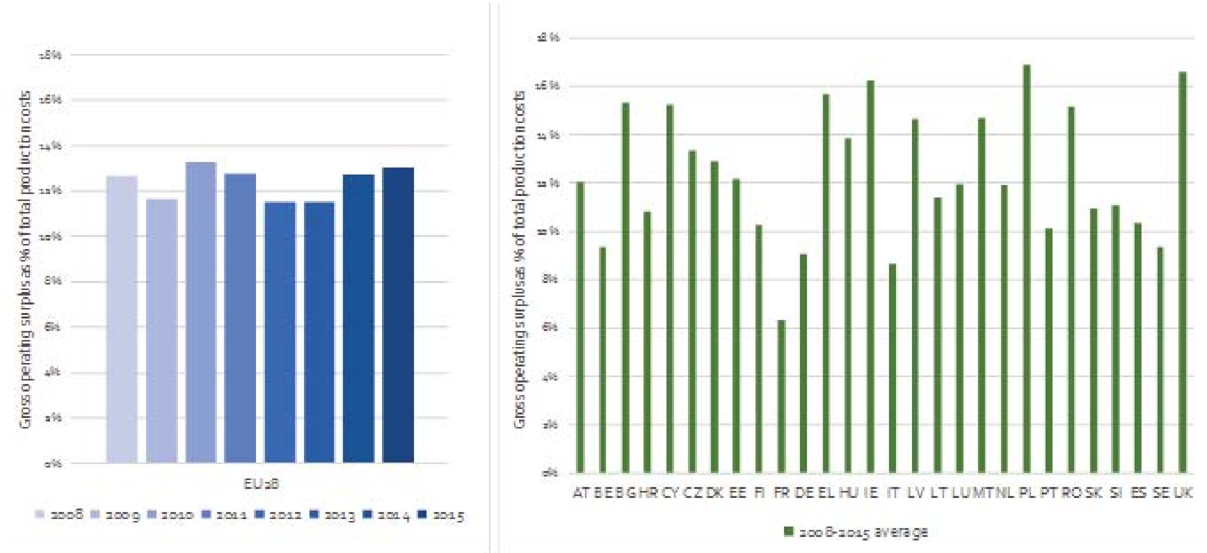


Figure 123 - Gross Operating Surplus in manufacturing in the EU and Member States, 2008-2015

Source: Trinomics et altri study

6.3 Exploring energy intensities

Energy intensity is the result of dividing the energy consumption by the Gross Value Added (GVA). Although is not is not a direct measure of energy efficiency of production (which could be measured by dividing the energy consumption by the volume of production) it is used as proxy of it. This is because comparable production volume data is not easily available. In any case, when using energy intensity as proxy for energy efficiency one should bear in mind that the energy intensity is subject to the factors that change the value added of the production, i.e. there are price effects (which are common and volatile and that can be due to various reasons like demand changes, monetary issues, etc.) that affect the value added and are not related to changes in the volume of production.

Figure 124, **Figure 125** and **Figure 126** (see next page/s) display the energy intensity of selected sectors in the period 2008-2015 showing that:

- Energy intensity varies considerably across sectors in accordance to the various production processes (*steel* and *cement* (>2 toe/1000 Euros) and *refineries* and *paper* (> 1 toe/1000 thousand Euros) display the highest values).
- Energy intensity decreased in most of the energy intensive sectors like *steel* (-1,9%/year since 2009), *refineries* and *paper* although it increased in *cement* (by around 3.1%/year since 2009), *grain products*, *sawmills* and *chemicals*. For the rest it remained relatively similar levels.
- Energy intensity was particularly volatile for *refineries*, *steel* and *man-made fibres* probably reflecting price affecting the value added of production.
- There were also proportionally significant decreases in the less energy intensive manufacturing sectors like in *textiles*, *stone*, *articles of paper*, *motor vehicles* (although for these sectors the indicator lies at a rather low level, i.e. between 0.3 and 0.1 toe/1000euros)
- Energy intensity also decreased in non-manufacturing sectors with the highest energy intensity (e.g. *land transport*, *electricity-gas*, *other mining* and *agriculture*) and remained relatively stable for the less energy intensive sectors.

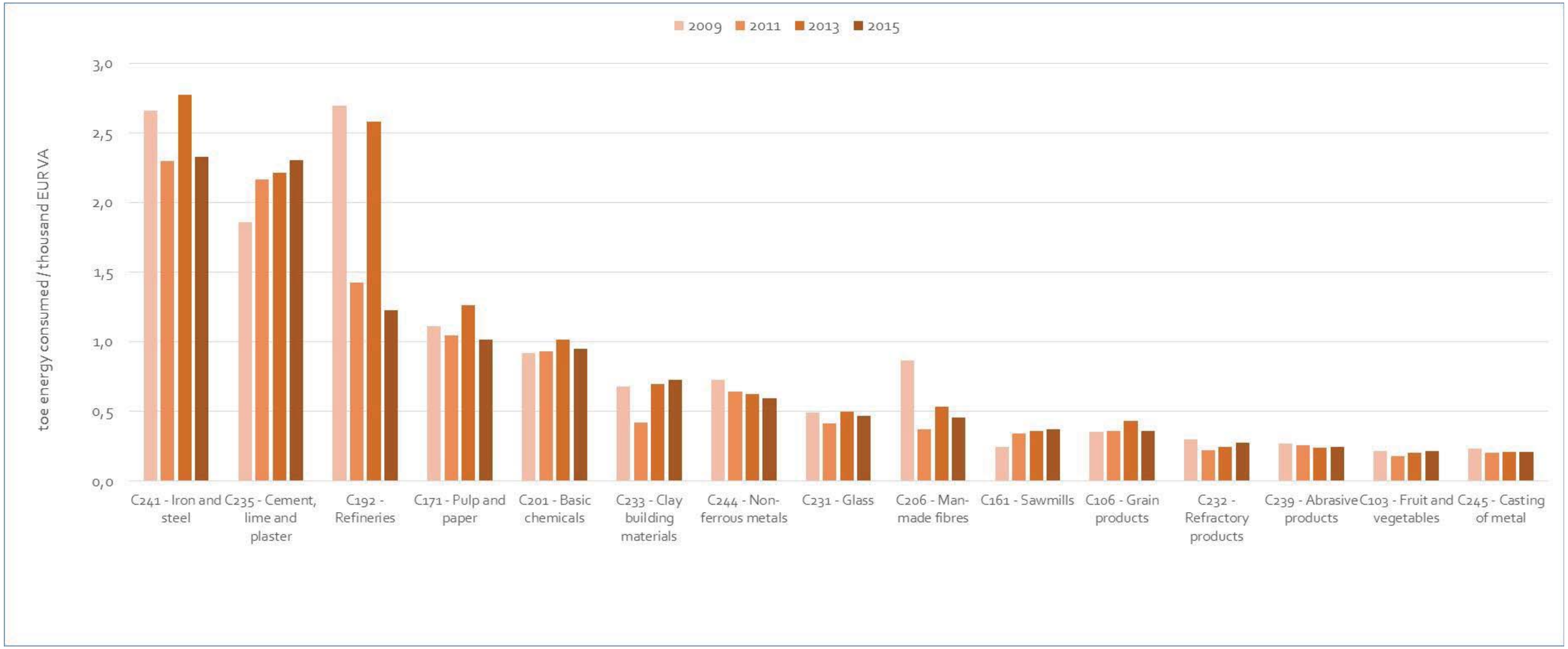


Figure 124 - Energy intensity (consumption/value added in nominal terms) for the most energy intensive manufacturing sectors (average of available countries)[77]

Source: Trinomics et altri study

[77] The energy intensity change includes both change due to energy efficiency of production and change due to price effects

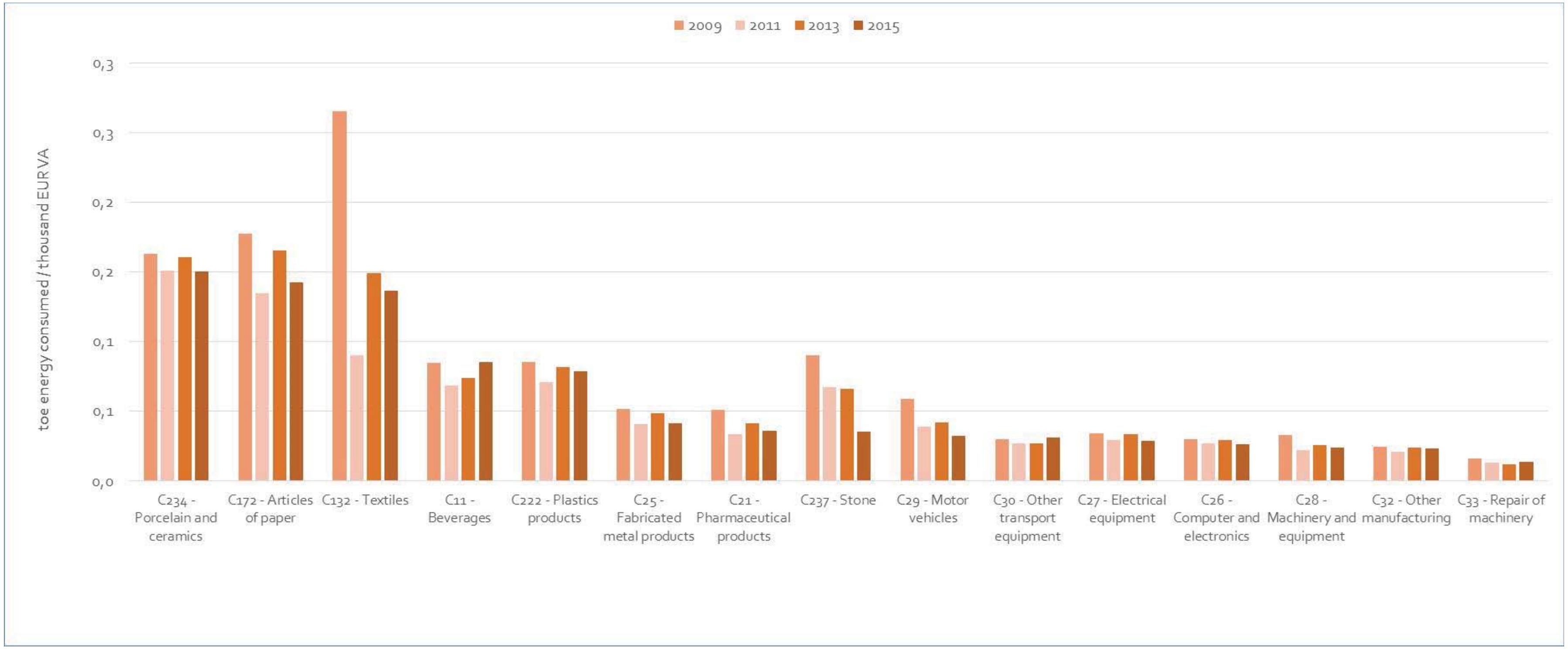


Figure 125 - Energy intensity (consumption/value added in nominal terms) for other manufacturing sectors (average of available countries)[78]

Source: Trinomics et altri study

[78] The energy intensity change includes both change due to energy efficiency of production and change due to price effects

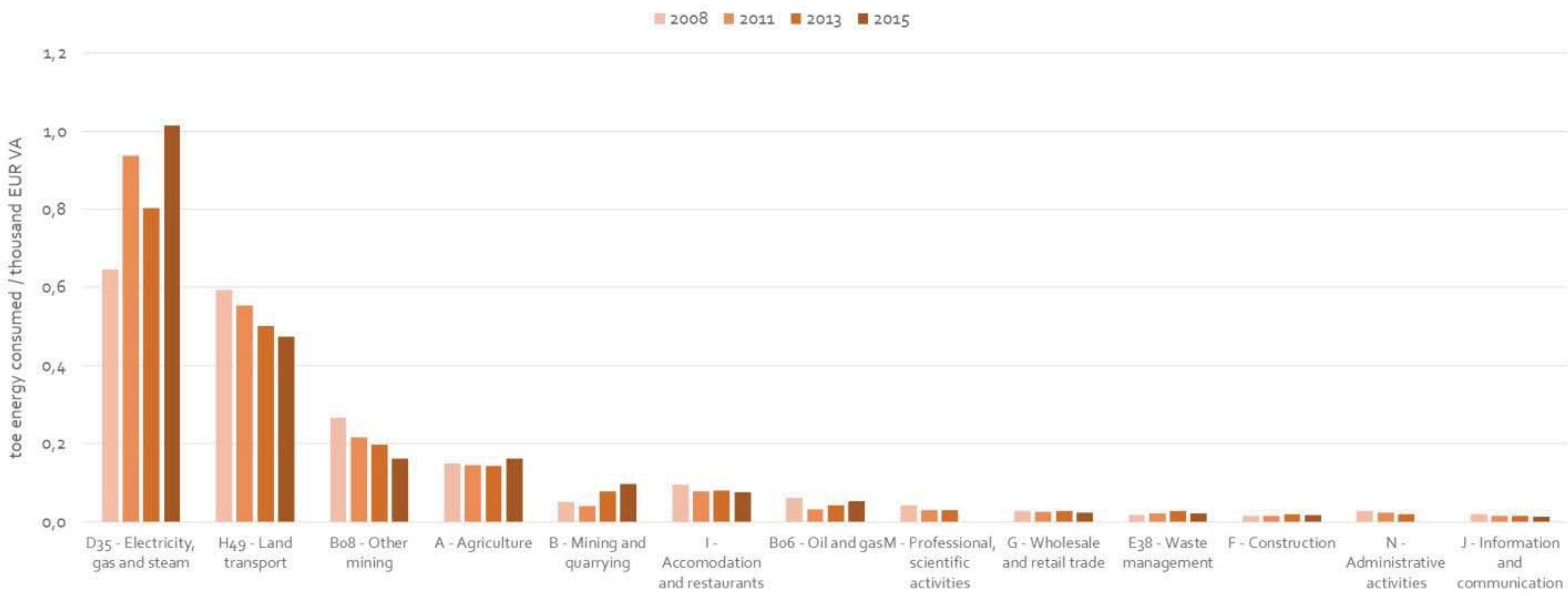


Figure 126 - Energy intensity (consumption/value added in nominal terms) for non- manufacturing sectors (average of available countries)[79]

Source: Trinomics et altri study

[79] The energy intensity change includes both change due to energy efficiency of production and change due to price effects

6.4 Energy costs drivers

Changes in energy costs over time can be the result of several factors. In this section we estimate how changes on energy prices, output and energy intensity impact energy costs. The section relies on the main findings of the decomposition analyses undertaken in the *Trinomics et altri* study which assesses the extent to which these three factors affected the energy costs of selected energy-intensive sectors over 2010-2015.

The decomposition was carried out using the *Log Mean Divisia Index (LMDI)* which shows for a given percentage change in energy costs over the period, the extent to which this change is attributable to changes in each driver over the same period. To make that analysis it was necessary to estimate the prices and the consumption by sector. The purchases of energy resulting from multiplying the estimated prices and consumption were not always similar to the results from historical data coming from 'purchases of energy' collected in Eurostat. A residual (the difference between the two) was therefore introduced in the analysis to take into account for these data discrepancies and ensure a coherent approach in the analysis of the energy costs in this document[80].

The ratio between energy costs and total production costs is also a good indicator of the impact on total costs and competitiveness of a sector. In this section after the analysis of the factors driving the real energy costs (numerator of the ratio) we also look at the factors that drive the production costs (denominator) so we can also assess the actual evolution of the *ratio*.

6.4.1 Drivers of energy costs (Purchases of energy)

Using the LMDI decomposition, the key drivers of energy costs can be identified.

$$Energy\ costs = Output(constant) \times \frac{Energy}{Output\ (constant)} \times Price\ of\ energy$$

The analysis in this section aims to use LMDI decomposition to explain the behaviour of the energy costs observed as energy purchases of energy from SBS data. Thus, a residual is introduced in the analysis to account for the difference between estimated energy costs and the SBS data for energy purchases of energy. For the purposes of this analysis, the change in energy costs over time is defined as follows:

$$\Delta Energy\ Costs = (real)\ output\ effect + (real)\ energy\ intensity\ effect + price\ effect + residual$$

[80] Energy price data was based on the prices from the consumption band from Eurostat relevant for each sector; energy consumption data came from the ODYSEE/MURE database and national data sources; gross output data from the Eurostat SBS. The difference between the estimated purchases of energy and the 'Purchases of Energy Products' data from the Eurostat SBS was attributed to a residual term, which captures data discrepancies which include *inter alia* the effect of fuel switching over the period (as the decomposition calculations assume fixed fuel shares over 2010-2015).

Where

- **Output effect:** the effect of changes in real production (GVA),
- **(Real) Energy intensity effect:** the effect of changes in energy per unit of real output (GVA) over time due to energy efficiency measures, behavioural changes and industry structural change;
- **Price effects:** the effect of changes in coal, gas and electricity prices.
- The **residual,** which includes the effect of unexplained data discrepancy with Eurostat SBS data on 'purchases of energy'.

Box – Interpretation of results

The interpretation of some of these effects is complex in some cases and may deserve some additional explanations.

The unexplained **residual** likely arises from missing data, in particular, on energy consumption. In these cases, data gaps were filled using sectoral energy-intensity figures for those countries where data is available. In some cases, that meant relying on trends of very few countries (Germany and few others) to predict the wider sectoral trends at the EU28 level. Therefore it is possible that the residual is partly reflecting some energy intensity effects that were impossible to identify from the limited energy consumption data available. Industry restructuring is indeed typical in periods following economic crises and intense international competition as the one suffered for some of the analysed energy intensive industries in the period under study. On the other hand, the residual was calculated as the difference from the Eurostat SBS data in order to ensure a coherent analysis in this section in line with the analysis on the previous sections of the chapter. However Eurostat SBS data could also present some inconsistencies as it is based on surveys which might also be partially incomplete.

The interpretation of the **price effect** is more complex that it seems and also deserves further explanations. The price effect captures the effect of changes in weighted-average energy prices on energy costs faced by firms. The prices used are nominal and exclude all recoverable tax and levies (such as VAT). The price effects are estimated by combining (fixed) estimates of the energy mix at a sectoral level and estimates of energy prices (by fuel) over the period 2010-2015. Energy price for each sector and fuel is estimated by using the Eurostat production price band in which most industrial production would fall into[81]. Therefore the price effect does not capture the behaviour of other fuel prices (price of biomass or heat) which are assumed to behave in line with the weighted average from coal, gas and electricity prices. Finally, price for each industry sector at the EU28 level, the Member State level prices are weighted by the total value of production (by Member State). Thus, the EU28 level results for each industry sector reflect a double-weighting of price: (i) (fixed) fuel shares used to derive a representative weighted-average fuel price for each industry and each Member State (ii) (dynamic) Member State production shares used to weight the Member State -level price effects, to derive an EU average price effect for each industry sector. The latter means that prices changes can be due to changes on the production structure of the sector at EU level (shifts of production across MS) which results on changes on the weights used for calculating the prices.

[81] Allocating industry sectors specified at the NACE 3-digit level to energy consumption bands specified by gross annual energy consumption is not straightforward; for many industries there is variation in total energy consumption at the plant level, so it is highly likely that different manufacturing plants will face different energy prices, even if they belong to the same industry sector and are located in the same Member State. For the decomposition analysis we are interested in changes in energy prices (and costs) over time, and so the mapping from industry sector to consumption band does not have a large bearing on the results in so far as the energy consumption bands reflect similar energy price trends over time. For example, at the EU28 level, electricity prices excluding recoverable taxes and levies increased by between 13% and18% in bands IA to IE over the period 2010-2015.

Results of the analysis of energy cost drivers at EU level

At aggregate level across all the manufacturing sectors analysed, the change of energy costs over the period 2010-2015 fell by 8%. This was the result of the following combined effects:

- energy price increases contributed to an increase of 7% in energy costs;
- real output changes had an impact close to zero on energy costs;
- lower energy-intensity contributed to energy savings that reduced energy costs by 4%.
- The residual (unidentifiable factors) drove energy costs down by 10%

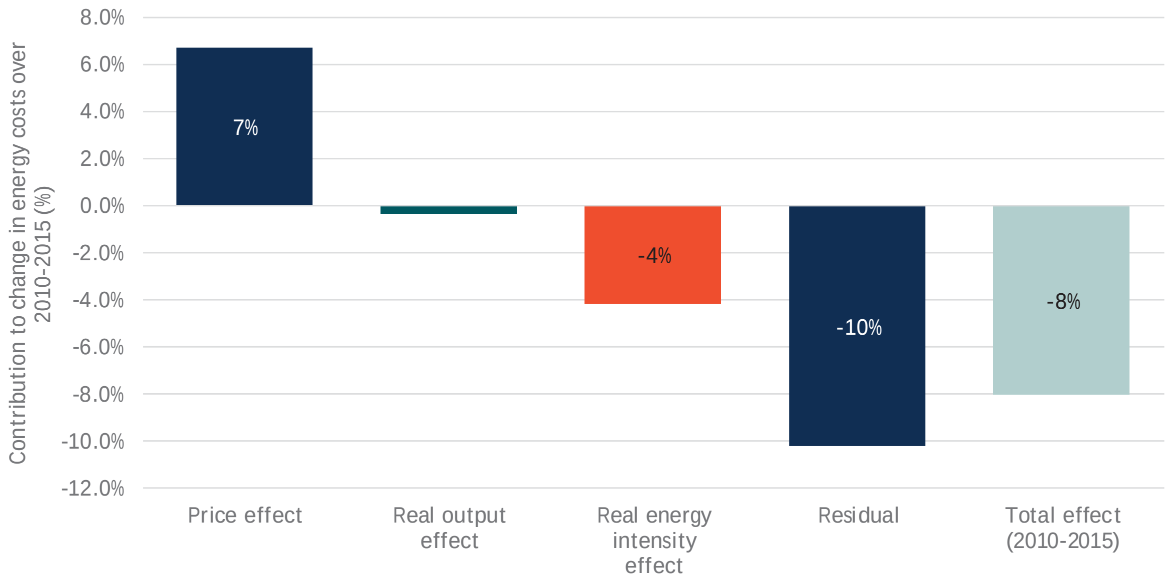


Figure 127 - Drivers of energy costs (absolute changes)

Source: Trinomics et altri

Results of the analysis energy costs drivers by sectors

Figure 128 summarises the analysis of the impact of energy cost drivers by sectors. It shows that the magnitude of the various effects across sectors is very diverse. The value of the residual also varies significantly across sectors signalling which sectors have the most robust estimates of the effects. A more detailed analysis by sector can be found in Annex 2.

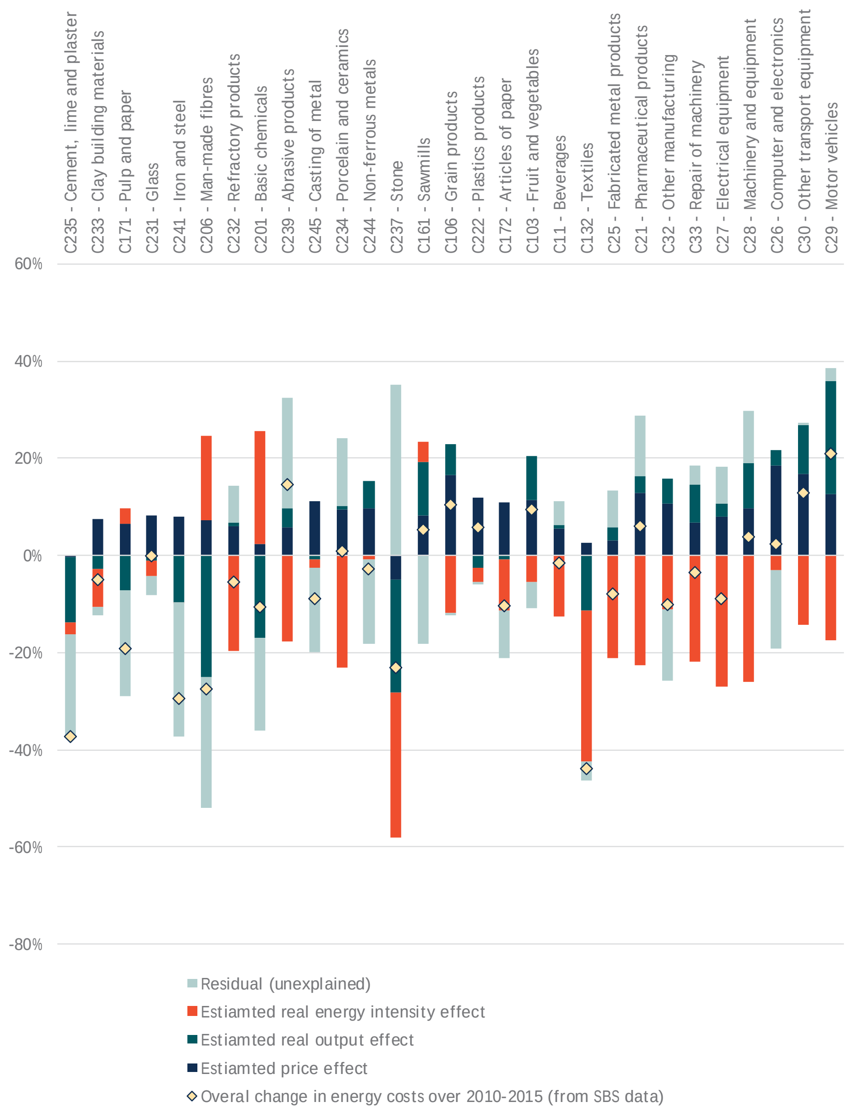


Figure 128 - Drivers of change in energy costs in EU manufacturing sectors over 2010-2015 (%)

NB: Industry sectors are ordered according to energy intensity

The **price effect** was positive across almost all industry sectors analysed contributing to a 5%-10% increase in current energy costs over the period 2010-2015. The price effect mainly reflects increases in prices of electricity, which accounts for the largest share of energy consumption for many of the sectors studied. Gas is also important for many energy-intensive industries but gas prices remained roughly stable over the period.

The price effect were modest (contributed a 0-5% increase in energy costs) in sectors like *Beverages (C11); Weaving of textiles (C132); Cement (C235), Fabricated metal products, except machinery and equipment (C25); Basic chemicals (C201).* In these sectors, the low price effect is largely because production took place in Member States where energy price rises were more modest and/or production shifted to Member States where energy prices are lower[82]. The decline on oil prices over the period also contributed to bring down the price

[82] In the case of *Manufacture of beverages (C11)*, for example, growth in output was highest in France (a country with relatively low industry electricity prices), while declines in output occurred in Denmark and Greece (countries with higher electricity prices).

effect in oil intensive sectors like *Basic chemicals (C201)*[83] and particularly C*ement (C235)*. The largest price effect was estimated in *Computer, electronic and optical products (C26)* which relies on electricity very importantly (80% of the sector's energy costs) and is prominently located in Member States which experienced significant electricity price rises over 2010-2015[84].

The **real output effect** was negative for most of the more energy-intensive industry sectors and positive for most of the less energy-intensive industry sectors, reflecting that for high energy-intensity industry sectors reductions in energy costs are closely linked to lower economic activity. The sectors (and Member States) that saw the largest falls in real output over 2010-2015 include *Basic chemicals (C201)* in France; *Man-made fibres (C206)* in the UK, the Netherlands, Belgium and Spain; *Cement (C235)* in Spain, Italy and Greece; *Cutting stone (C237)* in Italy and Spain.

The largest positive output effects appeared in sectors which are less affected by energy price increases like the *Motor vehicles (C29)* and *Other transport equipment (C30)*, where rises in real output[85] contributed to a 23% and 10% increase in energy costs, respectively.

Energy-intensity effects suggest that, in most cases, the energy intensity of manufacturing industries fell over the period. These results have however to be taken with precaution as, in many cases, they are reliant on data (or estimations) from very few countries[86]. The negative energy intensity effect can represent improvements in energy efficiency (due to behavioural change or investments in more energy efficient processes in response to higher prices or policies[87]) but also structural changes within sectors (as there can be considerable heterogeneity at the level of aggregation studied, i.e. NACE 3-digit level)[88]. It is interesting to see that reduction in (real) energy intensity appeared systematically among the 'less energy-intensive' sectors while it was not always the case for the 'most energy-intensive sectors'. This however might be due to the fact that data for the most energy-intensive industry sectors was sparser.

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[83] In Basic Chemicals (201), the benefits of lower oil prices were outweighed by the effect of increases in production in countries with relatively high industry electricity prices (Germany and Belgium) and reduced production in France, where industry electricity prices are below the EU average.

[84] Germany, France and the UK account for around 2/3 of the total value of production in the sector. The estimated electricity prices (excluding recoverable taxes) faced by the sector were estimated to have risen over the period in Germany (22%), France (32%) and the UK (58%).

[85] Gross output in these sectors increased most noticeably in Germany and the UK, which each experienced annual growth in constant price output of over 3% pa.

[86] From around five countries, where both energy consumption and gross output data is available, and used to proxy trends in energy-intensity at the EU level. In addition the unexplained residual component captures changes in energy intensity due to fuel switching and could also be partly capturing other energy intensity effects.

[87] Policies such as the carbon price, energy efficiency loans and grants, energy audit or energy management systems and a package of other measures that have been offered to energy-intensive industry sectors can incentivise energy efficient investments and reduce energy cost pressures.

[88] Steel production in the EU uses either the Basic Oxygen Furnace (BOF) or Electric Arc Furnace (EAF) process. While both production processes are energy-intensive, the energy requirements are very different. The main energy costs to the BOF process is coking coal, while electricity is the primary energy cost for the EAF process. Changes to the structure of the steel manufacturing sector therefore could substantially affect energy intensity and energy costs

6.4.2 Impact of energy costs on Total Production Costs

Based on Eurostat SBS data for energy purchases and total production costs, this section assesses the results of the decomposition of total production costs in order to assess the extent to which total production costs were driven by changes in energy costs.

$$Total\ production\ costs = \ Energy\ costs + \ Other\ costs\ of\ production$$

$$\Delta Total\ production\ costs\ = \Delta Energy\ costs + \ \Delta Other\ costs\ of\ production$$

The result of the analysis by *Trinomics et altri* estimates that, at aggregated level, energy costs had a close to zero impact on increasing total production costs over the period of study (2010-2015).

At sector level, the impact of changes in energy costs on total production costs was more diverse (See Table 12), ranging from -8% to +1%. In almost all cases the impact of energy costs was smaller than other cost drivers. Energy costs drove significant reductions in total costs of production in *Cement (-8%), Basic iron and steel (-3%), Paper (-2%), Man-made fibres (-2%), Clay building materials (-1%), Basic chemicals (-1%), Casting of metals (-1%)* and *Cutting of stone (-1%). Cement* was the only sector in which energy costs explained more than half of the reduction in total production costs, with energy costs falling primarily due to reductions in output. Among the less energy intensive sectors, energy costs (mainly driven by efficiency improvements, structural change and lower real output) had a negative impact on production costs only for *Weaving of textiles (-2%)*.

Table 12- Drivers of total production costs in manufacturing sectors

Code	Description	Main energy carrier used by sector	Energy cost effect	Other cost effect	Total effect
	High energy-intensity sectors				
C235	Manufacture of cement, lime and plaster	Oil	-8%	-7%	-15%
C233	Manufacture of clay building materials	Natural Gas	-1%	2%	1%
C171	Manufacture of pulp, paper and paperboard	Natural Gas	-2%	9%	7%
C231	Manufacture of glass and glass products	Natural Gas	0%	9%	9%
C241	Manufacture of basic iron and steel and of ferro-alloys	Natural Gas	-3%	-8%	-10%
C206	Manufacture of man-made fibres	Natural Gas	-2%	-7%	-9%
C232	Manufacture of refractory products	Natural Gas	0%	-3%	-3%
C201	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	Natural Gas	-1%	7%	7%
C239	Manufacture of abrasive products and non-metallic mineral products n.e.c.	Natural Gas	1%	10%	11%
C245	Casting of metals	Electricity	-1%	11%	11%
C234	Manufacture of other porcelain and ceramic products	Natural Gas	0%	14%	14%
C192	Manufacture of refined petroleum products	Oil (chemical feedstock); Natural Gas	1%	-15%	-14%

Code	Description	Main energy carrier used by sector (energy input)	Energy cost effect	Other cost effect	Total effect
C244	Manufacture of basic precious and other non-ferrous metals	Electricity	0%	17%	17%
C237	Cutting, shaping and finishing of stone	Electricity	-1%	-20%	-21%
C161	Sawmilling and planing of wood	Electricity	0%	22%	22%
	Lower energy-intensity sectors				
C106	Manufacture of grain mill products, starches and starch products	Natural Gas	0%	23%	23%
C222	Manufacture of plastics products	Electricity	0%	18%	18%
C172	Manufacture of articles of paper and paperboard	Natural Gas	0%	11%	11%
C103	Processing and preserving of fruit and vegetables	Natural Gas	0%	25%	26%
C11	Manufacture of beverages	Natural Gas	0%	6%	6%
C132	Weaving of textiles	Electricity	-2%	-2%	-3%
C25	Manufacture of fabricated metal products, except machinery and equipment	Electricity	0%	9%	9%
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Natural Gas	0%	17%	17%
C32	Other manufacturing	Electricity	0%	15%	15%
C33	Repair and installation of machinery and equipment	Electricity	0%	14%	14%
C27	Manufacture of electrical equipment	Electricity	0%	10%	9%
C28	Manufacture of machinery and equipment n.e.c.	Electricity	0%	22%	22%
C26	Manufacture of computer, electronic and optical products	Electricity	0%	-6%	-5%
C30	Manufacture of other transport equipment	Natural Gas	0%	28%	28%
C29	Manufacture of motor vehicles, trailers and semi-trailers	Electricity	0%	42%	42%

Source: Trinomics et altri study

6.4.3 Drivers of the energy costs as a share of production costs

The energy costs shares in total production costs ($\frac{Energy\ costs}{Total\ production\ costs}$) is a useful measure for assessing energy cost impacts. It is therefore interesting to see how this ratio has been affected by the dynamics in energy costs (the numerator of the ratio) and total production costs (the denominator).

Table 13 - Changes in energy costs and total production costs by sector

Code	Description	Main energy carrier used by sector	Change in energy costs (%)	Change in total production costs (%)	Percentage point change in ratio of energy costs in total costs
	High energy-intensity sectors				
C235	Manufacture of cement, lime and plaster	Oil	-37%	-15%	-5.8 pp
C233	Manufacture of clay building materials	Natural Gas	-5%	1%	-0.7 pp

Code	Description	Main energy carrier used by sector	Change in energy costs (%)	Change in total production costs (%)	Percentage point change in ratio of energy costs in total costs
C171	Manufacture of pulp, paper and paperboard	Natural Gas	-19%	7%	-2.7 pp
C231	Manufacture of glass and glass products	Natural Gas	0%	9%	-0.7 pp
C241	Manufacture of basic iron and steel and of ferro-alloys	Natural Gas	-29%	-10%	-2.0 pp
C206	Manufacture of man-made fibres	Natural Gas	-27%	-9%	-1.6 pp
C232	Manufacture of refractory products	Natural Gas	-5%	-3%	-0.2 pp
C201	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	Natural Gas	-11%	7%	-1.1 pp
C239	Manufacture of abrasive products and non-metallic mineral products n.e.c.	Natural Gas	15%	11%	+0.2 pp
C245	Casting of metals	Electricity	-9%	11%	-1.1 pp
C234	Manufacture of other porcelain and ceramic products	Natural Gas	1%	14%	-0.6 pp
C192	Manufacture of refined petroleum products	Oil (chemical feedstock); Natural Gas (energy input)	31%	-14%	1.3 pp
C244	Manufacture of basic precious and other non-ferrous metals	Electricity	-3%	17%	-0.7 pp
C237	Cutting, shaping and finishing of stone	Electricity	-23%	-21%	-0.1 pp
C161	Sawmilling and planing of wood	Electricity	5%	22%	-0.5 pp
	Lower energy-intensity sectors				
C106	Manufacture of grain mill products, starches and starch products	Natural Gas	11%	23%	-0.3 pp
C222	Manufacture of plastics products	Electricity	6%	18%	-0.3 pp
C172	Manufacture of articles of paper and paperboard	Natural Gas	-10%	11%	-0.6 pp
C103	Processing and preserving of fruit and vegetables	Natural Gas	10%	26%	-0.4 pp
C11	Manufacture of beverages	Natural Gas	-1%	6%	-0.2 pp
C132	Weaving of textiles	Electricity	-44%	-3%	-1.5 pp
C25	Manufacture of fabricated metal products, except machinery and equipment	Electricity	-8%	9%	-0.4 pp
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Natural Gas	6%	17%	-0.1 pp
C32	Other manufacturing	Electricity	-10%	15%	-0.3 pp
C33	Repair and installation of machinery and equipment	Electricity	-3%	14%	-0.2 pp
C27	Manufacture of electrical equipment	Electricity	-9%	9%	-0.2 pp
C28	Manufacture of machinery and equipment n.e.c.	Electricity	4%	22%	-0.1 pp
C26	Manufacture of computer, electronic and optical products	Electricity	2%	-5%	+0.1 pp
C30	Manufacture of other transport equipment	Natural Gas	13%	28%	-0.1 pp
C29	Manufacture of motor vehicles, trailers and semi-trailers	Electricity	21%	42%	-0.1 pp

Source: Trinomics et altri study

Note: Energy costs are taken from the 'Purchases of Energy Products' data (from Eurostat SBS). Other costs comprise 'personnel costs' and 'costs of goods and services, net of energy costs', calculated from the Eurostat SBS data. Results are rounded to the nearest percentage point and cases where the energy cost effect and the other cost effect do not sum to the total effect are due to rounding.

Table 13 shows that the energy costs shares in total production costs have fallen among nearly all sectors over the period of study. There was a wide variation in changes in energy costs (the numerator) over the period, with around half of the sectors experiencing increases in energy costs and the other half experiencing decreases. This means that, even though energy costs have increased among some sectors, they have not increased by as much as other non-energy costs of production resulting in lower energy costs shares. For most of the less energy-intensity industries, the ratio of energy costs in total production costs fell by -0.1pp to -0.6pp. For the more energy intensive sectors, there were typically larger reductions in the ratio of energy costs to total production costs, particularly in *Cement (-5.8pp), Paper (-2.7pp), Basic iron and steel (-2 pp), Man-made fibres (-1.6pp) and Weaving of textiles (-1.5pp).*

Figure 129 shows that the only sector in which energy costs increased at a faster rate than other non-energy costs of production over the period were *Computer products, abrasive non-metallic products* and *refinery products*.

	Reduction in energy costs over 2010-2015	Increase in energy costs over 2010-2015
Energy costs grew at a slower rate than non-energy costs of production	• Fabricated metal products (C25) • Repair and installation of machinery (C33) • Cutting and shaping stone (C237) • Weaving of textiles (C132) • Beverages (C11) • Refractory products (C232) • Cement, lime and plaster (C235 • Clay building materials (C233) • Electrical equipment (C27) • Other manufacturing (C32) • Paper and paperboard (C172) • Pulp, paper and paperboard (C171) • Glass (C231) • Iron and steel (C241) • Basic and non-ferrous metals (C244) • Chemicals (C201) • Man-made fibres (C206) • Casting of metals (C245)	• Other transport equipment (C30) • Fruit and vegetables (C103) • Plastics products (C222) • Grain mill products, starches (C106) • Motor vehicles (C29) • Sawmilling and planing of wood (C161) • Machinery and equipment n.e.c. (C28) • Pharmaceutical products (C21) • Other porcelain and ceramic (C234)
Energy costs grew at a faster rate than non-energy costs of production	-	• Computer, electronic and optical C26) • Abrasive non-mettalic minerals(C239) • Refined petroleum products (C192)

Figure 129 - Classification of sectors by comparing the dynamics of energy costs dynamics vs productions costs

Source: Trinomics et altri study

6.5 International comparisons

International competitiveness is a relative matter. We need to compare the energy costs to the EU trading partner to assess what is their actual impact on the cost-competiveness of our industry. The same applies to the energy efficiency indicators which can influence the relative energy consumption and therefore the energy costs. Finally, prices of energy products should also be compared as they are usually the main drivers of the energy costs. While data on international prices is relatively robust, the data available for energy costs and energy efficiency is rather limited and the results of the latter should be taken with certain caution.

The chapter compares retail industrial prices for the EU industry with those in G20 Members. It relies on the results of the *Trinomics et altri* study. It focuses on the international comparisons of prices for electricity and gas, which are the most relevant for energy costs in most of manufacturing. International comparisons on oil products prices can be also found in **section 3.3.7** as they are also relevant for the energy costs in some specific manufacturing sectors and non-manufacturing sectors.

6.5.1 Energy costs vs other G20 countries

In this section the energy costs of EU sectors are compared to those in main EU trading partners in order to assess the competitiveness of EU sectors. Unfortunately, as noted in the previous sections, specific data on energy cost shares is relatively limited across the main non-EU G20 partners.

Figure 130 shows a comparison of energy costs shares in production costs for the sectors and countries for which equivalent energy cost and production cost data were found.

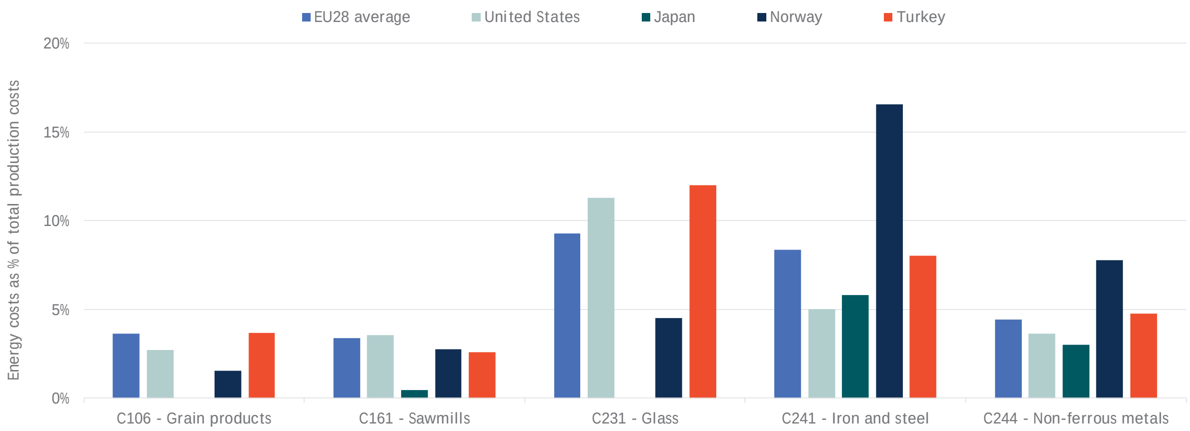

Figure 130 - International comparision of energy costs shares for selected energy intensive sectors

Source: Trinomics et altri study

The data for the available sectors show that EU shares in production costs are comparable to those of the US except for *steel* and *non-ferrous metals*. As to Japan, costs shares are higher in the EU energy costs shares in the 3 sectors for which data was available. These results are in line with those found in the 2016 energy prices and costs report where comparisons could be made for a larger number of sectors and were pointing to higher energy costs shares in energy intensive industries in the EU compared to Japan and similar energy costs shares in the EU and the US, with the exception of sectors subjected to higher international competitive pressure, for which EU cost shares were lower.

By using production value rather than production costs as the basis of the comparison the international analysis can be expanded to include South Korea and other sectors (See **Figure 131** and **Figure 132**). It is important to bear in mind that comparing energy costs to production value is not the same as comparing to production costs. Production value includes profits and this variable is much more volatile and also depends of other factors than production costs.

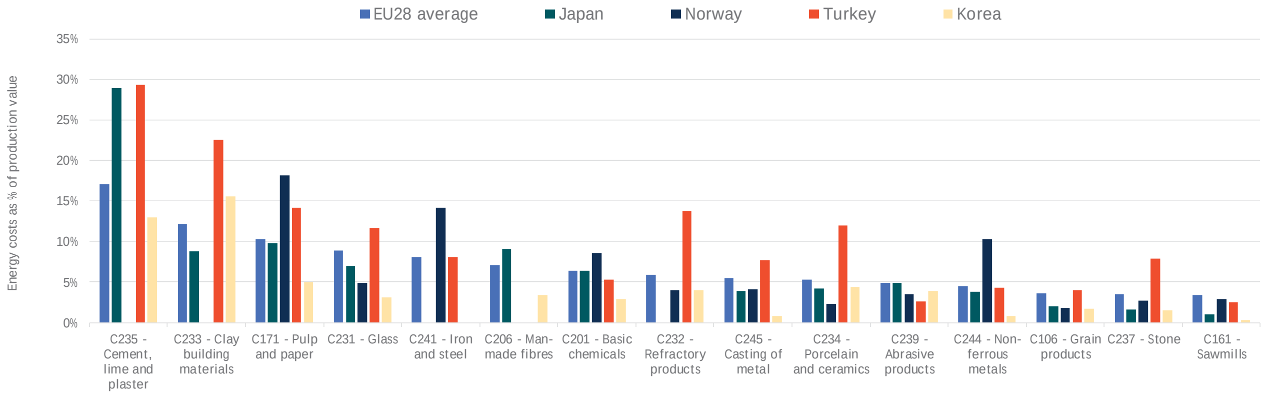

Figure 131 - Energy costs shares in production value for the most energy intensive sectors in manufacturing, 2008-2015

Source: Trinomics et altri study

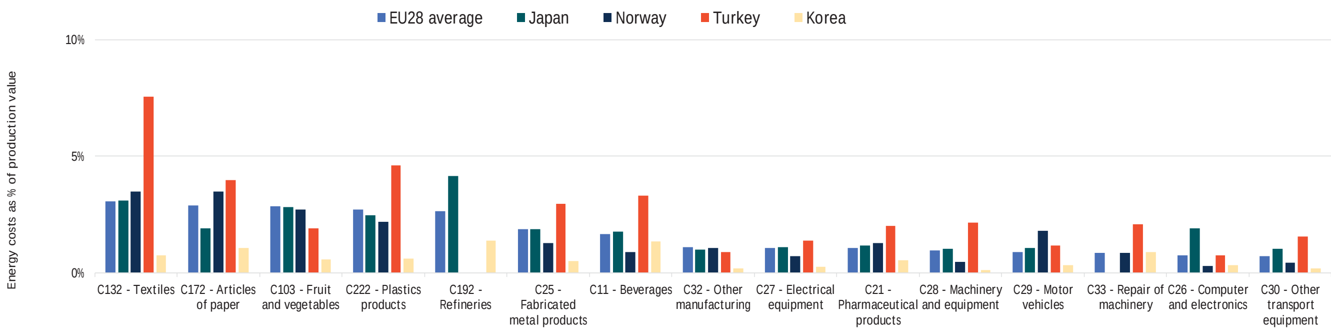

Figure 132 - Energy costs shares in production value for other manufacturing sectors, 2008-2015

Source: Trinomics et altri study

When we look at the energy costs shares in production value we observe that in most cases the EU shares continue to be higher than in those Japan although in some cases EU shares become comparable or even lower (i.e. for *computer and electronics*; *cement* and *refineries*). The EU energy cost shares were also higher than those in South Korea for almost all the sectors (particularly much higher than in *sawmills* and *transport equipment*; and with the only exception of *clay building materials*).

As to Norway, the result of the comparison is mixed. For some sectors the energy cost shares are much lower than in the EU (*Grain*, *Glass*, *Refractory Products*) while for some other they are much higher (paper, chemicals, steel and non-ferrous metals).

EU energy cost shares were in general lower in the EU than those of Turkey with the exceptions of few sectors (*fruit and vegetables*, *chemicals*, abrasive *products*, *non-ferrous metals* and *repair of machinery*.

Some observations can be drawn on some of the sectors. For *Grain products*, the EU average energy cost share is higher than in the US (where production is highly mechanised) and Norway; it is however similar to that in Turkey. For s*awmills* costs in the EU are a little lower than those in the US on average, but higher than in the other countries. For *Glass*, the EU cost shares are lower than in the US and Turkey, but higher than in Norway. For *steel* and *non-ferrous metals* the EU energy cost shares are lower than in Norway and comparable to those in Turkey, but higher than those in the US and Japan (and, for non-ferrous metals, particularly much higher than in South Korea).

6.5.2 Energy intensity of EU sectors vs other G20

Energy efficiency can also be factor for international competitiveness (the more energy efficient a firm is, the lower its relative consumption and energy costs). By comparing energy intensities across one can have an indication of the different energy efficiency in these compared sectors and countries. This complements the understanding of the role of energy cost shares. One should also be aware that the international data on energy intensity is rather limited (with often only one or two other international comparators available) and that these results should not be generalised.

Figure 133 and **Figure 134** display the trends in energy intensity on the available sectors and countries. Although it is difficult to draw any general conclusions it can be observed that that:

- Energy intensities in the EU compared to those in the US show considerable variation per sector for which data is available, with the EU being less energy intensive in *beverages*, *glass*, *fabricated metal products*, and the US being less energy intensive in *chemicals*, *Man-made fibres* and *computers and electronics*.
- The EU is less energy intensive than China in every sector for which data is available (except for *refineries* for which the EU have the highest energy intensity of the countries for which data was available).
- The EU sectors are also systematically less energy intensive that those in Turkey (note that the data set was the most complete)

Figure 133 - Energy intensity international comparisons for the most energy intensive manufacturing sectors

Source: Trinomics et altri study

Note: data limited for available sectors and countries

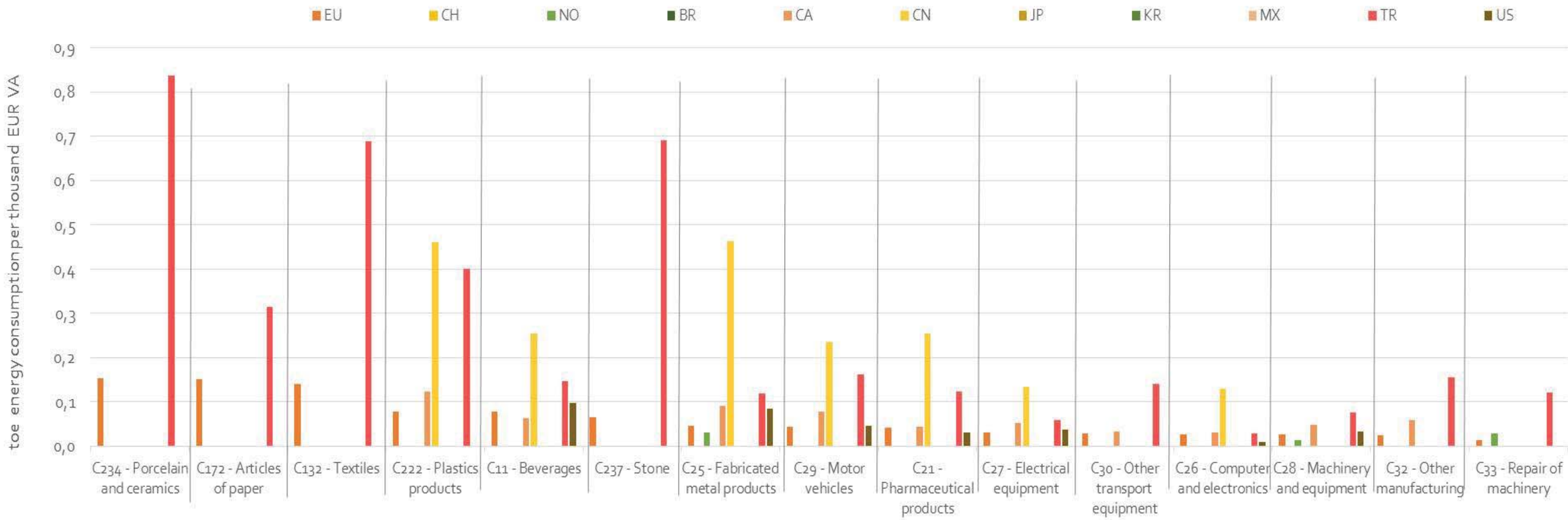

Figure 134 - Energy intensity international comparisons for other manufacturing sectors

Source: Trinomics et altri study

Note: data limited for available sectors and countries

6.5.3 Industrial electricity prices: EU vs G20 countries

This section compares retail industrial prices for electricity in the EU industry with those in G20 Members. It relies on the results of the *Trinomics et altri* study. International comparisons of electricity prices are very relevant for an assessment of cost competitiveness of sectors. Indeed electricity is the energy carrier which most often has the highest potential to impact the energy costs differential between energy intensive sectors in manufacturing.

Retail electricity prices for industry have relatively complete datasets. The price data covers EU28 and G20 countries from 2008-2018. EU28 prices are based on consumption band assumptions (mainly Eurostat consumption band ID) while data for non-EU G20 countries is normally based on the average of the countries (not based on consumption bands). The price data is however widely comparable (i.e. comparability checks were undertaken can be found in the study by *Trinomics et altri*). Finally, prices are exclusive of VAT and recoverable taxes and levies but include (non-recoverable) excise taxes and levies.

The main conclusions that can be drawn from this data are:

— EU28 average prices increased from around 100 EUR/MWh in 2008 to 120 EUR/MWh by 2013-2014, but since then prices have slowly declined to around 110 EUR/MWh.

— US prices are around half the EU average levels and have not changed significantly between 2008 and 2018.(See **Figure 135)**

— Prices in Japan were higher than the EU28 average but have declined since 2012 and converged in 2015-2016 to a broadly similar level .(See **Figure 135**)

— Prices in China began at a comparable level to EU prices but have declined since 2011 and thus diverged from EU levels. (See **Figure 135**)

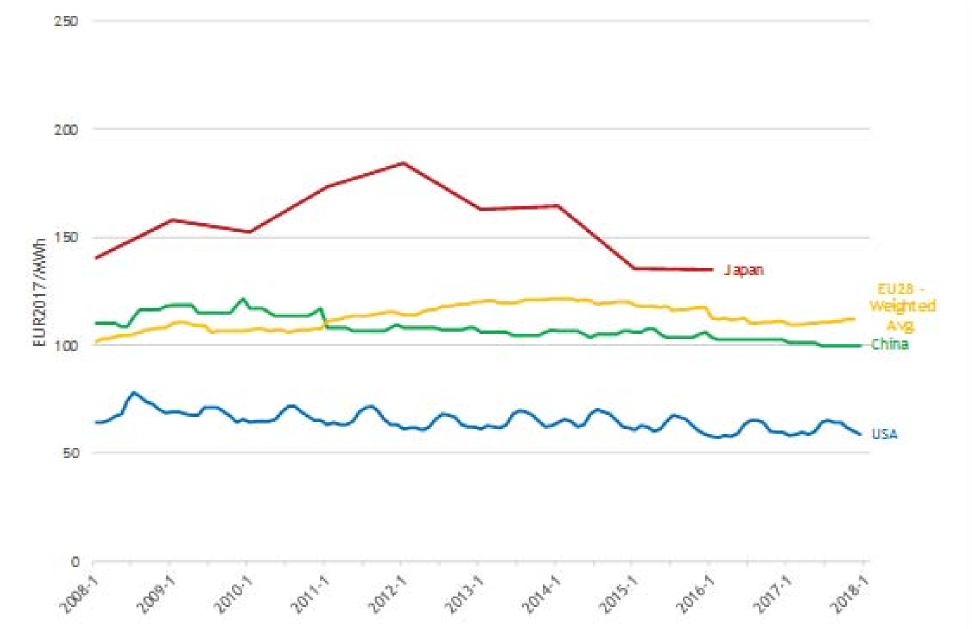

Figure 135 – Retail electricity prices for industry: EU vs China, Japan & US, 2008-2018

Sources: Eurostat, CEIC and IEA

— Most other G20 countries (Canada, India, Russia, Mexico, South Korea, Saudi Arabia, and Turkey) also have lower prices than the EU average. Only Brazil has higher prices. Prices in South Korea are lower but increasing and converging to EU levels, whilst prices in Mexico (already below cost) are diverging as they have significantly decreased since 2014. (See **Figure 136**)

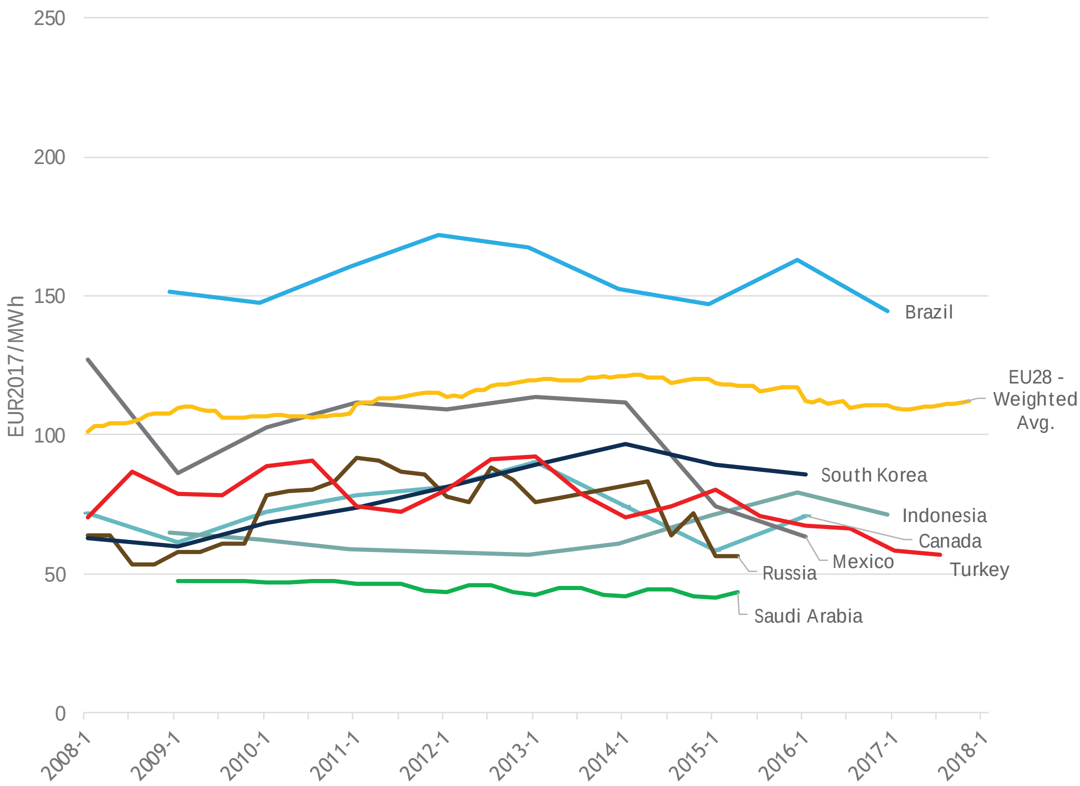

Figure 136 - Retail electricity prices for industry: EU vs other G20, 2007-2018

Sources: Eurostat, CEIC, IEA, ERRA

For Argentina, Australia, India there is only information from price indices (and not absolute price data). The evolution of the indices indicate that EU average prices have increased by around 10% since 2008 (+1.1%/year) while real price indices declined in India and particularly in Argentina. The Australian price index has increased in real terms by more than 60% over the period. – See **Figure 137**

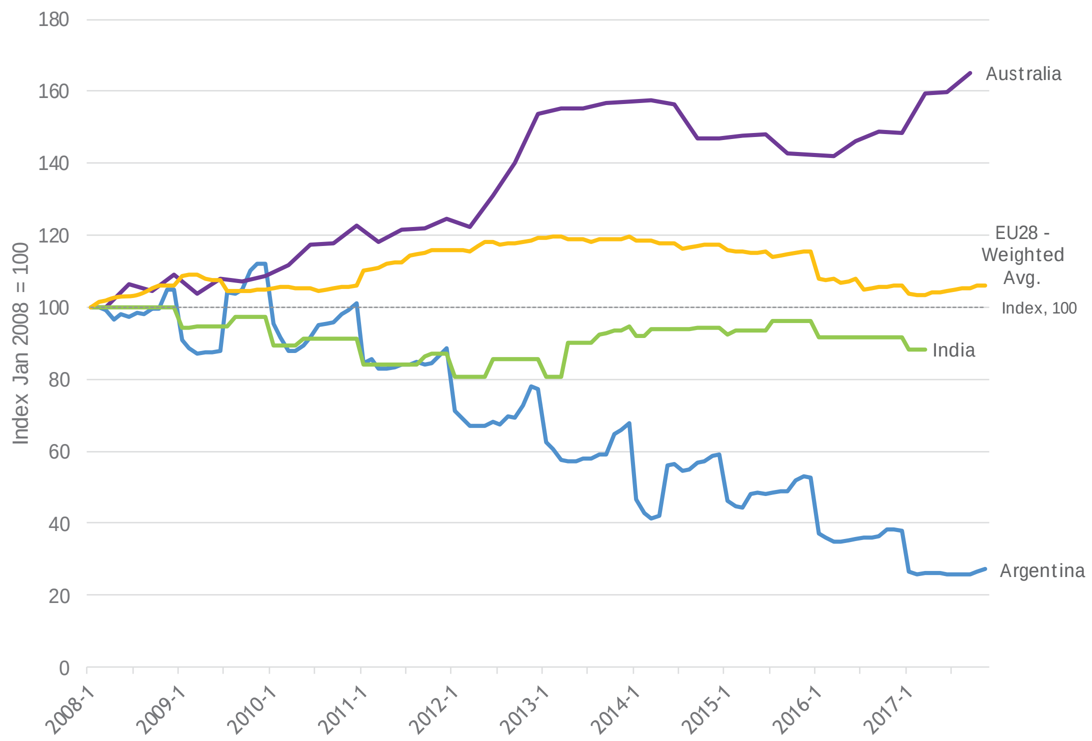

Figure 137 – Retail electricity indexes prices for industry: EU vs Argentina, Australia & India, 2008-2018

Sources: Eurostat, CEIC and IEA

— Price differentials (in real prices 2017) did not evolve favourably for the EU in most of the cases as EU prices increased (by 10%) while prices decreased in most of the G-20 countries (with the exception of Indonesia and South Korea). As a result of this divergent evolution, the price gap with the US and China (which was already favourable for these two countries at the start of the period analysed) has widened slightly. The gap with Japan (which was favourable for the EU) has shrunk. The price gap with the EU increased for most of the other G-20 countries, or in the case of Brazil, prices that were initially higher converged towards EU levels. Only the price gap with South Korea evolved favourably for the EU (while the gap with Indonesia remained roughly stable) – See Table 14

Table 14 - Changes in retail industrial electricity prices compared to EU prices, constant 2017 EUR/MWh

Country	Start price [EUR2017]	End price [EUR2017]	Change EUR	Change %	Start Gap [EUR]	End Gap [EUR]	Difference [EUR]	Impact for EU
EU28	**101.33**	**112.05**	10.72	10.6%				
Argentina								
Australia								
Brazil	**151.51**	**144.48**	-7.03	-4.6%	50.18	32.43	-17.75	Negative
Canada	**71.53**	**70.66**	-0.87	-1.2%	-29.80	-41.39	-11.59	Negative
China	**109.83**	**99.65**	-10.18	-9.3%	8.50	-12.40	-20.90	Negative
India								
Indonesia	**65.01**	**71.30**	6.29	9.7%	-36.32	-40.75	-4.43	Negative
Japan	**140.15**	**134.58**	-5.57	-4.0%	38.82	22.53	-16.29	Negative
Mexico	**127.10**	**63.20**	-63.90	-50.3%	25.77	-48.85	-74.62	Negative
Russia	**64.00**	**56.33**	-7.67	-12.0%	-37.33	-55.72	-18.39	Negative
Saudi Arabia	**47.25**	**43.60**	-3.66	-7.7%	-54.08	-68.46	-14.38	Negative
South Africa								
South Korea	**62.94**	**85.82**	22.88	36.3%	-38.39	-26.23	12.16	Positive
Turkey	**70.21**	**56.80**	-13.41	-19.1%	-31.12	-55.25	-24.13	Negative
USA	**63.85**	**58.71**	-5.14	-8.1%	-37.48	-53.34	-15.86	Negative

Source: Trinomics et altri study.

Note: a positive impact for the EU is recorded if the price gap has improved over time, e.g. that if a country had lower prices initially the gap is now smaller or prices are higher than the EU average, or if a country had higher prices and that the gap has increased. A negative impact is recorded if a country had lower prices than the EU, and that the gap has now increased, or if the country had higher prices than the EU but this gap has narrowed or the country now has lower prices.

— The analysis of the drivers of international prices (see Table 15) shows that monetary effects (inflation and exchange rate changes) played a very significant role in the evolution of nominal prices. High inflation played a key role in pushing up prices in countries like Brazil and Indonesia. In Russia and Turkey the effects of high inflation were mitigated or offset by exchange rates depreciations. Exchange rate appreciations also played a role in pushing up Chinese and US prices. EU prices increased by around 12% in real terms between 2008 and 2017 (1.3%/year). In contrast, real prices declined in Brazil, Mexico, China, the US and Saudi Arabia. However, national prices increased in real terms in the remainder of the G20 in a comparable or higher magnitude.

Table 15 - Factors in observed industrial retail electricity price changes per country, nominal prices, per MWh

Country	Start date	End date	Nominal Start price EUR	Change due to inflation [EUR]	Change due to price change in national currency [EUR]	Exchange rate effect [EUR]	Total change [EUR]	Nominal End price EUR	Change due to inflation [%]	Change due to real price change in national currency [%]	Exchange rate effect [%]	Total change [%]
EU28	2008-1	2017-11	**92.80**	8.20	11.05	0.00	**19.25**	**112.05**	8.8%	11.9%	0.0%	**20.7%**
Argentina	No data											
Australia	No data											
Brazil	2008-12	2016-12	**111.68**	71.01	-15.02	-14.87	**41.12**	**152.80**	63.6%	-13.4%	-13.3%	**36.8%**
Canada	2008-1	2016-1	**48.18**	4.02	23.20	-2.86	**24.36**	**72.55**	8.3%	48.2%	-5.9%	**50.6%**
China	2008-1	2017-12	**62.87**	14.43	-5.98	26.03	**34.48**	**97.34**	23.0%	-9.5%	41.4%	**54.8%**
India	No data											
Indonesia	2008-12	2016-12	**40.72**	18.18	9.96	5.56	**33.70**	**74.41**	44.6%	24.5%	13.7%	**82.8%**
Japan	2008-1	2016-1	**94.40**	-1.15	18.50	26.44	**43.79**	**138.19**	-1.2%	19.6%	28.0%	**46.4%**
Mexico	2008-1	2016-1	**85.61**	26.29	-32.71	-14.30	**-20.72**	**64.89**	30.7%	-38.2%	-16.7%	**-24.2%**
Russia	2008-1	2015-4	**43.11**	30.16	17.35	-33.08	**14.43**	**57.54**	70.0%	40.2%	-76.7%	**33.5%**
Saudi Arabia	2009-1	2015-4	**35.65**	6.78	-3.78	5.89	**8.89**	**44.53**	19.0%	-10.6%	16.5%	**24.9%**
South Africa	No data											
South Korea	2008-1	2016-1	**42.40**	6.35	34.28	5.09	**45.72**	**88.12**	15.0%	80.9%	12.0%	**107.8%**
Turkey	2008-1	2017-7	**64.30**	42.27	27.94	-77.71	**-7.50**	**56.80**	65.7%	43.5%	-120.9%	**-11.7%**
USA	2008-1	2017-12	**43.01**	5.65	-3.61	10.97	**13.01**	**56.02**	13.1%	-8.4%	25.5%	**30.2%**

Source: Trinomics et altri.study

Explanation: this table shows the different components of the observed nominal price change, decomposed into inflation, price change and exchange rate effects. By summing the components between the Nominal start price EUR and Total change [EUR] the total change can be calculated, this corresponds to the difference between the Nominal Start price EUR and the Nominal End price EUR.

Note: this table presents nominal prices, differences can be observed with the previous table which used constant prices, the start prices differ due to application of the currency deflator for the constant price calculation, whilst the end prices differ due to small differences in the conversions used in the two calculations, this latter difference is typically less than +/- 5% of the price.

Note on the range and dispersion of industrial electricity prices in the EU

The industrial electricity prices in the EU Member States have spanned a range of 50-270 EUR/MWh between 2008 and 2018 (see figure below looking at the maximum and minimum prices registered in MS between 2008–2018)

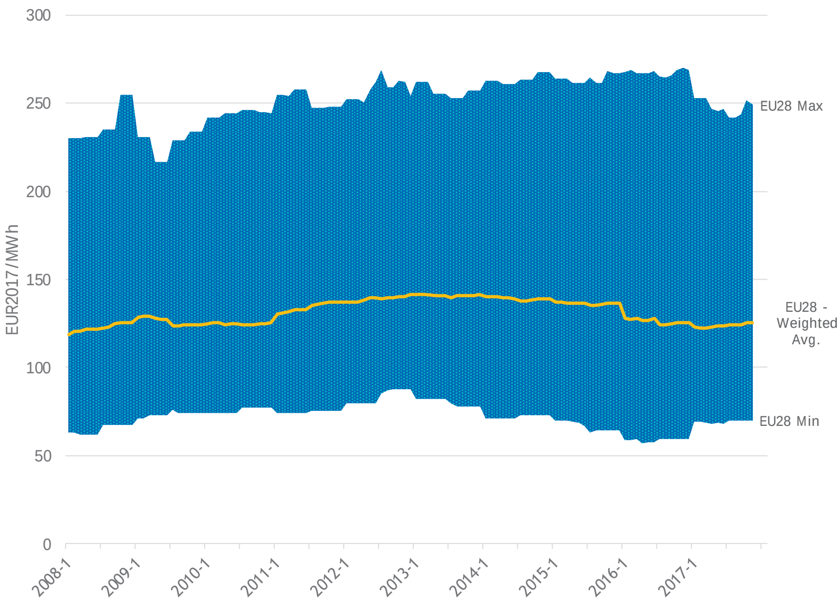

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Figure 138 - Range of retail electricity prices for industry in the EU

Source: Eurostat

This wide range does not necessary mean that there huge differences in prices between the Member States .It reflects steady price differential between Member States (ie Members with consistently higher or lower prices than the EU average) but also temporary price divergences (e.g. price spikes) in some countries. The dispersion of EU prices can be better assessed by the Box plot figure below (in which the square shows the range of the prices of the 25% of the MS being above the average and 25% of the MS being below the average price (ie 50 of the sample))

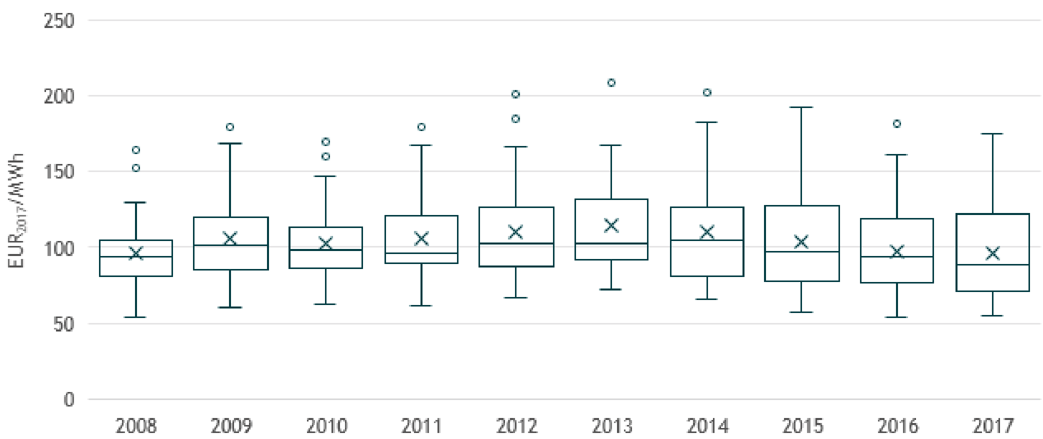

Figure 139 - Box plot of EU28 industrial retail electricity prices 2008-2017

Source: Trinomics et altri study

The figure below allows for identifying the MS which are close to the maximum and minimum range as well as those with significant and steady deviations from the average.

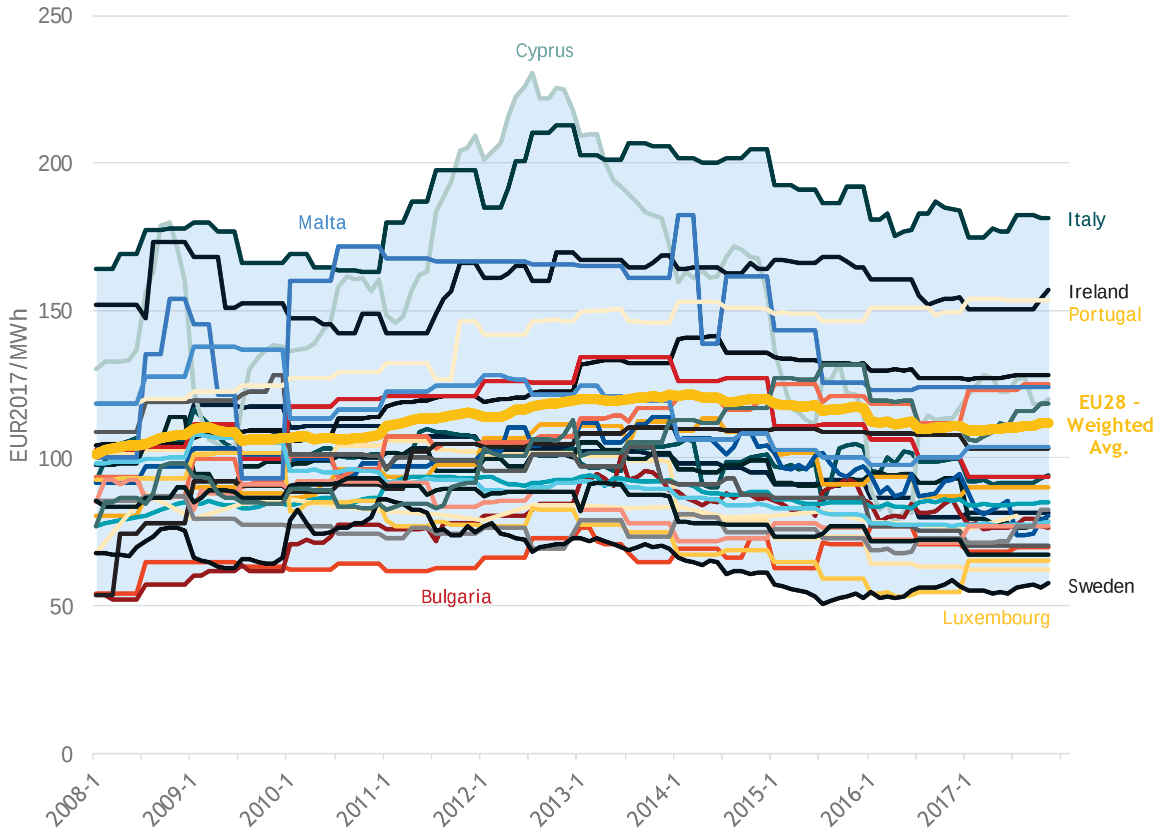

Figure 140 - EU28 industrial retail electricity prices 2008-2017, individual Member States lines visible, outliers named

Source Trinomics et altri study

6.5.4 Industrial gas prices: EU vs G20 countries

Retail gas prices for industry also have relatively complete datasets, the following figures present gas price data for the EU28 and G20 countries from 2007-2018. Prices are excluding VAT and all recoverable taxes and levies. From the analysis of the data one can conclude that:

— EU prices were in the range of 25-40 EUR/MWh but since 2016 they have declined to a level below 25 EUR/MWh (marking a fall of around 20-25% over the 2008-2017).

— Industry gas prices in the **US** (and **Canada**) are considerably lower than the EU average, having been around the same in 2008 (around 30 EUR/MWh), they have declined considerably more to reach around 10 EUR/MWh in 2016. Prices in **China** have stayed around 40 EUR/MWh throughout the period. Prices in **Japan** prices increased between 2009 and 2014 (diverging from the EU average) but since (2015-16) decreased to get close to EU prices. – See **Figure 141**

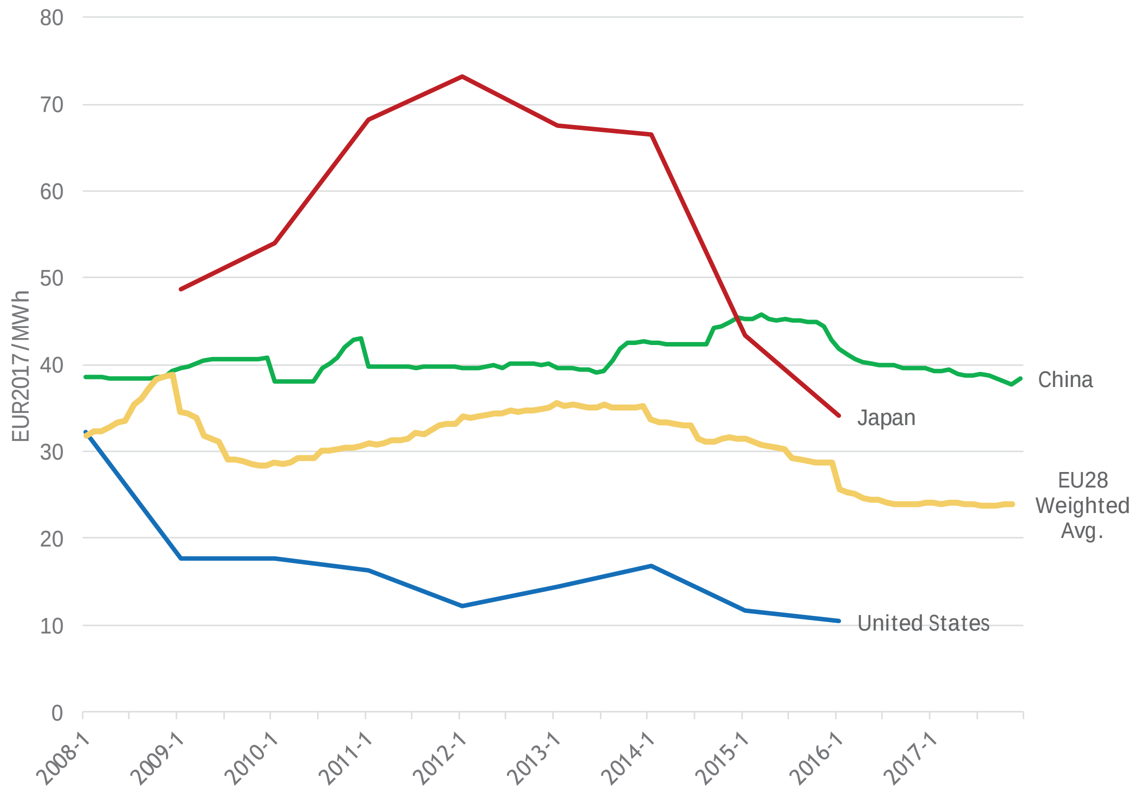

Figure 141 - Retail gas prices for industry: EU vs China, Japan and the US, 2008-2018

Sources: Eurostat, CEIC

— Prices in **Turkey** display similar, but slightly lower, levels and trends to the EU average. Prices in **South Korea** more closely mirror the price trends in Japan, diverging between 2009-2014, then converging between 2015-16. Prices in **Brazil** and **Russia** are around half the EU levels, comparable to prices in the US (and Canada). Prices in **Argentina** are the lowest of all, held artificially low by policy (they have started to increase since 2015). – See **Figure 142**

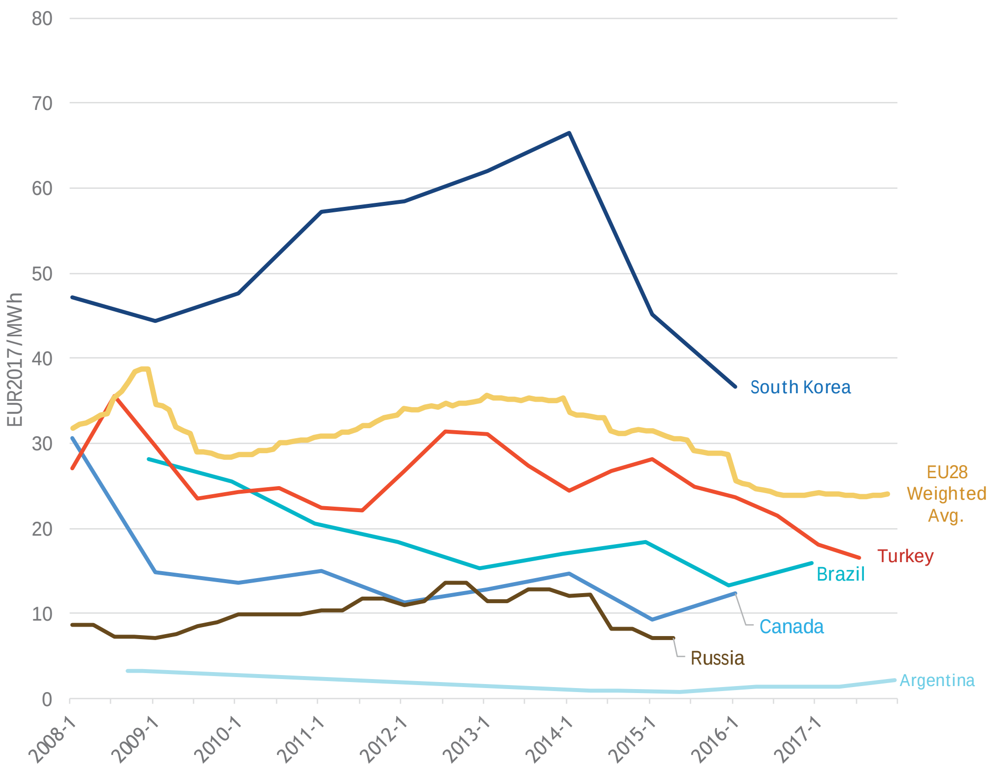

Figure 142 - Retail gas prices for industry: EU vs other non-EU G20 countries, 2008-2018

Sources: Eurostat, CEIC, ERRA, IEA

NB. Information for Australia and Mexico comes only from price indices (no absolute prices). It shows that whilst EU average prices have declined by around 20-25% since 2008, in contrast prices in national currency in Mexico have remained around the same in real terms, whilst prices in Australia have increased by around 50% in real terms (4.6% annual average increases) - See **Figure 143**

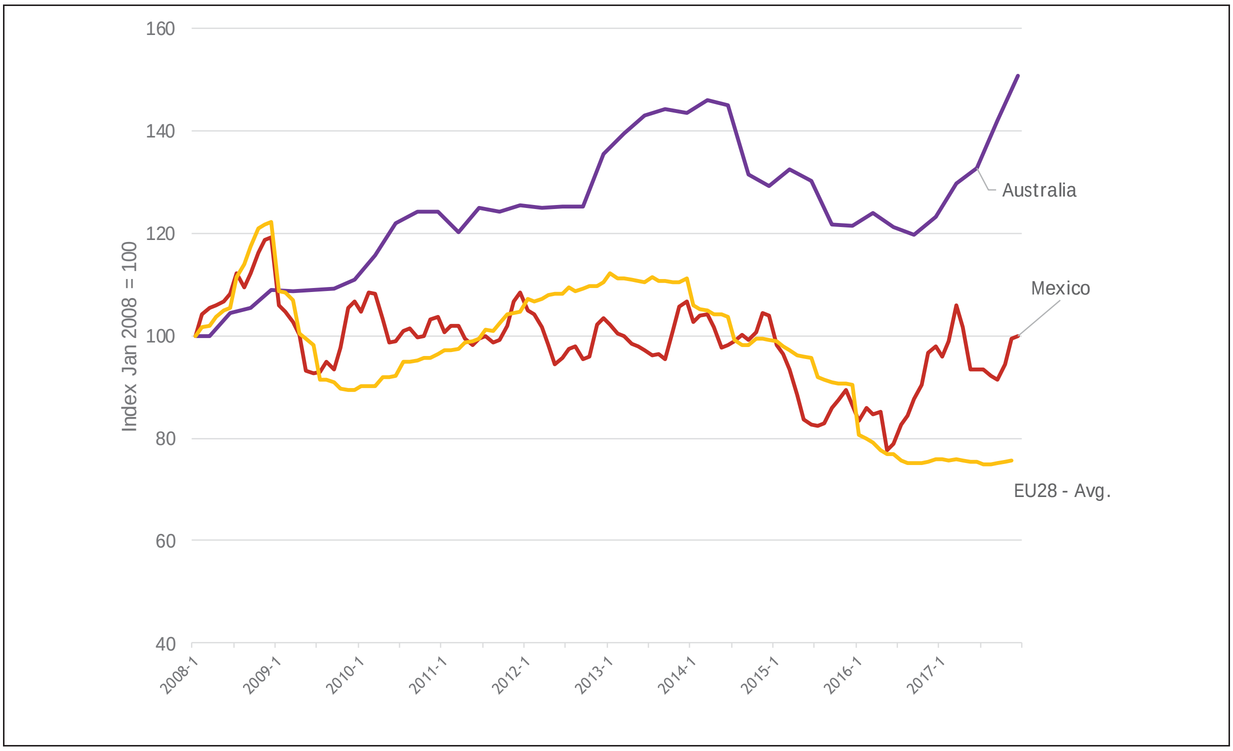

Figure 143 - Retail gas indexes prices for industry: EU vs AU and MX, 2008-2018

Source: Trinomics et altri study

— Price differential (in 2017 euros) did not evolve favourably for the EU with regard to half of the countries (particularly the US and Canada) in which prices fell more than the EU average. The price gap with Russia evolved positively for the EU as Russian prices increased slightly. The price gap with China, Mexico and Australia have also evolved favourably for the EU as prices in these countries at the end of period have were roughly comparable to those in 2008 or increased. (see **Table 16**)

Table 16 - Changes in the industry retail natural gas price differential compared to EU prices, constant 2017 euros per MWh

Country	Start price [EUR2017]	End price [EUR2017]	Change EUR	Change %	Start Gap [EUR]	End Gap [EUR]	Difference [EUR]	Impact for EU
EU28	31.74	23.97	-7.77	-24.5%				
Argentina	3.16	2.17	-0.99	-31.3%	-28.58	-21.80	6.78	Positive
Australia								
Brazil	28.17	15.93	-12.24	-43.5%	-3.57	-8.04	-4.47	Negative
Canada	30.55	12.38	-18.18	-59.5%	-1.19	-11.60	-10.41	Negative
China	38.51	38.47	-0.04	-0.1%	6.77	14.50	7.73	Positive
India								
Indonesia								
Japan	48.67	34.09	-14.59	-30.0%	16.93	10.12	-6.82	Negative
Mexico	37.57	37.57	0.00	0.0%	5.82	13.59	7.77	Positive
Russia	8.58	7.12	-1.46	-17.0%	-23.16	-16.85	6.31	Positive
Saudi Arabia								
South Africa								
South Korea	47.14	36.72	-10.42	-22.1%	15.40	12.74	-2.65	Negative
Turkey	27.08	16.60	-10.48	-38.7%	-4.66	-7.37	-2.71	Negative
USA	32.21	10.41	-21.80	-67.7%	0.47	-13.56	-14.03	Negative

Source: Trinomics et altri study

Note: a positive impact for the EU is recorded if the price gap has improved over time, e.g. that if a country had lower prices initially the gap is now smaller or prices are higher than the EU average, or if a country had higher prices and that the gap has increased. A negative impact is recorded if a country had lower prices than the EU, and that the gap has now increased, or if the country had higher prices than the EU but this gap has narrowed or the country now has lower prices.

— The analysis of the factors driving price differential (see **Table 17**) shows that EU nominal prices in Euros decreased by 18% over the period 2008 to 2017 (-2% per year). Of the other G20 countries, nominal prices in national currency only decreased in the US and Canada, increasing in all others and by particularly high amounts in Argentina, Russia and Turkey. When taking exchange and inflation effects into account we find that in real terms in national prices that the EU decrease was around 26% (-3.3% per year), but that real decreases were experienced not only in the US and Canada, but also in Argentina, Brazil, Japan, Russia and Turkey. This difference being explained in Argentina, Russia and Turkey by high inflation and exchange rate effects. In Brazil high inflation was the most important explanatory factor, whilst in Japan the changes were only small.

— In terms of the differentials in real national price changes the EU experienced negative differentials with Argentina, Brazil, Canada, Russia, Turkey and the US; and positive differentials with China, Japan, Mexico and South Korea. In the 3 Asian countries it is likely driven by differences in supply, with these being much more reliant on LNG shipments, with this reflected in wholesale prices. This highlights the fact that whilst EU prices have declined in both nominal and real terms over this period that, outside Asia and Mexico, prices in the rest of the G20 have decreased even further.

Table 17 - Factors in observed industrial retail natural gas price changes per country, nominal prices, per MWh

Country	Start date	End date	Nominal Start price EUR	Change due to inflation [EUR]	Change due to price change in national currency [EUR]	Exchange rate effect [EUR]	Total change [EUR]	Nominal End price EUR	Change due to inflation [%]	Change due to real price change in national currency [%]	Exchange rate effect [%]	Total change [%]
EU28	2008-1	2017-11	**29.07**	2.57	-7.67	0.00	**-5.10**	**23.97**	8.8%	-26.4%	0.0%	**-17.5%**
Argentina	2008-9	2017-12	**1.49**	3.76	4.01	-7.41	**0.36**	**1.85**	252.2%	269.0%	-497.0%	**24.1%**
Australia	No data											
Brazil	2008-12	2016-12	**15.75**	10.02	-9.35	-1.46	**-0.79**	**14.97**	63.6%	-59.4%	-9.3%	**-5.0%**
Canada	2008-1	2016-1	**20.58**	1.72	-9.09	-0.50	**-7.87**	**12.71**	8.4%	-44.2%	-2.4%	**-38.2%**
China	2008-1	2017-12	**22.04**	5.06	0.43	10.05	**15.54**	**37.58**	23.0%	2.0%	45.6%	**70.5%**
India	No data											
Indonesia	No data											
Japan	2009-1	2016-1	**36.72**	-0.23	1.01	-2.51	**-1.73**	**35.00**	-0.6%	2.8%	-6.8%	**-4.7%**
Mexico	2008-1	2008-1	**25.30**	0.00	0.00	0.00	**0.00**	**25.30**	0.0%	0.0%	0.0%	**0.0%**
Russia	2008-1	2015-4	**5.78**	4.04	1.63	-4.18	**1.49**	**7.27**	69.9%	28.2%	-72.3%	**25.8%**
Saudi Arabia	No data											
South Africa	No data											
South Korea	2008-1	2016-1	**31.75**	4.76	-0.99	2.18	**5.95**	**37.70**	15.0%	-3.1%	6.9%	**18.7%**
Turkey	2008-1	2017-7	**24.80**	16.30	-1.79	-22.71	**-8.20**	**16.60**	65.7%	-7.2%	-91.6%	**-33.1%**
USA	2008-1	2016-1	**21.69**	2.57	-16.38	2.80	**-11.01**	**10.69**	11.8%	-75.5%	12.9%	**-50.8%**

Source: Trinomics et altri study (2018)

Note on the range and dispersion of retail gas prices for industry in the EU

The max-min range of gas prices in the EU Member States was roughly between 15-50 EUR/MWh. The dispersion in gas is thus much lower than for electricity with most of the countries being much closer to the average price.

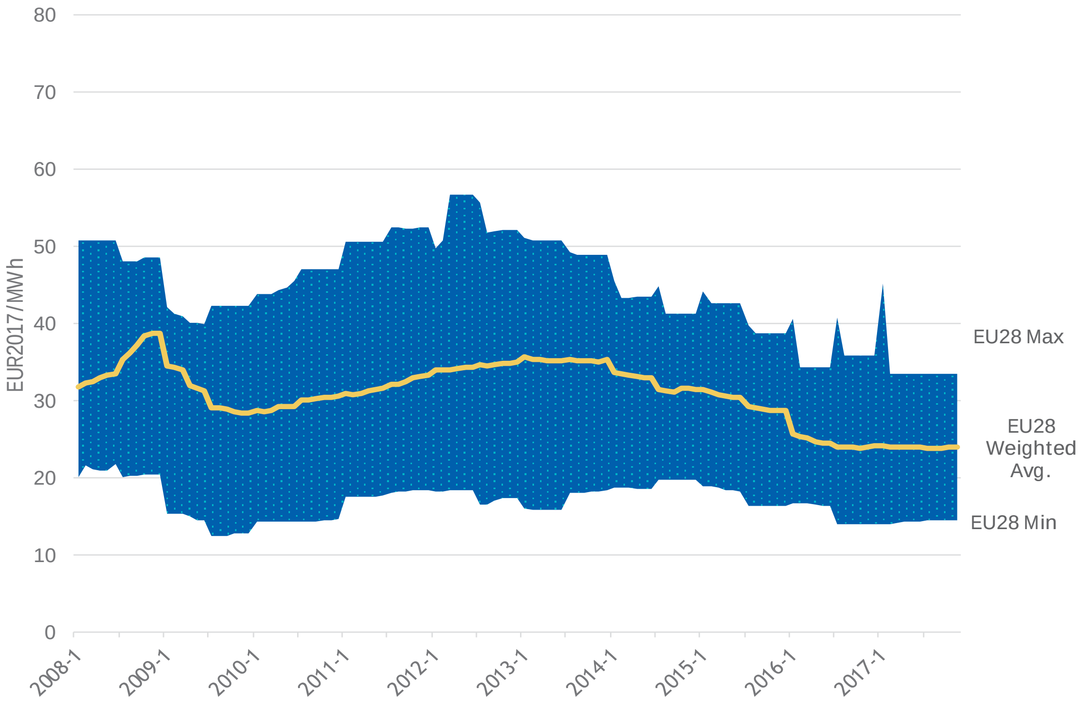

Figure 144 - Max-min range of retail gas prices for industry in the EU, 2008-2018

Sources: Eurostat

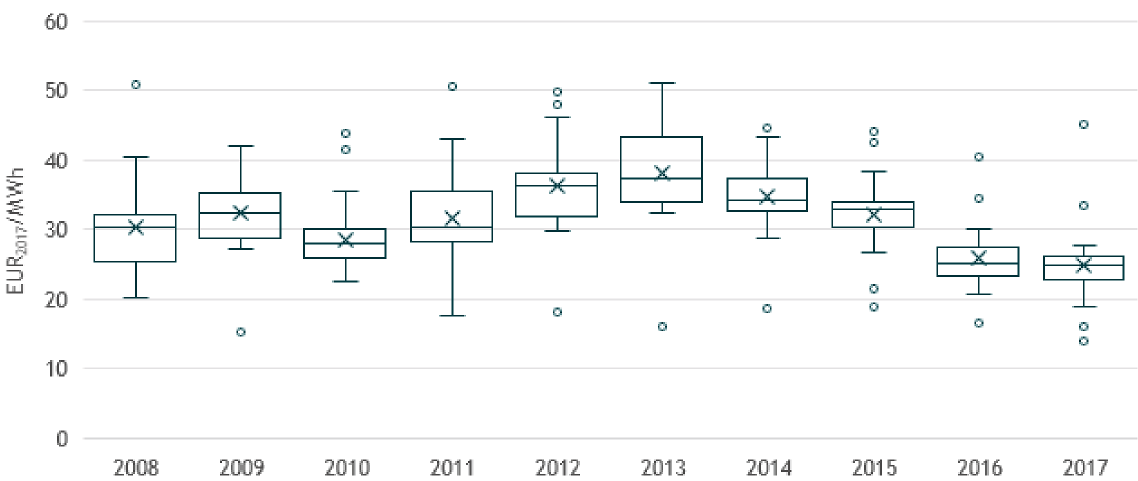

Figure 145 - Box plot of industrial gas prices, 2008-2017

Source: Trinomics et altri study

Note: the square represents the range of the prices for the 25% of countries above and below the average (50% of the sample)

The figure below allows for identifying the MS which are close to the maximum and minimum range as well as those with significant and steady deviations from the average.

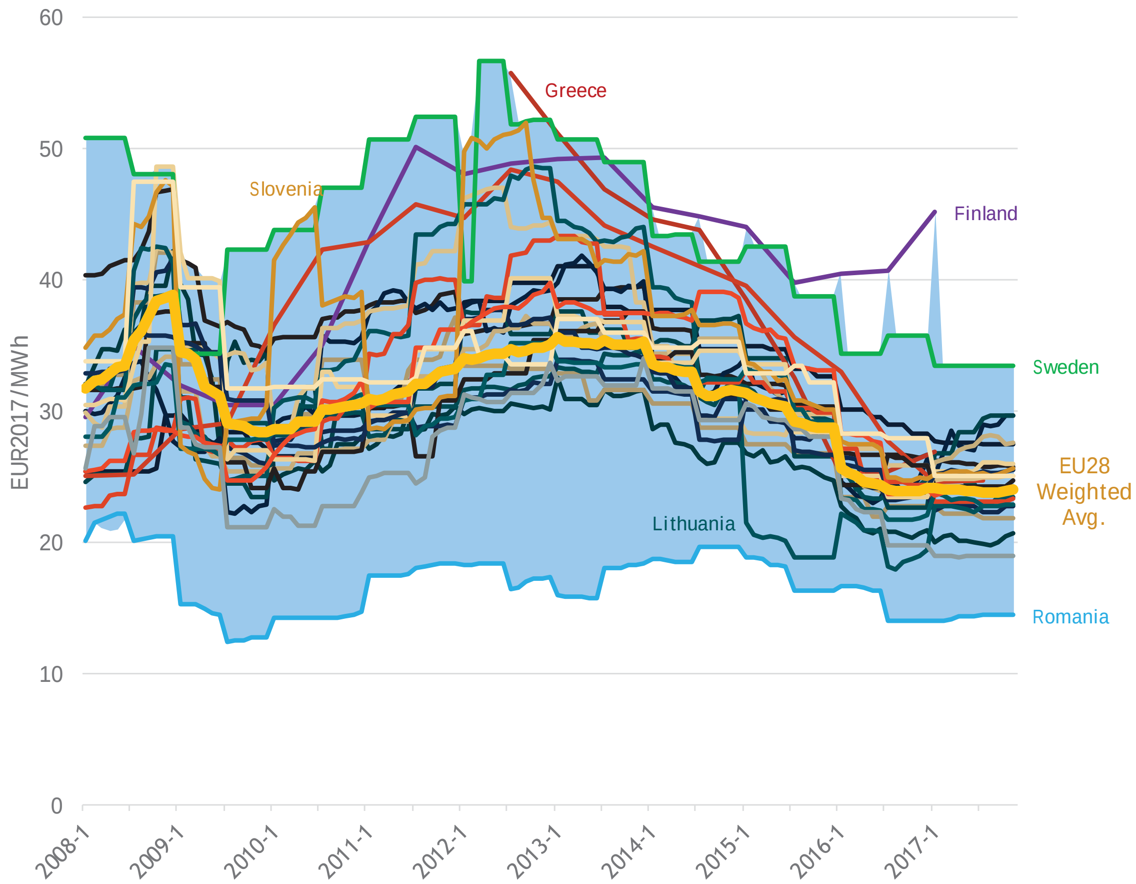

Figure 146 - EU28 industrial retail natural gas prices 2008-2017, individual Member States lines visible, outliers named

Source: Trinomics et altri study

Note on the estimation of the price effect on the EU international competitiveness

The previous sections of this chapter show that energy prices in the EU were in many cases higher than in trading partners over the period of study. This could have had some negative impact on the cost competitiveness of the EU industry. It is interesting to complement the analysis in this chapter by an assessment of the impact of price differences on the competitiveness of some EU energy intensive sectors (at NACE 2 level) over the period 2008-2016.

This is done in the *Trinomics et altri* study through an ex-post analysis where a counterfactual scenario is developed in which gas and electricity prices in the EU are aligned with the lower prices faced by the EU's main trading partners. This counterfactual scenario is then compared to historical data to assess the impact on the competitiveness of some EU sectors, i.e. how much lower the energy costs and prices of these sectors would have been if they had paid the lower energy prices available in the EU trading partners.

To assess the hypothetical scenario the E3ME (a comprehensive macro-econometric model) was used[89]. The energy prices (excluding VAT) were taken from Eurostat and IEA. For the counterfactual scenario, the weighted average energy prices (by total trade) from the 15 top EU-trading countries over the period 2008-2016[90] was calculated.

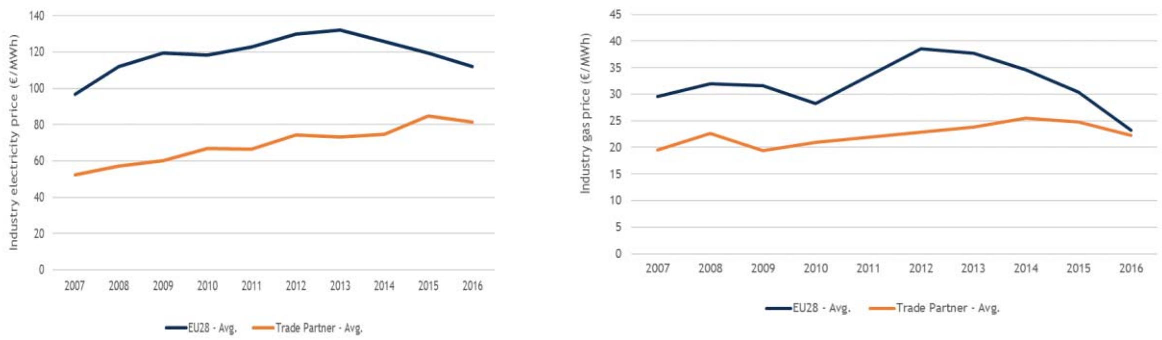

Figure 147 - Average industry electricity (left) and gas (right) prices in the EU and among the top 15 EU trade partners (current prices)

Source: Trinomics et altri study

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[89] As a macro-econometric model, E3ME uses an extensive historical database[89] and is well placed to carry out ex-post economic analysis. E3ME is built around an input-output structure with a detailed representation of industry interdependencies. The input-output framework in E3ME shows, for each industry sector in each EU Member State, the cost of energy relative to total production costs. The input-output framework thus reflects industry-specific exposure to competitiveness risks from international variation in energy costs. The E3ME model also includes a series of price equations (estimated for each sector and country) which reflect different cost pass-through rates among sectors and reflect how energy costs ultimately affect prices of the goods and services produced. Import and export prices and bilateral trade equations are also estimated in each sector and country. Detailed information about E3ME is available in the Trinomics et altri study.

[90] A trade-weighted average electricity price is used for the counterfactual scenario. Trade weights applied are as follows: USA (24%); China (22%); Switzerland (10%); Russia (8%); Turkey (6%); Norway (5%); Japan (5%); South Korea (4%); India (3%); Brazil (3%); Canada (3%); Saudi Arabia (2%); Mexico (2%); Singapore (2%); United Arab Emirates (2%).

The figures below show how industry unit costs would have evolved in the EU sectors analysed over 2008-2016 (had industry gas and electricity prices matched the lower prices faced by the EU's main trading partners).In most sectors, unit costs[91] would have been around 0.5-1.0% lower but much lower (2.0-2.5%) in the most energy intensive industries like Basic metals or non-metallic minerals lower (See Figure). Prices of goods manufactured would have been between 0.2% and 0.8% lower over.

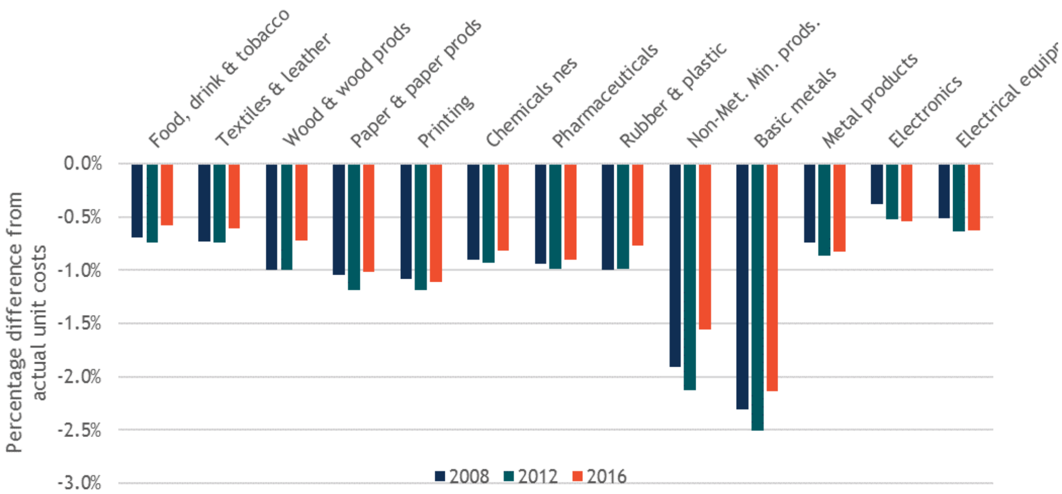

Figure 148 - Impact on EU industry unit costs in a counterfactual scenario where EU energy prices over 2007-2016 are comparable to energy prices faced by the EU's main trading partners

Source: Trinomics et altri study

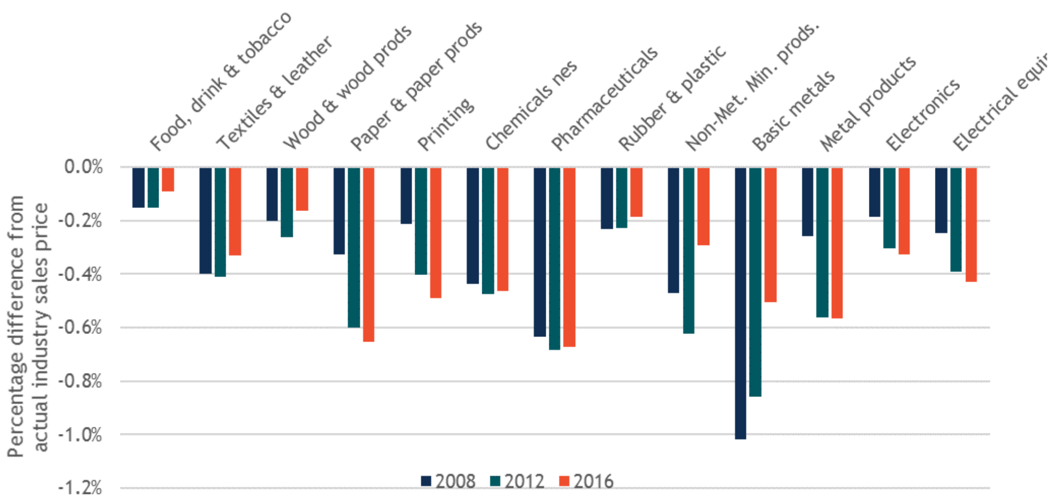

Figure 149 - Impact on EU industry prices in a counterfactual scenario where EU energy prices over 2007-2016 are comparable to energy prices faced by the EU's main trading partners

Source: Trinomics et altri study

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[91] I.e. the sum of material costs, energy costs and labour costs

6.6 Case studies of selected Energy Intensive Industries

Previous sections and chapters have analysed energy prices and costs for industry from highly aggregated statistical information (top-down approach). In this section, we look at energy prices and costs[92] in some selected energy intensive industries at a more disaggregated level and the role they can play in their competitiveness, based on primary data collected from individual companies (bottom-up approach). This bottom-up approach aims at completing the analysis by addressing the specificities of (sub-)sectors where energy costs are most relevant and may significantly affect their competitiveness and which effect may not be fully captured at aggregated level.

The results presented here are based on the study carried out for the European Commission by CEPS and Ecofys[93]. Primary data, including energy bills, were collected at plant level via a dedicated questionnaire.

6.6.1 Scope and samples

The bottom-up analysis covers the entire EU over a 10-year period going from 2008 to 2017. It focusses on the following sectors: bricks and roof tiles, wall and floor tiles, glass tableware, packaging glass, primary aluminium, secondary aluminium, downstream aluminium industry, electric arc furnace steelmaking (referred to as EAF steel), blast furnace-basic oxygen furnace steelmaking (referred to as BOF steel), nitrogen fertilisers and refineries.

The selection of these sectors ensures wide coverage of key features of EU energy intensive industries. The sectors covered include in particular:

- Natural gas-intensive sectors (e.g. bricks and roof tiles, packaging glass) and electricity-intensive sectors (e.g. primary aluminium, EAF steel);
- Sectors purchasing additional energy carriers, including coking coal (e.g. BOF steel) and crude oil (e.g. refineries);
- Sectors concentrated in a limited number of Member States (e.g. wall and floor tiles, primary aluminium) and sectors geographically dispersed in Europe (e.g. packaging glass, secondary and downstream aluminium);
- Sectors dominated by large companies (e.g. primary aluminium, glass tableware) and sectors including many SMEs (e.g. bricks and roof tiles, wall and floor tiles);
- Net importer sectors (e.g. primary, secondary and downstream aluminium, EAF and BOF steel), net exporter sectors (e.g. wall and floor tiles, glass tableware) and sectors that are relatively less exposed to international competition (e.g. bricks and tiles, packaging glass).

For each sector, data were collected on a sample of ‘typical’ plants across the EU, which reflect the average features of EU plants operating in that sector[94]. Table 18 shows the sample

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[92] All energy prices and costs in this section are in nominal terms (no price deflator is applied). Both prices and costs are expressed in unit terms. Energy prices are computed as total price paid to purchase energy (net of recoverable taxes, such as VAT, and of any ex ante exemption, such as RES levy exemption) divided by total amount of energy purchased. Unlike prices, energy costs take also account for reimbursements (ex post exemption), payments for flexibility schemes and self-generation of energy.

[93] CEPS and Ecofys (2018). Study on composition and drivers of energy prices and costs: case studies in selected energy intensive industries – 2018.

composition for each sector[95] as well as its representativeness at EU level (share of the sample in the EU turnover or production capacity). The full sample includes 194 plants from 11 sectors spread over three aggregated EU regions[96]. EU representativeness of the samples for 2016 observations ranges from 11% for wall and floor tiles to above 90% in the case of glass tableware.

Table 18 - Size and EU representativeness of the samples in the bottom-up analysis

	Number of plants by geographical region[(1)]				**Representativeness in 2016**[(2)]
Sector	**Central-Eastern Europe**	**North-Western Europe**	**Southern Europe**	**Total**	**Share of turnover (T) or production capacity (C)**
Bricks and roof tiles	11	36	11	**58**	11% (T)
Wall and floor tiles	8	4	10	**22**	12% (T)
Glass tableware	2	4	6	**12**	92% (T)
Packaging glass	8	8	8	**24**	17% (T)
Aluminium primary	1	5	4	**10**	60% (T)
Aluminium secondary	2	1	6	**9**	n.a.[(3)]
Aluminium downstream	1	4	3	**8**	13% (T)
Steel EAF	3	13	2	**18**	14% (C)
Steel BOF	3	4	0	**7**	26% (C)
Nitrogen fertilisers	4	1	3	**8**	17% (C)
Refineries	1	8	4	**13**	19% (C)
TOTAL	**44**	**88**	**57**	**189**	**-**

Source: CEPS/Ecofys

(1) **Central-Eastern Europe:** Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia; **North-Western Europe:** Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden, the UK; **Southern Europe:** Cyprus, Greece, Italy, Malta, Portugal, Spain.
(2) Estimates of the representativeness vary from year to year due to turnover/production capacity variation both in the sample and the sector as well as potential missing observations in the sample for a given year. For illustrative purpose, figures are shown for 2016 (figures with similar orders of magnitude can be observed for the other years).
(3) Due to data unavailability at this level of sectoral disaggregation the representativeness could not be computed.

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94 The construction of a 'statistically representative' plant sample per sector was not feasible due to the constraints of the study. Instead, a sample of typical plants with a broad geographical coverage and which represents at least 10% of the sectoral turnover or production capacity was built for each sector. Result findings were further cross-checked through stakeholder consultation and secondary data validation.
95 For a given indicator, due to some inconsistent or missing data, the actual sample size may be lower than the numbers indicated in Table 18 and, as such, will be mentioned in the relevant tables/figures.
96 Sectorial results had to be aggregated at a regional level to respect confidentiality. See Table 18 for the details of the EU aggregated regions.

6.6.2 Cross-Sectorial comparisons

Electricity prices and costs

We can observe across sectors a straightforward relationship between increased electricity consumption levels and decreased average prices (**Figure 150**). At the lower range of electricity consumption (2016 figures), we can find the bricks and tiles industry, with a median electricity consumption of around 6 GWh/year per plant, which pays on average 84 EUR/MWh, while in the upper range the primary aluminium industry, with a median consumption of around 2.3 TWh/year per plant (almost 400 times higher than for bricks and tiles), pays 39 EUR/MWh on average. The sector which pays the highest electricity prices is wall and floor tiles with a price of 99 EUR/MWh on average, which is around 150% more expensive than the price paid by primary aluminium.

The average electricity prices are associated in most sectors with high price spreads (the most extreme case being refineries), which reflect the high variability of conditions in different Member States.

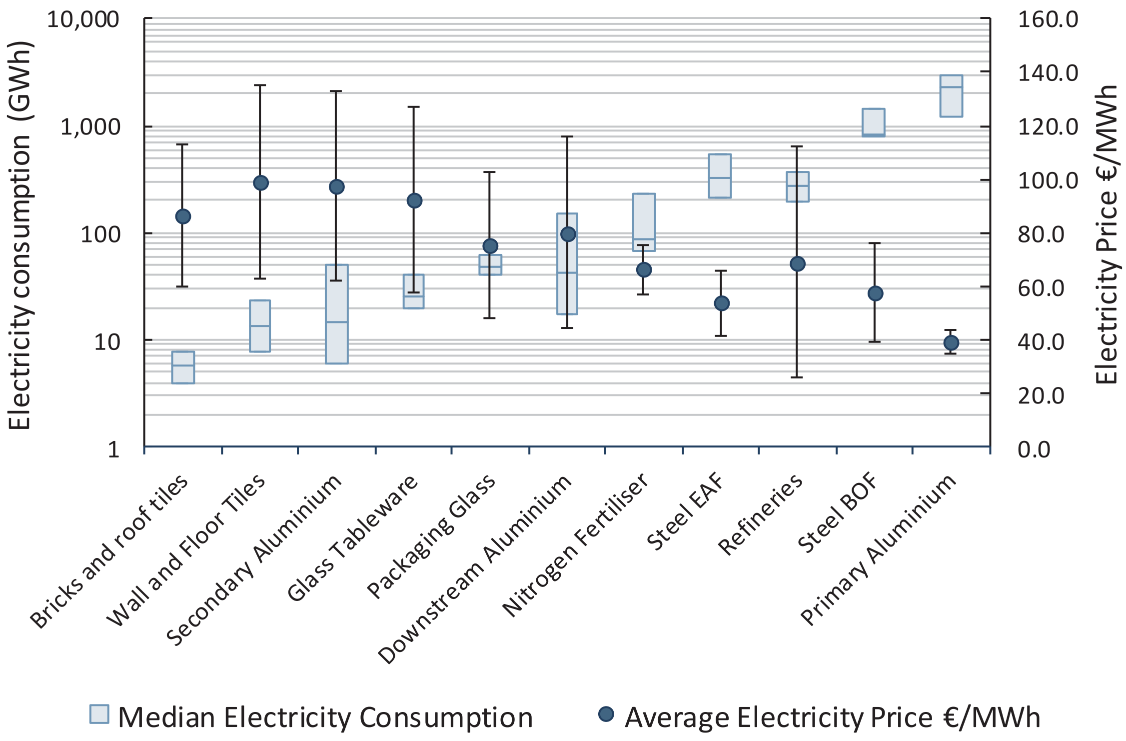


Figure 150 - Plant electricity consumption and average electricity prices by sector, 2016 (185 observations)

Source: CEPS/Ecofys.

Figure 151 presents the average electricity prices of plants grouped by 4 electricity consumption bands, irrespective of the sector:

- 1-10 GWh (35% of sampled plants), mostly equivalent to electricity band IC or ID;
- 10-100 GWh (37% of sampled plants), mostly equivalent to electricity band ID or IE;
- 100-1,000 GWh (21% of sampled plants), mostly equivalent to electricity band IF or IG;
- 1,000-10,000 GWh (7% of sampled plants), equivalent to electricity band IG.

The negative correlation between consumption and average prices of electricity appears quite robust over the period (lower bands pay a higher price and upper bands pay a lower price). In general, electricity prices peaked in 2011 for the two upper bands (100-10,000 GWh) and in 2012 for the two lower bands (1-100 GWh) and have been decreasing since then in all four consumption bands.

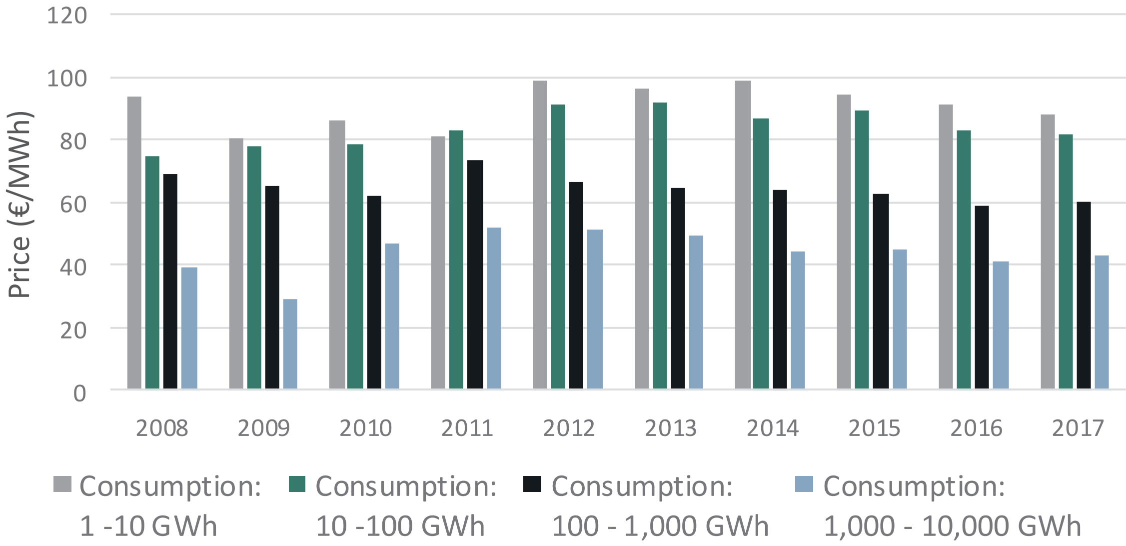


Figure 151 - Average electricity prices by consumption level, 2008 – 2017 (2008: 120 observations; 2009: 73; 2010: 141; 2011: 86; 2012: 154; 2013: 161; 2014: 161; 2015: 158; 2016: 185; 2017: 182)

Source: CEPS/Ecofys.

The trend of lower prices for industries that have plants with high electricity needs can be explained by various reasons:

i. Some larger consumers may negotiate more favourable supply price conditions through the wholesale market or through striking better deals with providers in exchange for the amount of power they purchase and their load consumption profile.
ii. Larger consumers from energy-intensive sectors may be granted exemptions from certain taxes and levies, or be provided with lower prices in Member States with regulated prices.
iii. Some industries, in particular the primary aluminium industry, run a flat profile process from day to night, hence benefit from lower electricity prices (base load prices).

With accounting for reimbursements[97], payments for flexibility schemes and revenues from self-generated electricity sold to the grid, **Figure 152** shows electricity costs vs. electricity consumption at plant level by sector. We observe for costs the same trends as before for prices, but since some plants either receive reimbursements, payments and/or self-produce electricity, electricity costs are generally lower than electricity prices. The difference between

[97] By nature, reimbursements are received with a delay (often the following year or even after). As it was not possible to trace them back with the associated consumption, they were accounted for in the year they are actually received. In general, reimbursements deducted in the costs are due to previous years' tax payments.

prices and costs varies both across sectors and years (full details can be found in the CEPS and Ecofys study). Across sectors, the difference tends to be larger in 2016 and 2017 in comparison with previous years, but it remains moderate in any case. For instance in 2016, costs were between 0% (downstream aluminium) and 11% (wall and floor tiles) lower than prices (**Figure 152** compared to **Figure 150**).

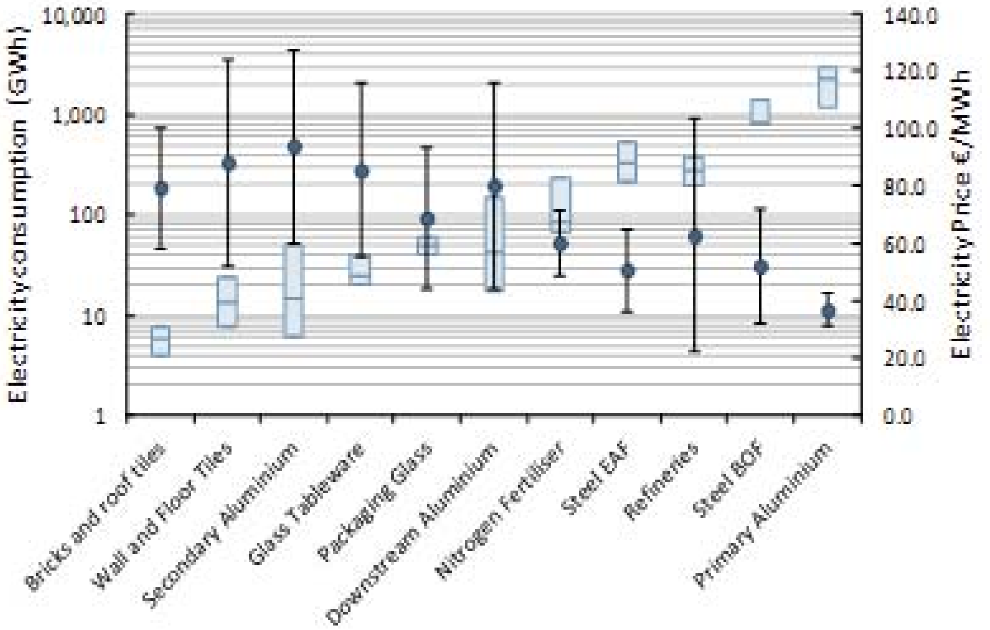


Figure 152 - Plant electricity consumption and average electricity costs by sector, 2016 (185 observations)

Source: CEPS/Ecofys.

Natural gas prices and costs

A correlation between natural gas consumption and the natural gas price paid by plants can be seen, but is much less significant when compared with the analysis on electricity prices (**Figure 153**). In 2016, nitrogen fertiliser plants (the most natural gas intensive plants in the analysis) had a median natural gas consumption of 4,5 TWh and paid for it 19 EUR/MWh on average, while plants from the bricks and roof tiles industry (the least natural gas intensive plants in the analysis) had a median natural gas consumption of 51 GWh (almost 100 times less than nitrogen fertilisers) and paid for it 25 EUR/MWh on average. The sector which pays the lowest natural gas prices is BOF steel with a price of 17 EUR/MWh on average. The maximum natural gas price differential (the highest natural gas price paid compared to the lowest in relative terms) observed in the sampled energy intensive industries is around +46%, which is still significant, but the price range is much lower than in the case of electricity (maximum price differential: +152%).

The lower variation in natural gas prices both within (price spreads) and across sectors compared to electricity prices can be explained by the fact that:

i. The proportion of taxes, levies and network costs is relatively small in the total natural gas price. Consequently, there is less opportunity for governments to adapt prices through discounts and exemptions.
ii. Natural gas costs heavily depend on international prices set by natural gas producing countries. Since EU Member States are mostly net importers of natural gas, there is little room for price negotiation. By contrast, electricity prices depend on the generation mix within that Member State and the surrounding Member States, so are more country and region specific.

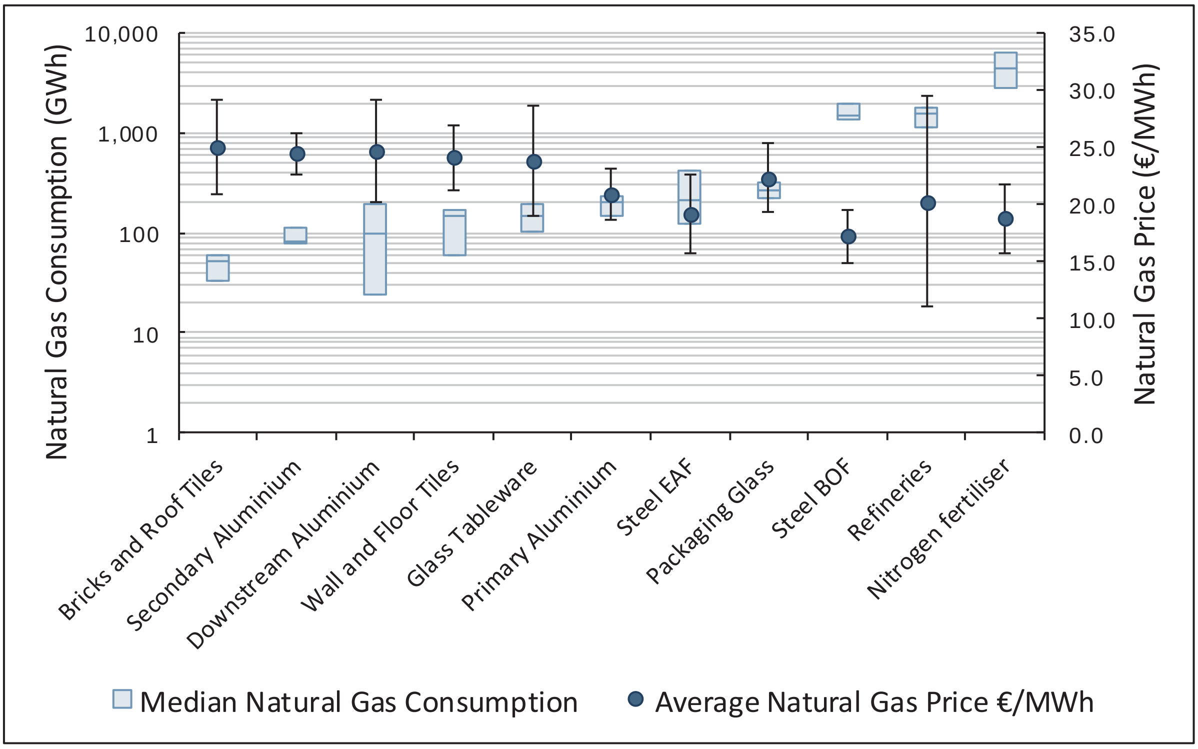


Figure 153 - Plant natural gas consumption and average natural gas prices by sector, 2016 (165 observations)

Source: CEPS/Ecofys.

As in the case of electricity, plants can be grouped, regardless of the sector, by natural gas consumption bands. **Figure 154** shows the average natural gas prices for 3 natural gas consumption bands:

- 10-100 GWh (42% of sampled plants), mostly equivalent to natural gas band I3 or I4;
- 100-1,000 GWh (44% of sampled plants), mostly equivalent to natural gas band I4 or I5;
- 1,000-10,000 GWh (11% of sampled plants), mostly equivalent to natural gas band I6.

The impact of natural gas consumption levels on average natural gas prices (negative correlation) is robust over years but less pronounced than for electricity. In general, natural gas prices peaked in 2012 for the two upper bands (100-10,000 GWh) and in 2013 for the lowest band (10-100 GWh) and have been decreasing since then. However, we can note that natural gas prices increased again in 2017 for the highest band (1,000-10,000 GWh).

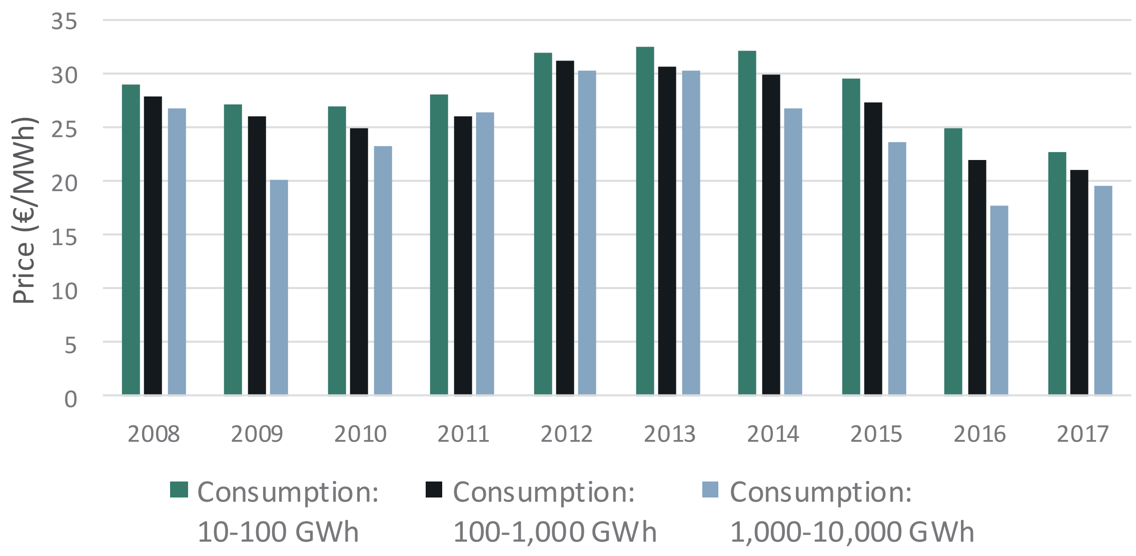


Figure 154 - Average natural gas prices by consumption level, 2008 – 2017 (2008: 110 observations; 2009: 74; 2010: 129; 2011: 81; 2012: 137; 2013: 145; 2014: 149; 2015: 147; 2016: 165; 2017: 163)

Source: CEPS/Ecofys.

Unlike electricity, in the case of natural gas, reimbursements, payments for flexibility schemes or revenues from self-generated natural gas do no play any significant role. As a result, natural gas costs are similar to natural gas prices and are then not shown here.

6.6.3 Prices across Member States

General remarks

Based on the data collected in the CEPS and Ecofys study, average energy prices (electricity and natural gas) faced by energy intensive sectors in some specific Member States can be calculated by pulling together all the sampled plants in a given Member State, regardless of the sectors. Due to confidentiality reasons, only Member States with reliable data available from at least three independent companies have been included in this part of the analysis[98].

It is important to keep in mind that the samples at Member State level are relatively small and have not been designed to be representative of those Member States[99]. For a given Member State, some energy intensive sectors may be over-represented while some others may be under-represented. In particular, a Member State with mostly large plants in the sample, associated with larger energy consumption, may tend to exhibit lower energy prices, but these prices might not be representative for all plants within that Member State. In the same way, a Member State with mostly small plants in the sample, associated with lower energy consumption, may show higher energy prices, but again these prices might not be representative for all plants within that Member State. Results should therefore be taken with caution and not interpreted as national average prices for energy intensive industries but rather as average prices faced by the energy intensive companies included in the samples.

[98] Note that any year with less than three independent observations are always omitted.

[99] We refer the reader to the CEPS and Ecofys study for the details of the samples by Member State.

Electricity prices

Figure 155, Figure 156 and **Figure 157** show the average electricity prices and its main components (energy, network, RES support/levies and other non-recoverable taxes/levies) for energy intensive sectors in Member States of the NWE region (France, Germany, the Netherlands and the UK), SE region (Portugal, Italy, Spain and Greece) and CEE region (Poland and Bulgaria), respectively.

In most Member States, average electricity prices for energy intensive sectors increased on the period 2008-2012 and have started to decline since 2012-2013. This can be seen in France, Germany, the Netherlands, Greece, Spain and Bulgaria. In some cases, the peak in electricity prices came later, for example in 2014 in Poland and in 2015 in the UK. However, average electricity prices have started to increase again in 2016 or 2017 in a number of these Member States (e.g. France, Germany, the Netherlands, Spain and Poland).

Plants in Germany, the UK, Italy and Bulgaria experience noticeably higher electricity prices compared to other Member States included in the analysis. This is generally the result of higher non-recoverable taxes and levies including RES levies and network costs.

The levels and relative shares of the different price components for energy intensive sectors vary significantly between Member States. The most pronounced differences are observed in the regulatory components, i.e. network costs, RES support/levies and other non-recoverable taxes/levies. These differences can be attributed to:

- The considerable variation of exemptions for electricity-intensive sectors, including the scope, rules (*ex ante* vs. *ex post* exemptions[100]) and magnitude, between Member States;
- The variation of visibility of price components in bills from one Member State to another (For example, RES levies are sometimes not visible in the bill, though existing, and may then be accounted for in another component by the respondents. This is particularly the case for the plants in the Netherlands, Portugal and Spain, which report very little or no RES levies but these costs have likely been included in network costs or in other non-recoverable taxes/levies);
- The different overall network costs and RES support payments within Member States, which depend on the way in which renewables and the network grid are funded, the extent of renewable deployment and the level of grid upgrades.

Natural gas prices

Figure 158, Figure 159 and **Figure 160** show the average natural gas prices and its main components (energy, network and non-recoverable taxes/levies) for energy intensive sectors in Member States of the NWE region (France, Germany, the Netherlands and the UK), SE region (Portugal, Italy and Spain) and CEE region (Poland and Bulgaria), respectively.

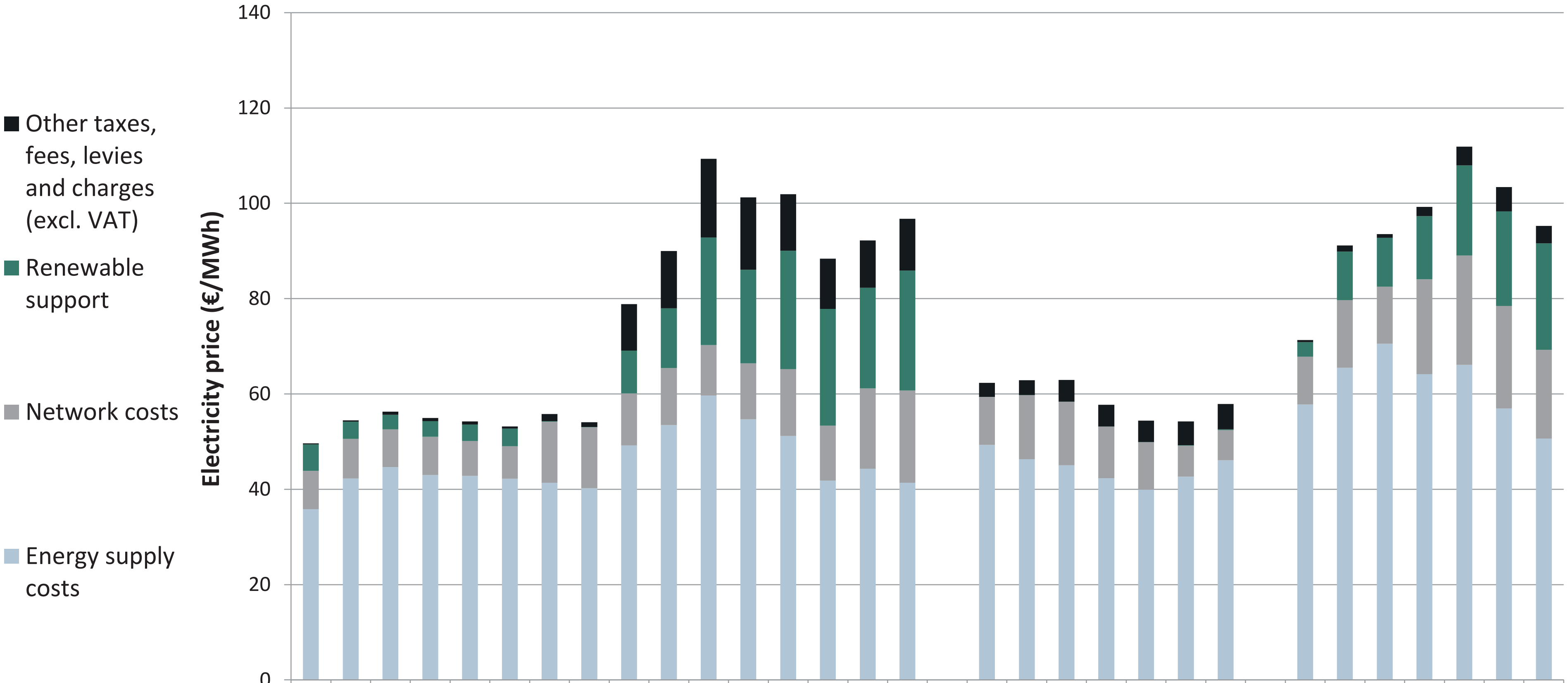
Average natural gas prices for energy intensive sectors showed a peak in 2012/13 and since then have been decreasing in all Member States, with much lower prices in more recent years. Between 2013 and 2017, natural gas prices declined by around 1/3 in all countries (except in Germany where the reduction is 20%).

[100] It should be remembered that prices, unlike costs, do not account for ex post exemptions (reimbursement).

Plants in the NWE region appear to benefit from lower natural gas prices compared to plants in the SE and CEE regions. This is mostly attributable to lower wholesale natural gas prices, but also to lower network costs.

Plants in Portugal, Bulgaria, Italy and Spain experience the highest natural gas prices. Although this is largely due to higher wholesale natural gas prices, these Member States (with the exception of Spain) also have higher network costs.

Overall, we observe less variation in natural gas prices across Member States compared to electricity prices. This is due to less leverage from governments to adapt natural gas prices through intervening with regards to taxes and levies (the proportion of non-recoverable taxes/levies is relatively small in the total natural gas price compared to electricity), as well as the fact that there are no differences in generation costs.



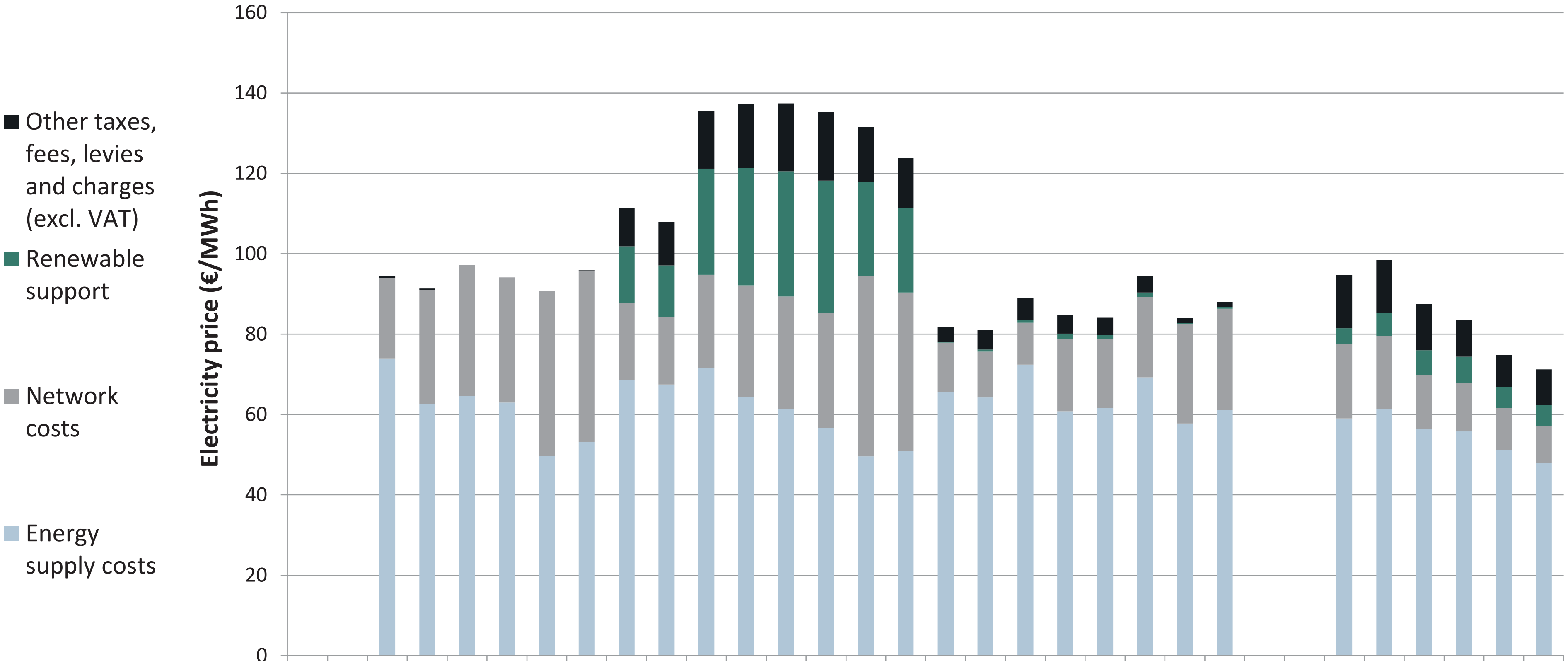
	France								Germany							
	2008	2010	2012	2013	2014	2015	2016	2017	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations	3	8	10	11	11	12	23	24	9	10	10	11	11	11	10	9
Other taxes, fees, levies and charges (excl. VAT)	0,2	0,3	0,7	0,6	0,7	0,5	1,5	1,0	9,8	12,1	16,5	15,2	11,9	10,5	9,9	10,9
Renewable support	5,6	3,6	3,0	3,2	3,4	3,7	0,1	0,1	9,0	12,5	22,6	19,6	24,9	24,5	21,1	25,1
Network costs	8,0	8,3	7,9	8,1	7,3	6,8	12,8	12,8	10,9	12,0	10,6	11,8	14,0	11,6	16,9	19,4
Energy supply costs	35,8	42,3	44,7	43,0	42,8	42,2	41,4	40,2	49,2	53,5	59,6	54,7	51,2	41,8	44,3	41,4

	Netherlands								UK							
	2008	2010	2012	2013	2014	2015	2016	2017	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations		6	6	6	6	6	6	6		5	5	7	8	8	8	10
Other taxes, fees, levies and charges (excl. VAT)		2,9	3,1	4,6	4,6	4,5	5,0	5,3		0,4	1,2	0,8	1,9	3,9	5,1	3,7
Renewable support		0,0	0,0	0,0	0,0	0,0	0,1	0,2		3,1	10,2	10,2	13,2	18,9	19,8	22,3
Network costs		10,1	13,5	13,4	10,8	9,9	6,5	6,3		10,0	14,2	12,0	19,9	22,9	21,5	18,6
Energy supply costs		49,3	46,3	45,0	42,3	39,9	42,6	46,1		57,8	65,5	70,5	64,1	66,1	56,9	50,6

Figure 155 - Structure of average electricity prices in the surveyed plants in the NWE region (France, Germany, the Netherlands and the UK) in absolute terms (€/MWh), 2008 – 2017

Source: CEPS/Ecofys.

Note: The data presented on the graph are the average prices faced by the surveyed plants but are not representative of national prices. Direct comparisons between two Member States should be avoided.



Portugal	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations			3	3	3	3	3	3
Other taxes, fees, levies and charges (excl. VAT)			0,7	0,4	0,0	0,0	0,0	0,0
Renewable support			0,0	0,0	0,0	0,0	0,0	0,0
Network costs			20,0	28,4	32,5	31,1	41,1	42,6
Energy supply costs			73,9	62,6	64,6	63,0	49,7	53,2

Italy	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations	10	14	14	14	14	14	18	18
Other taxes, fees, levies and charges (excl. VAT)	9,4	10,8	14,3	16,0	16,9	17,0	13,8	12,5
Renewable support	14,2	13,0	26,4	29,2	31,1	33,0	23,3	20,9
Network costs	19,1	16,7	23,2	27,8	28,1	28,5	44,9	39,5
Energy supply costs	68,6	67,5	71,6	64,3	61,2	56,7	49,6	50,9

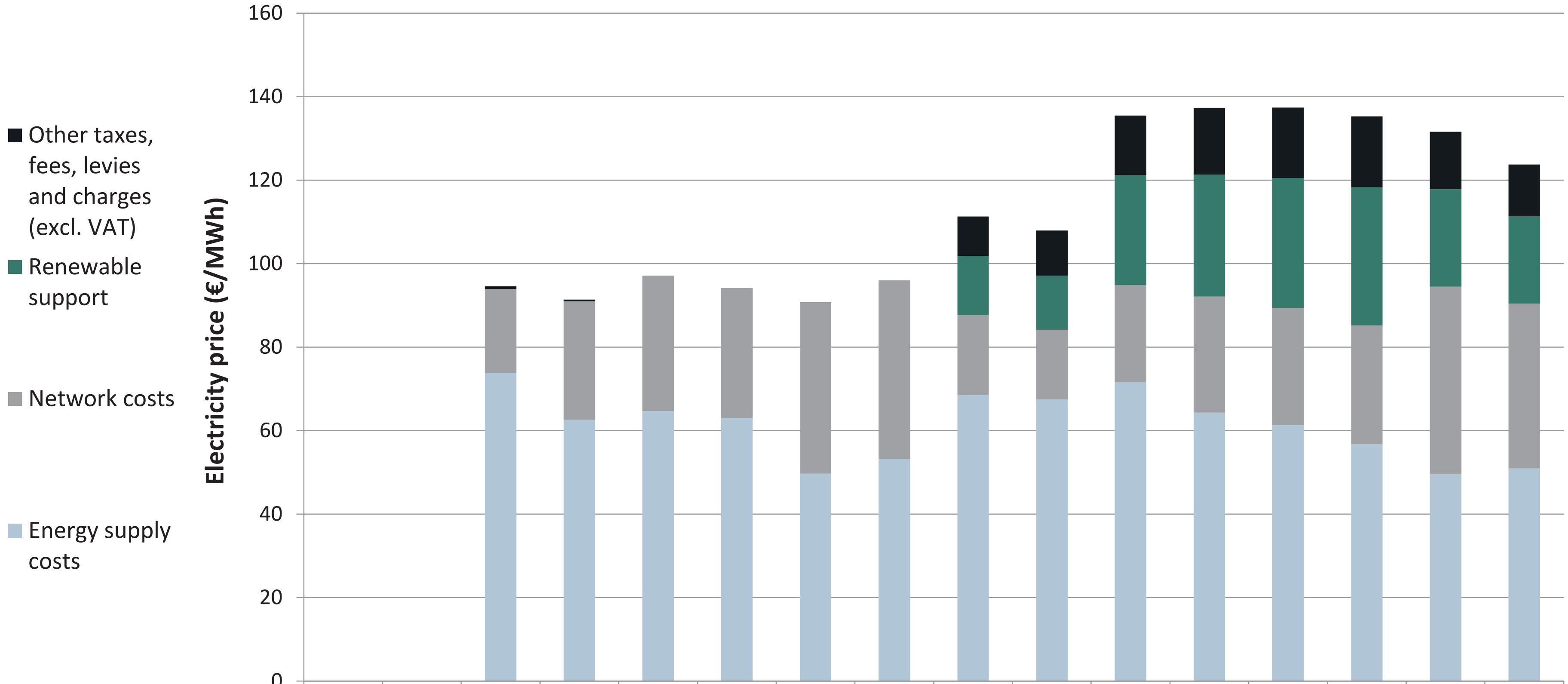
Spain	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations	6	8	10	11	10	10	16	16
Other taxes, fees, levies and charges (excl. VAT)	3,8	4,8	5,4	4,7	4,4	4,0	1,2	1,4
Renewable support	0,2	0,6	0,6	1,3	1,0	1,1	0,3	0,3
Network costs	12,4	11,4	10,4	18,1	17,1	20,0	24,7	25,2
Energy supply costs	65,5	64,2	72,5	60,8	61,6	69,3	57,8	61,1

Greece	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations			6	6	6	6	6	6
Other taxes, fees, levies and charges (excl. VAT)			13,3	13,2	11,5	9,2	7,9	8,9
Renewable support			4,0	5,7	6,2	6,5	5,3	5,2
Network costs			18,5	18,2	13,4	12,1	10,4	9,3
Energy supply costs			59,0	61,3	56,5	55,8	51,2	47,9

Figure 156 - Structure of average electricity prices in the surveyed plants in the SE region (Portugal, Italy, Spain and Greece) in absolute terms (€/MWh), 2008 – 2017

Source: CEPS/Ecofys.

Note: The data presented on the graph are the average prices faced by the surveyed plants but are not representative of national prices. Direct comparisons between two Member States should be avoided.

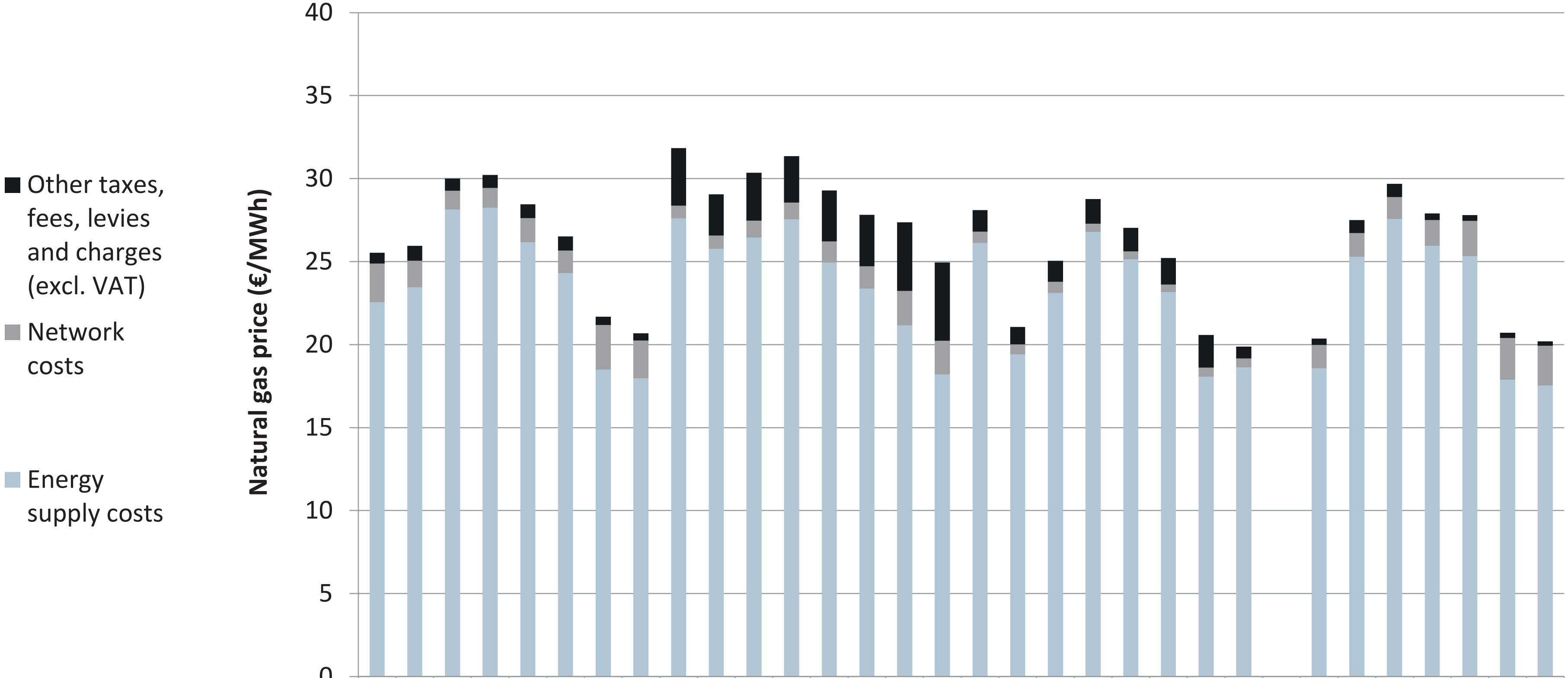


	Poland								Bulgaria							
	2008	2010	2012	2013	2014	2015	2016	2017	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations			8	8	8	5	10	8	3	4	4	3	3	3	4	4
Other taxes, fees, levies and charges (excl. VAT)			0,7	0,4	0,0	0,0	0,0	0,0	9,4	10,8	14,3	16,0	16,9	17,0	13,8	12,5
Renewable support			0,0	0,0	0,0	0,0	0,0	0,0	14,2	13,0	26,4	29,2	31,1	33,0	23,3	20,9
Network costs			20,0	28,4	32,5	31,1	41,1	42,6	19,1	16,7	23,2	27,8	28,1	28,5	44,9	39,5
Energy supply costs			73,9	62,6	64,6	63,0	49,7	53,2	68,6	67,5	71,6	64,3	61,2	56,7	49,6	50,9

Figure 157 - Structure of average electricity prices in the surveyed plants in the CEE region (Poland and Bulgaria) in absolute terms (€/MWh), 2008 – 2017

Source: CEPS/Ecofys.

Note: The data presented on the graph are the average prices faced by the surveyed plants but are not representative of national prices. Direct comparisons between two Member States should be avoided.



France	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations	3	7	9	9	10	10	23	24
Other taxes, fees, levies and charges (excl. VAT)	0,7	0,9	0,7	0,8	0,8	0,8	0,5	0,4
Network costs	2,3	1,6	1,1	1,2	1,5	1,4	2,7	2,3
Energy supply costs	23	23	28	28	26	24	18	18

Germany	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations	7	8	8	8	9	9	10	9
Other taxes, fees, levies and charges (excl. VAT)	3,5	2,5	2,9	2,8	3,1	3,1	4,1	4,7
Network costs	0,8	0,8	1,0	1,0	1,3	1,4	2,1	2,0
Energy supply costs	28	26	26	28	25	23	21	18

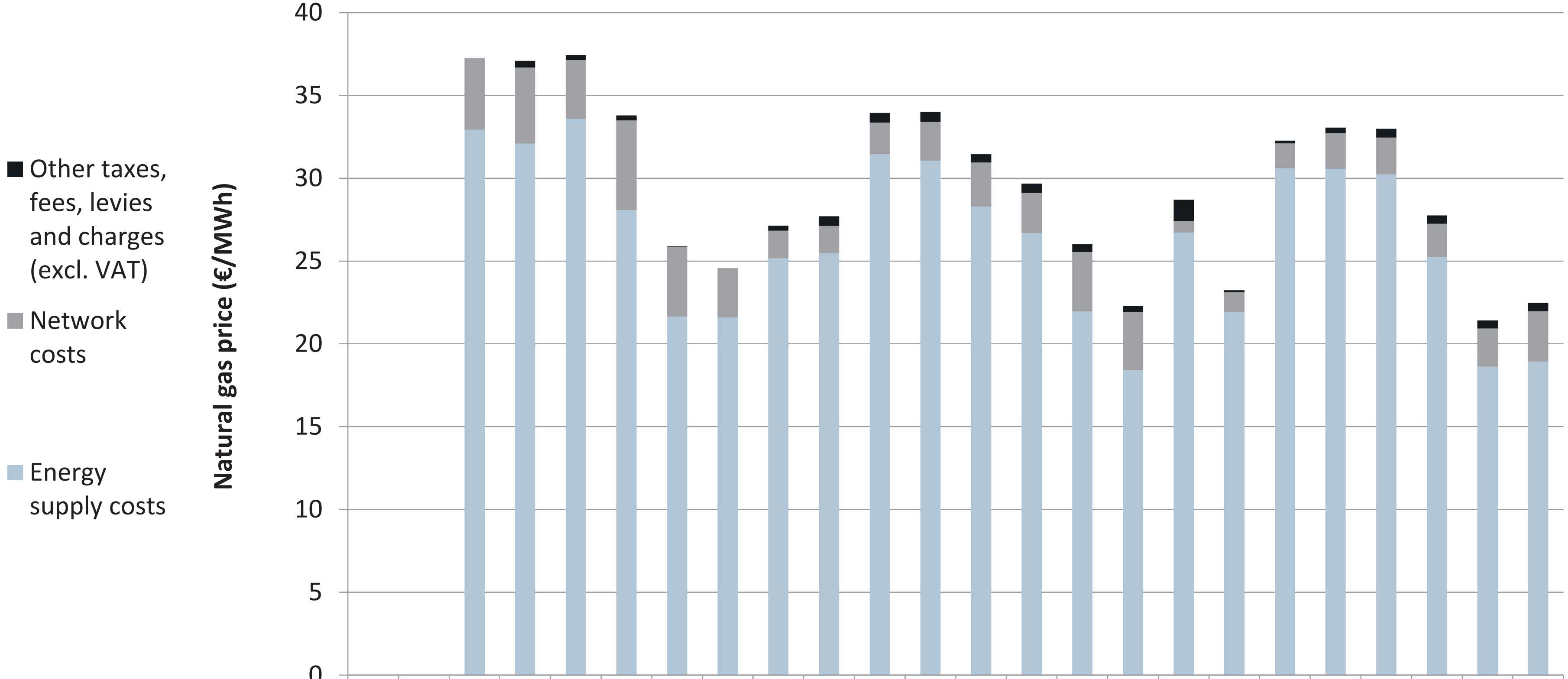
Netherlands	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations	4	5	5	6	6	6	6	6
Other taxes, fees, levies and charges (excl. VAT)	1,3	1,1	1,3	1,5	1,4	1,6	2,0	0,7
Network costs	0,7	0,6	0,7	0,5	0,5	0,5	0,5	0,5
Energy supply costs	26	19	23	27	25	23	18	19

UK	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations		5	7	7	8	7	7	7
Other taxes, fees, levies and charges (excl. VAT)		0,4	0,8	0,8	0,4	0,4	0,3	0,3
Network costs		1,4	1,4	1,3	1,5	2,1	2,5	2,4
Energy supply costs		19	25	28	26	25	18	18

Figure 158 - Structure of average natural gas prices in the surveyed plants in the NWE region (France, Germany, the Netherlands and the UK) in absolute terms (€/MWh), 2008 – 2017

Source: CEPS/Ecofys.

Note: The data presented on the graph are the average prices faced by the surveyed plants but are not representative of national prices. Direct comparisons between two Member States should be avoided.

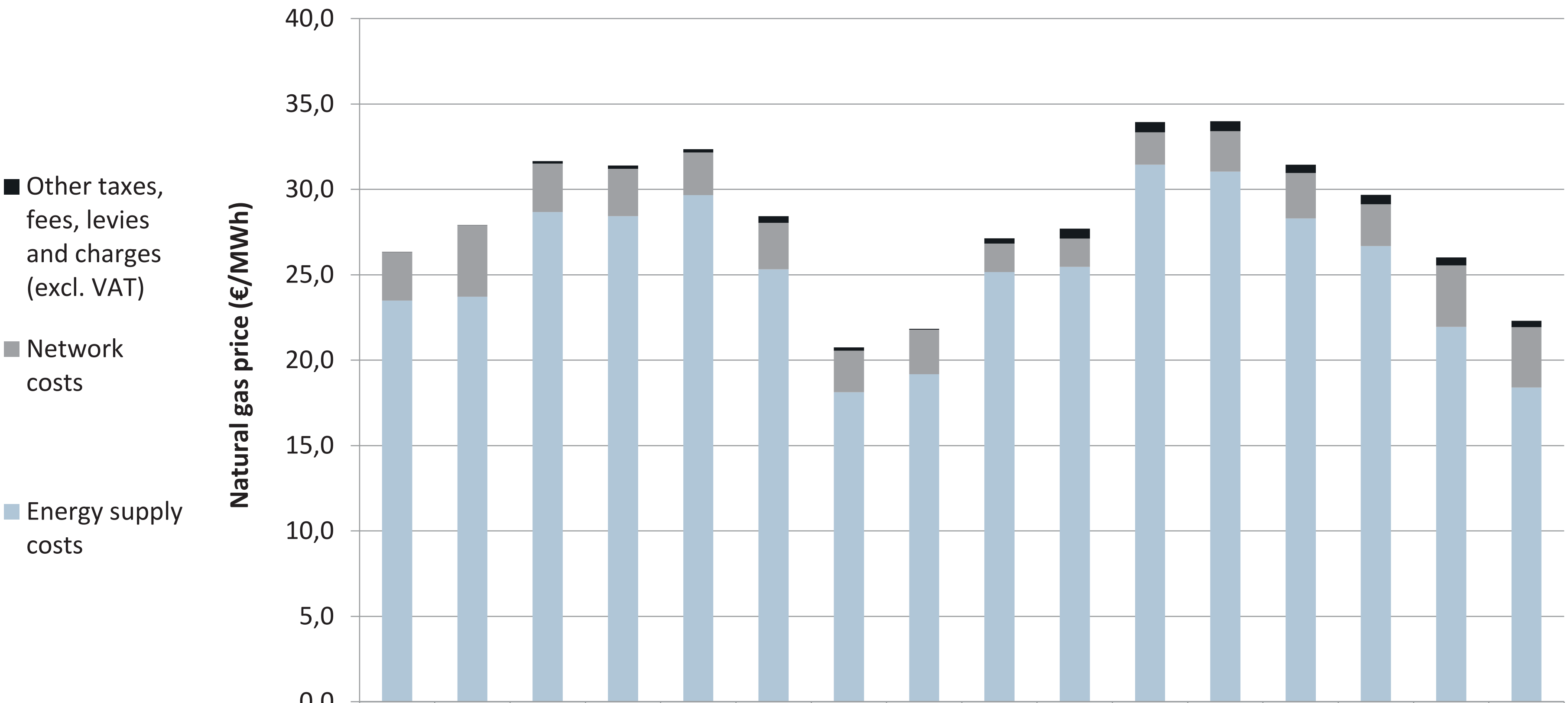


	Portugal								Italy								Spain							
	2008	2010	2012	2013	2014	2015	2016	2017	2008	2010	2012	2013	2014	2015	2016	2017	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations			3	3	4	4	5	5	8	13	15	15	16	14	19	20	9	11	13	12	12	12	18	18
Other taxes, fees, levies and charges (excl. VAT)			0,0	0,4	0,3	0,3	0,0	0,0	0,3	0,6	0,6	0,6	0,5	0,6	0,5	0,4	1,3	0,1	0,2	0,3	0,5	0,5	0,5	0,5
Network costs			4,3	4,6	3,5	5,4	4,2	2,9	1,7	1,6	1,9	2,4	2,7	2,4	3,6	3,5	0,7	1,2	1,5	2,2	2,2	2,0	2,3	3,1
Energy supply costs			32,9	32,1	33,6	28,1	21,6	21,6	25,2	25,5	31,5	31,0	28,3	26,7	22,0	18,4	26,7	21,9	30,6	30,6	30,2	25,2	18,6	18,9

Figure 159 - Structure of average natural gas prices in the surveyed plants in the SE region (Portugal, Italy and Spain) in absolute terms (€/MWh), 2008 – 2017

Source: CEPS/Ecofys.

Note: The data presented on the graph are the average prices faced by the surveyed plants but are not representative of national prices. Direct comparisons between two Member States should be avoided.



	Poland								Bulgaria							
	2008	2010	2012	2013	2014	2015	2016	2017	2008	2010	2012	2013	2014	2015	2016	2017
Number of observations	5	7	8	8	8	5	10	8	3	4	4	4	4	4	4	4
■ Other taxes, fees, levies and charges (excl. VAT)	0,0	0,0	0,1	0,2	0,2	0,4	0,2	0,0	0,3	0,6	0,6	0,6	0,5	0,6	0,5	0,4
■ Network costs	2,8	4,2	2,8	2,8	2,5	2,7	2,4	2,6	1,7	1,6	1,9	2,4	2,7	2,4	3,6	3,5
■ Energy supply costs	23,5	23,7	28,7	28,4	29,7	25,3	18,1	19,2	25,2	25,5	31,5	31,0	28,3	26,7	22,0	18,4

Figure 160 - Structure of average natural gas prices in the surveyed plants in the CEE region (Poland and Bulgaria) in absolute terms (€/MWh), 2008 – 2017

Source: CEPS/Ecofys.

Note: The data presented on the graph are the average prices faced by the surveyed plants but are not representative of national prices. Direct comparisons between two Member States should be avoided.

6.6.4 Overview of results of specific case studies

For each sector analysed, energy prices and costs and information on their main drivers were collected and main features of production cost structures and international competitiveness were reviewed. The details of the analysis by sector are presented in **Annex 1**. Note that technical descriptions of production processes and technologies in each sector and detailed trade analyses are not part of this report but can be found in the CEPS and Ecofys study[101].

Key findings for typical plants in Europe of the sectors analysed are summarised in **Table 19**.

Table 19 - Key plant level results from the case studies (2016) – EU values

Sector	Median electricity consumption (GWh)	Average electricity price(1) (€/MWh)	Average electricity costs(1) (€/MWh)	Median natural gas consumption (GWh)	Average natural gas price(1) (€/MWh)	Main energy carriers used(2)	Share of total energy costs in total production costs(3) (%)
Bricks and roof tiles	5.9	86.3	79.3	51.3	25.1	Natural gas	19.0
Wall and floor tiles	13.5	99.2	88.1	146.4	24.1	Natural gas	15.6
Glass tableware	25.2	92.4	85.8	150.3	23.8	Natural gas, electricity	13.7
Packaging glass	49.0	75.4	68.9	266.5	22.3	Natural gas	19.6
Primary aluminium	2267.1	39.4	37.0	199.8	20.9	Electricity	42.9
Secondary aluminium	14.9	97.6	93.9	82.8	24.4	Natural gas, electricity	14.0
Downstream aluminium	42.4	80.0	80.0	97.4	24.7	Electricity	1.9
Steel EAF	330.7	53.7	50.6	209.8	19.2	Electricity	12.3
Steel BOF	817.5	57.6	52.1	1,499.1	17.2	Coking coal/coke	4.4(4)
Nitrogen fertilisers	86.0	66.5	60.3	4,464.7	18.8	Natural gas	58.7
Refineries	277.4	69.0	62.9	1,596.9	20.3	Crude oil	84.4

(1) Electricity and natural gas costs take account of reimbursements, self-production and flexibility schemes, while electricity and natural gas prices do not. As natural gas costs appear to be similar to natural gas prices, they are not shown in the table.
(2) Energy carriers include all energy raw materials, either used for energy (energy sources) or non-energy (feedstocks) purpose.
(3) Total energy costs include only electricity and natural gas costs; in the case of refineries, the costs of other fuels including feedstocks (crude oil, fuel oil, petroleum coke and refinery gases) are also included. Total production costs include all costs (both OPEX and CAPEX) directly relating to the production process.
(4) This share refers to the costs of electricity and natural gas only. The costs of coking coal and coke are not included.

101 CEPS and Ecofys (2018). Study on composition and drivers of energy prices and costs: case studies in selected energy intensive industries – 2018.

The mix of energy carriers used (i.e. the proportion of electricity, natural gas, etc.) varies hugely from sector to sector and even within sectors. The analysis shows that the situation in terms of energy consumption and costs is rather diverse across sectors and even within sectors (e.g. primary, secondary and downstream aluminium producers, or EAF steel vs. BOF steel). In some cases (e.g. refineries), energy feedstocks can also play a major role in energy costs. The range observed for the share of total energy costs in total production costs is very broad in the sectors looked at. In 2016, it went from 2% in downstream aluminium industry to 84% in refineries. Overall, the case studies show that energy costs play a significant role in determining the production costs in most sectors analysed and directly affect their competitiveness. Nevertheless, other non-energy production costs are also very relevant to take into account when analysing the drivers of the sector competitiveness.

EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 4/11

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(2019) 1 final}

EN EN

PART III

Energy subsidies and government revenues from energy products

7 Energy subsidies

Main findings

- In order to fulfil its energy and climate objectives, and to comply with international commitments on phasing out subsidies to fossil fuels, the European Commission and its Member States aim to better monitor fossil fuel subsidies. Fossil fuel subsidies are encouraging wasteful energy consumption and put an obstacle to green investments.
- Based on the previous study on energy costs and subsidies in 2014[102], this report extends the scope of the analysis beyond the energy sector, looking at energy related subsidies in sectors such as transport, agriculture, energy intensive industries, residential sector, etc.
- In 2016 energy-related subsidies in the EU amounted to €169 bn, up from €148 bn in 2008. The largest part of this amount was absorbed by the energy sector (€102 bn in 2016), the residential sector (€24bn), energy intensive manufacturing industry (€18 bn) and transport (€13 bn).
- Between 2008 and 2016 a threefold increase could be observed for renewable subsidies (mainly wind and solar electricity generation), up from €25 bn to €76bn. Over the same period subsidies in the form of free emission allowances fell from €41bn to €4 bn, in parallel with decreasing carbon prices and less eligible sectors for receiving free ETS allowances, such as most of the electricity generation sector.
- Subsidies to fossil fuels remained overall stable between 2008 and 2016 (€54-55 bn, however, in 2012 they reached €60 bn). Subsidies did not decrease in spite of the EU international commitments to phase fossil fuels out in the medium term. As to the sectors, in the transport sector a slight increase could be observed over this period (from €10 bn to 12 bn), while in the other sectors, subsidies decreased or remained stable. In 2016 the energy sector represented €16 bn of the total fossil fuel subsidies, followed by transport (€12 bn) and the manufacturing and household sectors (both €8.5 bn). Within the total fossil fuel support, €28 bn could be attributed to petroleum products, €13 bn to natural gas and €7 bn to coal and lignite in 2016 in the EU, while more than €7 bn could not be allocated to given fossil technologies (multiple sources).
- The importance and nature of subsidies to different energy products can vary across economic sectors. In the energy sector most of the subsidies are linked to the production of energy while in other sectors subsidies are related to energy consumption. In the energy sector more than two thirds of the total subsidies were related to renewables (solar, wind, biomass, hydro) in 2016. In the agriculture and transport sectors 90% of the subsidy amount could be linked to fossil fuels, predominantly petroleum products. In the case of energy intensive industries almost half of all subsidies could be linked to fossil fuels and around 35% to electricity. In the case of the residential sector electricity and gas both had a significant share.
- Energy subsidies had a measurable impact on the wholesale electricity market over the last decade, as they increased the installed renewable capacities and higher renewable

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102 https://ec.europa.eu/energy/sites/ener/files/documents/ECOFYS%202014%20Subsidies%20and%20costs%20of%20EU%20energy_11_Nov.pdf

generation had a lowering impact on the wholesale price level. Our analysis shows that one percent increase in the share or variable renewable sources resulted in a wholesale price decreasing by 0.5 €/MWh between 2008 and 2016. In some Member States the competitiveness of energy intensive industries is protected by exemption from energy and climate policy tax measures.

- In the case of households subsidies to energy efficiency investments can substantially lower electricity and gas bills, having an impact on the overall energy demand and energy market prices.
- According to the latest available international comparisons (2015 data), subsidies to fossil fuels have an even bigger importance outside the EU. Subsidies to petroleum products, which account for the largest share within fossil fuels, strongly correlate with the evolution of crude oil prices, especially in those countries, where consumption is subsidised by retail price caps. In the EU petroleum consumption is rather subsidised through excise duty and tax exemptions, being independent from crude oil prices.

Overview of energy subsidies in the EU

The production and system costs of different types of energy can be difficult to assess and are not easy to compare. In competitive markets, prices can be taken to reflect costs. However, the energy sector is marked by often low levels of competition, an extensively regulated asset base, externalities and other market failures and significant public intervention through regulation and subsidies. Observed prices are therefore rarely an accurate reflection of costs. Where the price signal is impaired the efficiency of producers is hidden and the size and nature of subsidies and cross-subsidisation between different types of power generation is not transparent. The complex interplay of direct, indirect, financial, or regulatory support measures adds to the lack of clarity.

In order to better understand the nature of government interventions affecting the EU internal energy market, first it is needed to collect information on a uniform basis in all EU countries. Definition and measurement of government interventions and subsidies can follow different approaches, however, in order to ensure comparability a common methodological base is needed. The first attempt to quantify energy subsidies in the EU was made in a Commission study on energy costs and subsidies in 2014. This study aimed at collecting data on electricity and heat generation costs, in parallel with external costs and setting up an inventory in government interventions in the energy sector. However, for further policy needs the sectorial coverage of this first study needs to be extended, as important economic sectors where energy-related subsidies are applicable (e.g.: transport, agriculture, energy intensive industries, etc.) were not covered in the 2014 study.

Both in the EU and at international fora the issue of fossil fuel subsidies gained much attention over the last years. The Commission's "Clean Energy for all Europeans" package (November 2016) 'is stepping up EU's action in removing inefficient fossil fuel subsidies in line with international commitments under G7 and G20 and in the Paris Agreement. The remaining but still significant public support for oil, coal and other carbon-intensive fuels continues to distort the energy market, creates economic inefficiency and inhibits investment in the clean energy transition and innovation. The Market Design Reform is intended to remove priority dispatch for coal, gas and peat and will limit the need for capacity mechanisms which often relied on coal.

The Commission will also establish regular monitoring of fossil fuel subsidies in the EU. The Commission is carrying out a REFIT evaluation of EU framework for energy taxation in order to define possible next steps also in the context of the efforts to remove fossil fuel subsidies. Member States' integrated national energy and climate plans should enable them to identify the investments needed for the clean energy transition. Member States should also use these plans to monitor the phase-out of fossil fuel subsidies.

Since the September 2009 Pittsburgh summit, G-20 countries have recurrently expressed their commitment to 'phase out and rationalise over the medium term inefficient fossil fuel subsidies while providing targeted support for the poorest - also noting that 'inefficient fossil fuel subsidies encourage wasteful consumption, reduce our energy security, impede investment in clean energy sources and undermine efforts to deal with the threat of climate change'.

The 2016 G7 Declaration stated that group's commitment to "the elimination of inefficient fossil fuel subsidies and encourage all countries to do so by 2025". Inefficient fossil fuel subsidies (IFFS) that encourage wasteful consumption distort energy markets, impede investment in clean energy sources, place a strain on public budgets, and incentivise unsustainable infrastructure investments.

Taking into account the data needs of ongoing policy initiatives and giving a first guidance to Member States who will have the obligation (every two years as of 2023) to report on fossil fuel subsidies, a new chapter on measuring subsidies in the EU has been put in the 2018 energy prices and costs report. Compared to the 2014 subsidy report, the scope of analysis has been extended beyond the energy sector to transport, agriculture and energy intensive industries, which led to a significant increase of the number of total interventions. The time horizon of the new data collection now covers the period of 2008-2016, whereas the latest data in the 2014 subsidy study were of 2012. Reporting systems in most of the EU Member States underwent significant developments over the last few years, filling in the data gaps we faced during the preparation of the study in 2014.

In this report we follow the definition of OECD on energy related government interventions, according to which subsidy is 'any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduces costs for consumers or producers'. The study is following a bottom-up approach, collecting data on individual measures and then aggregating them for each economic sector, energy carrier, country, subsidy type, etc. As minimum requirement, all state aid decisions in the energy sector, notified to the European Commission, were considered as subsidies. However, the subsidy definition used in this report is a broader concept than state aid cases. Items such as regulated prices and all tax reductions are considered subsidies irrespective of having been qualified as state aid. Therefore, the amount of total subsidies is higher than that of state aid notifications.

Looking at the results of the study prepared by Trinomics et al. on energy prices and costs, we can see that the total amount of subsidies to the energy sector, representing the largest part of energy related subsidies, has been significantly upwardly revised compared to the 2014 study on energy costs and subsidies[103] (for 2012 the 2014 study gave a number of €99 bn, whereas the current study estimates the 2012 subsidy value for €147 bn for the energy sector – if everything on **Figure 161** except transport and agriculture are included). The difference mainly stems from aforementioned better quality of data reporting from the Member States.

103 https://ec.europa.eu/energy/sites/ener/files/documents/ECOFYS%202014%20Subsidies%20and%20costs%20of%20EU%20energy_11_Nov.pdf

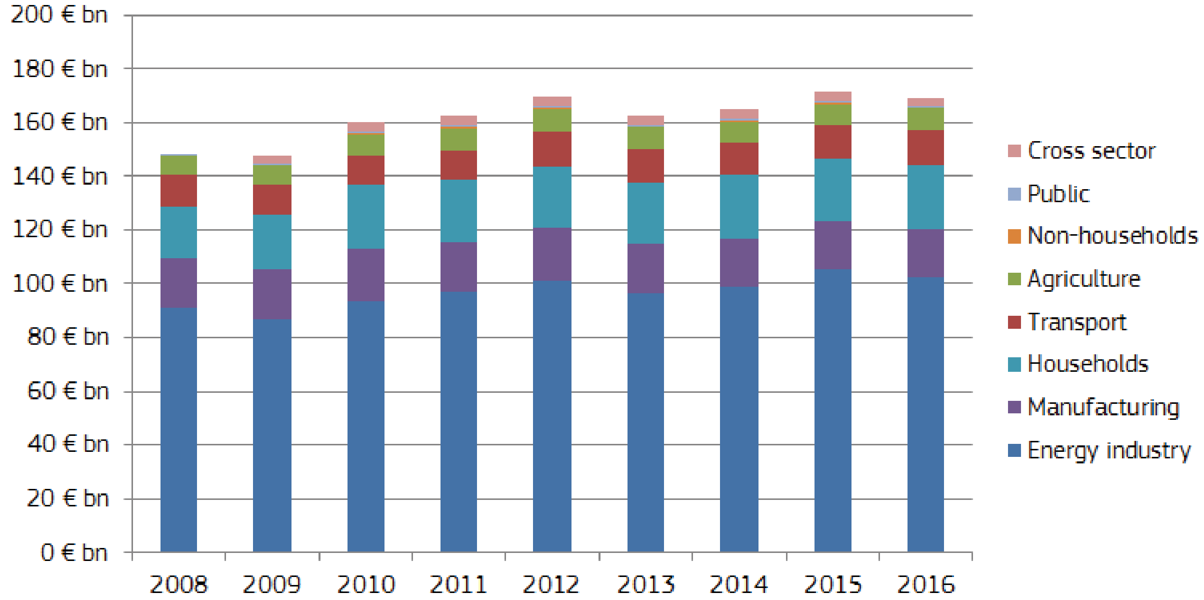

Figure 161 – Financial support by sector[104] in the EU-28 (expressed[105] in €2017bn)[106]

Source: DG ENER, data from Trinomics et altri study (2018)[107]

Besides the energy sector, significant subsidies occurred in the residential sector (€24 bn in 2016), owing to preferential energy prices (e.g.: lower VAT rates), in some countries and support for energy savings and efficiency measures. In the case of manufacturing industries subsidies, amounting to €18bn in 2016, occurred mainly for ensuring competitiveness of European energy intensive industries at global level, exempting certain sectors from energy taxes and other policy levies (e.g.: renewable generation support). The transport sector was the fourth largest regarding subsidy volumes (€13 bn in 2016), primarily owing to fuel subsidies (e.g.: reduction or exemption from excise duties). In the agriculture subsidies (€8 bn in the same period) could be linked to fuel tax reductions or exemptions.

As both **Figure 161** and **Figure 162** show, amount of subsidies in the EU-28 showed an increasing trend between 2008 and 2016. Subsidies to renewable energy tripled in this time period, however, in the last few years the increase slowed down. At the same time, subsidies to fossil fuels remained stable (€54-55 bn). On **Figure 162** "All" gathers all interventions that either cover all energy sources, for instance the measures supporting energy efficiency and Free emission allowances (ETS), as well as all the measures combining energy sources classified in more than two different groups of energy, for instance a measure supporting CHP

[104] Definition for the specific sectors:
Public institutions: Amounts inventories are mainly dedicated to public building retrofits and public lighting programme.
Non-households: All types of actors (public and private companies, public institutions, local authorities, religious institutions, associations, NGOs) involved in any economic sector, except the households that are the only actors not eligible to this instruments.
Cross sector: All economic sectors and actors are eligible, i.e. public and private companies, public institutions, local authorities, religious institutions, associations, NGOs and/or households involved in any economic sector

[105] Unless otherwise stated, in this chapter subsidy amounts are expressed in €2017 bn and referring to the EU

[106] State aid notified to the Commission amounted to € 56 billion in 2016. The difference with the ca. €102 bn of aid is explained by subsidies which do not fall under the category of State aid like price regulation, general tax reductions, support to infrastructure, etc.

[107] Unless otherwise stated, in this chapter the data source is the study on Energy prices and costs in the EU for all charts

fuel with coal, natural gas and biomass. Primarily owing to a significant decrease in emission allowances support (from €41 bn to €4 bn between 2008 and 2016), the share of this "All" category fell significantly. Support to the electricity sector and to nuclear did not change too much over time.

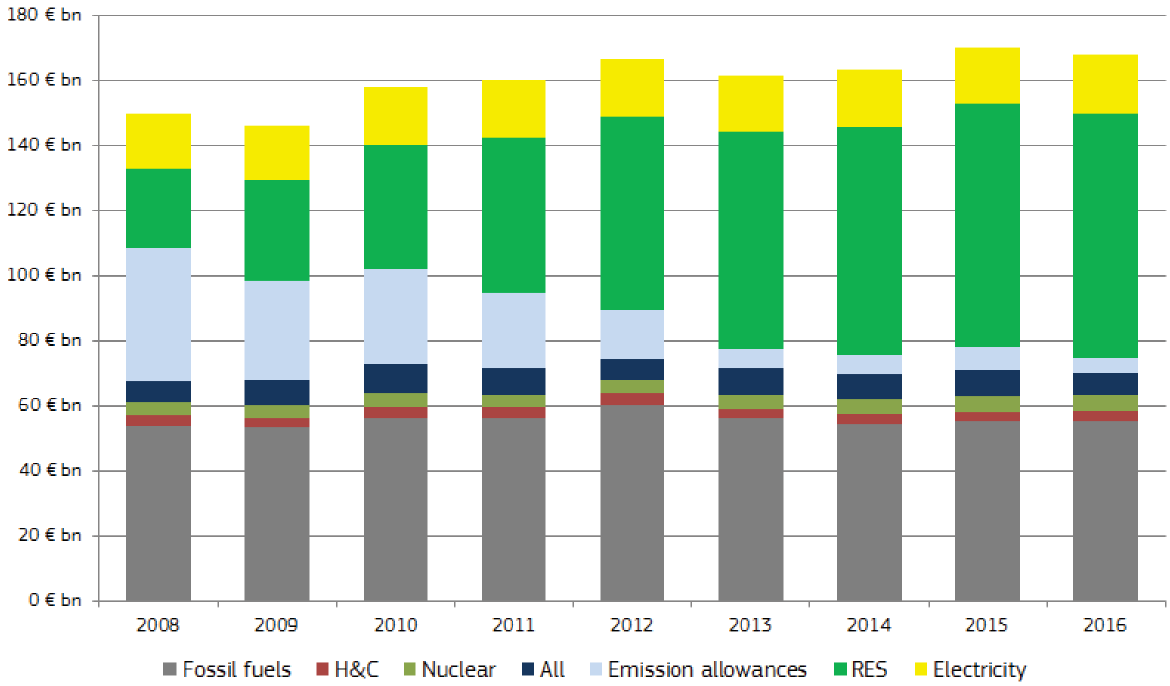

Figure 162 – Financial support by energy group (expressed in €2017bn)

Source: DG ENER, data from Trinomics et altri study (2018)

Figure 163 shows the financial support in each Member state in 2016 by energy source. Germany spent the most on renewable energy support in this year (€27 bn), while the United Kingdom spent the most on fossil fuel support (€12 bn). Germany, Italy, France and Spain spent more on subsidising renewable energies than on fossil fuels. As percentage of Gross Domestic Product (GDP) Bulgaria spent the most on energy subsidies (2.7%), while Luxembourg spent the lowest share (0.3%). In the EU as whole, energy subsidies amounted to 1.1% of the GDP in 2016[108].

[108] The ratio Subsidies/GDP depends on the various factors impacting GDP

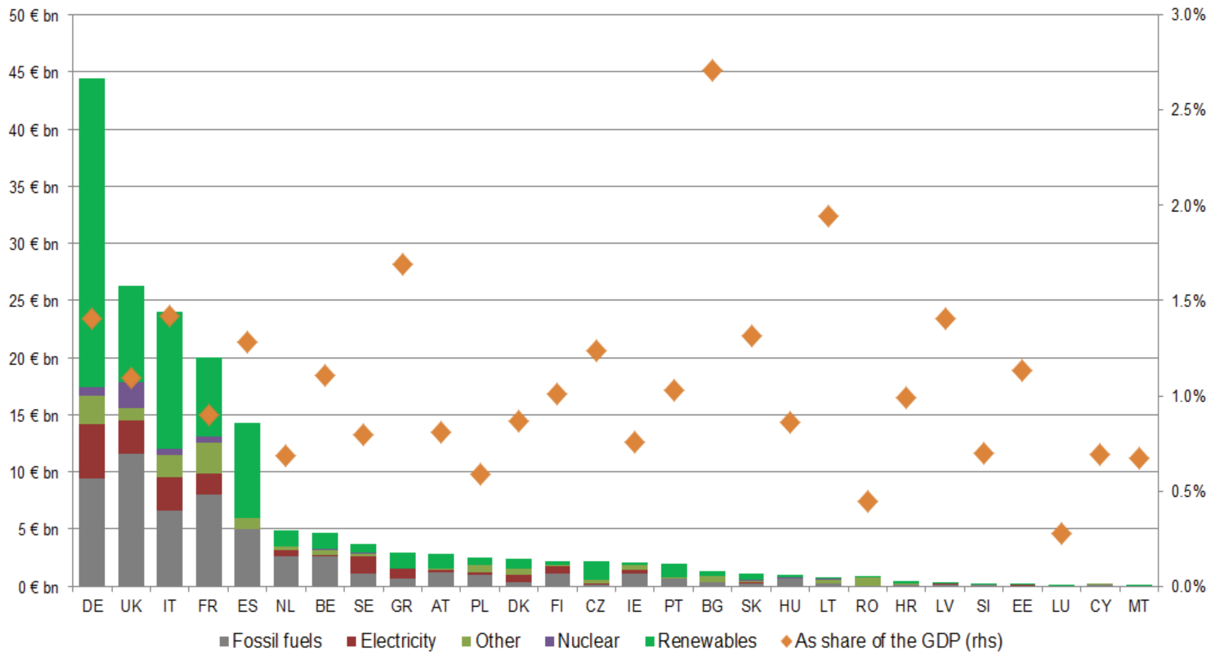

Figure 163 – Financial support in 2016 by energy source and EU Member States (expressed in €2017bn and as the percentage of Gross Domestic Product - GDP)

Source: DG ENER, data from Trinomics et altri study (2018)

7.1 Subsidies in the energy sector

The energy sector has been the largest recipient of subsidies related to energy products. As Figure 164 shows, subsidies in the energy sector were relatively stable as of 2011, reaching around €100 bn in each year in the EU-28. However, the structure of subsidies significantly changed between 2008 and 2016. The most visible change was relating to emission allowances, as in parallel with the decrease in carbon price between 2008 and 2013 and owing to the third phase of the ETS system, putting an end to the eligibility of the electricity sector to free emission allowances, support to emission allowances shrunk by several magnitudes (from €41 bn in 2008 to €4 bn in 2016).

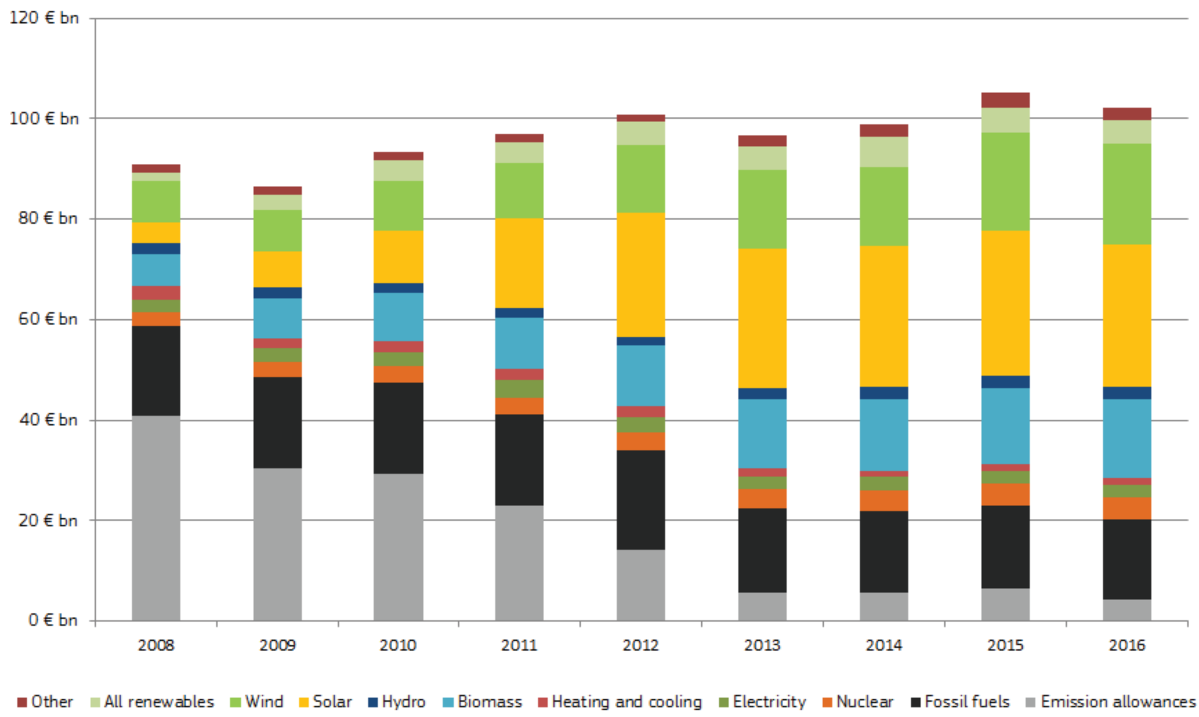

Figure 164 – Subsidies in the energy sector, by generation technology

Source: DG ENER, data from Trinomics et altri study (2018)

On the other hand, subsidies to renewable energy sources (biomass, hydro, wind and solar) rose from €23 bn to €71 bn between 2008 and 2016. The biggest rise could be observed between 2008 and 2013; since then only a moderate increase could be observed.

7.1.1 Fossil fuel subsidies in the energy sector

Fossil fuel subsidies in the energy sector were fairly stable between 2008 and 2011, averaging around €18 bn in each year. After a peak of €20 bn measured in 2012, in 2013 the amount of total fossil fuel subsidies in the EU energy sector fell back to €17 bn and it slowly decreased until 2016, falling below16 bn.

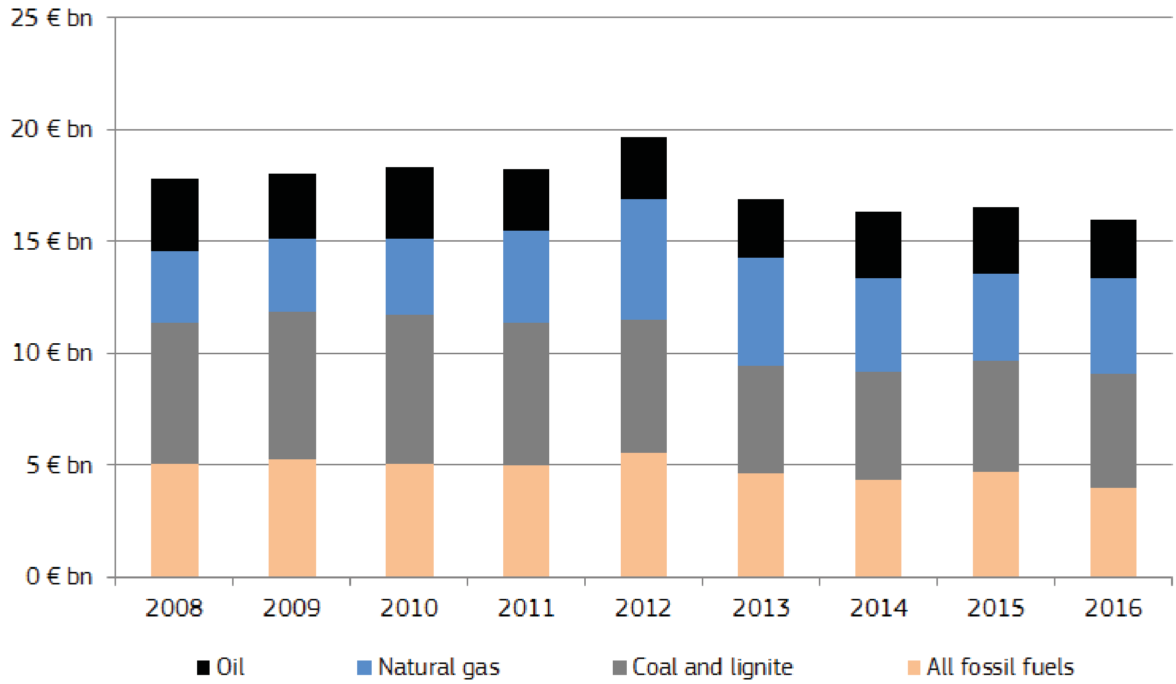

Figure 165 – Subsidies to fossil fuels in the energy sector, by generation technology

Source: DG ENER, data from Trinomics et altri study (2018)

When we compare these figures with those in the previous study on subsidies (Ecofys, 2014), we observe that the share of fossil fuels is now higher and the coal and gas shares are lower. The subsidies not linked to any specific technology, being the principal reason of higher subsidy numbers compared to the last study, mainly comprises of subsidy types related to combined power and heat generation, infrastructure, mine decommissioning and in some cases R&D expenditures.

7.1.2 Renewables

The rapid increase in subsidies to renewable technologies over the years 2008 to 2012, especially for wind and solar power generation, slowed down since 2013. This was owing to several factors: Most important, the costs of generation (especially for solar PVs) significantly decreased over the last decade, resulting in reduction of Feed-in-Tariffs (FiT) and Feed-in-Premiums (FiP). Several Member States (for instance Spain since 2012, Italy in 2014 for PV, etc.) ended support in the case of new contracts. New regulations have also been introduced (the so-called concept of “development corridor”) in order to control the development of the installed capacities. On the other hand, the fall in wholesale electricity prices between 2012 and 2016 in Europe (see Chapter 1.1 on wholesale electricity markets) has driven the amount of subsidies upward by increasing the difference between the wholesale price and the fixed price from FiT contracts.

Between 2008 and 2016 the biggest increase in subsidies among renewables could be observed for solar technologies (from €4 bn to €28 bn), implying a six-fold increase. At the same time support for wind energy rose from €8 bn to €20bn. However, it is important to recall that the increase in the share of renewable sources within the EU power generation mix was predominantly owing to the increase in the share of wind, as its share went up from 3.5% to 12% between 2008 and 2017 (see Chapter 1.1 on wholesale electricity prices). At the same time the share of solar remains lower (less than 4% in 2017 on average across Member

States). Renewable support schemes in the past decade contributed to a higher increase in wind penetration than for solar energy.

Looking at the two most widespread renewable support instruments, FiTs and FiPs, we can say that FiTs had a much bigger role between 2008 and 2016 (increasing from €18 bn to €50bn in this period) than renewable supports under FiP regimes (increasing from €1bn to €6.4 bn).

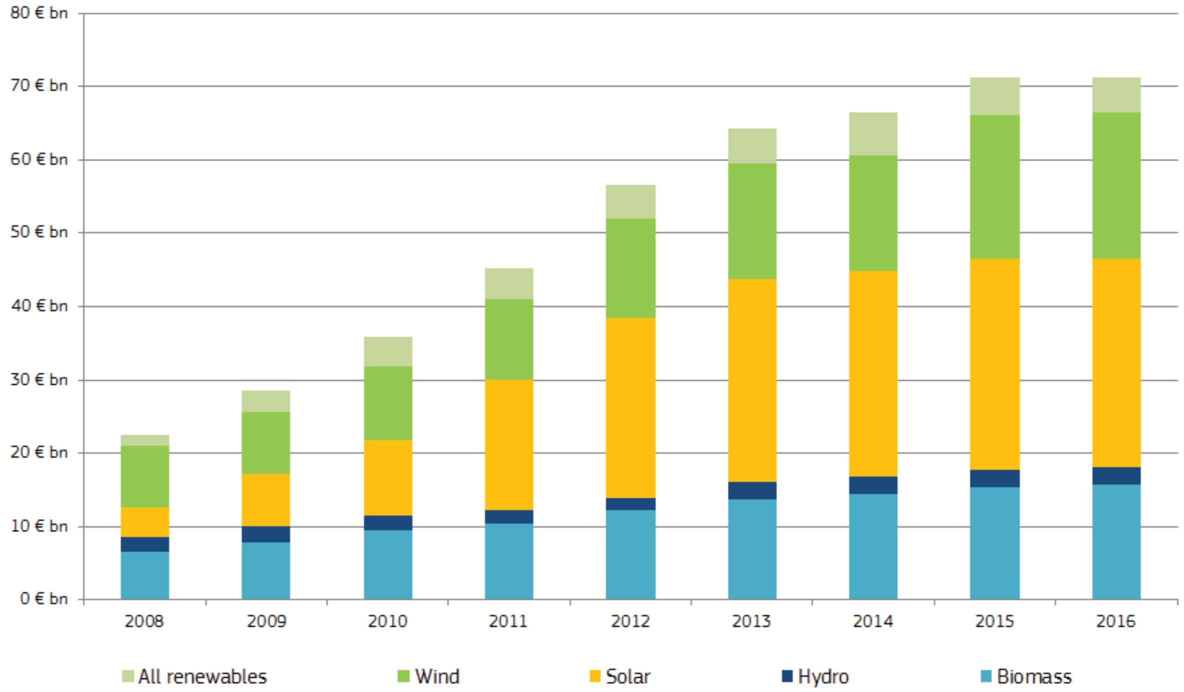

Figure 166 – Support to renewable energy sources in the EU Member States

Source: DG ENER, data from Trinomics et altri study (2018)

7.1.3 Nuclear

In the nuclear sector the main subsidy instrument is the research and development support. This is applicable on both national and European level, as **Figure 167** shows. Not surprisingly the biggest amount of support has been spent in France on nuclear related R&D activities between 2008 and 2016, given the country's significant nuclear generation capacities and industry. Besides France significant amounts were spent in Germany, UK, Czech Republic and Belgium over the last few years. The total amount of support spent on nuclear R&D has been slightly above €1 bn in each year since 2012.

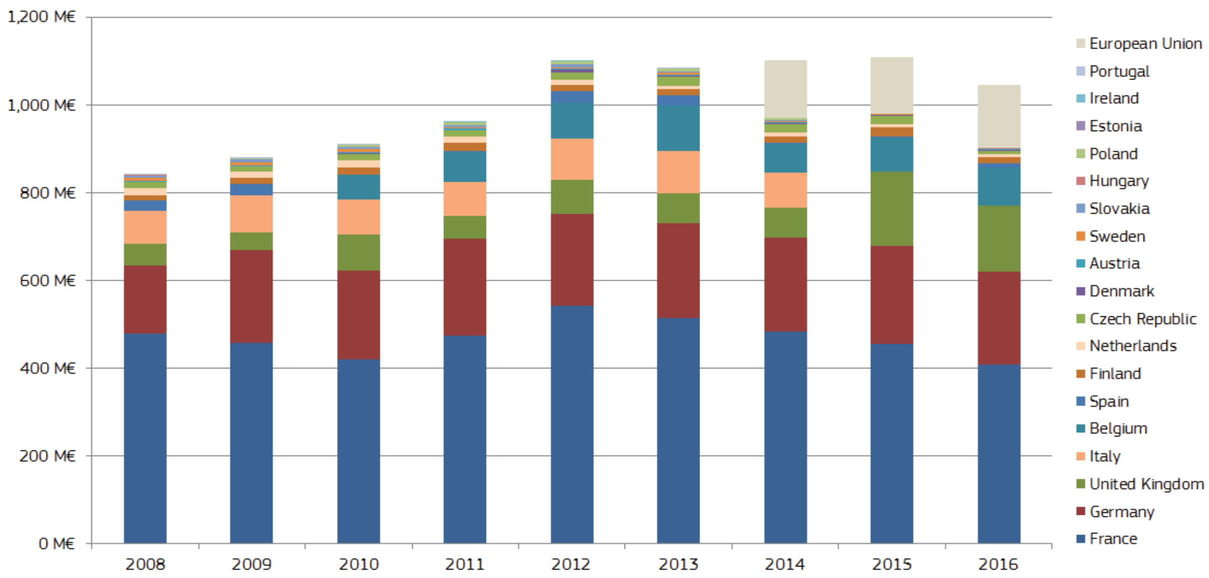

Figure 167 – Nuclear R&D support in the EU Member States

Source: DG ENER, data from Trinomics et altri study (2018)

Subsidies from EU funds on nuclear research activities also appeared as of 2014, as the EU plans to spend €1.6 bn on the nuclear research programme Euratom under the Horizon 2020 programme in the 2014-2020 period.

The next chart (**Figure 168**) shows the financial support to nuclear decommissioning[109] in some EU Member States. In 2016 the nuclear sector received the biggest decommissioning support in the UK, amounting to €2.2 bn. However, in this country nuclear energy is also used for non-energy market (i.e.: military) purposes which is not easy to identify as a separate item, implying that the actual support could be lower. In Italy nuclear decommissioning also received a significant support in 2016 (€ 560), while in Lithuania the financial support was related to the decommissioning of the former Ignalia power plant.

[109] In the case of some reactors decommissioning was driven by political decisions so that the "financial support" is a compensation for the operator not being able to accumulate sufficient funds for decommissioning

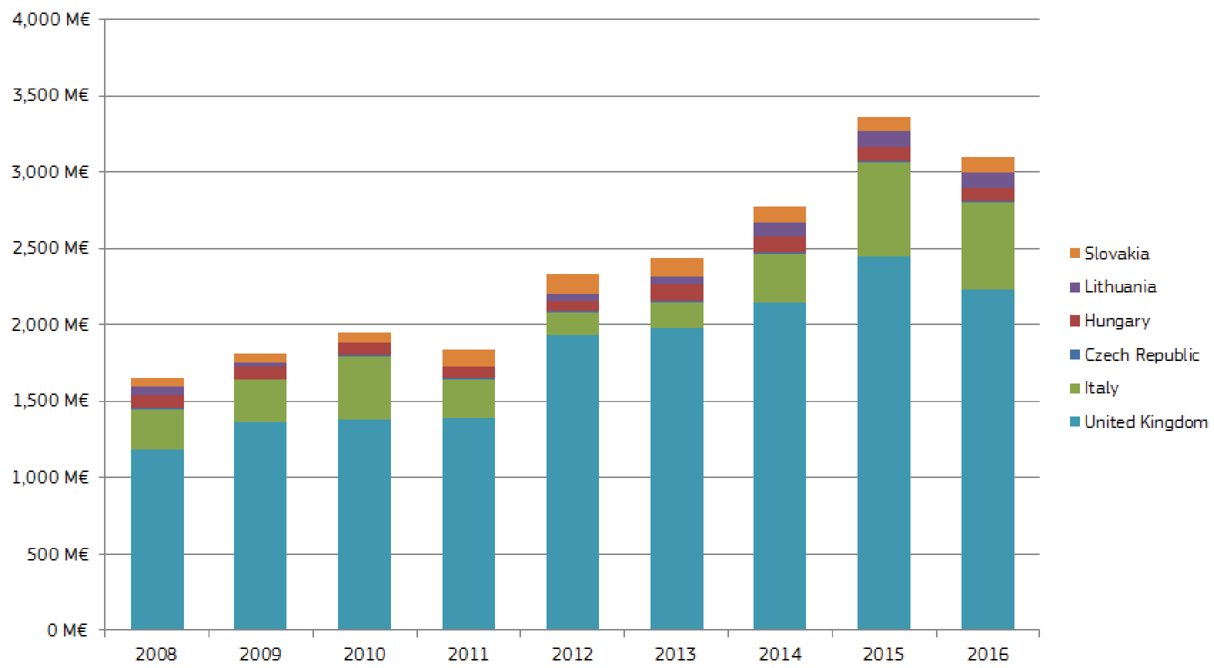

Figure 168 – Support to nuclear decommissioning in some EU Member States

On the top of support to decommissioning, in some countries (e.g.: France, Sweden and Romania) another € 200 million was spent on stranded assets and issues (e.g.: nuclear safety) financed by public national funds.

Financial support for nuclear third party liability may exist (as liability of nuclear operators is limited in most EU Member States and as the financial securities to be provided by operators for the coverage of the risk do not match the potential costs resulting from a severe nuclear accident) but, cannot be estimated at this stage. The reasons for this include the fact that there is neither a sufficiently developed nor harmonised approach by EU Member States on how the insurance, private and financial markets could provide for increased coverage in this field. The European Commission is investigating this specific topic further in separate studies.

Finally, State aid cases decisions may serve to identify other subsidies to nuclear generation[110]

7.1.4 Other specific subsidies

After looking at the most important generation technologies there are some specific subsidies relating to the energy sector that should be presented in this subchapter.

As the next chart (**Figure 169)** shows, there were significant changes in 2013, as the power sector was no longer eligible for free emission allowances under Phase-III of the ETS system, and the manufacturing sector's free allowances have also been reduced. In parallel, carbon prices on the market fell significantly, from 19.4 €/tCO2$_e$ in 2008 to 5.2 €/tCO2$_e$.in 2016. In consequence, total financial support to free emission allowances dropped from €41 bn to €4 bn between 2008 and 2016. Although the aviation sector is also eligible for free allowances, the magnitude of support cannot be compared to the sectors with stationary installations.

[110] Decisions on State aid: insurance cost (SA.46602), cost of waste management (SA.45296).

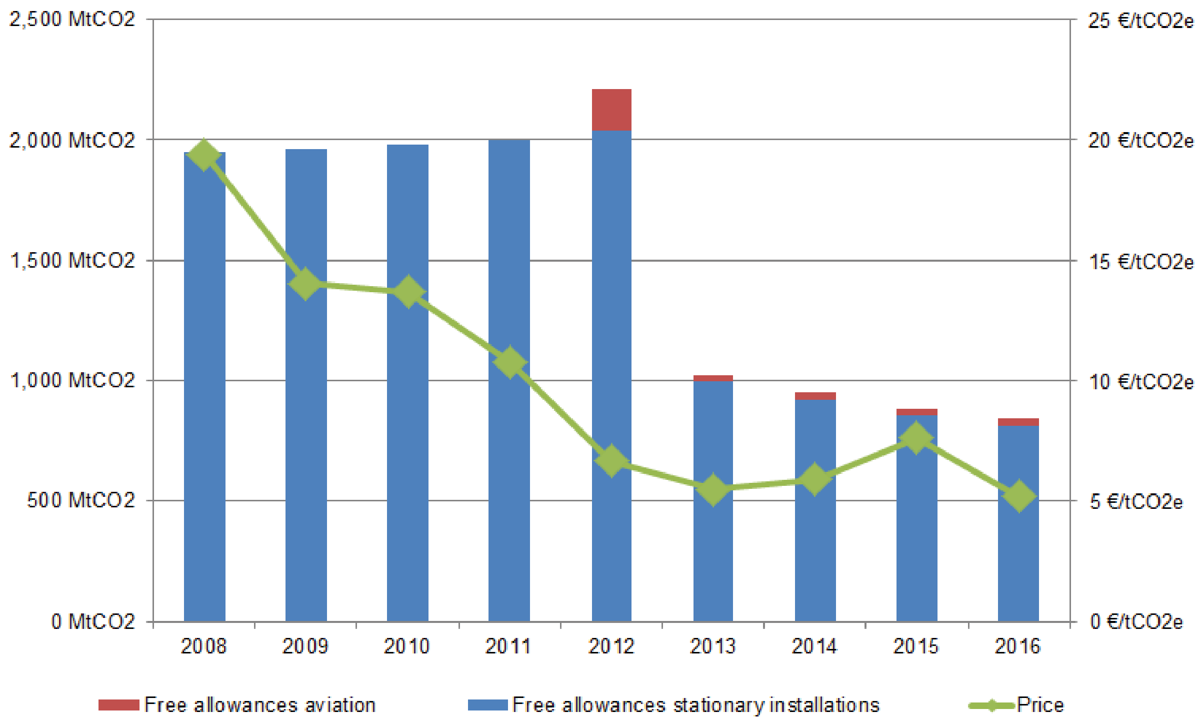

Figure 169 – Free emission allowances allotted to stationary installations, to the aviation sector, and the evolution of the carbon price in the ETS system[111]

Source: DG ENER, data from Trinomics et altri study (2018)

Capacity markets make an important policy issue in European energy policy as introduction of such instrument is always subject to an a priori inquiry from the European Commission whether the planned instrument is compatible with the EU State aid guidelines. Capacity payments are compatible with the EU internal electricity market rules; however, they should not lead to any distortion in the neighbouring markets. Capacity markets are also important from decarbonisation perspective, as in most cases they cover fossil fuel (coal or gas) generation technologies used as strategic or balancing reserves.

Figure 170 shows the capacity payments in some EU Member states (where capacity markets could be identified in the period of 2008-2016). Capacity payments in the EU as whole varied between €1 bn and €2.1 bn over this period, with the biggest payment amounts observed in Ireland, Spain and Greece. In 2015 a new capacity mechanism, aiming at keeping brown coal (lignite) power plants in the strategic reserve but normally out of operation, was introduced in Germany as well. In other countries, such as Sweden, Finland and Belgium, capacity payments only amounted to few millions of euros, and this instrument plays only a marginal role in the given country's electricity generation (primarily during high demand periods, such as colder winter days).

[111] Assuming the continuation of the slightly decreasing trend between 2013 and 2016 in the amount of free allowances, and bearing in mind that in January-October 2018 the average CO_2 price rose to 14.9 €/$tCO2_e$, measurably up from 5.2 in 2016 and 5.9 in 2017, the financial support to free emission allowances might have significantly increased in 2018, compared to the 2016 support (€4 bn).

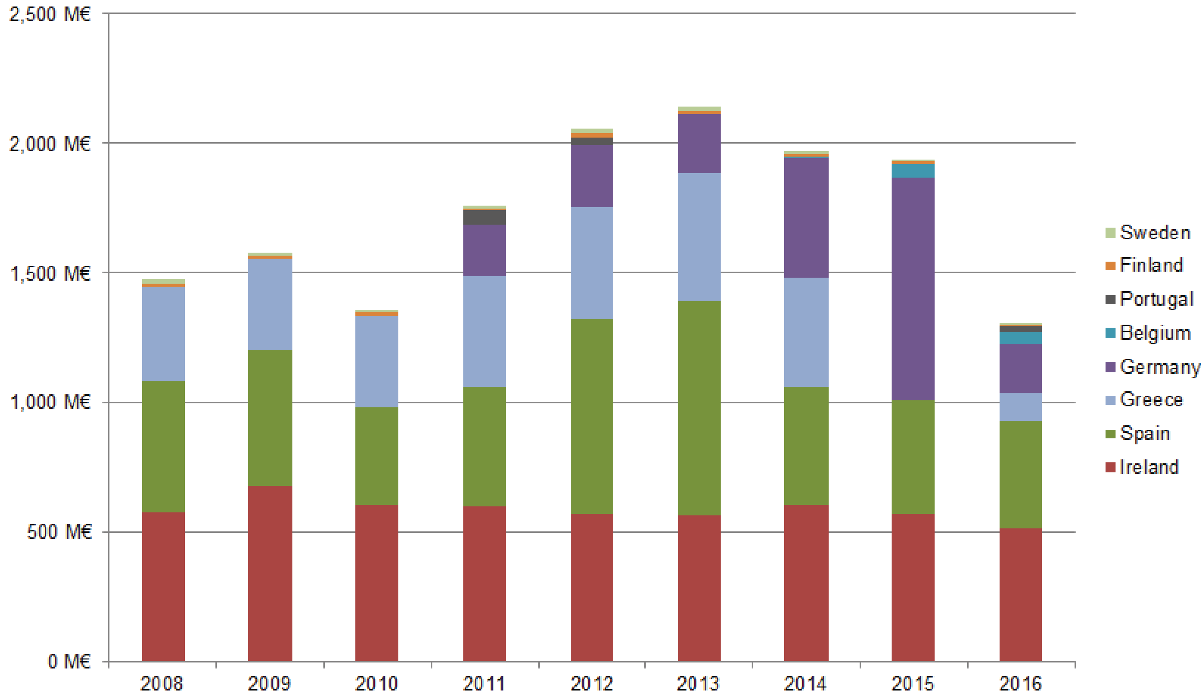

Figure 170 – Capacity payment support in some EU Member States

Source: DG ENER, data from Trinomics et altri study (2018)

Demand response instruments, as an alternative or complementary measure to balancing on the electricity market, have an increasing importance on European electricity markets. **Figure 171** shows how they impact subsidies in the electricity markets in Member States with available data.

In Spain, Italy and Portugal the annual amount of interruptible load scheme related subsidy can reach several hundreds of million euros. In Spain the interruptibility service is a tool managed by the Transmission System Operator (TSO) to reduce load of certain consumers in case the system needs it to keep the system balanced. This service is provided by big industrial consumers. In Italy the TSO contracts annual capacity of demand-side response (DSR) from energy-intensive industries with electricity consumption usually higher than 7 GWh.

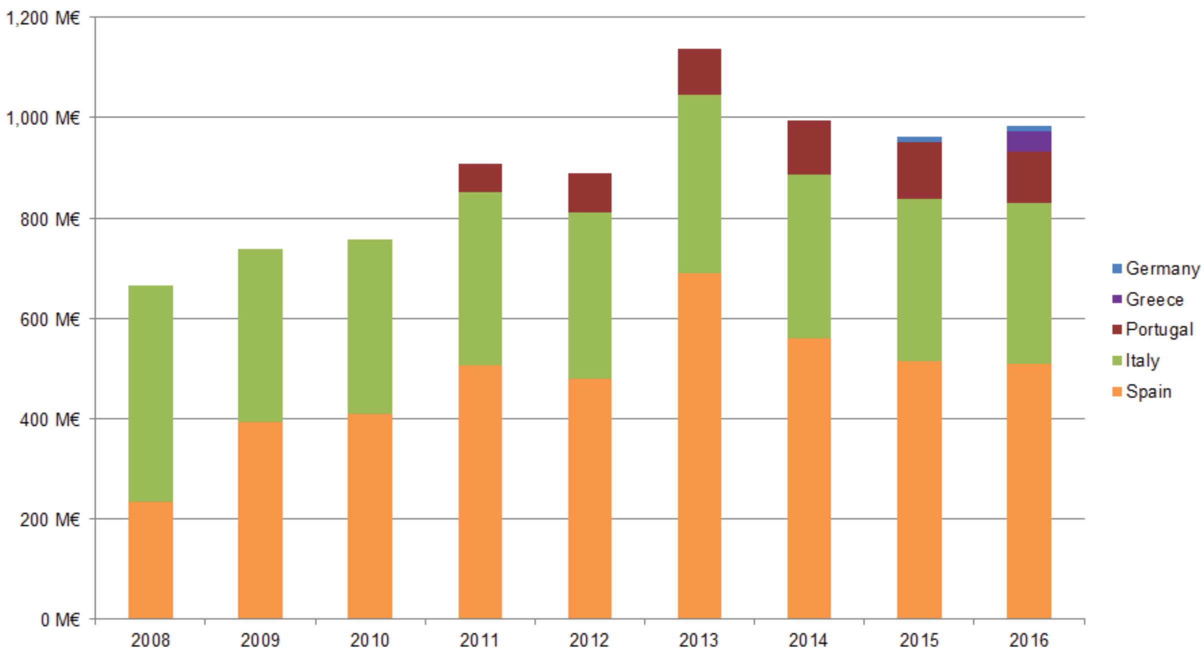

Figure 171 – Financial support to interruptible load schemes in some EU Member States

Source: DG ENER, data from Trinomics et altri study (2018)

7.2 Subsides beyond the energy sector

The energy sectors accounts for the majority of energy subsidies but energy subsidies beyond the energy sector are also significant. This section first focuses on fossil fuels subsides not given to the energy industry. Then the distribution of these subsidies across the non-energy sectors (namely, Households, Manufacturing, Transport and Agriculture) is analysed

7.2.1 Fossil fuels subsidies beyond the energy sector

Between 2008 and 2016 subsidies to fossil fuels remained stable in the EU-28, and reached around €54-55 bn in both 2008 and 2016. However, in 2012 support to fossil fuels peaked above €60 bn. Within this, subsidies to petroleum products increased from €26 bn to €28 bn, that could mainly be observed in the transport sector, as both **Figure 172** and **Figure 173** show. On the other hand, subsidies to coal and lignite, natural gas, and other fossil fuels remained stable or decreased between 2008 and 2016.

These subsidy figures do not include excise duties differences between petrol and diesel fuels. The scope of this study does not cover subsidies across different fuels, as subsidy calculations are not based on energy content. However, several countries consider the difference in the excise duty rates as tax expenditure and include it in their annual budget / finance law reports.

This is the case of Denmark (€0.2bn in 2016), Italy (€5bn in 2016) and Sweden (€0.9bn in 2016). Most of the Member States, however, do not currently consider the excise duty rate difference between diesel and gasoline as tax expenditure. This is another reason why this measure has been excluded of our study. Few other Member States have released official estimations of their potential tax losses. This is at least the case for France (€6.9bn in 2011) and Germany (€8bn in 2015).

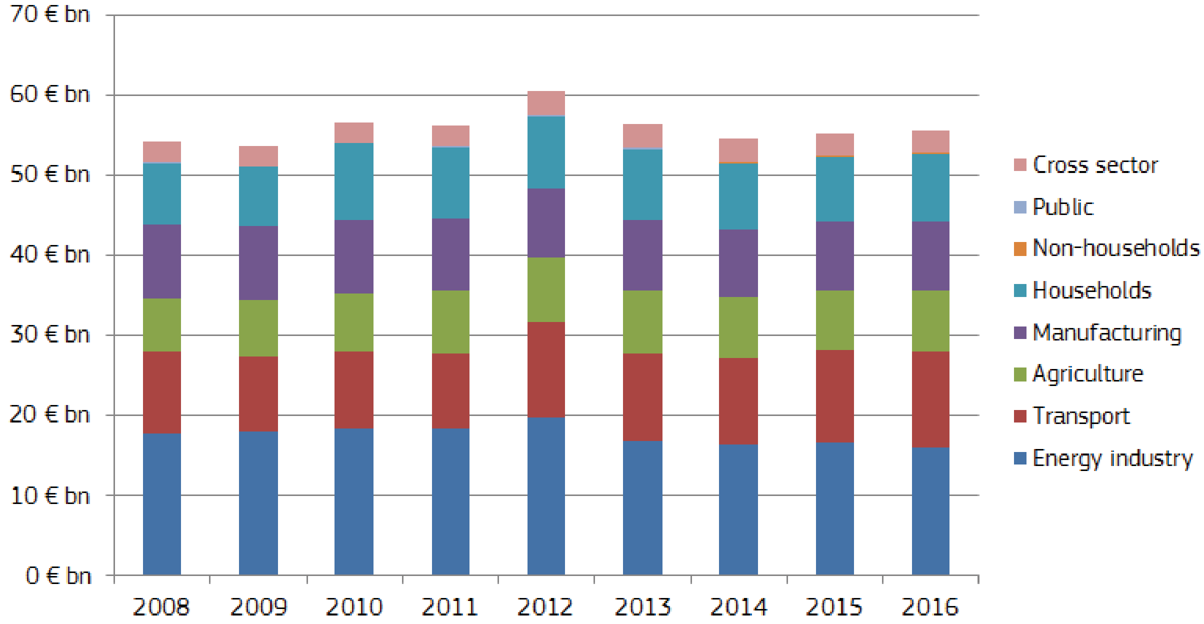

Figure 172 – Fossil fuel subsidies in different sectors in the EU

Source: DG ENER, data from Trinomics et altri study (2018)

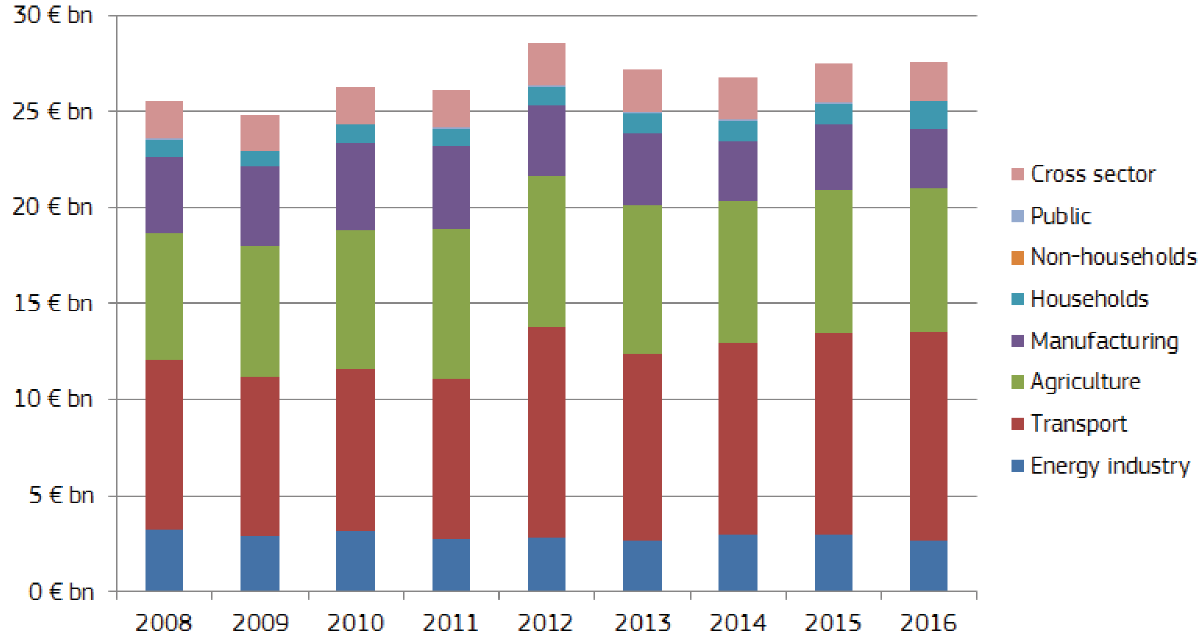

Figure 173 – Subsidies to oil and petroleum products in different sectors in the EU

Source: DG ENER, data from Trinomics et altri study (2018)

7.2.2 Sectors receiving subsidies beyond the energy industry

It is worth taking a look at the other non-energy sectors (**Figure 174**) consuming energy and receiving energy-related subsidies.

In the case of *Households*, receiving €24 bn of subsidies in 2016, the largest part of subsidies was assigned to Electricity (€8.2 bn), followed by natural gas (€7 bn). The third largest category was other subsidies (€3.7 bn) in 2016 and heating and cooling also received €1.8 bn as subsidy. Most of these subsidies for households covered fuel payments for given types of households, energy savings measures, investments for refurbishment of housing to enhance energy efficiency, price support measures or reduced taxes for household energy consumption. Consumption of electricity is also subsidised, for example in some countries households electricity consumption falls under a preferential VAT rate, or face reduced excise taxes. Households also received subsidies through regulated electricity and natural gas prices. The uptake of renewable energy generation by households is also subsidised in many Member States.

Manufacturing industry (mainly the energy intensive industries) received €18 bn in the form of energy related subsidies in 2016. Around 35% of the total support in the sector could be assigned to electricity consumption (€6.4 bn in 2016). In the case of large energy consumers (energy intensive industries) the preservation of the international competitiveness for their products is ensured by preferential electricity tariffs or exemptions/reductions from energy taxes, costs of carbon emission and other climate policy measures (renewables levies or carbon taxes). Subsidies to petroleum products (€3 bn in 2016) could also be observed, mainly in the chemical industries and in the form of exemption from excise duties. The remaining part of subsidies in the energy sector could be assigned to general fossil fuel measures (€ 3bn), coal and lignite (1.8 bn).

The *Transport* sector received €13 bn energy-related subsidies in 2016. More than 80% of that support (around €11 bn) could be linked to oil and petroleum products, mainly in the form of preferential tax and excise duty rates (exemptions or partial refund) for transport vehicles consuming petroleum products. Support to natural gas used in road transport amounted to €1 bn and support for the use of electricity in rail transport was € 600 million. Subsidy in the form of free emission allowances to air transport amounted to €4.4 bn in 2012 but decreased to only €158 million in 2016. This is because the EU has decided to lmit the EU ETS to intra-EEA flights in light of ICAO Resolution of 2016[112]. Support to biofuels use in road transport (biofuel blending) through reduced excise taxes amounted to around 700 million euros in 2016.

In 2016 the total support to *Agriculture* amounted to €8 bn. The overall majority (96% in 2016) of the total support could be attributed to the consumption of petroleum products. This mainly covered support to fuel consumption (reduced tax rates, exemptions from excise taxes or refunds). Renewables also received support, mainly to support investments in energy efficiency. There were some individual cases when natural gas and electricity consumption in the agricultural sector received subsidies (e.g.: heating of greenhouses) under conditions to invest in energy efficiency.

As miscellaneous category, '*Cross sector'* includes mainly general energy measures, aiming at energy savings or investments in more energy efficient products, or other measures directly not attributable to one single sector or generation technology.

[112] The 2016 ICAO General Assembly Resolution sets out the objective and key design elements of the global scheme, as well as a roadmap for the completion of the work on implementing modalities. In June 2018, ICAO endorsed the Standard and Recommended Practises (SARP) detailing the Carbon Offsetting Scheme for International Aviation due to start for its voluntary phase in 2021. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) aims to stabilise CO2 emissions at 2020 levels by requiring airlines to offset the growth of their emissions after 2020. As of 29 June 2018, 73 States, representing 75.96% of international aviation activity, intend to voluntarily participate in CORSIA from its outset. In accordance with the EU ETS Directive, the Commission will then assess the key features of CORSIA and consider ways to implement CORSIA in Union law, taking into account the Union economy-wide greenhouse gas emission reduction commitment for 2030.

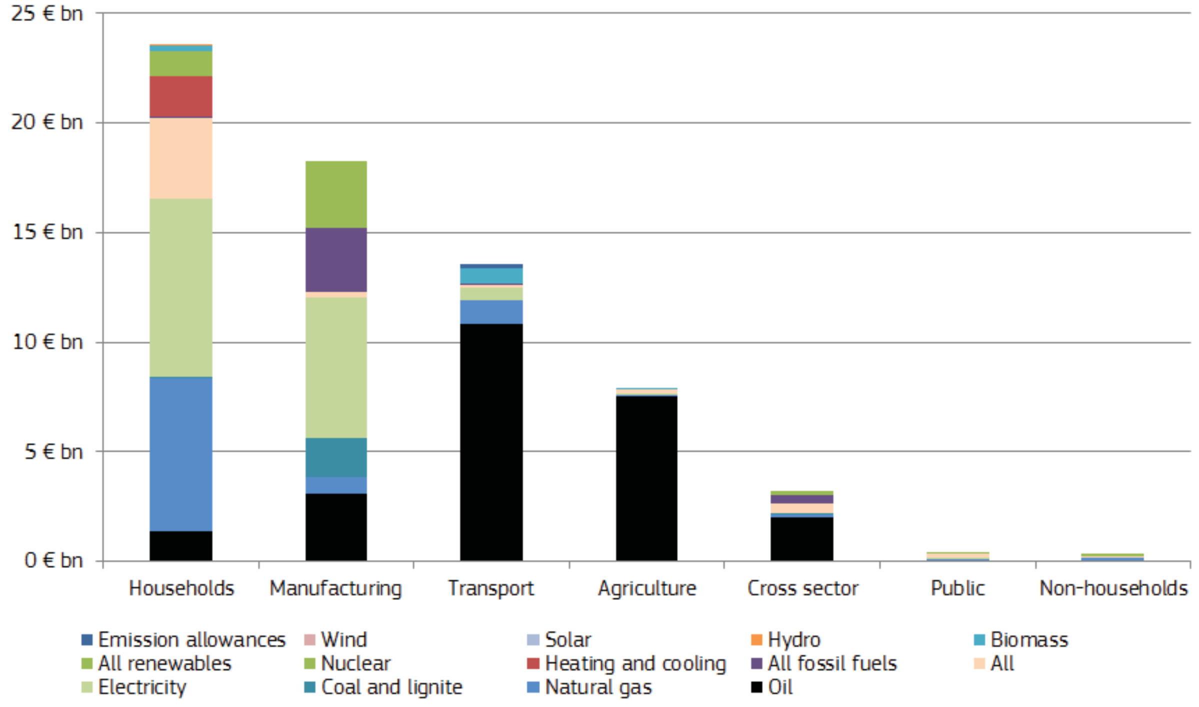

Figure 174 – Distribution of support among energy sources in 2016 in the EU

Source: DG ENER, data from Trinomics et altri study (2018)

7.3 Impact of subsidies on energy prices for consumers

Beyond setting up an inventory of subsidies, it is essential to analyse their impact on the energy markets. In this subchapter we are looking at how different types of subsidies impact wholesale and retail electricity and gas prices for different types of consumers (energy intensive industries, medium-sized industrial energy consumers and households).

Subsidies can impact wholesale electricity prices, as for example higher penetration of renewable energy sources in the electricity mix, as it can be seen in Chapter 1.1, will lead to lower prices in the market. Electricity production subsidies, such as Feed-in-Tariff and/or investment grants, are likely to have affected the electricity generation mix. Through these impacts on the electricity generation mix, the electricity production subsidies could have had subsequent (indirect) impacts on wholesale electricity prices, due to the merit order effect.

For many countries in the EU, if support for renewables did not exist, less renewables capacity would have been installed over the past ten years: these emerging technologies would not have initially been able to compete with other generation technologies, due to the large initial investment cost required and relatively high levelised costs of electricity generation

The underlying study on energy prices and costs showed that one percent increase in the share renewable energy sources in the generation mix will drive down the wholesale price by 0.5 €/MWh in Germany, but elsewhere in the EU we have similar (or slightly lower) expectations. As modelling results show, without subsidies to production of renewable energies in Germany, the share of wind and solar together would be 8% lower in the country's electricity mix, implying that wholesale electricity prices decreased by 4 €/MWh in the consequence of subsidies to renewables.

On the other hand, wholesale gas prices, predominantly determined by import sources, are not significantly impacted by any subsidies in the EU. Due to the high import dependency, the marginal price of gas in the EU is determined by supply and demand interactions in international energy markets.

The energy prices and costs study in the EU provides some analysis on how tax relieves, grants for energy efficiency and energy demand moderation and subsidies to energy production can impact retail electricity and gas prices paid by industrial and household customers.

In the case of industrial customers it is worth comparing large consumers (energy intensive industries) and consumers with medium energy consumption. As **Figure 175** shows, energy intensive industries receive measurable subsidies in the form of tax relieves in Germany, Sweden and Finland, while in other countries and in non-energy intensive industries the support is not so significant. It is important to recall that these subsidies serve as compensation for non-recoverable taxes and levies.

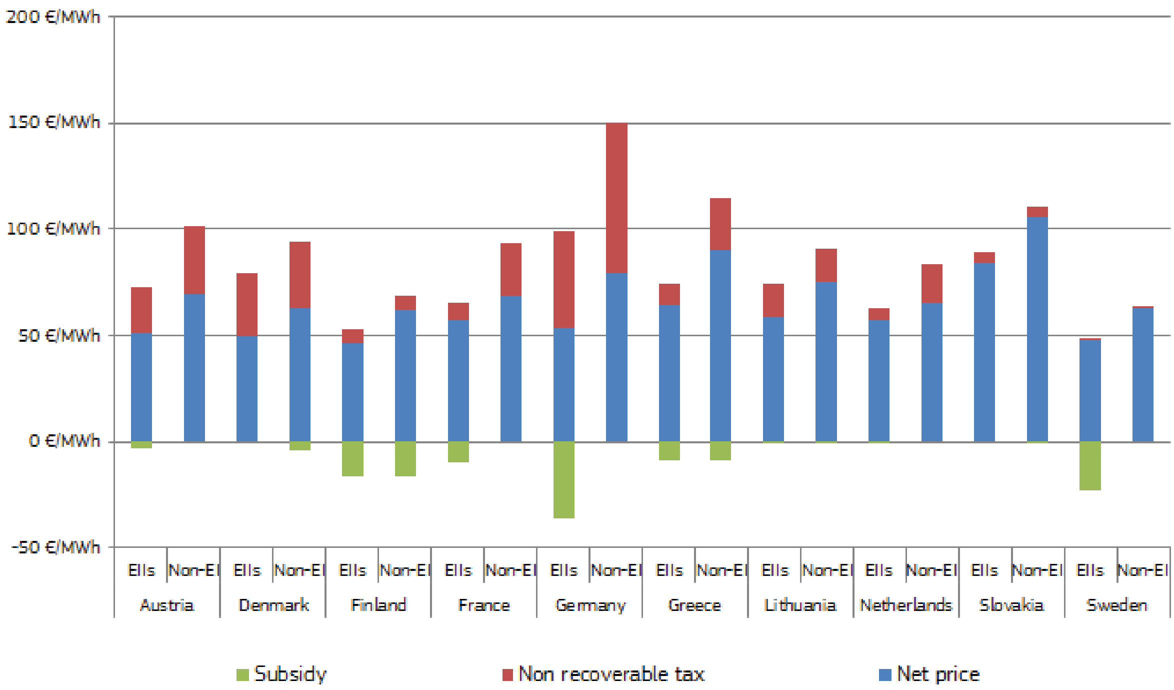

Figure 175 – Retail electricity prices, recoverable taxes and tax relieves paid by large industrial (energy intensive) and median level electricity customers in some EU Member States in 2016[113]

Source: DG ENER, data from Trinomics et altri study (2018)

In the case of natural gas, energy intensive (large consumer) industries received significant tax relieves in Austria, Finland, and some support can be observed in the UK. However, in the case of natural gas the role of taxes and levies (non-recoverable) aiming at fulfilling energy and climate policy objectives is less important than in the case of electricity.

[113] The charts on retail electricity and gas prices for energy intensive industries, business customers with medium annual electricity and gas consumption and households show how subsidies (green bar) lowered the overall retail price the customer actually paid in 2016.Otherwise said, prices without the impact of subsidies would have been greater by the amount the green bars symbolise.

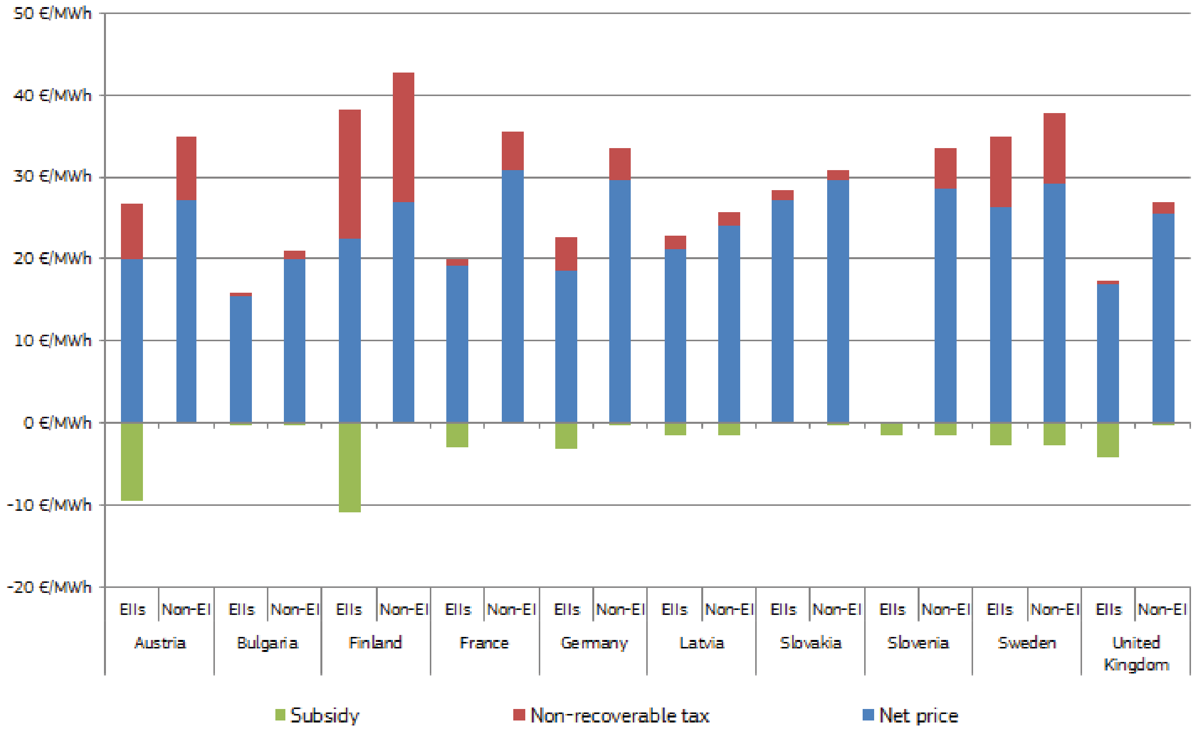

Figure 176 – Retail gas prices, recoverable taxes and tax relieves paid by large industrial (energy intensive) and median level gas customers in some EU Member States in 2016

Source: DG ENER, data from Trinomics et altri study (2018)

In households, one of the main motivations for VAT and other tax exemptions is to reduce incidence of fuel poverty, particularly where the housing stock is inefficient and of poor quality in thermal insulation, or where there is a high share of rented accommodation. **Figure 177** and **Figure 178** show the impact of tax relief for household electricity and gas prices.

The impact of energy tax relief policies on household electricity prices was the largest in the UK, where households face a reduced VAT rate of 5% for electricity and gas (compared to a standard VAT rate of 20%). Households in Latvia and Lithuania also face reduced VAT rates for heat energy, while in Denmark, there is an income tax allowance, 'the green check', to compensate for increased energy and environment costs imposed on consumers.

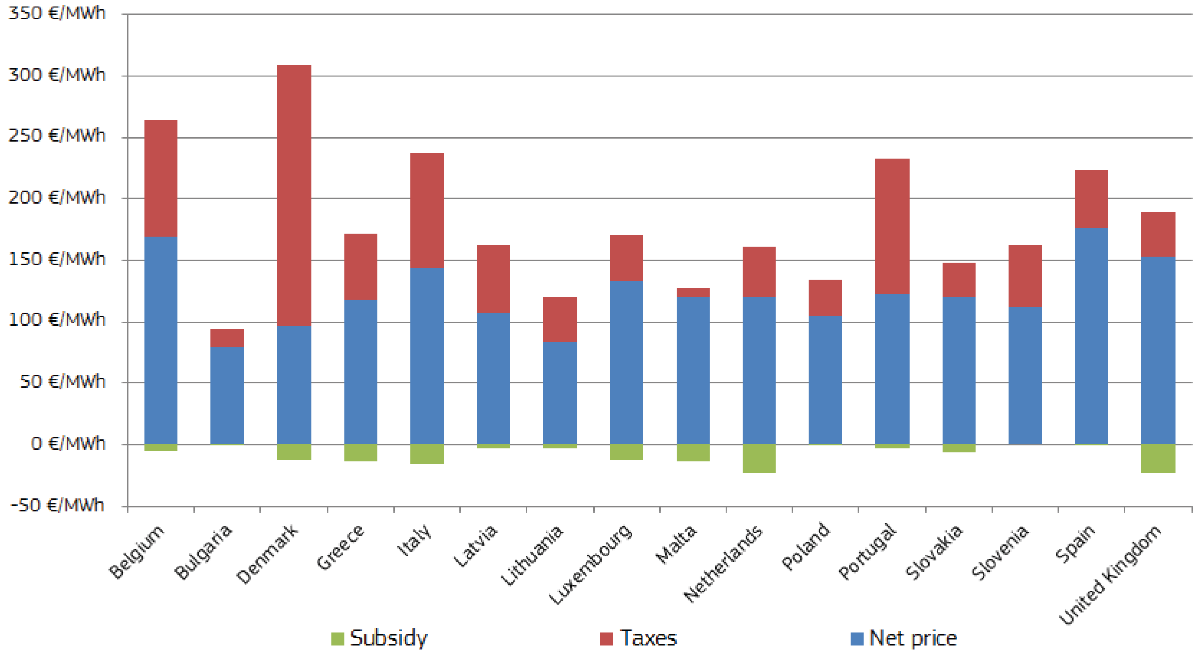

Figure 177 - Retail electricity prices, recoverable taxes and tax relieves paid by households in some EU Member States in 2016

Source: DG ENER, data from Trinomics et altri study (2018)

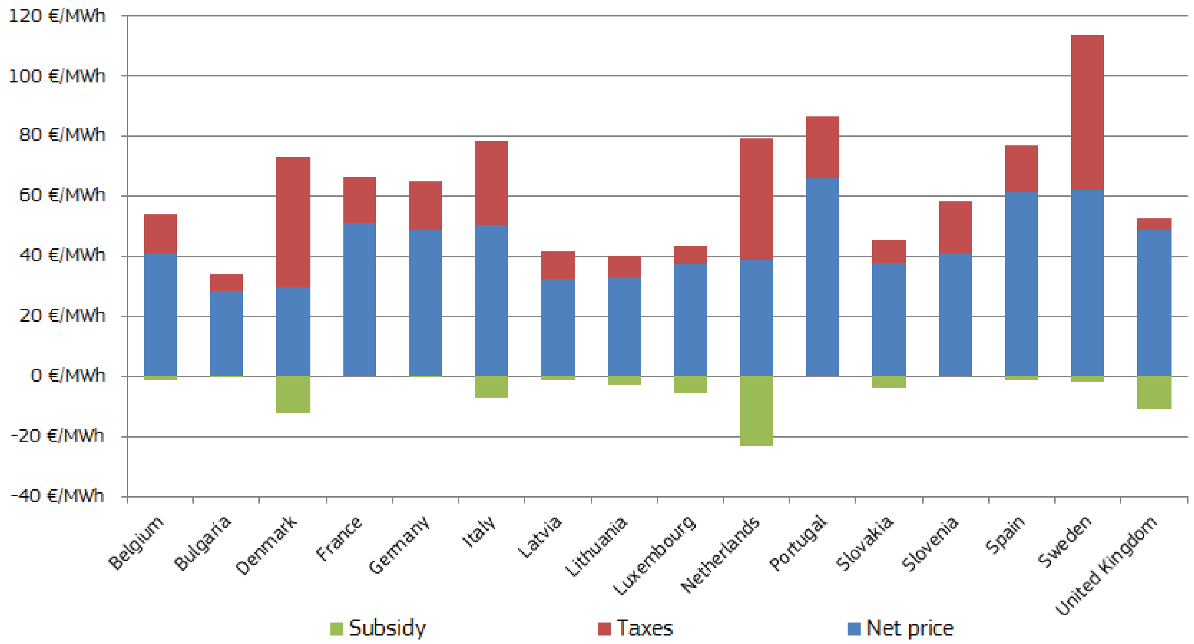

Figure 178 - Retail gas prices, recoverable taxes and tax relieves paid by households in some EU Member States in 2016

Source: DG ENER, data from Trinomics et altri study (2018)

Energy loans and grants do not have a direct impact on gas and electricity prices but do affect gas and electricity demand and, through their impact on total energy consumption, affect energy costs faced by final users. Three types of loans and grants were identified in the energy prices and costs study:

The *energy savings grants and loans* are targeted to improve energy efficiency and reduce energy consumption.

The *energy demand subsidies* reimburse consumers' energy costs and typically comprise a lump sum payment for certain energy consumers.

The *investment subsidies* include grants for energy efficiency improvements, CHP, micro-generation and other energy investments. **Figure 179** shows the impact of these measures on electricity and gas consumption.

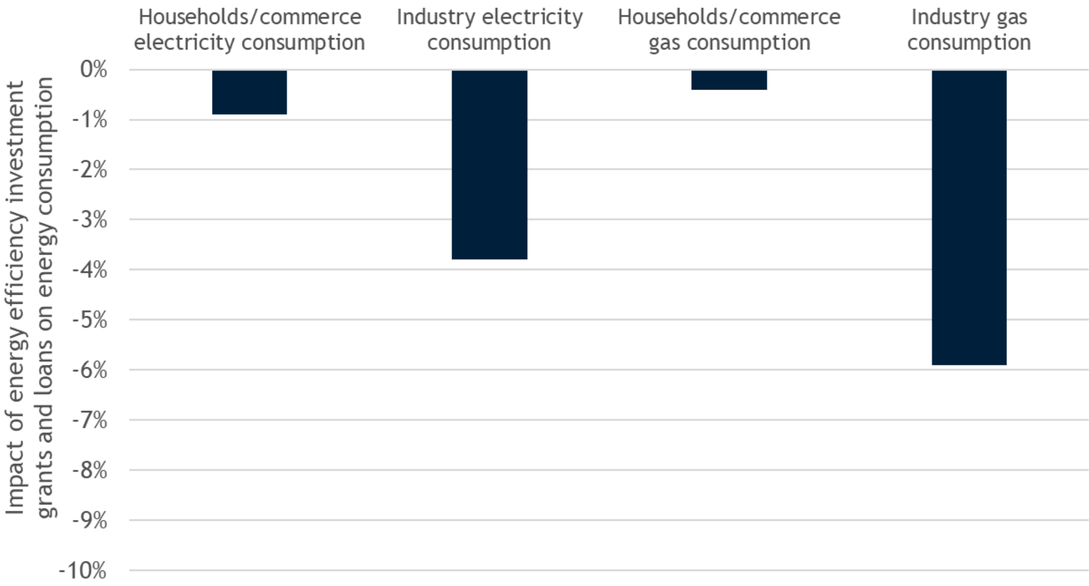

Figure 179 - The impact of loans and grants for energy efficiency measures and/or other investments on EU28 household and industry energy consumption between 2008 and 2015

Source: DG ENER, data from Trinomics et altri study (2018)

The largest impact of these support instruments could be observed in the case of industrial gas consumption and household electricity consumption, decreasing respectively by 6 and 4% between 2008 and 2015. Industrial gas consumption decreased by 40% in Latvia and by 28% in Estonia, while industrial electricity consumption fell by 38% in the Czech Republic in this period.

7.4 International comparisons of fossil fuel subsidies

At the beginning of this chapter the global initiatives on rolling back fossil fuel subsidies have been mentioned, alongside with the efforts in the EU. Although different institutions, such as the IMF, OECD, IEA, etc. use different definitions, methodology and data sources for measuring fossil fuel subsidies, often resulting in numbers being barely comparable, it is always useful to put the results of the energy prices and costs study in global comparison. Over the last few years OECD and IEA tried to merge the results of their data collection, covering 76 countries around the world. The study on energy prices and costs follows a similar methodology to that of the OECD, setting up a subsidy inventory using a bottom-up approach.

As **Figure 180** shows, the estimated global amount of fossil fuel subsidies showed an increase between 2010 and 2012, and then fell back significantly until 2015. This was mainly due to the decrease in subsidies to petroleum products, the largest share of fossil fuel support.

At global level the amount of support for fossil fuels followed closely the price evolution of crude oil and petroleum products. In many countries in the world consumption of petroleum products for final customers (e.g.: residential customers) are subsidised, using below-cost end-user prices. In the period of high oil prices, the subsidies will increase automatically if the end-user prices are to be maintained, while in parallel with decrease oil and petroleum product prices it falls back. However, over the last few years many policy measures were taken around the world (e.g.: Mexico, Middle East countries) in order to reduce such type of subsidies.

In contrast, subsidies to petroleum products in the EU countries do not show close correlation with oil prices, as most of these subsidies can be linked to tax and fixed amount of excise duty reductions and exemptions, being independent from petroleum product prices. Subsidy to natural gas showed proportionally a similar evolution to crude oil products, in parallel with high fossil fuel prices in 2012 gas subsidies also went up, however, given the different magnitudes, the amounts seem to be more stable over time on **Figure 180**. Subsidy to coal showed a high degree of stability both in the EU and on global scale.

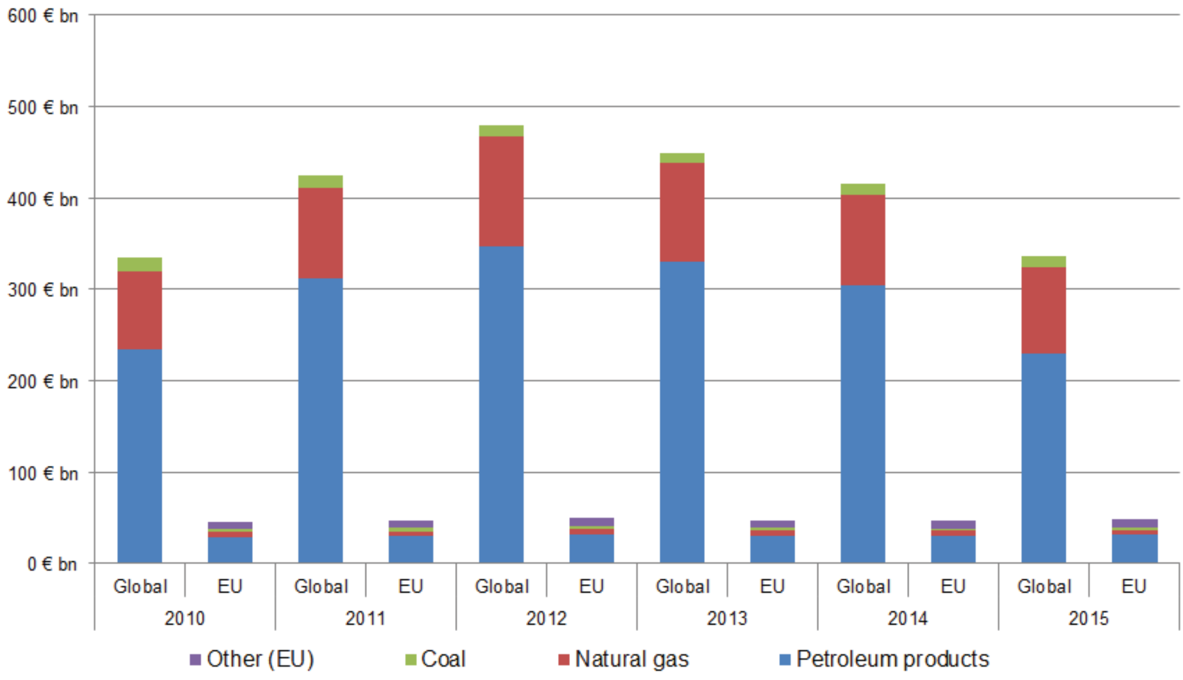

Figure 180 – Fossil fuel subsidies in the world and in the EU

Source: IEA-OECD common database (OECD companion to the Inventory of Support Measure for Fossil fuels, 2018), converted to euro and the study on Energy prices and costs in the EU

The aforementioned international institutions (IMF, IEA, OECD) have done several studies, aiming at quantifying fossil fuel subsidies over the past few years, however, since the publication of the last Energy prices and costs report at the end of 2016 no new results have been made available that cover regions beyond Europe. Nevertheless, these international institutions (especially OECD) are active in collecting data on subsidies and any updates will be taken into account at international comparisons in the next edition of this report.

8 The role of energy for government revenues and inflation

8.1 Government revenues from the energy sector

Main findings

- In 2016, energy taxes collected by EU Member States amounted to EUR 280.4 billion, equivalent to 1.88% of EU GDP. As a percentage of GDP and total tax revenue, energy tax revenue has been rather stable since the 2008 economic crisis.

- In individual Member States, the role of energy taxes in government revenues and GDP shows a significant variety: Member States with a lower GDP/capita typically have a higher share of energy taxes from both total tax revenue and from GDP.

- The energy tax revenue per 1 tonne of oil equivalent of gross inland energy consumption was EUR 171 in 2016. In real terms, this average calculated tax rate increased by 20.5% between 2010 and 2016, more than offsetting the fall of energy consumption in this period.

- Excise duties constitute the largest part of energy taxes, amounting to around EUR 244 billion in 2017. When adjusted for inflation, excise duty revenues have been rather stable in 2011-2014 but increased by 2-3%/year in 2015-2017.

- Oil products continue to dominate excise duty revenues, with a share consistently above 80%, although this share has slightly decreased over the last decade, at the benefit of gas and electricity. In 2017, the share of petroleum products was more than 50% in all Member States and more than 90% in 19 Member States.

- For the main oil products, the nominal excise duty revenue is gradually growing, driven by increasing excise duty rates and, in the last few years, rising consumption. In 2013-2015, growing excise duty revenues were offset by lower VAT revenue driven by falling oil and oil product prices. As a result, the nominal tax revenue from petroleum products has been relatively stable but in real terms the tax revenue decreased.

8.1.1 Energy taxes

Taxes and duties imposed on energy products are an important source of government revenue in EU Member States. In 2016, energy taxes[114] collected by EU Member States amounted to 280.4 billion euros. This was equivalent to 1.88% of EU GDP and 4.70% of total revenues from taxes and social contributions (including imputed social contributions).

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[114] Energy-related environmental taxes as defined in "Environmental taxes – A statistical guide" (http://ec.europa.eu/eurostat/documents/3859598/5936129/KS-GQ-13-005-EN.PDF/706eda9f-93a8-44ab-900c-ba8c2557ddb0?version=1.0); this category includes taxes imposed on energy production and on energy products used for both transport and stationary purposes, as well as on greenhouse gases but does not include VAT imposed on energy products

While nominal energy tax revenues increased by 27% between 2009 and 2016 (on average by 3.5%/year), as a percentage of GDP and tax revenue they remained relatively stable, showing only a marginal increase in this period.

According to the estimations of the Commission's Taxation and Customs Union Directorate-General, around 70% of energy tax revenues come from transport fuels.[115]

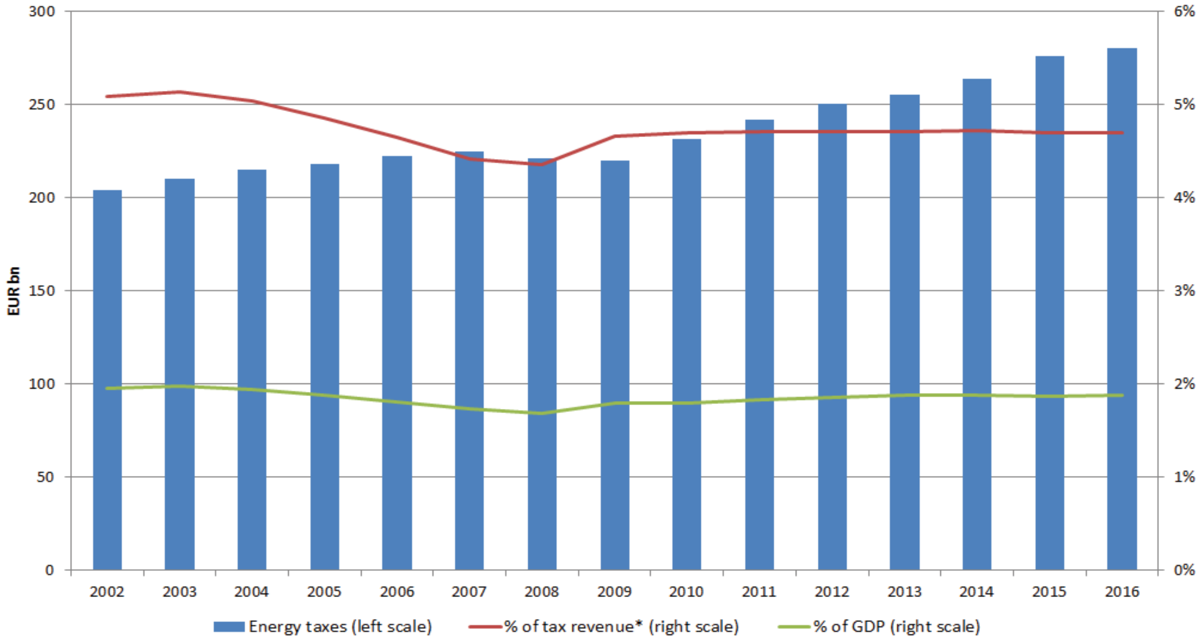

Figure 181 - Energy taxes in the EU-28

Source: Eurostat (data series env_ac_tax)

*percentage of total revenues from taxes and social contributions (including imputed social contributions)

Looking at individual Member States, the role of energy taxes in government revenues shows a significant variety: in 2016, energy taxes in Latvia made up 9.85% of total revenues from taxes and social contributions (including imputed social contributions) while this share was only 3.03% in Belgium. When compared to the GDP, energy tax revenue was highest in Slovenia (3.28%) and lowest in Ireland (1.12%). Typically, Member States with a lower GDP/capita have a higher share of energy taxes from both total tax revenue and from GDP.

[115] Taxation Trends in the European Union (2018); https://ec.europa.eu/taxation_customs/sites/taxation/files/taxation_trends_report_2018.pdf

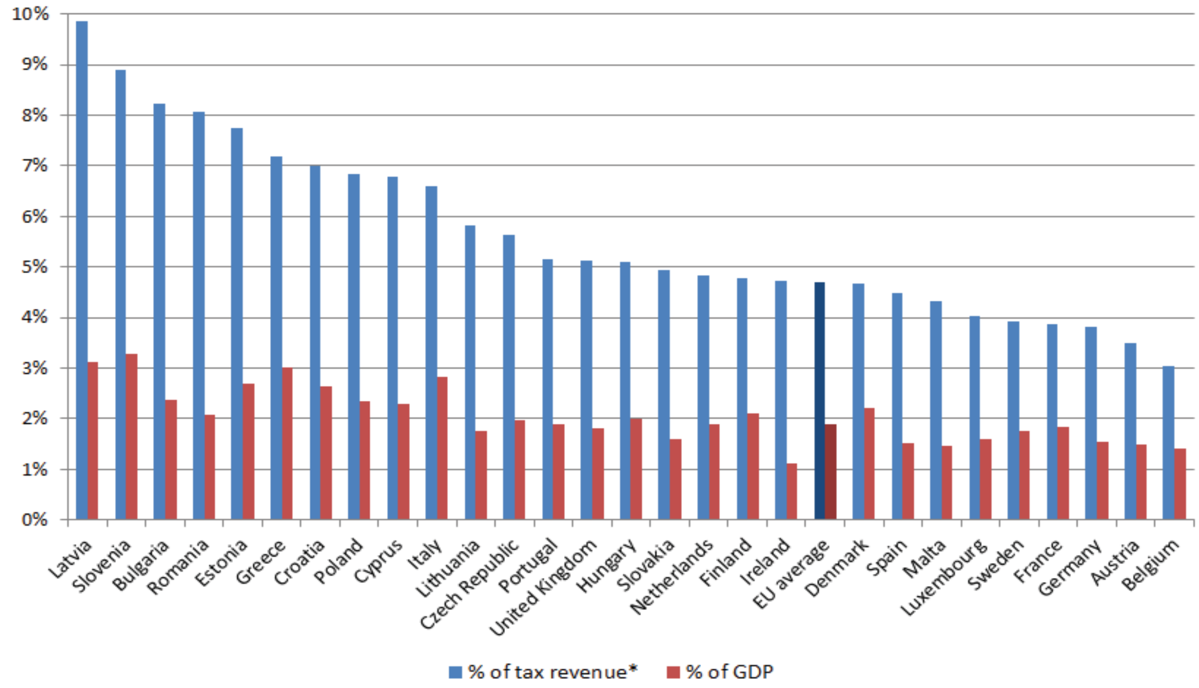

Figure 182 - Energy taxes as a percentage of tax revenue and of GDP in 2016

Source: Eurostat (data series env_ac_tax)

*percentage of total revenues from taxes and social contributions (including imputed social contributions)

Households are the main contributors to energy tax revenues: in 2015, they payed 46% of total energy taxes. This represents a small decrease compared to 2009 when this share reached 50%. From economic activities, transportation, manufacturing and other services were the three sectors paying the largest amount of energy taxes in 2015, with 12%, 11% and 10% of total energy taxes, respectively.

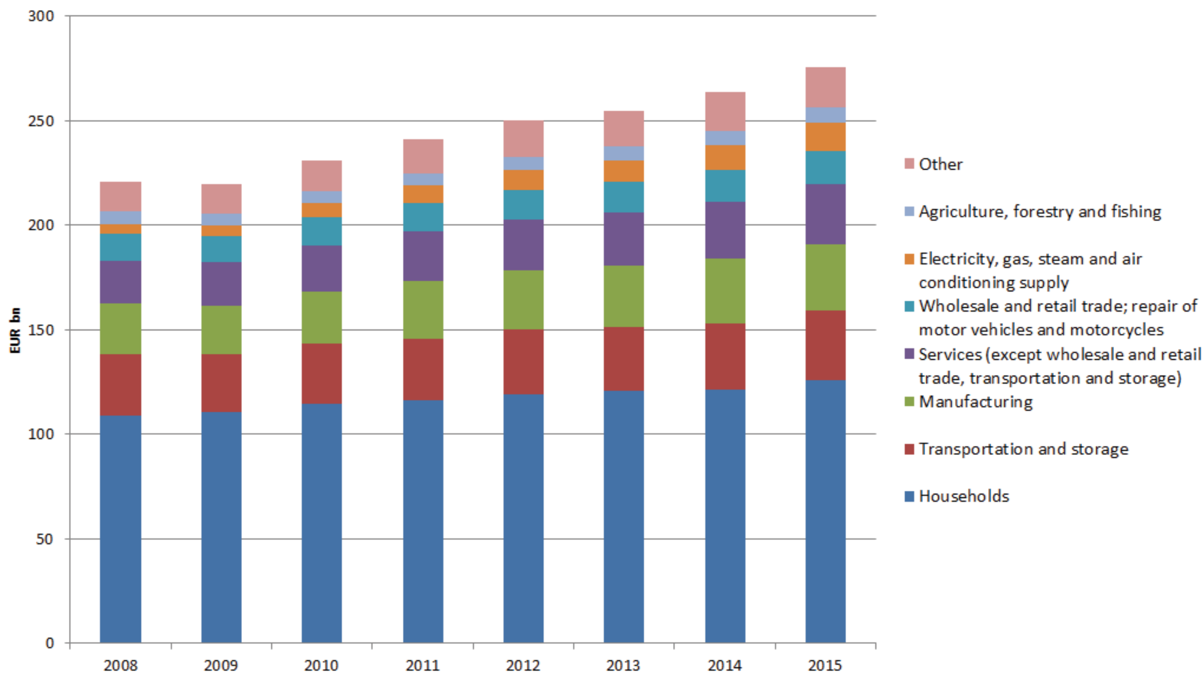

Figure 183 - Energy taxes by economic activity

Source: Eurostat (data series env_ac_taxind2)

The underlying tax base of energy taxes declined in the last decade: the EU's gross inland energy consumption decreased by 12.6% between 2006 and 2014, followed by a slight increase in 2015 (+1.3%) and 2016 (+0.7%). This decline was more than offset by the increase of the average calculated tax rate which increased from EUR 121 per 1 tonne of oil equivalent (toe) of gross inland energy consumption in 2006 to EUR 171/toe in 2016.

When allowing for inflation, the average calculated tax rate decreased between 2002 and 2010 (with a dip in 2008) but increased afterwards. Between 2010 and 2016, the real tax burden increased by 20.5% (by 3.2%/year), from EUR 142/toe to EUR 170/toe (both measured in 2015 euros).

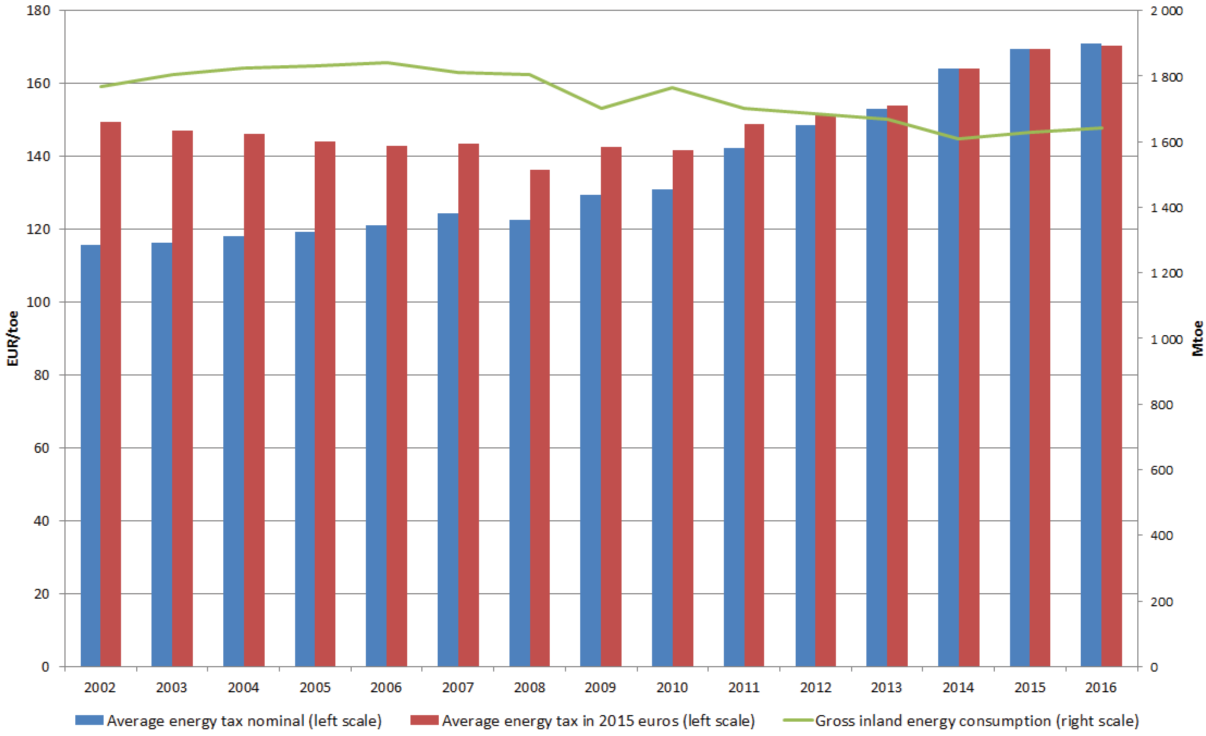

Figure 184 – Average energy tax for 1 toe of gross inland energy consumption in the EU-28

Source: DG Energy calculation based on Eurostat data (data series env_ac_tax, nrg_100a and prc_hicp_aind)

On average, the energy tax revenue per 1 toe of gross inland energy consumption was EUR 171 in 2016, but there was a huge variation across Member States, from EUR 63 in Bulgaria to EUR 352 in Denmark. Member States with higher GDP and a higher share of oil in the energy mix tend to have higher energy taxes per 1 toe of gross inland energy consumption.

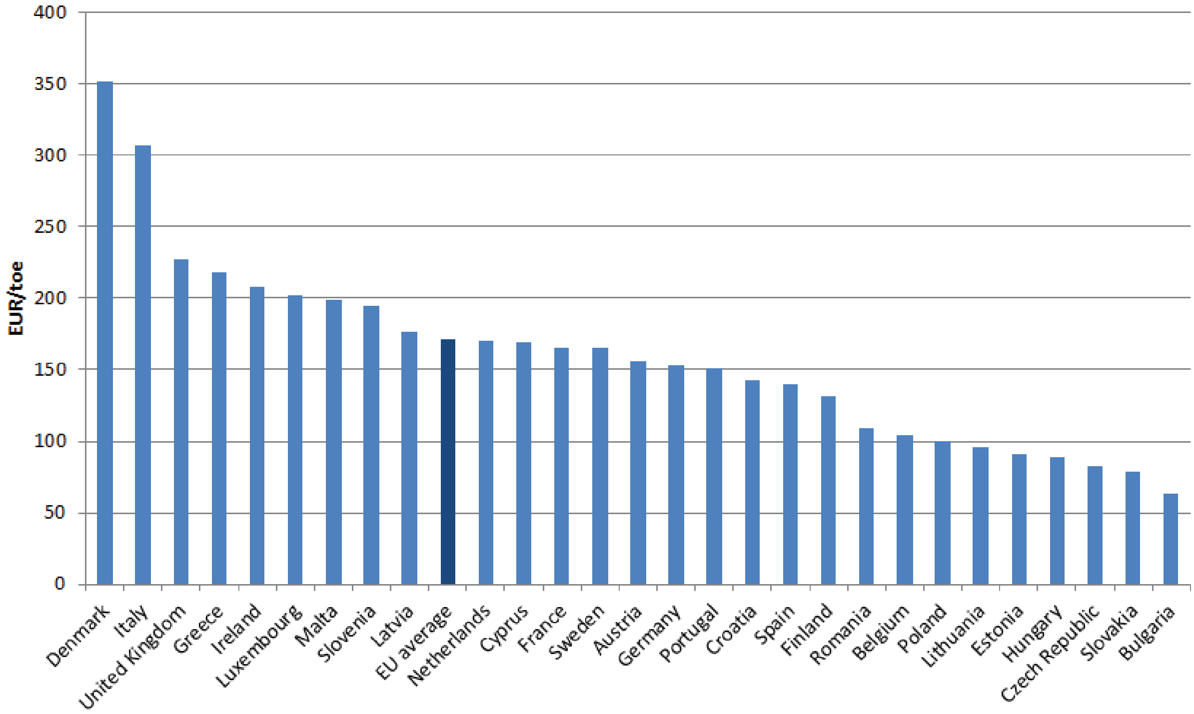

Figure 185 – Average energy tax for 1 toe of gross inland energy consumption in 2016

Source: DG Energy calculation based on Eurostat data (data series env_ac_tax and nrg_100a)

8.1.2 Excise duties

Excise duties constitute the largest part of energy taxes.

Excise duties are indirect taxes imposed on the sale or use of specific products, typically alcohol, tobacco and energy products. All revenue from excise duties goes to the budgets of Member States. Excise duties are set in absolute values, i.e. as a fixed amount per quantity of the product (e.g. per litre/kg/GJ/MWh). Accordingly, assuming that the rates don't change, the revenue will depend on the consumption of the specific product. In contrast, price changes should not impact revenues (at least not directly).

Current EU rules for taxing energy products are laid down in Council Directive 2003/96/EC174[116] (the Energy Tax Directive), which entered into force on 1 January 2004. The Directive covers petroleum products (gasoline, gasoil, kerosene, LPG, heavy fuel oil), natural gas, coal, coke and electricity. In addition to establishing a common EU framework for taxing energy products, the Directive sets minimum excise duty rates.

The Commission's Taxation and Customs Union Directorate-General (TAXUD) regularly publishes the excise duty rates applicable in EU Member States[117] and the revenue from excise duties[118].

[116] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:283:0051:0070:EN:PDF

[117] https://ec.europa.eu/taxation_customs/sites/taxation/files/resources/documents/taxation/excise_duties/energy_products/rates/excise_duties-part_ii_energy_products_en.pdf

[118] https://ec.europa.eu/taxation_customs/sites/taxation/files/resources/documents/taxation/excise_duties/energy_pro

As far as revenues are concerned, the latest available data relate to 2017.[119] According to these data, excise duty revenues amounted to EUR 244 billion in 2017. From 2009, total revenue shows an increasing trend.

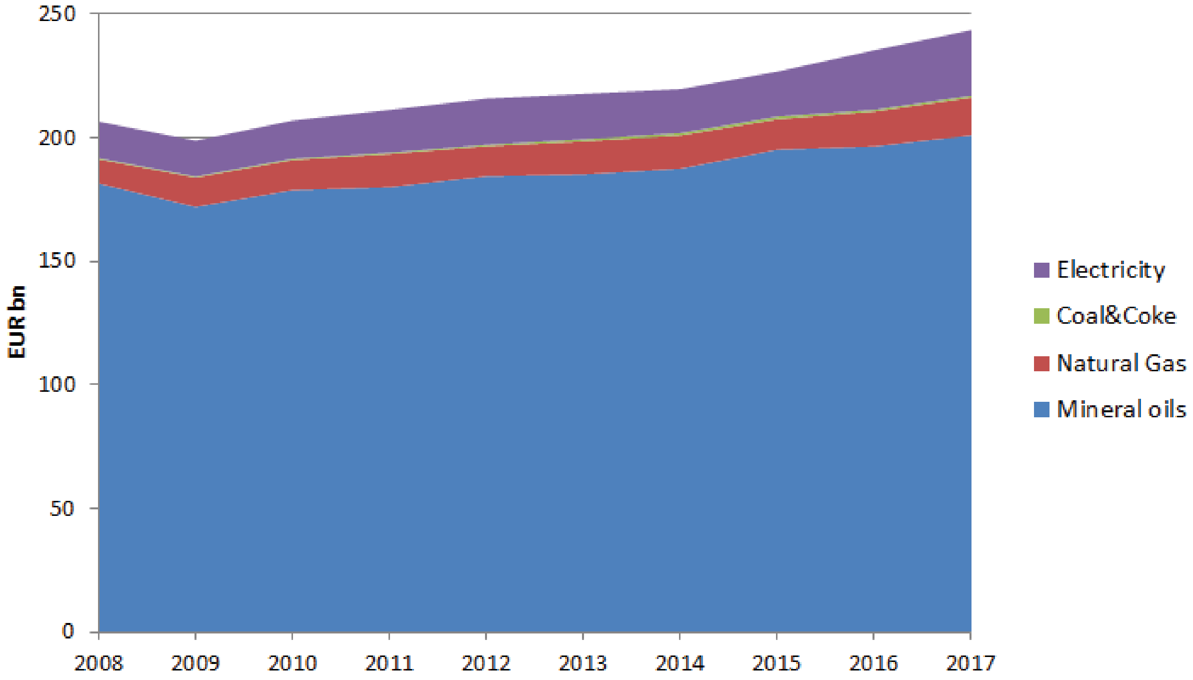

Figure 186 - Excise duty revenues from energy consumption

Source: DG Taxation and Customs Union

If adjusted for inflation, excise duty revenues have slightly decreased between 2008 and 2014: measured in 2015 euros, they amounted to EUR 230 billion in 2008 and EUR 220 billion in 2014. In the last here years (2015-2017), however, real revenues increased by 3.4%, 3.5% and 1.9%, respectively.

ducts/rates/excise_duties_energy_products_en.pdf (at the time of writing the report, this document included revenue data for the period 2008-2017)

[119] 2017 figures were not available for the UK; therefore, for this country, 2016 figures were used instead.

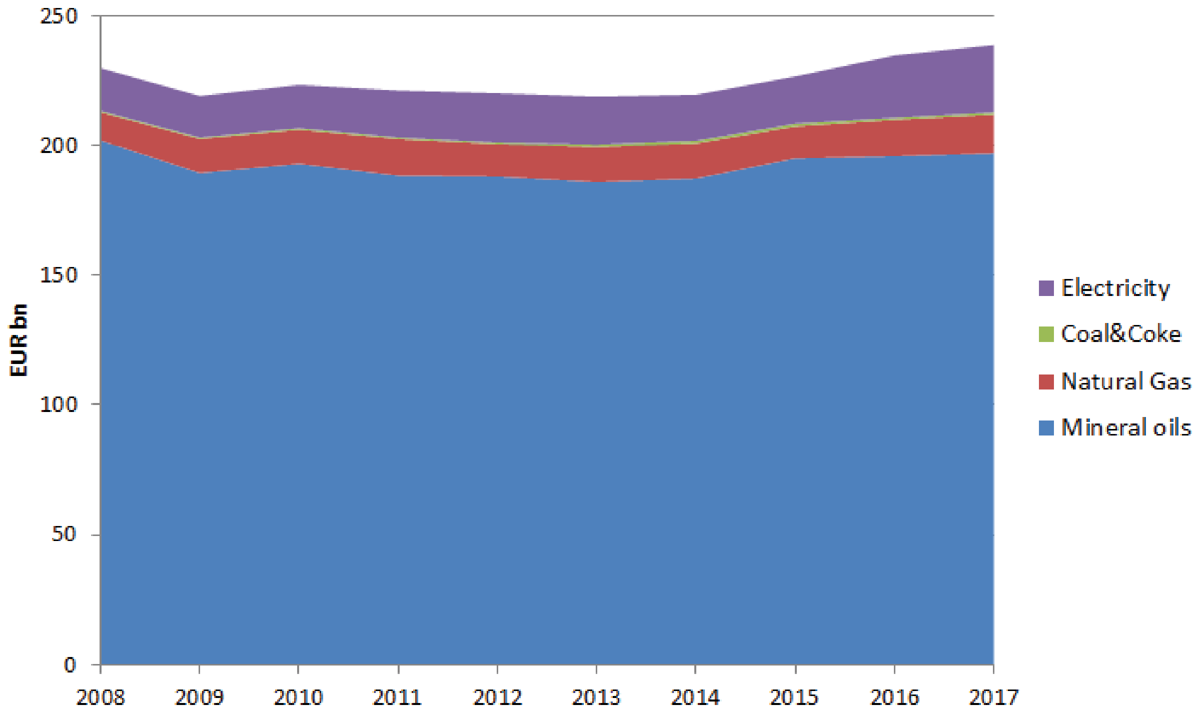

Figure 187 - Exercise duty revenues from energy consumption, adjusted for inflation (in 2015 euros)

Source: DG Taxation and Customs Union, adjusted by HICP

In 2017, oil products were the main source of excise duty revenue, covering 82.5% of all excise duty revenue from energy products. The rest was shared by electricity (10.9%), gas (6.3%) and coal (0.3%).

The share of oil products from total revenues decreased from 87.8% in 2008 to 82.5% in 2017 mainly at the benefit of gas and electricity.

Between 2008 and 2017, revenues from taxes on oil products increased by 10.8%, on gas by 55.3%, on electricity by 78.3% and on coal by 93.7%. In this 9-year period, inflation measured by the Harmonised Index of Consumer Prices (HICP) was 13.5%.

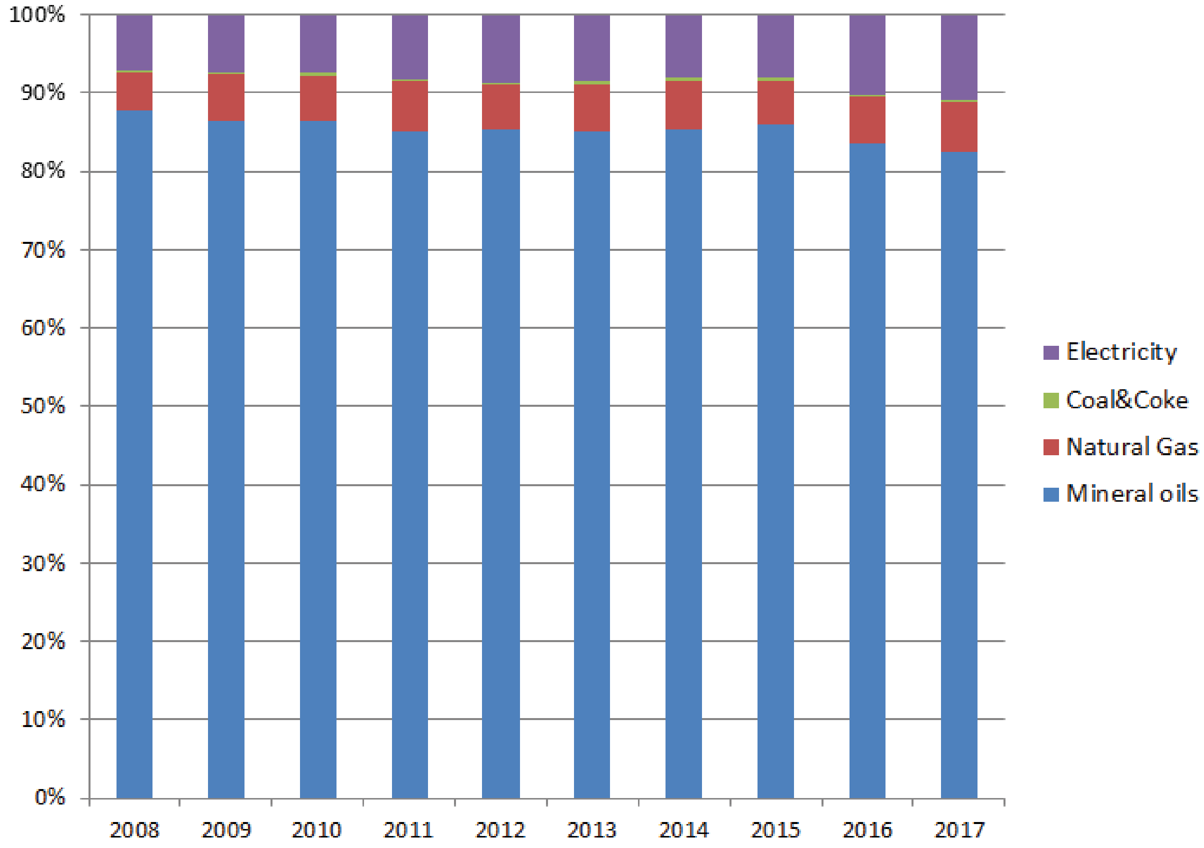

Figure 188 - The share of excise duty revenues by energy product

Source: DG Taxation and Customs Union

Oil products make up more than 60% of the excise duty revenue in all Member States except Denmark; in 19 Member States they make up more than 90%.

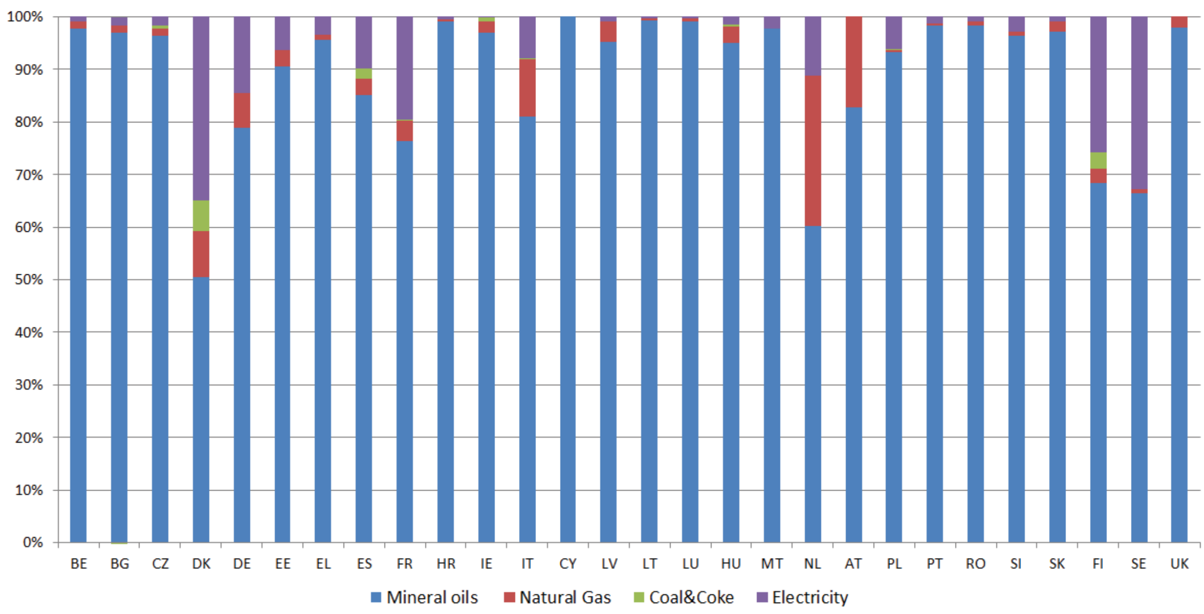

Figure 189 - The share of excise duty revenues by energy product, 2017

Source: DG Taxation and Customs Union

8.1.3 Value added tax (VAT)

VAT imposed on energy products is another important source of government revenue. However, unlike for excise duties, there is no publicly available data for VAT revenues from energy products.

The VAT is a general consumption tax assessed on the value added to goods and services. It applies to practically all goods and services (including energy products) that are bought and sold for use or consumption in the EU. The VAT is borne ultimately by the final consumer; companies can reclaim the VAT they pay on the products and services they use as an input. VAT is charged as a percentage of the price which means that an increase of the price will entail an increase in the tax revenue and vice versa.

The VAT Directive (2006/112/EC)[120] requires that the standard VAT rate must be at least 15% and Member States can apply one or two reduced rates of at least 5% but only to goods or services listed in Annex III of the Directive (energy products are not in the list). In addition, there are multiple exceptions to the basic rules (usually with conditions/deadlines), including

- possibility of reduced rates for goods and services other than those listed in the directive (e.g. Article 102 allows the use of reduced rate to the supply of natural gas, electricity and district heating, "provided that no risk of distortion of competition thereby arises");
- several country-specific exceptions, including the permission to use "super reduced" rates under 5% (including zero rates) for certain (including energy) products.

The EU-28 average standard VAT rate increased by 2 percentage points between 2008 and 2015 but has been rather stable since then: it was 21.5% in 2016 and 2017 and also at the start of 2018. Hungary has the highest VAT standard rate (27 %), followed by Croatia, Denmark and Sweden (all 25%). Luxembourg (17%) and Malta (18%) apply the lowest standard rate.

Figure 190 - The average standard VAT rate in the EU

Source: DG Taxation and Customs Union

About half of the Member States use reduced VAT rates for certain energy products, mainly gas, electricity, district heating, firewood and heating oil. Of course, this has an impact on household retail prices and partly explains the price differences across Member States. For

[120] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:347:0001:0118:en:PDF

example, the applicable VAT rate for gas and electricity ranges from 5% to 27%. DG TAXUD regularly publishes the VAT rates applied by Member States for different product groups/services.[121]

As a follow-up of the Action Plan on VAT[122], the Commission adopted a number of legislative proposals related to the VAT system with the objective of working towards the completion of a single EU VAT area. On 18 January 2018, a proposal was adopted to introduce more flexibility for Member States to change the VAT rates they apply to different products. According to the proposal, the current list of goods and services to which reduced rates can be applied would be abolished and replaced by a new "negative" list to which the standard rate of 15% or above would always be applied. The proposed "negative list" contains most oil products, requiring the application of the standard rate. On the other hand, Member States would continue to be able to apply a reduced rate for electricity, gas, LPG, district heating and firewood.[123]

8.1.4 Tax revenues from oil products

Oil products, especially motor fuels, are the main source of tax revenue from the energy sector for government budgets. Data from the Weekly Oil Bulletin[124] allows a more detailed analysis of tax revenues from petroleum products, including an estimation of VAT revenues (assuming that no VAT is reclaimed).

Our analysis covers the three main petroleum products sold in the retail sector: gasoline (Euro-super 95), diesel (automotive gas oil) and heating oil (heating gas oil). For most Member States, the analysis covers the years 2005-2017, except Bulgaria (2008-2017), Croatia (2013-2017) and Romania (2008-2017).

For each year and each Member State, an average price was calculated as an arithmetic average of the weekly prices. The EU average price was then calculated as the weighted average of these. In the absence of 2017 annual consumption figures, for 2017 we used the 2016 consumption data as the weight.

Based on the development of consumption, consumer prices and their components, we estimated the tax revenues collected by Member States. It is important to underline that most enterprises can reclaim the VAT they pay, so the calculated VAT revenue is a theoretical maximum; the actual VAT revenue collected by Member States must be significantly lower.

The estimated revenue from excise duties shows an increasing trend between 2005 and 2017. Although the combined consumption of the three product groups decreased between 2008 and 2014, this was largely offset by the increase of the average excise duty rates. If adjusted for inflation, however, excise duty revenues slightly decreased in this period. Supported by the low oil prices and the economic recovery, fuel consumption increased in 2015-2016, giving a boost to excise duty revenues.

As the VAT is an ad valorem tax, the estimated (theoretical) VAT revenue is fluctuating in line with the net price. Accordingly, it decreased from 97.5 billion euros in 2012 to 76.7

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121 https://ec.europa.eu/taxation_customs/sites/taxation/files/resources/documents/taxation/vat/how_vat_works/rates/vat_rates_en.pdf

122 https://ec.europa.eu/taxation_customs/sites/taxation/files/com_2016_148_en.pdf

123 http://europa.eu/rapid/press-release_IP-18-185_en.htm

124 https://ec.europa.eu/energy/en/statistics/weekly-oil-bulletin

billion euros in 2016 (a decrease of 21%). In the same period, the estimated excise duty revenue increased from 180.3 billion euros to 192.6 billion euros (an increase of 7%). In line with rising fuel prices, estimated VAT revenues increased in 2017 while the estimated excise duty revenue was practically unchanged compared to 2016.

Assuming that roughly half of the VAT is reclaimed (i.e. the actual VAT revenue is half of the theoretical value depicted on the below graph), the increase of excise duty more or less offset the decrease of the VAT revenue in 2012-2016, resulting in a relatively stable tax revenue from petroleum products. When adjusted for inflation, this means the value of the tax revenue has slightly decreased.

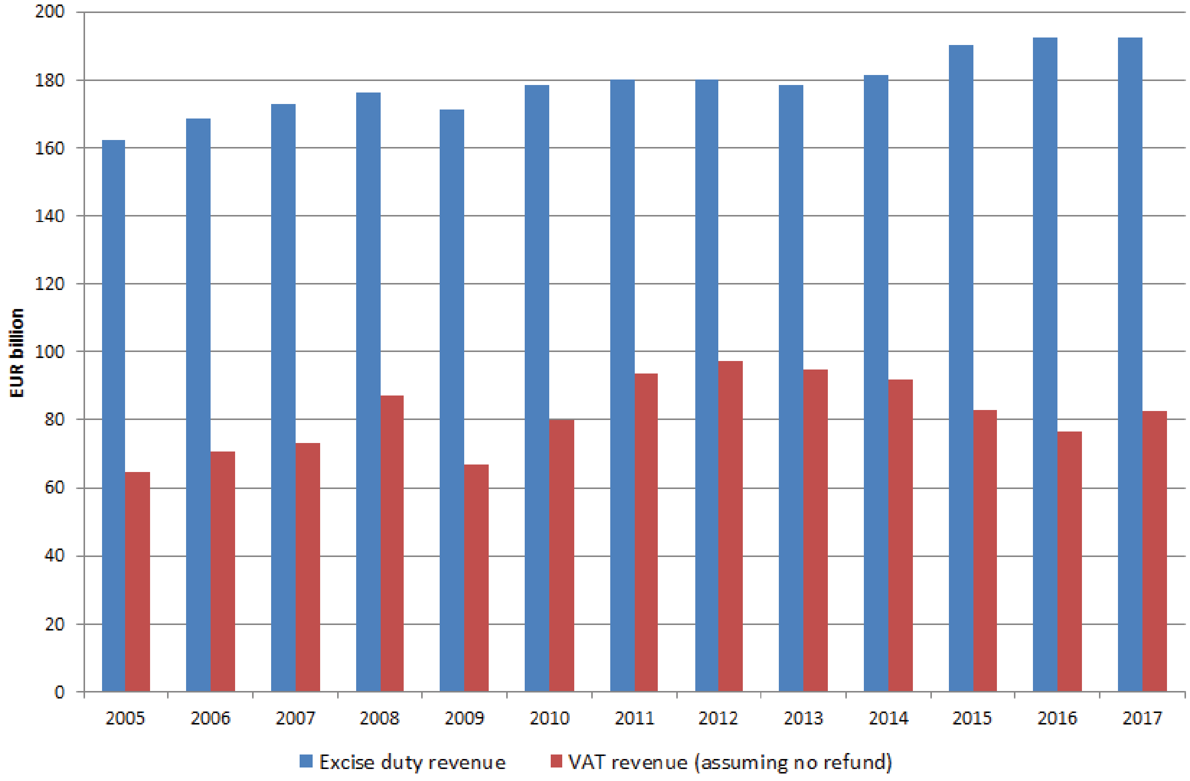

Figure 191 - Estimated tax revenue from gasoline, diesel and heating oil

Source: DG Energy calculation

PART IV

Prices and Costs and Future Investments

9 Prices and costs and future investments

Main Messages

— Future electricity production costs are projected to follow diverging trends: higher cost components for fossil fuel power plants (import prices, carbon price), lower for renewables, notably for solar and wind (decreasing investment cost, higher capacity factor) (section 9.2.1).

— In a context of a slowly increasing demand for electricity, and an ageing fossil fuel fleet, the projected range for future electricity prices is similar to the range of costs of mature RES technologies. This means that, beyond market prices, less (or even zero) public support would be needed for enabling investments in the most mature RES technologies (section 9.3).

— The future range of prices is projected below the cost ranges for the fossil fuel technologies. Future electricity prices are expected not be encouraging additional investments in new fossil fuels capacity, which is expected to steadily decline driven are old plants are decommissioned (sections 9.4 and 9.5).

9.1 Introduction and definitions

Very significant investments in the electricity market will be needed to enable the transition into a low carbon energy system over the coming decades. There will be even more important needs in the future in the light of the expected increasing electrification of our energy system.

In this chapter we look at the impact that prices can have on triggering investments in electricity markets. Prices need to cover total production costs to generate profits. Without the existence of current or expected market profits it will be difficult that investments are undertaken. When market profits are not sufficient government can intervene and offer public support to make investments possible if they consider those investments beneficial for the society.

In this section we look forward, up to 2030, and we assess to which extent current and future market prices are expected to be encouraging the additional investments in the various electricity technologies. In our analysis we also look at the main factors that can drive future electricity prices like the future carbon price and the prices of fossil fuels (oil, coal and gas) which are directly or indirectly relevant for producing electricity.

We compare in this section observed electricity prices, expected electricity prices in 2030 and expected electricity production costs in 2030 in the EU.

- Historical electricity prices considered in the analysis are the hourly day-ahead prices[125] observed in different power markets in the EU28.
- Expected hourly electricity prices in 2030 computed[126] as the hourly marginal cost of production.
- Production costs are expressed as levelised cost of electricity (LCOE), which include fixed costs per produced kWh (investment, amortization) and variable costs per produced kWh (fuel cost including losses, CO_2 emission costs, O&M). The LCOE per technology type thus depends on the projected load factor. Costs are shown both for new investments and for the overall power mix.

Prices and costs per markets are averages, weighted over electricity produced, of prices and costs per Member State belonging to the market.

Volumes traded on day-ahead markets have been increasing over time, and were equivalent to around 50% of the total consumption of electricity in 2016 (**Figure 192**). In some European regional market like Nord Pool or the Iberian Peninsula this ratio is close to 100%. This reflects the growing importance of these markets for the electricity system.

[125] day-ahead wholesale daily average baseload contracts
[126] Using the METIS model, see: https://ec.europa.eu/energy/en/data-analysis/energy-modelling/metis

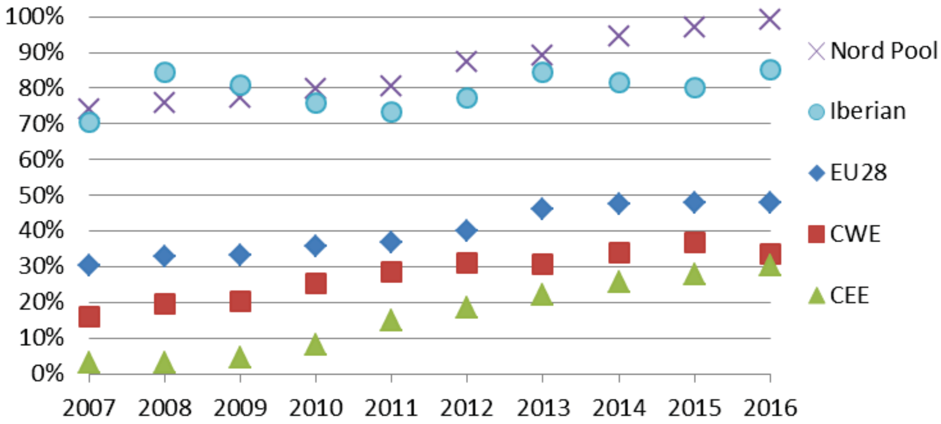

Figure 192- Ratio between volume traded annually on day-ahead market and electricity final

Source: Eurostat, Platts, European power exchanges

9.2 Drivers of electricity costs and prices

9.2.1 Renewable costs are declining

Wind and solar production costs have experienced decreases over the last decade (**Figure 193**). PV in particular has seen a sharp decrease of costs since the early 2010s. Wind has also gone through investment cost decrease, albeit at a lower pace than solar PV, but also is undergoing improvement of the load factors, which ultimately leads to a decrease of the production cost.

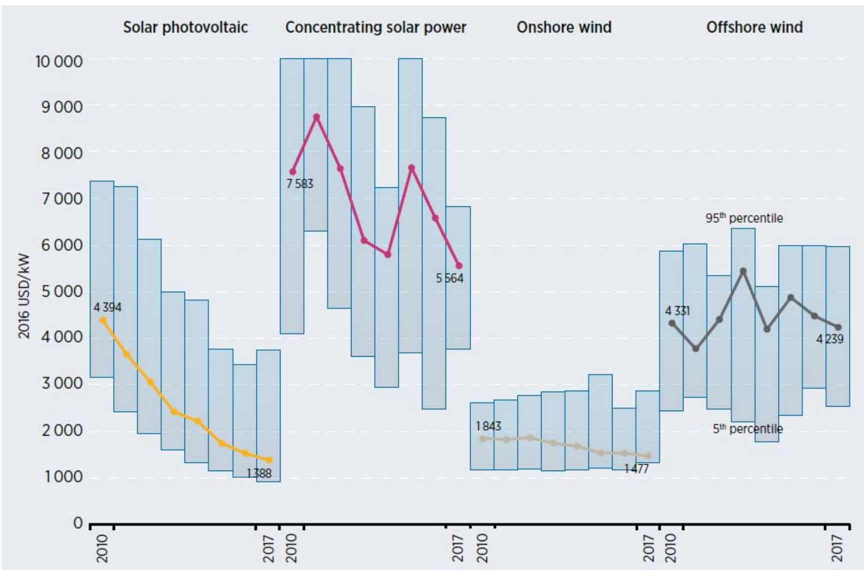

Figure 193 - Evolution of investment costs of renewables

Source: IRENA (2018)[127]

Note: Global data (expressed in USD), the thick lines represent the weighted average.

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[127] IRENA (2018), Renewable Power Generation Costs in 2017, International Renewable Energy Agency, Abu Dhabi

These improvements are expected to continue in the coming decades, including for offshore wind, further improving the future competitiveness of renewables (**Figure 194**) at EU and global level, and thus creating market opportunities outside the EU for European manufacturers[128].

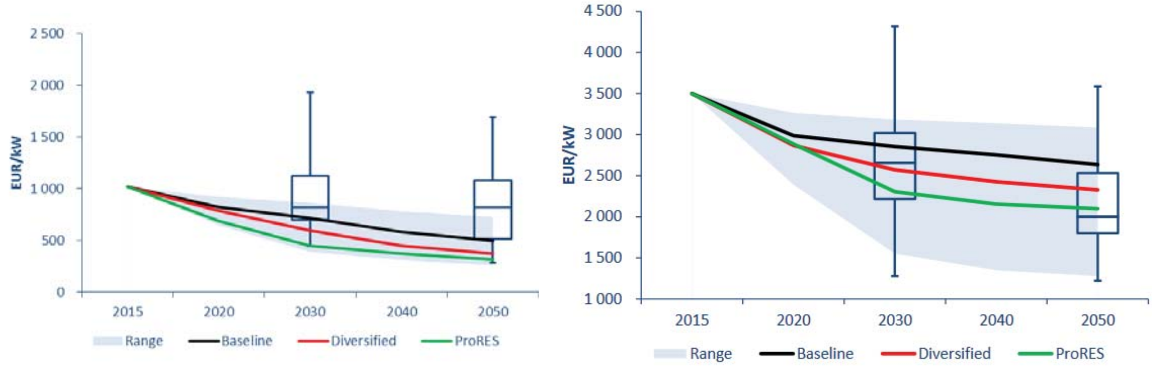

Figure 194 - Expected development of investment costs of renewable energy technologies in the long term under different scenarios (lines) and uncertain factors (range): example of solar and wind (left: utility scale photovoltaics, right: offshore wind turbines)

Source: JRC (2018)[129]

[128] JRC (2017), Magagna, D., Shortall, R., Telsnig, T., Uihlein, A. and Vazquez Hernandez, C., Supply chain of renewable energy technologies in Europe - An analysis for wind, geothermal and ocean energy, EUR28831 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-74281-1, doi:10.2760/271949, JRC108106 http://publications.jrc.ec.europa.eu/repository/bitstream/JRC108106/kjna28831enn.pdf

[129] JRC (2018), Tsiropoulos I,Tarvydas, D, Zucker, A, Cost development of low carbon energy technologies – Scenario - based cost trajectories to 2050, 2017 Edition, EUR 29034 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-77479-9, doi: 10.2760/490059, JRC109894

9.2.2 Fossil fuel prices and carbon price

Fossil fuel prices are expected to rise by 2030 compared to 2015, as underlined in most international energy outlooks (IEA WEO 2017[130] and WEO 2018[131], JRC GECO 2017[132], EIA IEO 2018[133]), due to cheap resource becoming scarcer and in particular to the oil production moving progressively towards heavier and more expensive oil types. The projections underpinning this analysis are consistent with this assumption. They have been elaborated for the Long Term Strategy Baseline scenario.

9.2.2.1 Gas price

Gas is an important contributor to the European power system, with 20% of the total electricity production in 2016[134].

Gas import price has been slightly decreasing over the last 10 years, but has been increasing slightly in 2018. It is expected to keep rising by 2030 to about 35 €/kWh (partially driven by the expected increase of oil price – see 9.2.2.3.). This is consistent with, for instance, IEA WEO2017[131], which sees natural gas import price 75% higher than the price observed in 2016, and 5% higher than the price observed in 2010.

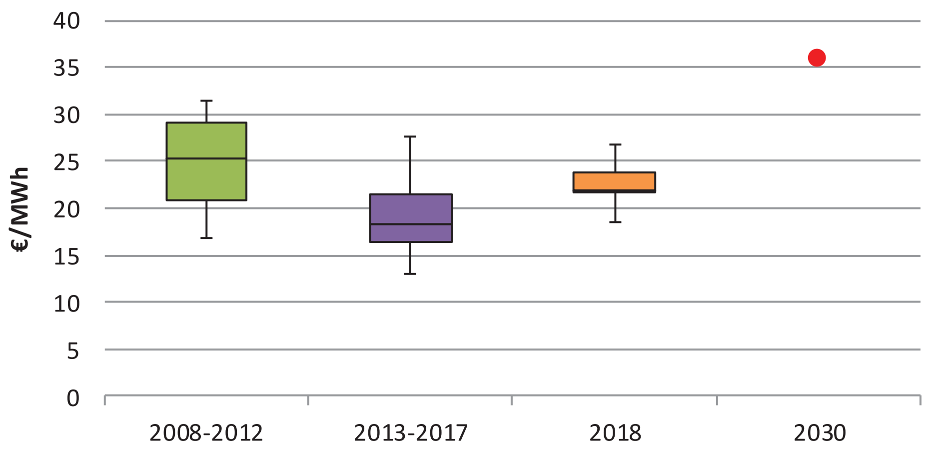

Figure 195 - Monthly gas import price

Source: 2008-2017: BAFA, 2018: UK NBP, 2030: European Commission (LTS Baseline)

Note 1: the box plots show the minimum observed in a given period (lower whisker), the first quartile (lower bar), the median (black line), the third quartile (upper bar) and the maximum (upper whisker).
Note 2: historical prices are in current €, 2030 point is in €2013
Note 3: "2018" covers January-September

130 https://www.iea.org/weo2017/
131 https://webstore.iea.org/world-energy-outlook-2018, not published at the time of this analysis
132 https://ec.europa.eu/jrc/en/geco
133 https://www.eia.gov/outlooks/ieo/
134 https://ec.europa.eu/energy/en/data-analysis/country

9.2.2.2 Coal price

Coal still represents a sizeable share of the power production of the EU, around 22% in 2016, although steadily decreasing (39% in 1990, 25% in 2010[135]).

The coal import price has been declining over the last 10 years, but is on the rise in 2018. It is expected to keep rising by 2030, reaching on average the highest levels observed over 2008-2018.

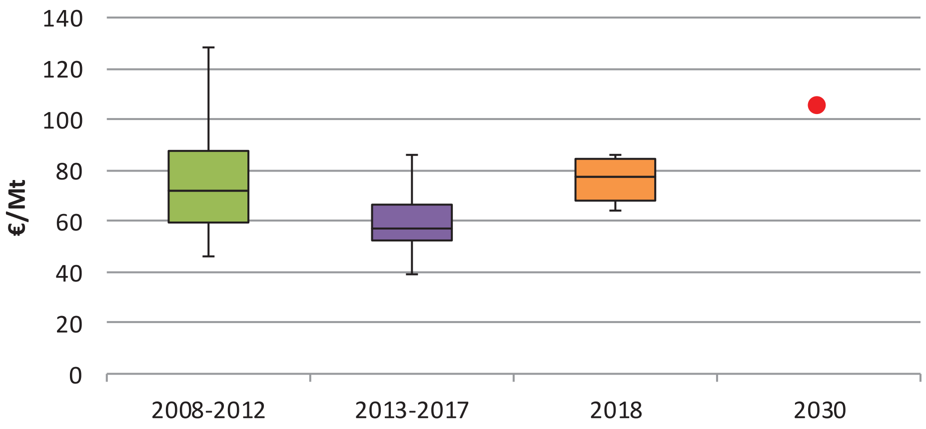

Figure 196 - Monthly coal import price

Source: PLATTS (Coal CIF ARA spot) for 2008-2018, 2030: European Commission (LTS Baseline)

Note 1: historical prices are in current €, 2030 point is in €2013
Note 2: "2018" covers January-September

9.2.2.3 Oil price

Oil is a marginal fuel in the power system (2% of the total production[135], 10 times less than gas or coal), but oil price will still play a role since it will influence the evolution of the gas price.

While the average oil price has been fairly stable over the periods observed 2008-2012, then 2013-2017 and 2008), **Figure 197** shows a great variability. Oil price is expected to get close to 95 €/bl by 2030, in line with the general trends projected by most long-term oil market outlooks (for instance, IEA WEO2017[108] sees the international oil price reaching $(2016) 94 /bl in 2030, more than twice higher the low point reached in 2016, and 10% higher than the high values observed in 2010).

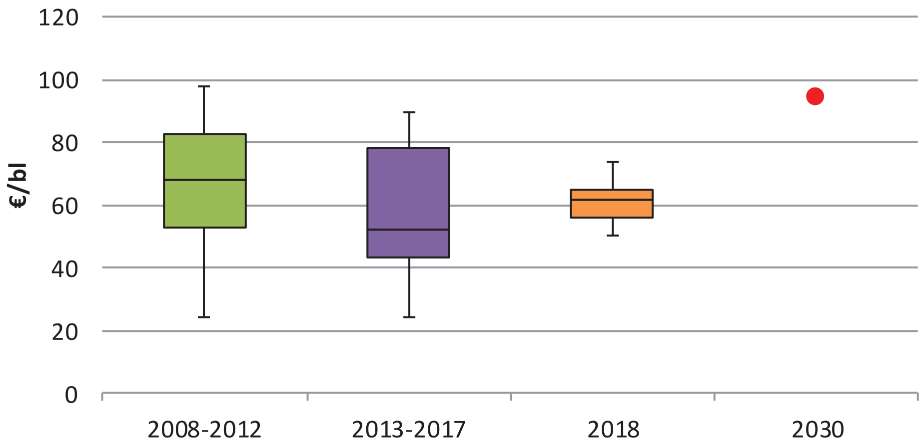

Figure 197 - Daily oil price (Brent)

Source: Historical Brent oil price from EIA (2018 until 09/10/2018)[135], $-€ exchange rate from ECB[136]; 2030: European Commission (LTS Baseline)

Note: historical prices are in current €, 2030 point is in €2013

9.2.3 Carbon price

After having reached low levels in 2013-2017, the carbon price is clearly on an upwards trend in 2018 (see **Figure 198** and **Figure 199**), and is likely to increase further in the coming years due to the strengthening of the ETS targets and to the policy instruments (like the Market Stability Reserve) recently put in place to support the market[137]. The LTS Baseline value is 28 €(2013)/tCO_2 in 2030, which will affect fossil-fuel based electricity production.

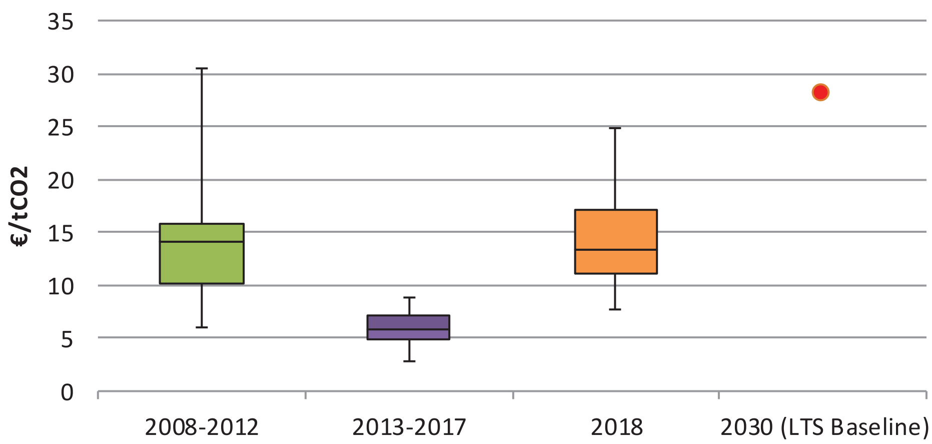

Figure 198 - Daily ETS price

Source: EEX EUA; 2030: European Commission (LTS Baseline)

Note: historical prices are in current €, 2030 point is in €2013
Note 2: "2018" include the daily prices from 01/01/2018 until 16/10/2018

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[135] https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm (retrieved 31/07/2018)

[136] https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.html# (retrieved 31/07/2018)
[137] https://ec.europa.eu/clima/policies/ets_en

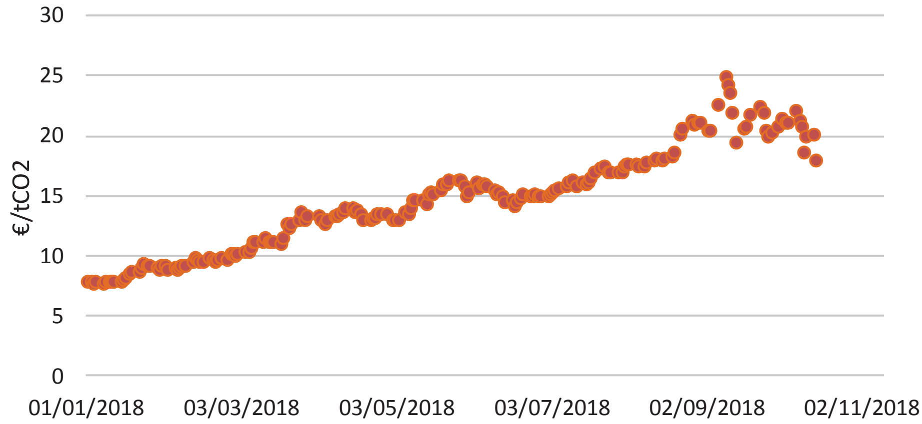

Figure 199 - Daily ETS price in 2018

Note: last point is 16/10/2018.

9.3 Need for new capacities

The need for new power generation capacity in the next decade will depend on demand for electricity and on the energy and climate policies of the European Union. Energy policy will directly affect electricity demand, through on the one hand stronger energy efficiency and on the other hand expected electrification of transport, heating & cooling as well as, to some extent, industry. Policy targets will also affect the type of technologies that are deployed with different requirements for the system, including storage and more flexible demand side response.

9.3.1 Evolution of electricity demand

After a stabilisation since 2008, electricity demand is expected to increase slowly by 2030, up to 3000 TWh. In order to understand drivers of energy consumption, the European Commission uses, among other tools, projections from energy system models. **Figure 200** shows projections for final electricity consumption calculated for different projection exercises.

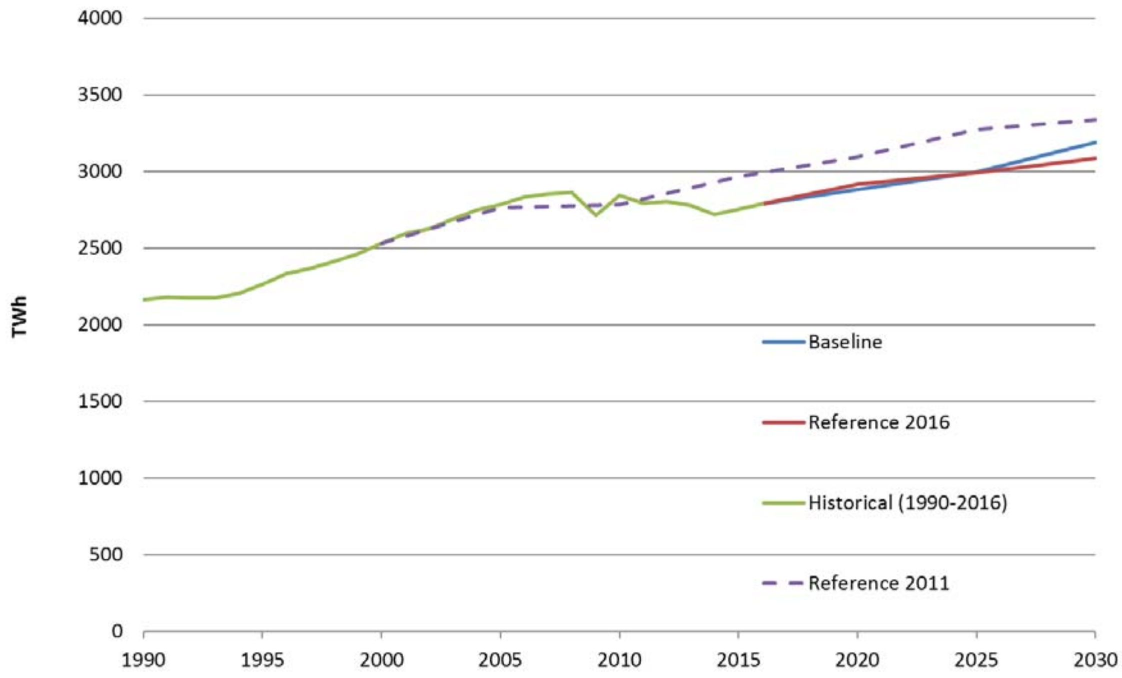

Figure 200 - Final electricity consumption in the EU28, historical data and projections.

Source: historical from Eurostat (nrg_105a), projections by European Commission, DG ENERGY.

With the economic recovery, electricity consumption in the European Union is set to moderately increase remaining close to its 2005 peak. Several macroeconomic trends are contributing to the moderate prospects for electricity demand. First, the European recession precipitated a restructuring of the Union's economy towards less energy-intensive activities. Second, the energy efficiency policy of the Union is promoting efficiency standards and mobilising investments in energy conservation. These policies have a considerable impact on electricity demand: According to IEA[138], energy efficiency measures reduced the growth of electricity demand in IEA member countries from an expected 1.3% per year to the observed 0.2% per year.

Finally, the aging population and the projected moderate economic growth cap energy demand while markets for several energy-intensive products show signs of saturation. These trends are contrasted by a shift from fossil fuels to electricity driven by climate policies (with low cost of renewables technologies, electrification becomes an effective mean to decarbonise the economy).

All these trends combined will have important consequences on the volume of investments in energy assets. Investments in conventional fossil fuel technologies will be effected to a greater extent.

The projections realised before 2010, on the other hand, pointed to a continued growth of electricity consumption as it can be seen in **Figure 200.** Following the great recession of 2009, the later scenarios were updated with the latest available macroeconomic projections[139]

[138] IEA 2018, World Energy Outlook 2018

[139] Macroeconomic projections were taken from the 2015 Ageing Report of the European Commission (DG ECFIN).

and calibrated to the latest statistical data. The new projections show an almost flat demand for electricity, only marginally increasing in 2030 compared to the 2005 peak.

Up to 2030, the upward trend is fairly similar in the Reference 2016 scenario and in the LTS Baseline, which takes into account the agreed new targets on energy efficiency (at least 32%) and renewables (at least 32.5%) for 2030. The economic trends described above result in reduced electricity demand compared to past projections (e.g., the projections in the 2011 Reference scenario also shown in **Figure 200**). After 2025, the electrification of the economy starts having a noticeable impact on electricity demand.

9.3.1.1 Age structure of fossil fuel fired power plants

To understand the impact the developments shown in the previous sections will have on energy assets investments, it is necessary to analyse the age profile on the power plants operating in the Union. It is possible to extract the approximate age profile of power plants by fuel type from data sets such as the Platts WEPP database and the PRIMES database. **Figure 201** shows the installed gas capacity by age in the EU in 2015 from these two datasets.

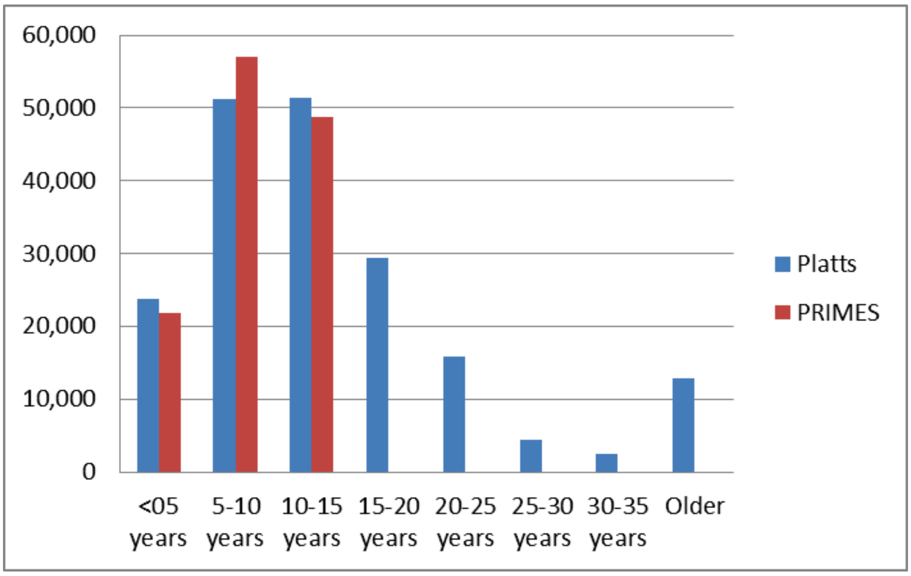

Figure 201 - EU 2015 Installed gas capacity by age [MW]

Source: Platts and PRIMES databases.

Figure 202 and **Figure 203** show the same bar plot for coal and oil generation capacity from the Platts database. While gas capacity is dominated by younger power plants, the age distribution of coal and oil power plants in dominated by older installation relative to the expected lifespan. For consistency with the assumption used for the PRIMES projections, the expected lifetime of fossil fuels power plants is assumed to be 30 years, 40 year and 35 years for gas, coal and oil, respectively.

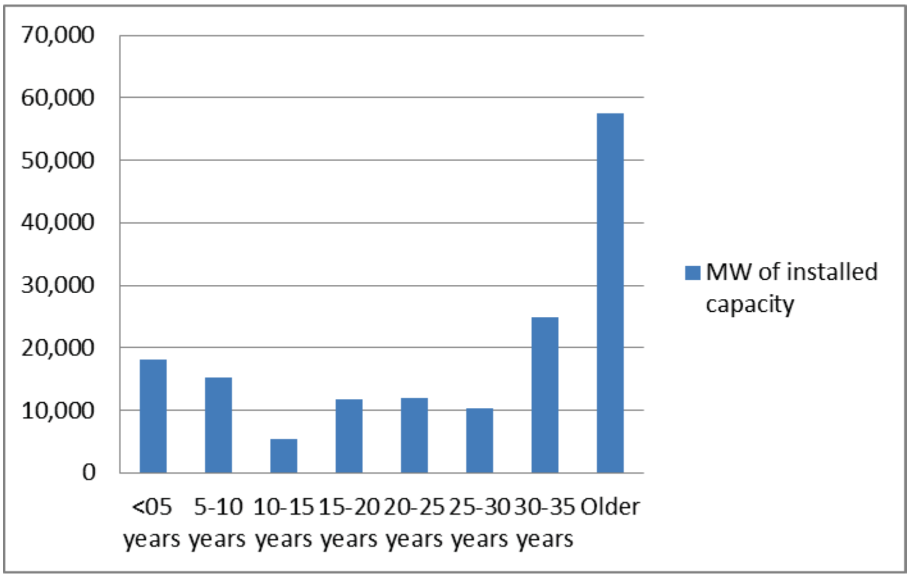

Figure 202: EU 2015 installed coal capacity

Source: Platts

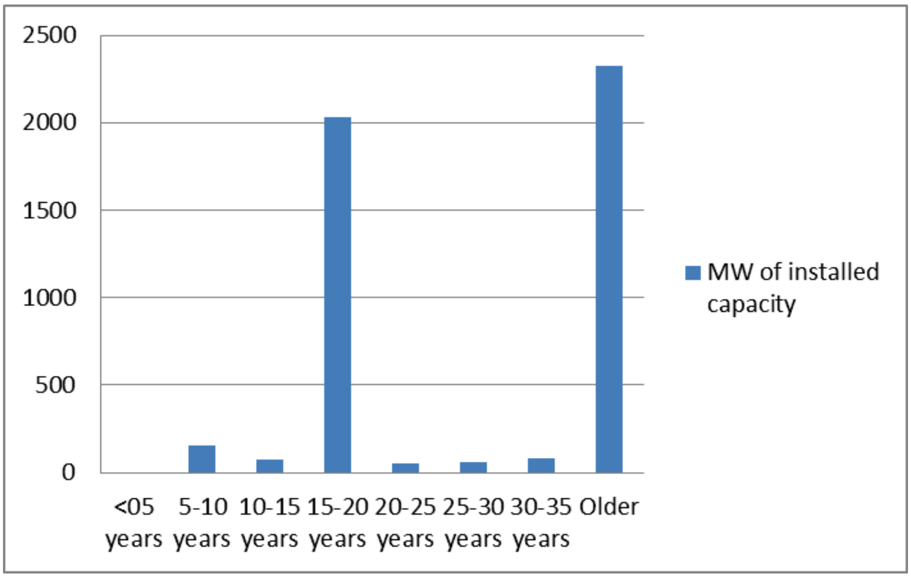

Figure 203 - EU 2015 installed oil capacity

Source: Platts

The differences between the age profiles of the different technologies can be explained by the pattern of investments over the last decade. **Figure 204**, **Figure 205** and **Figure 206** show the year-by-year retirements and additions of gas, coal and oil power plants respectively. All charts refer to the EU and are taken from the Platts power plants database. The years between 2007 and 2013 have seen a particularly high deployment of gas power plants. Gas power plants additions are greater than retirements even in later years and for every year in the data series. For coal and oil plants, on the other hand, retirements have been greater than addition for the last several years. This resulted in a higher share of older power plants for coal and oil as shown in **Figure 201**, **Figure 202** and **Figure 203**.

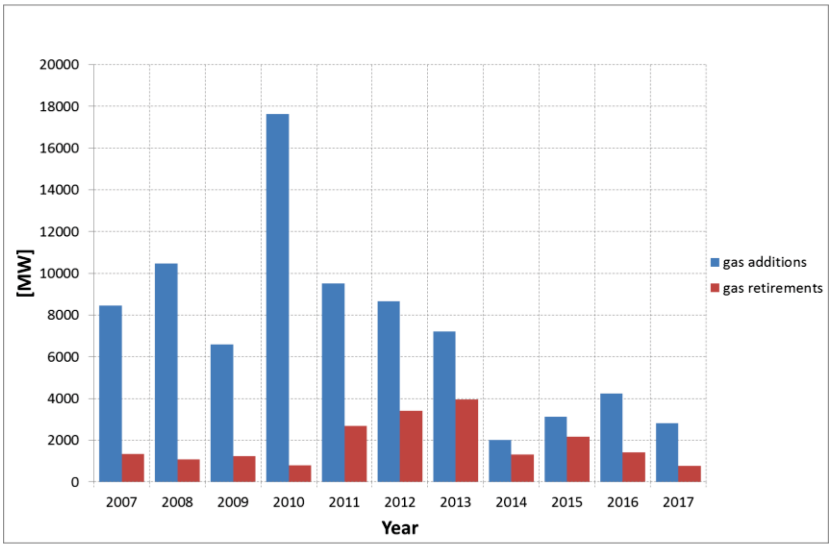

Figure 204 - additions and retirement of gas power plants.

Source: Platts

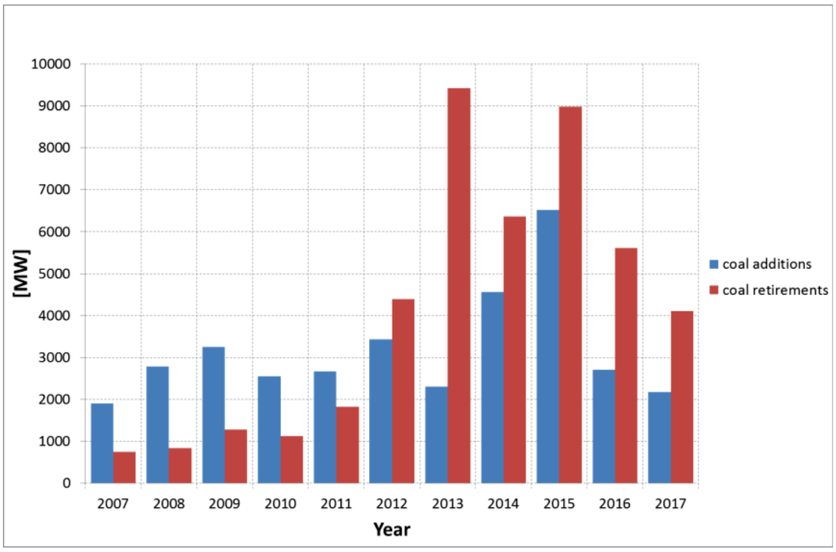

Figure 205 - additions and retirement of coal power plants.

Source: Platts

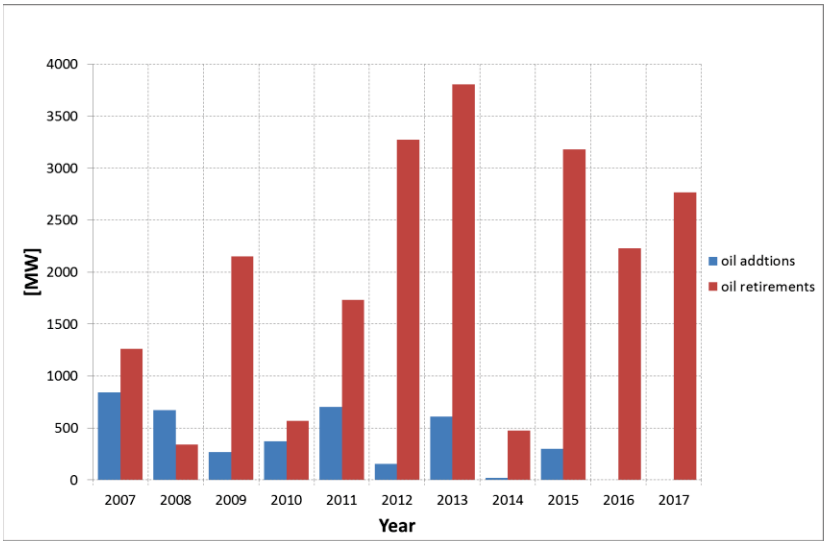

Figure 206 - additions and retirement of oil power plants.

Source: Platts

9.4 Electricity prices vs costs up to 2030 in the EU

Electricity prices[140] have decreased slightly over the past 10 years, with a fairly highly dispersion of daily prices. The average prices are expected to go higher by 2030, with even larger dispersion upwards.

Figure 207 shows that increasing prices[141] would cover the production costs[142] of the most mature renewables (wind, hydro, solar)[143] *installed* in 2030. On the other hand, the expected production cost of installed fossil-fuel based and biomass plants would tend to be higher than average expected prices due to rising fossil fuel import prices, rising carbon price, and also to decreasing load factor. Fossil fuel plants are expected to come into play in the market when there will be higher prices than usual (unexpected lower supply due to low supply by renewables and higher demand). In the medium-term this should partially compensate for the lower utilisation rate.

While the financing of *new* gas, oil and nuclear capacities would be more uncertain, investments in new capacities of hydro, wind and solar would increasingly be supported by the market prices. This also means that less additional public support, beyond market prices, would be needed for encouraging investments in these most needed technologies for the transition to a low carbon electricity system.

[140] Day-ahead wholesale prices
[141] The Figure shows the distribution of daily prices as observed over 2008-2018 and as projected for 2030.
[142] Expressed as the levelised cost of electricity production (LCOEs)
[143] More estimates on future LCOEs can be found in e.g.: Ram, M. et al. (2018). A comparative analysis of electricity generation costs from renewable, fossil fuel and nuclear sources in G20 countries for the period 2015-2030. Journal of Cleaner Production Volume 199, 20 October 2018, Pages 687-704 https://doi.org/10.1016/j.jclepro.2018.07.159

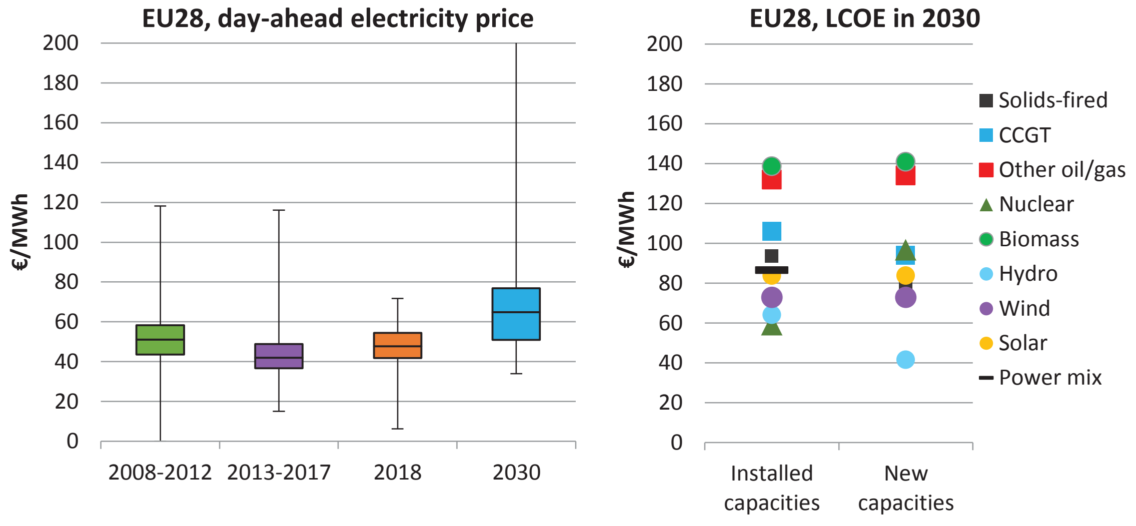

Figure 207 - EU28: electricity prices and cost

Source: Left graph: 2008-2018: Platts, 2030: METIS model; Right graph: PRIMES model.

Note 1: the box plots show the minimum observed in a given period (lower whisker), the first quartile (lower bar), the median (black line), the third quartile (upper bar) and the maximum (upper whisker).
Note 2: for visualisation purposes the left graph has been capped to 200 €/MWh.[144]
Note 3: costs for storage and additional interconnections are not accounted for in this Figure.
Note 4: historical prices are in current euros, values for 2030 are in 2013 euros. Prices and costs are averaged over the EU28 and per technology category (e.g. "wind").
Note 5: "2018" includes daily prices from 01/01/2018 until 16/10/2018

9.5 Investment in power production assets

In order to meet its renewable energy and emission reduction targets, the European Union will have to invest considerable amounts in power production assets and in renewable energy technologies in particular. The European Commission used the PRIMES energy model system to produce projections of the future capacity needs. **Figure 208** shows a comparison between the projected capacity addition for selected fossil fuels and renewables technologies (in MW for 5 years periods). **Figure 209** shows a similar chart for investments in billion € for five years periods. While renewables investments are set to expand considerably, the prospects for fossil fuels in power generation are limited. As coal is phased out, gas confirms its role as a transition fuel. However, as discussed in section 9.3.1.1, the fleet of gas power plants is relatively young. With the common assumption of a 30 years lifetime, a significant share of the gas plants operating today will still be in operation in 2030. Investments in new gas generation until 2030 will be only a fraction than in the previous decade. (In particular, the higher electricity demand due to electrification is to a large extent satisfied by more ambitious renewable targets.) According to PRIMES projection approximately 40 GW of new gas-fired capacity will be installed in the EU up to 2030.

[144] Projections of spot prices are uncertain and actual prices will depend on a number of factors difficult to predict, including the weather conditions or unforeseeable events affecting the grid.

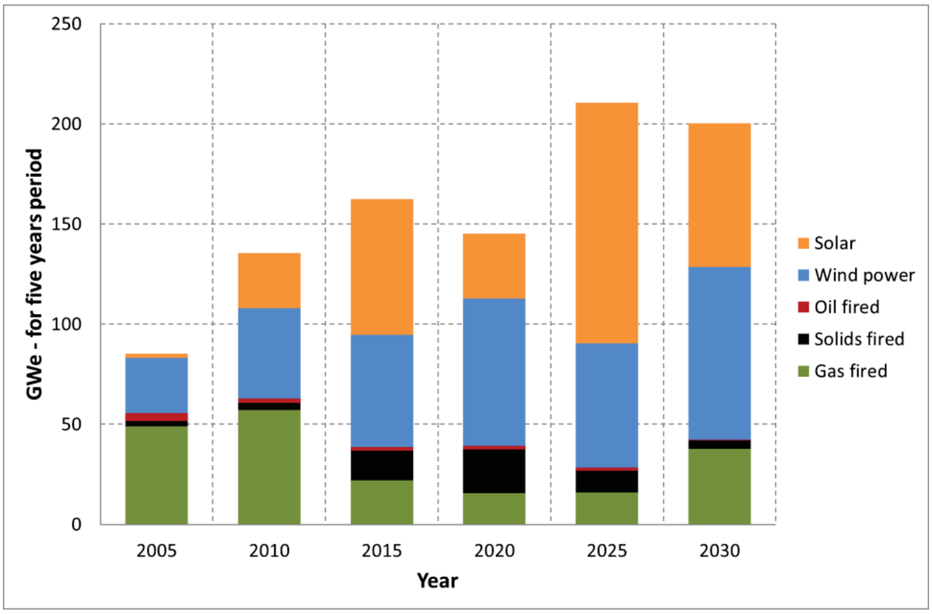

Figure 208 - New power generation capacity - PRIMES projections.

Source: PRIMES

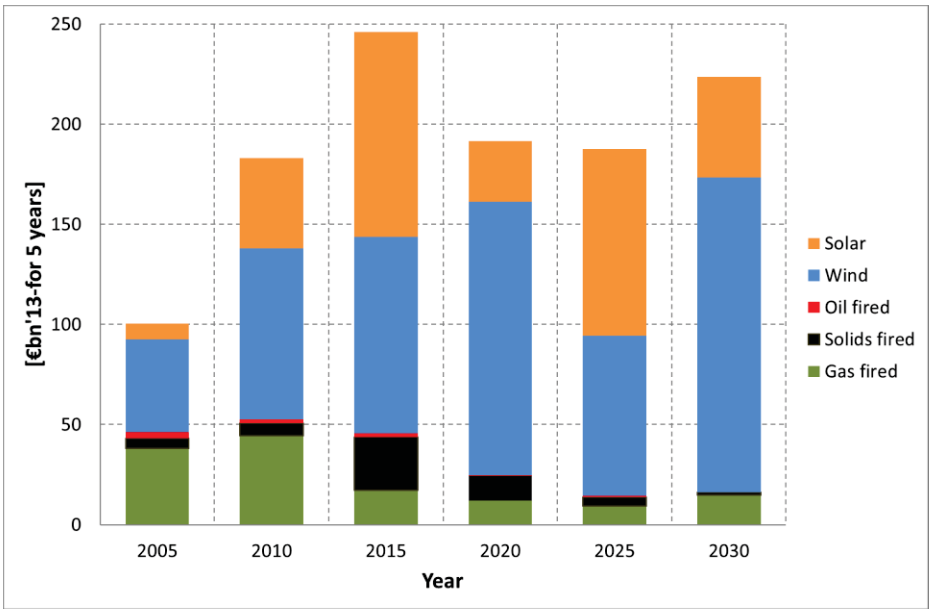

Figure 209 - New power generation investments - PRIMES projections.

Source: PRIMES

It should be pointed out that new investments depend strongly on the assumed lifetimes (and, hence, retirement rates) of fossil fuel power plants. In particular, the future of gas is tied to the phasing out of coal. Ten member states have stated their intention to eliminate coal in power generation or have already done so. These policies have not been taken into account in the projections shown above. Phasing out coal at a faster pace than projected by PRIMES could substantially increase the need for investments in new gas power plants[145].

[145] For instance, this would be in line with the gas consumption projections from WEO2018

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Brussels, 9.1.2019
SWD(2019) 1 final

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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(2019) 1 final}

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PART IV

IMPACT OF PRICE REGULATION

Main findings

Price regulation

Household markets

- There has been consistent progress towards phasing out regulated prices in EU Member States household markets during the period of analysis (2008-2016), which comes after the entry into force in 2009 of the 3rd energy market liberalisation package. Over that period a significant share of Member States have deregulated prices in household electricity markets while progress was slower in the household gas market, with only Ireland phasing out regulated prices
- Member States that phased out regulated prices before 2008 display markets where there are more suppliers that increase choice for consumers, consumers are more engaged and markets appear to be more competitive, with lower market concentration and more contract diversification. Notably, Member States which have phased out or are in the process of phasing out price regulation have a higher variety of electricity contracts, including dynamic price contracts which are only observed in these markets.
- There is a correlation between the share of households under regulated prices and the dynamism of the household market, even in Member States where regulated prices still exist. A lower share of households under regulated prices correlates with positive developments in indicators for competition, both when looking at individual years and over time. This is evidenced by developments in recently deregulated Member States or those that have gradually reduced the share under price regulation.
- Lower prices and mark-ups (gross margins) are observed in Member States with a majority of households under regulated prices. This could be explained by the fact that general price regulation for households may likely represent a significant squeeze on margins of suppliers, possibly at levels below net costs for suppliers. The frequency of tariff deficits is more frequent in Member States with regulated prices.
- Evidence from households electricity markets does not suggest that regulated prices lead to better affordability nor lower levels of energy poverty[146]. Moreover, evidence does not support either that the phase out regulated prices leads to lower affordability nor higher energy poverty. When assessing these indicators, the impact of the economic crisis in Europe must be discounted for.
- In terms of the consumer perception of the functioning of the market, both regulated and deregulated markets score well, with indications that deregulated markets score slightly better among consumers for electricity, while regulated markets tend to score slightly better among consumers for gas.

Non-household markets

- In the EU Member States non-household electricity and gas markets there has also been consistent progress towards phasing out regulated prices since the introduction of the 3rd energy package.

[146] Household energy poverty may also significantly be affected by other fuels (e.g. gas, heating oil, gasoline) which were not analysed in this chapter. Economic factors can also impact energy poverty. A full picture of energy poverty could only be attained by looking at all these factors together.

- Regulated electricity and gas prices for business consumers are phased out faster than those for residential consumers.
- End-user price regulation has a decreasing role for businesses. By 2016, the large majority of businesses in the EU were already using non-regulated prices, with the exception of those in Bulgaria (gas and electricity), Cyprus and Malta (electricity) and Greece, Latvia and Poland (gas).
- The energy supply costs for business consumers tend to be higher in Member States relying on price regulation than in Member States that have phased it out.
- Contrary to observations on household markets, higher mark-ups (gross margins) are observed in markets with regulated prices for non-households. However, very few Member States still apply regulated prices and the aggregate results are significantly impacted by high prices in Malta for electricity and Greece for gas.

Dynamic pricing

- Dynamic pricing contracts (DPC) are currently available in 7 Member States (Estonia, Finland, Sweden, Spain[147], Netherlands, Denmark and the United Kingdom) and Norway and gradually spreading out to countries that have already opened up their retail markets for competition. As an observation, consumers do not have access to dynamic price contracts in Member States where a majority of households are under regulated prices. The reasons for non-availability may range from a lack of available smart metering infrastructure, regulatory hurdles or needs of reforms in the functioning of the retail markets. The case of Spain with a regulated default dynamic price contract is unique.
- Based on the evidence gathered so far, providing access to dynamic price contracts empower consumers and can in many cases significantly reduce the energy supply component of the electricity bill. For example, in the case of small consumers (Eurostat band A, annual consumption below 1 000 kWh) the annual saving can be in the range of 15 – 80 EUR per year, representing about 22 – 70 % of the energy supply component in the annual bill. Similar, if somewhat lower benefits can be expected in the case of natural gas.
- The specific features of dynamic price contracts need further investigation. Access to real consumer metering data and therefore undertaking subsequent analysis has proven very challenging in many Member States. Providing transparent access to consumer data, while fully protecting data privacy, is not only important for the setting up of the optimal design features of dynamic price contracts, this is also an essential element to reinforce contestability on the retail market. The difficulty of accessing data related to consumer profiles increases transaction costs and can act as a barrier dissuading new companies from entering markets.

[147] Spain has a system with a regulated dynamic price contract as the default supply contract, in which only the margin charged on top of the wholesale prices is subject to regulation.

10 Price regulation

Price regulation exists where the price of energy is subject to control by public authorities, typically the government or the National Regulatory Authority (NRA). Regulated prices stand in contrast to market-based prices, where the forces of supply and demand determine the price of energy. Regulated price schemes vary from country to country in terms of the *type of energy (electricity or gas)* they apply to, the *customers* who pay a regulated price and *how* the regulated prices are fixed. Depending on the country, regulated prices may apply to both electricity and gas although in many cases the price regulation is applied for only one of these. Regulated prices can cover either all customers, only households or only vulnerable households. Finally, the methodology for determining the regulated prices also varies, and may include outright discretionary price setting, price caps, caps on the rate of return of suppliers or caps on margins. This chapter does not discuss or distinguish between the different types of methodologies.

The final retail energy price consists of an 'energy component', a 'network component' and 'taxes and levies'. This chapter focuses on the price setting of the 'energy component'.

The existing EU *acquis* from the 3rd Energy Package, as interpreted by the Court of Justice, only permits price regulation if strict conditions are met. The Court has ruled that energy supply prices must be determined solely by supply and demand.[148] However, Member States can impose price regulation in the form of a Public Service Obligation (PSO) that is adopted in the general economic interest, is clearly defined, non-discriminatory and verifiable, guarantees equality of access for EU companies to national customers and is limited in time and the scope of beneficiaries. The European Commission proposal for a recast Electricity Directive of 1 December 2016 (part of the *Clean Energy for All Europeans* Package), has sought to further restrict the ability to impose price regulation.

This chapter analyses the retail markets of EU Member States with both regulated and liberalised 'energy component' prices. The objective is to compare these markets and to assess the impact of regulated prices on the prices, costs and the general functioning of the retail market. A series of indicators have been identified to assess competition, prices, consumer satisfaction and tariff deficits. These indicators will be assessed across EU Member States in the period from 2008 to 2016, which corresponds roughly with the implementation of the EU *acquis* of the 3rd Energy Package, which entered into force in 2009. The markets for household and non-household electricity and gas are analysed separately.

Similar analyses on the functioning of retail energy markets have been conducted, notably in the ACER/CEER Market Monitoring Report. This analysis is however the first attempt to focus on the effects of price regulation by looking at a range of indicators on retail market functioning. In order to isolate the effects of regulated prices, where they prevail, EU Member States have been grouped according to whether price regulation exists in the market and, if so, how extensively is applied. The prevalence of regulated prices is determined by the share of consumers and the volumes consumed under regulated prices. The countries that deregulated their prices during the period from 2008 to 2016 are also isolated as a separate group, in order to capture the immediate impact of price deregulation on each indicator.

[148] Case C-265/08, Federutility and others v Autorità per l'energia elettrica e il gas. The Court judgement was based on Article 23(1)(c) of Directive 2003/55 of the Second Energy Package which provides that Member States must ensure that all customers are free to buy natural gas from the supplier of their choice as from 1 July 2007. The relevant provisions has remained unchanged in the Third Package Directives.

In addition to a cross-section analysis focusing on the year 2016, most indicators are analysed over time in order to capture the evolution of market functioning across the groups during the period of analysis.

10.1 Impact of price regulation on competition, prices, quality of services and investments

Introduction

The ability of suppliers to set prices freely is essential to develop retail market competition. In markets where suppliers are not able to set prices freely, and especially where prices are set below cost levels, we can expect to observe lower competition in the form of fewer suppliers, higher market concentration, lower savings from switching suppliers and fewer offers available to consumers. Price regulation in retail energy markets may therefore significantly hamper the development of well-functioning retail energy markets.

Because it is inherently difficult to establish cost-reflective prices for energy via regulation, as opposed to via market forces, regulated prices come with the inherent risk of setting prices which are below market costs. That risk could be magnified by the energy transition, as more variable renewable generation could increasingly create mismatches between wholesale prices and regulated retail market prices. This could ultimately lead to consumers paying either too much or too little for energy.

Regulated prices below market costs are particularly detrimental for retail market functioning. In this situation suppliers are forced to absorb losses from supplying their customers, which may lead to tariff deficits, a deteriorating economic health of the companies and ultimately restricted competition. On the other hand, regulated prices below market costs may create skewed expectations among consumers as they receive a de facto subsidies energy price, which could lead to over consumption and popular opposition to establishing cost-reflecting prices.

In practice, Member States that regulate retail energy prices commonly use hybrid systems where regulated prices exist within a liberalised market with competition among suppliers and opportunities for supplier switching. However, experience from deregulation processes shows that the existence of regulated prices in a liberalised market can still be significantly distortive. Distortions occur as the regulated price is set too low relative to net margins required for supplier competition, meaning that even though the gross margin is not below cost, the level of the regulated price effectively eliminates competition. In addition, where the regulated price is set above cost there is a risk that the regulated price becomes a benchmark for price setting which all suppliers cluster around, as opposed to allowing various wholesale prices and purchasing strategies to dictate retail price formation.

As prices in Member States with price regulation are impacted by the administratively set level of the prices and given the challenges of correctly replicating the market equilibrium in administrative procedures, it is expected that prices in markets with price regulation are lower than those of liberalised markets. On the other hand, we can expect that liberalised markets are significantly more dynamic, with more suppliers, lower market concentration and a wider choice of contracts and services available to consumers. In broad terms, we expect to see that liberalised markets are more conducive towards developing the flexible retail energy markets required for a future with higher shares of variable renewable energy and electric vehicles.

Structure of the analysis

The analysis assesses the impact that price regulation on indicators for competition, prices and quality of service in retail gas and electricity markets for households and non-households. The analysis adopts a comparative approach between regulated and non-regulated markets and markets in-between these two categories. Due to limited data availability, several non-price indicators are only available for the household electricity and gas markets. In addition, a separate analysis investigates the relationship between tariff deficits and the existence of regulated prices.

The starting point for these analyses is to identify the countries where regulated prices exist and to assess how widespread they are. Both ordinary regulated prices available to all consumers and social tariffs are considered to be regulated prices, the determinant of whether price regulation exists is whether there is a form of intervention in the price setting for the supply of energy, regardless of whether it is targeted or not. Due to differences in characteristics, analyses are performed separately for gas and electricity for the following market segments:

- Household electricity.
- Household gas.
- Non-household electricity.
- Non-household gas.

In order to allow the analysis to clearly separate between the Member States that apply price regulation, and those that do not, within each market segment, the analysis distinguishes between four groups depending on the prevalence of regulated prices:

- **Group 1 (< '08)**: Markets which fully phased out regulated prices before 2008 (i.e. a maximum of 5% of consumers have regulated prices since 2008);
- **Group 2 ('08-'16)**: Markets which phased out regulated prices between 2008 and 2016 (i.e. a maximum of 5% of consumers have regulated prices in 2016).
- **Group 3 (> 50%)**: Markets in which more than 50% of the consumers have regulated prices;
- **Group 4 (5-50%)**: Markets in which 5% to 50% of the consumers have regulated prices;

These groups enable us to nuance the analysis and make meaningful comparisons between countries, while also analysing separately the countries that have deregulated prices historically and more recently. It enables us to make observations corresponding to each of these groups, such as whether the prevalence of regulated prices as a share of the market matters in terms of market functioning. Countries that use social tariffs are also grouped in accordance with the criteria for these analytical groups. Weighted averages are calculated for each group, per indicator, to provide grounds for comparison between the groups. The indicators considered are:

- For **competition**, we consider indicators on the number of active suppliers, the level of market concentration, the annual switching rates and the savings from switching available to consumers.
- For **prices**, we look at the level of the prices, the co-movement and mark-ups to wholesale prices, energy expenditure as a share of disposable income and the levels of energy poverty.
- For **quality of service**, we look at market performance indicators and the level of trust, comparability and perceived ease of switching in the market.
- For **tariff deficits**, we cross-compare countries that had tariffs deficits with the list of countries that regulate prices.

The analysis performed in this section is a comparative analysis between the identified groups. It may also be important to know about the trajectory of market development in each

Member State to complement this analysis. Country detailed information can be found in the country facts-sheets in the *Trinomics et altri* study (Annex I of the study).

10.2 Price regulation in household gas and electricity markets

Although several EU Member States still maintained a policy of retail price regulation in 2016, there has been a clear trend towards phasing out regulated prices in recent years, coinciding with the implementation of the requirements of the 3rd energy package which entered into force in 2009 (**Figure 210**).

Existence of price regulation

In household electricity markets, the Member States that still maintained price regulation in 2016 were Belgium, Bulgaria, Cyprus, France, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Spain.

Only Belgium, Latvia, Portugal and Spain had fewer than 50% of household electricity consumers under regulated prices.

In household gas markets, the Member States that still maintained price regulation in 2016 were Belgium, Bulgaria, Denmark, Greece, France, Croatia, Hungary, Lithuania, Latvia, Poland, Portugal, Romania, Slovakia and Spain.

Only Belgium, Denmark, Spain and Portugal had fewer than 50% of household gas consumers under regulated prices.

Phase out of price regulation in recent years

Between 2008 and 2016 several Member States phased out regulated prices for households.

In household electricity markets regulated prices were phased out in Croatia (2015), Denmark (2016), Estonia (2013), Greece (2013) and Ireland (2011).

In household gas markets regulated prices were phased out only in Ireland (2014).

Electricity Gas

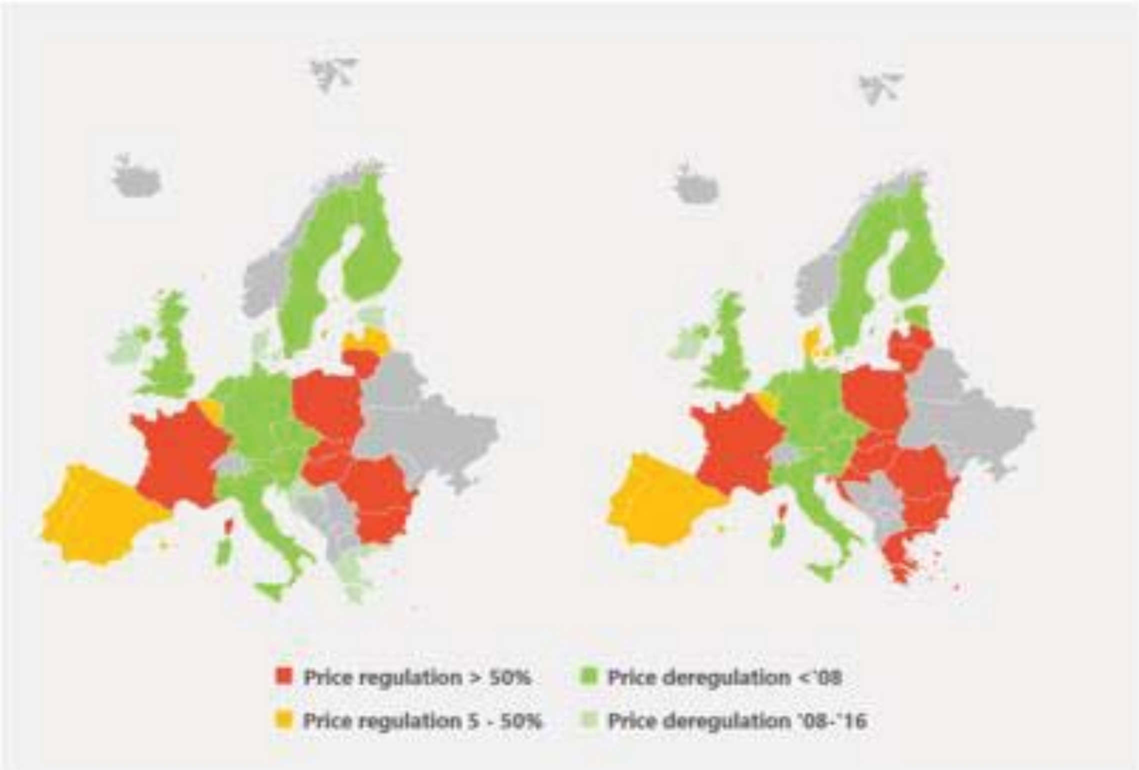


Figure 210- Household price regulation in EU Member States in 2016

Source: CEER data and NRA representatives

10.2.1 Share of households under regulated prices

There are substantial differences in the prevalence of regulated prices in the EU Member States that still use that policy. In some the share of households under regulated prices had dropped dramatically between 2008 and 2016 (the end year of our analysis), whereas in others the share has remained static (**Figure 211**).

For **electricity**, the weighted average share of households under regulated prices in Member States with more than 50% of households under regulated prices remained high in 2016, at 92.4%.

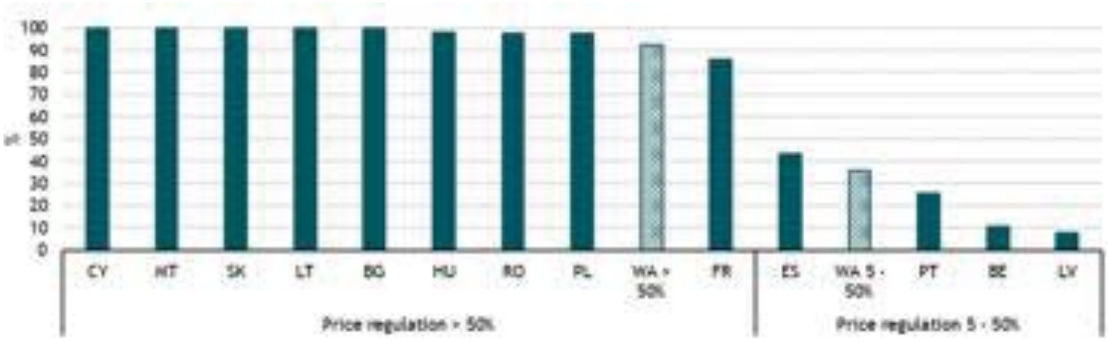
The weighted average share of households under regulated **electricity** prices in Member States with a 5-50% share of households under regulated prices in 2016 is significantly lower, at 35.8%.

For **gas**, the weighted average share of households under regulated prices in Member States with more than 50% of households under regulated prices remained high in 2016, at 81.6%.

The weighted average share of households under regulated **gas** prices in Member States with a 5-50% share of households under regulated prices is significantly lower in 2016, at 19.5%.

This reinforces the need to separate between those Member States that had made clear and sustained progress towards phasing out regulated prices and those that have made little progress, thereby enabling an analysis of whether a correlation can be made between lower shares of consumers under regulated prices and improved market functioning.

Electricity



Gas

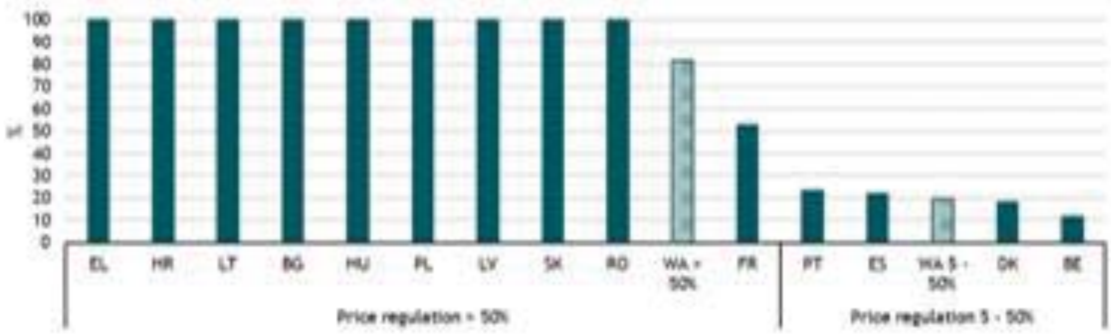


Figure 211 - Share of consumers under regulated prices in EU Member States in 2016

Source: CEER data and NRA representatives
Note: Used weights are the total number of household consumers per country and per energy market.
A description of the weighted averages' groups is provided in section 10.2

Evolution in the share of households under regulated prices

The share of consumers under regulated prices in Member States that still maintain price regulation has evolved differently from 2008 to 2016: Some Member States have seen rapid decreases in the share of consumers under regulated prices while other Member States phased our price regulation completely (**Figure 212**).

For **electricity**, significant decreases in the share of households under regulated prices were observed between 2008 and 2016 in Portugal (where the share decreased from 95% to below 30%), Spain (from around 90% to below 45%) and Latvia (from 100% in to 8%).

In addition Croatia, Denmark, Estonia, Greece and Ireland entirely phased out regulated prices for electricity.

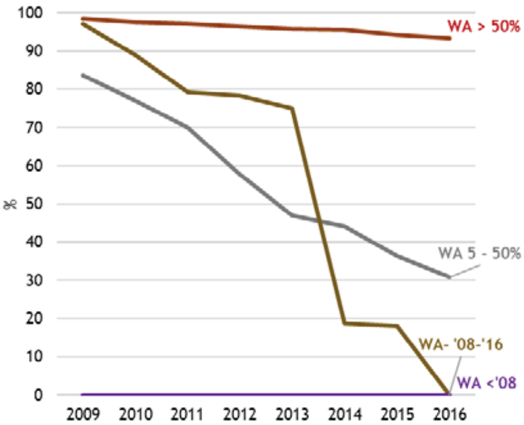
For **gas**, significant decreases in the share of households under regulated prices between 2008 and 2016 were observed in Portugal (where the share decreased from 100% to 23%), Spain decreased (from 55% to 21%) and Denmark (which had a share of 18% of consumers under regulated **gas** prices in 2016).

In addition Ireland entirely phased out regulated prices for **gas**.

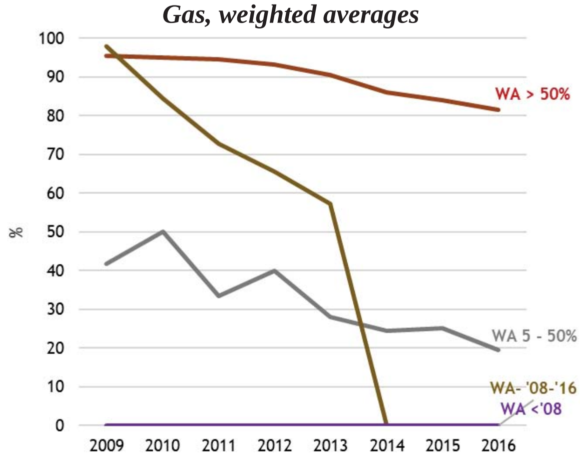
For the group of countries with more than 50% of consumers under price regulation there was little progress towards phasing out regulated prices between 2008 and 2016, with the only noticeable decreases occurring in France, which slightly reduced the share of households under regulated prices for **electricity** (from 98% to 86%) and decreased more markedly the share of households under regulated prices for **gas** (from 89% to 53%).

This suggests that there are clear differences between the 5-50% group, which has been more successful, and the above 50% group, which has been less successful with the phase out.

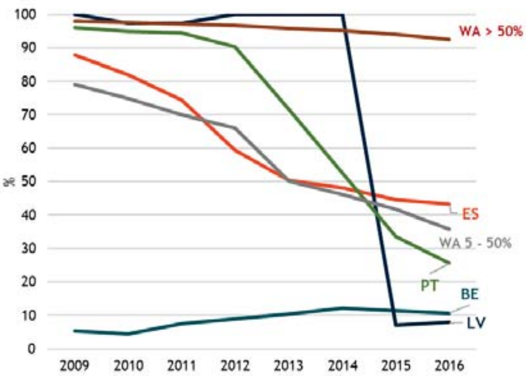
Electricity, weighted averages



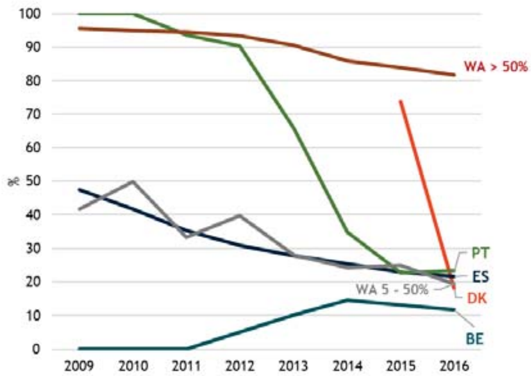
Gas, weighted averages



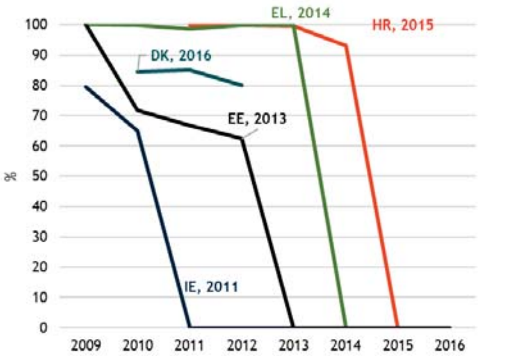
Electricity, MS with 5 – 50% of consumers under price regulation



Gas, MS with 5 – 50% of consumers under price regulation



Electricity, MS which phased out regulated prices between 2008 and 2016



Gas, MS which phased out regulated prices between 2008 and 2016

No data for Ireland which is the only MS in this category

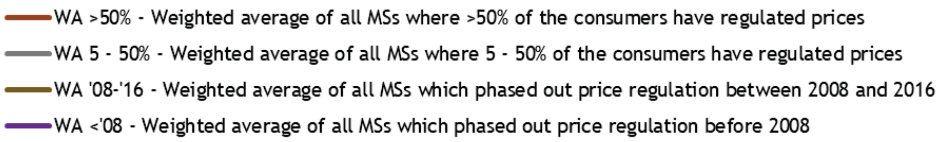


Figure 212 - Evolution in the share of households under regulated prices

Source: CEER data and NRA representatives
Note: the year in which price regulation was phased out is mentioned in the graphs when relevant.
Used weights are the total number of household consumers per country and per energy market. A description of the weighted averages' groups is provided in section 10.1.

10.2.2 Share of consumers under social tariffs

Social tariffs constitute a form of price regulation that is only applicable to a limited group of consumers for purposes of protecting vulnerable consumers with limited financial means. Social tariffs only exist in the household gas and electricity markets. Social tariffs are considered to be price regulation if the social tariff is based on an intervention in the price setting of the energy component.

For **electricity**, Italy and Greece are Member States that are not considered to have regulated prices but have social tariffs. In the case of Italy, the social tariffs constitute an intervention in price setting but it has consistently been applied to only a very small share of households. In the case of Greece, the social tariffs do not constitute an intervention in price setting.

Belgium and Latvia do not apply a general policy of price regulation for **electricity**, however they are considered to have regulated prices due to the relatively large share of consumers on social tariffs based on interventions in price setting. The remainder of the countries that apply social tariffs for **electricity** also maintain a policy of general price regulation.

For **gas**, Italy is the only country that is not considered to have regulated prices but has social tariffs. As for electricity, the social tariffs for **gas** in Italy have consistently applied to only a very small share of households.

Belgium does not apply a general policy of price regulation for **gas**, however it is considered to have regulated prices due to the relatively large share of consumers on social tariffs based on interventions in the price setting. The remainder of the countries that apply social tariffs for **gas** also maintain a policy of general price regulation.

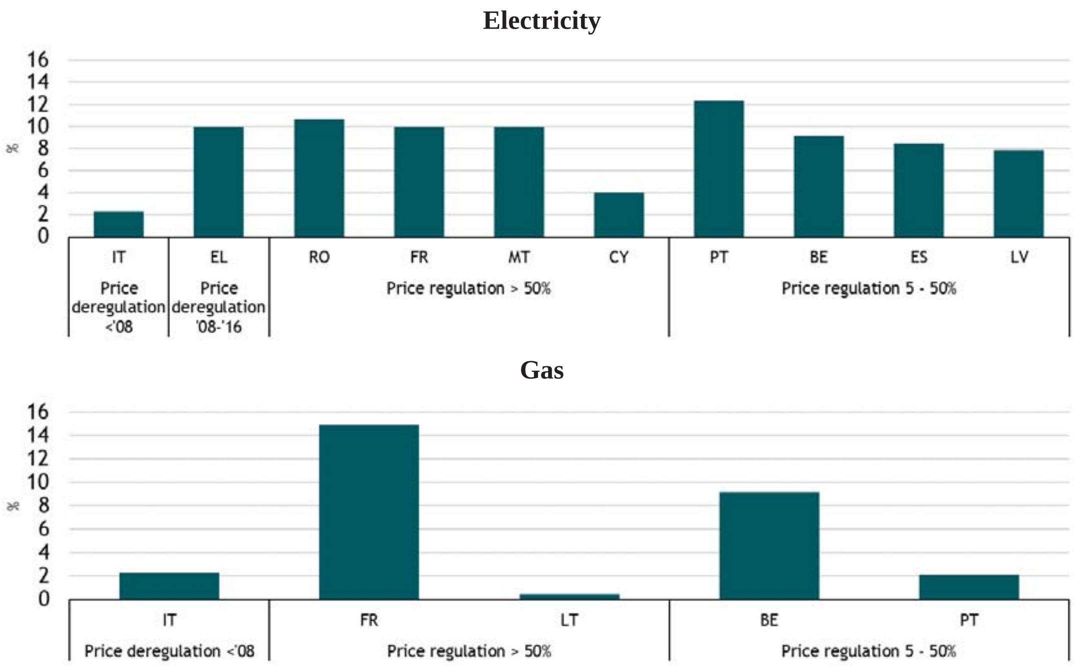


Figure 213 - Share of households under social tariffs in EU Member States

Source: CEER data and NRA representatives
Note that MS without social tariffs in 2016 are not shown. BG reported a very low share of consumers with social tariffs slightly greater than zero.

Evolution in the share of households under social tariffs

The evolution in the share of households under social tariffs appears to be country specific, with diverging patterns across Member States (**Figure 214**).

For **electricity**, the share of households under social tariffs decreased in Malta, Romania and Spain, while it increased in Belgium, France, Greece, Latvia and Portugal. Notably, for Portugal the increase in the share of households under social tariffs from 1% to 12% from 2014 to 2016 coincides with a decrease in the share of households under general price regulation from 53% to 26% in the same period. The same occurred in Latvia, where general price regulation was phased out entirely in 2015 and replaced by a social tariff regime. In France, a correlation between small decreases in shares on general price regulation and increases in social tariffs is also observed.

For **gas**, the share of households under social tariffs remained static in Italy and Bulgaria over the period of analysis. Again, reductions in the share of households under general price regulation for **gas** in France from 89% to 53% coincide with an increase of households under social tariffs for **gas** from 3% to 15%. In Portugal the same correlation is observed, where a substantial decrease of households under general price regulation for **gas** coincides with a minor increase in the share under social tariffs.

Although not uniformly conclusive, data from France, Latvia and Portugal suggests a trend away from general price regulation towards a more targeted policy of social tariffs. For Latvia and Portugal this is more pronounced for **electricity**. While for France it is more pronounced for **gas**.

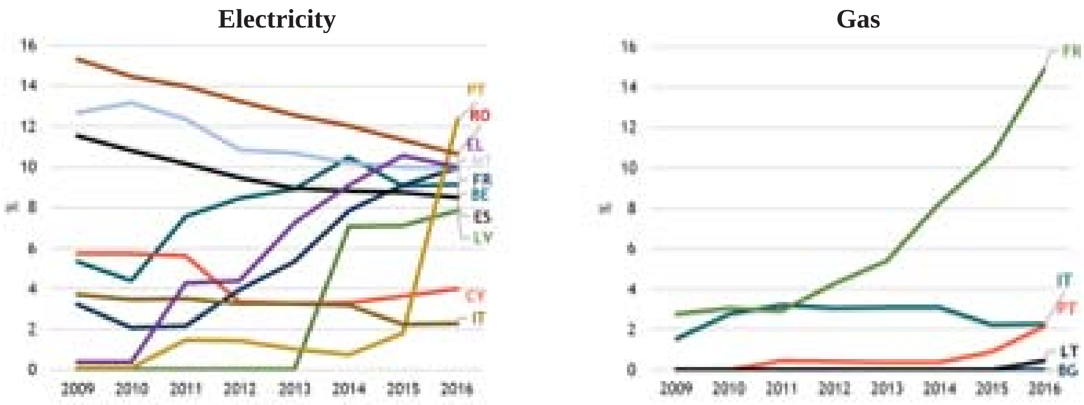


Figure 214 - Evolution in the share of households under social tariffs in EU Member States

Source: CEER data and NRA representatives
Note: Used weights are the total number of household consumers per country and per energy market.

10.3 Impact of regulated prices on household retail markets

10.3.1 Impact on competition and consumer engagement

This section assesses the impact of regulated prices on selected aspects of competition and consumer engagement. These two aspects are closely interrelated, there cannot be competition without consumer engagement in the form of choosing new suppliers and products, and there cannot be consumer engagement without competing suppliers providing choices for the consumers. In this section consumer choice, consumer engagement and market concentration indicators are assessed in order to better understand the dynamics of retail market functioning across the identified groups of Member States.

Consumer choice

The ability of consumers to effectively make choices on the market, whether in the form of a new supplier or a new product, and the ability to generate savings from switching, are key indicators to assess the functioning of retail energy markets. A primary objective of EU policies for retail energy markets are to ensure that all consumers have adequate choice and opportunities for engagement, allowing them to be active participants in the energy transition and benefit from a range of products and services, including dynamic price contracts. This means that consumers should have choices on the market that allow them to engage and be active.

Choice of supplier

The number of suppliers per 100,000 citizens indicates the level of choice and the number of suppliers competing in the market. There appears to be a relationship between the number of suppliers available per citizen and the existence of price regulation, with liberalised markets performing better than regulated markets (**Figure 215**).

Member States that deregulated **electricity** prices before 2008 had on average 0,88 suppliers per 100,000 customers in 2016, which is 319% higher than in Member States with price regulation for a majority of households. The Member States that had a majority of **electricity** household customers under price regulation, had on average 0,21 suppliers per 100,000 citizens. For Member States that deregulated **electricity** prices in the period from 2008 to 2016 the average number of suppliers is 0,42, which is 100% higher than in Member States with a majority of households under regulated prices. Member States that had a minority of **electricity** household customers under regulated prices had on average 0,46 suppliers per 100,000 citizens, which is 103% higher than in Member States with a majority of households under regulated **electricity** prices.

Member States that deregulated **gas** prices before 2008 had on average 0,56 suppliers per 100,000 citizens in 2016, while the Member States that deregulated between 2008 and 2016 had 0,13 suppliers on average. The Member States that had a majority of household **gas** customers under regulated prices had 0,14 suppliers on average, while the Member States that had a minority of household **gas** customers under regulated prices had 0,16 on average. The Member States that deregulated prices before 2008 therefore had 300% and 250% more suppliers on average than Member States with a majority and minority of household **gas** customers under regulated prices respectively, while Member States that deregulated **gas** prices between 2008 and 2016 had on average 7% and 18% fewer **gas** suppliers than Member States with a majority and minority of household **gas** customers under regulated prices respectively.

This confirms that for **electricity** there was a clear correlation in 2016 between the share of household customers under regulated prices and the average number of suppliers per 100,000 citizens. In particular Member States that deregulated prices before 2008 show a substantially higher number of suppliers compared with the other groups, while the Member States that either deregulated prices between 2008 and 2016 or that have a minority share of households under regulated prices also show a higher average number of suppliers than for countries that have a majority of households under regulated prices. For **gas**, a similar observation can be made for the group that deregulated prices before 2008 versus the other groups, while the differences between the other groups are insignificant. This suggests that there is more choice for consumers and more competition among suppliers in Member States that have phased out regulated prices.

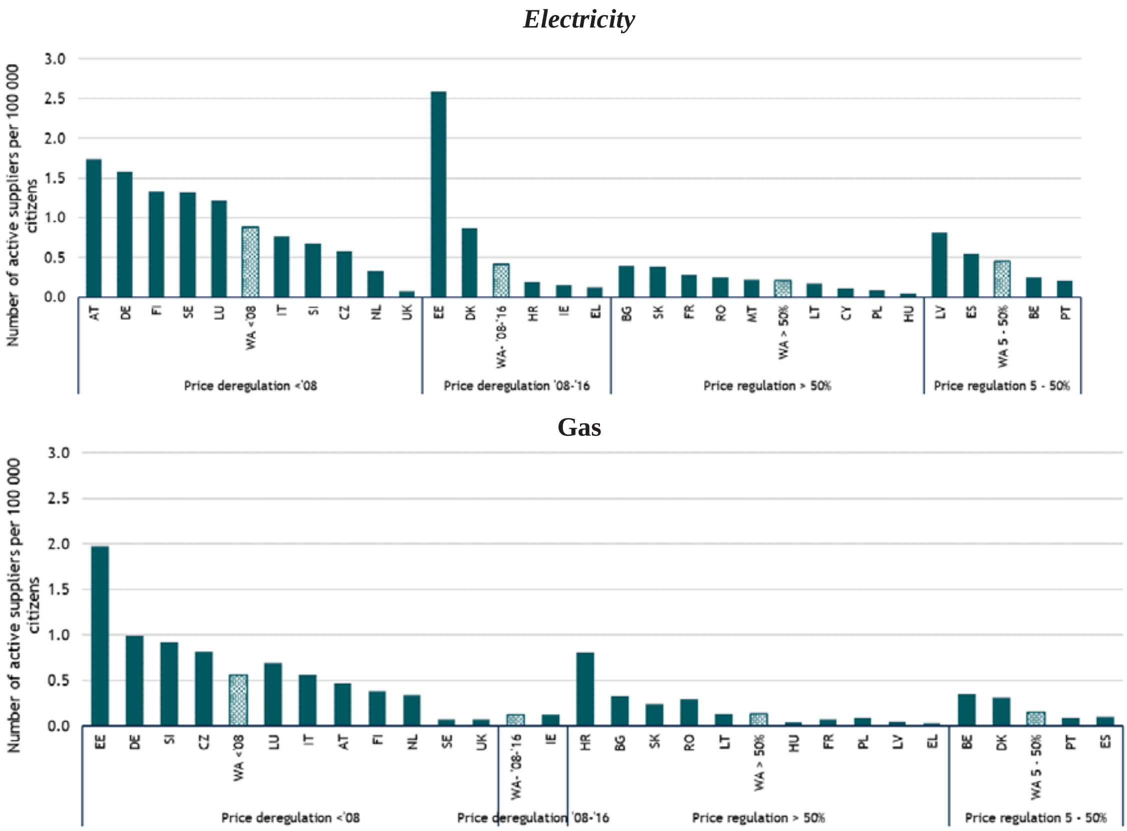


Figure 215 - Number of active suppliers per 100,000 citizens in 2016

Source: CEER data and NRA representatives

Evolution in the choice of supplier

The evolution in the number of suppliers per 100,000 citizens during the period from 2009 to 2016 indicates the trajectory of development in terms of choice and the number of potential competing suppliers in the market in this period (**Figure 216**).

For **electricity**, the evolution is clearly more positive for Member States that phased out regulated prices before 2008, which show a substantial increase in the number of suppliers during the period of analysis between 2009 and 2016. For Member States that deregulated during this period, the evolution is less positive and less consistent, although a consistent positive trend can be observed from 2012 and onwards. For Member States that had a minority share of consumers under regulated prices by 2016, the evolution is very positive, which could indicate an increasing momentum in terms of competition due to a gradual phase out of regulated prices. The Member States that had a majority share of consumers under regulated prices in 2016 had no evolution during the period, suggesting the existence of less dynamic market structures.

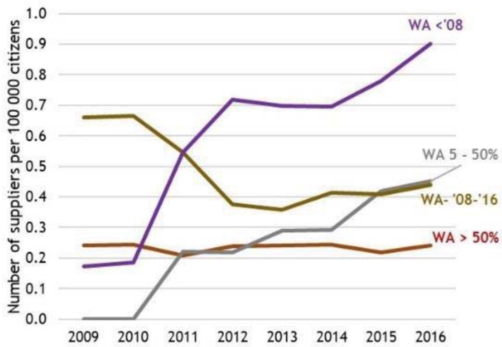
The individual Member States that phased out regulated **electricity** prices during the period from 2008 to 2016 do not appear to give any clear indication on an immediate impact of consumers choice from removing price regulation, a slight decrease is observed from 2013 in Estonia, no change is observed in 2016 for Denmark, while Croatia, Ireland and Greece did not display any significant evolution over the period.

For **gas**, a positive evolution is observed for the Member States that phased out regulated prices before 2008, with marked increase in the number of suppliers per 100,000 citizens between 2009 and 2016. For Member States that either phased out or gradually deregulated during this period a positive evolution is also observed, albeit less significant than for the pre-2008 group. The Member States that had a majority share under regulated in 2016 remained static over the period of analysis.

Ireland was the only Member State that phased out household regulated prices for **gas** during the period from 2008 to 2016, and it does not appear that the event of deregulation in 2014 had any immediate impact on consumer choice.

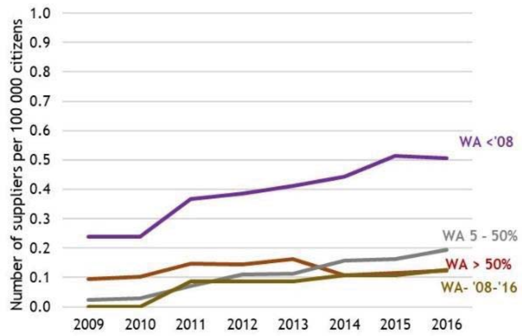
The evolution in the number of suppliers per 100,000 citizens during the period from 2009 to 2016 shows that there is a clear positive evolution in the Member States that phased out regulated **gas** and **electricity** prices before 2008. Again for **both the gas and electricity markets,** there appears to be a clear positive trend for both the Member States that phased out price regulation completely and those gradually phased out price regulation but which still had a minority share by 2016. For Member States with a majority of consumers under regulated prices there is no evolution in terms of the number of suppliers per 100,000 citizens, which suggests that the market structure has remained static during the period.

Electricity, weighted averages



Electricity, MS which phased out regulated prices between 2008 and 2016

Gas, weighted averages



Gas, MS which phased out regulated prices between 2008 and 2016

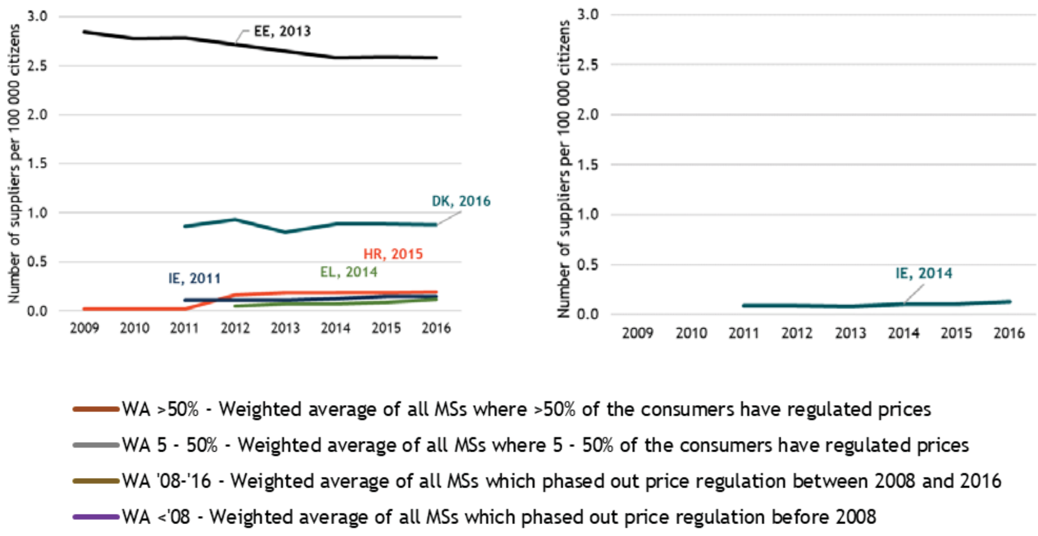


Figure 216 - Evolution in the number of active suppliers per 100,000 citizens in 2016

Source: CEER data and NRA representatives
Note: the year in which price regulation was phased out is mentioned in the graphs when relevant.
Used weights are the total household consumption per country and per energy market.

Supplier switching

Supplier switching rates are an indication of the level of consumer engagement and a proxy for the level of competition in the market. There appears to be a relationship between a phased out or lower levels of households under regulated prices and the level of switching rates **(Figure 217**).

For **electricity**, switching rates in Member States that have either deregulated before 2008 or that had a minority share under regulated prices by 2016 are substantially higher than in markets where a majority of households are under regulated prices. Member States that deregulated between 2008 and 2016 display switching rates at twice the level of Member States that have a majority of households under regulated prices, but still only at half the level when compared to the other two groups.

For **gas,** switching rates in Member States that have either deregulated before 2008 or that had a minority share under regulated prices by 2016 are again substantially higher than in markets where a majority of households are under regulated prices. Ireland was the only Member State to deregulate its household **gas** market between 2008 and 2016 and displays a high rate of switching in 2016. The Member States with a majority of households under regulated prices display switching rates at half the level of the other groups.

The data on supplier switches from 2016 reinforce the view that market structures in Member States with regulated prices are more static and less conducive to consumer engagement, as evidenced by the substantially lower switching rates in those Member States.

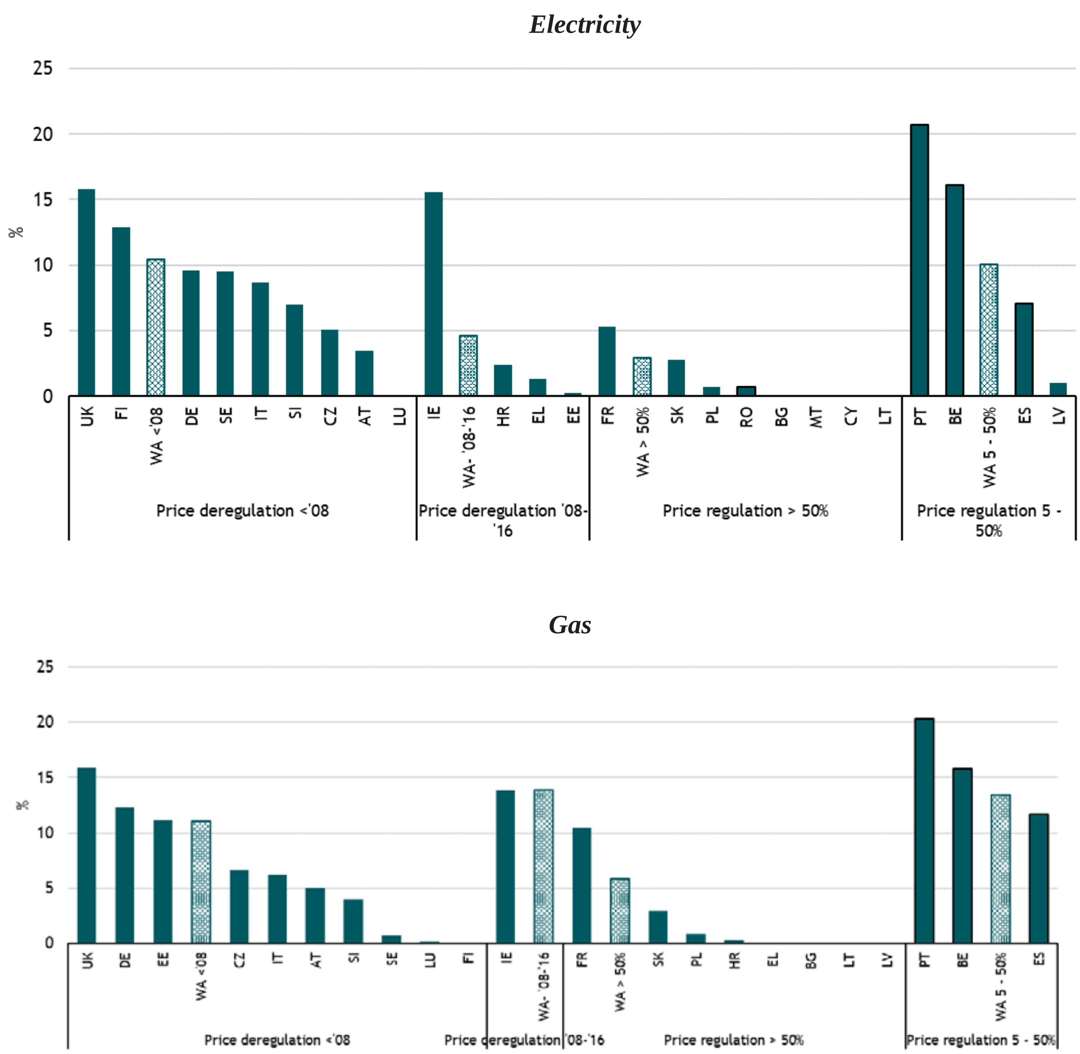


Figure 217 - Annual switching rates in 2016

Source: CEER data and VAASAETT. Switching rates for households in relation to the total number of metering points.
Note: data is missing for NL and HU for electricity and for NL, HU and RO for gas.
Used weights are the total household consumers per country and per energy market.

Evolution in the choice of supplier

The evolution in switching rates indicates the trajectory of consumer engagement and by proxy the competitiveness of the market, by showing the rate at which consumers are changing suppliers, thereby adding to competitive pressure among suppliers. Switching rates are substantially higher in markets without regulated prices or in markets with a lower share of consumers under regulated prices (**Figure 218**).

For **electricity**, there has been a sustained increase in average switching rates among the Member States that phased out price regulation before 2008, reaching an average above 10% in 2016. The group of Member States with a minority of households under regulated prices in 2016, which have been conducting a gradual phase out, had the largest increases in switching rates over the period from 2009 to 2016. This is likely due to the effects of a policy of a gradual phase out, which is reflected in switching statistics where households are incentivised to switch out of regulated prices, as opposed to a mandated phase out in the group of countries that fully deregulated between 2008 and 2016, which is not reflected in switching statistics in the same manner as the regulated prices are completely abolished. The Member States that deregulated between 2008 and 2016 had an even trajectory of switching rates at relatively low levels during the period, but still at higher levels relative to the group of Member States that had a majority share of households under regulated prices.

For **gas**, the Member States that abolished regulated prices between 2008 and 2016 and the group that had a minority share of households under regulated prices by 2016 saw marked increases followed by sustained high switching rates in the period. The Member States that deregulated prices prior to 2008 also saw sustained moderate switching rates. Again the Member States that had regulated prices for a majority of households had a low but increasing level of switching rates.

The evolution in supplier switching rates from 2008 to 2016 show that in particular countries undertaking a gradual phase out of regulated prices, which fall under the group that had a minority share under regulated prices in 2016, achieve high levels of consumers engagement during the phase out period. Both for **electricity** and **gas** there is clear evidence that Member States without regulated prices, evidenced by the group that deregulated before 2008 in particular, have higher levels of consumer engagement and a by proxy more competitive markets.

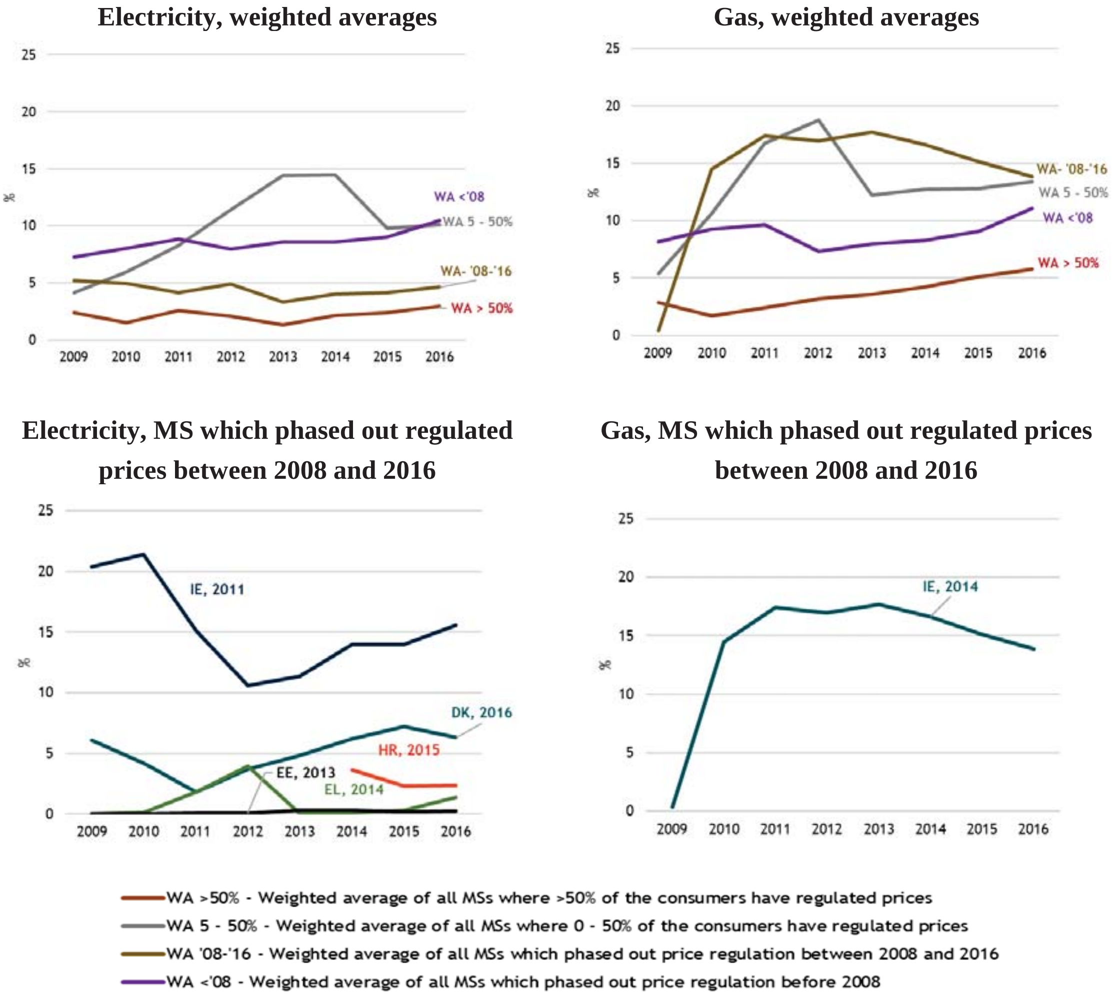


Figure 218 - Evolution in annual switching rates

Source: CEER data and VAASAETT. Switching rates for households in relation to the total number of metering points
Note: Used weights are the total household consumers per country and per energy market.
The country label indicates the phase out year for regulated prices

Choice of contract

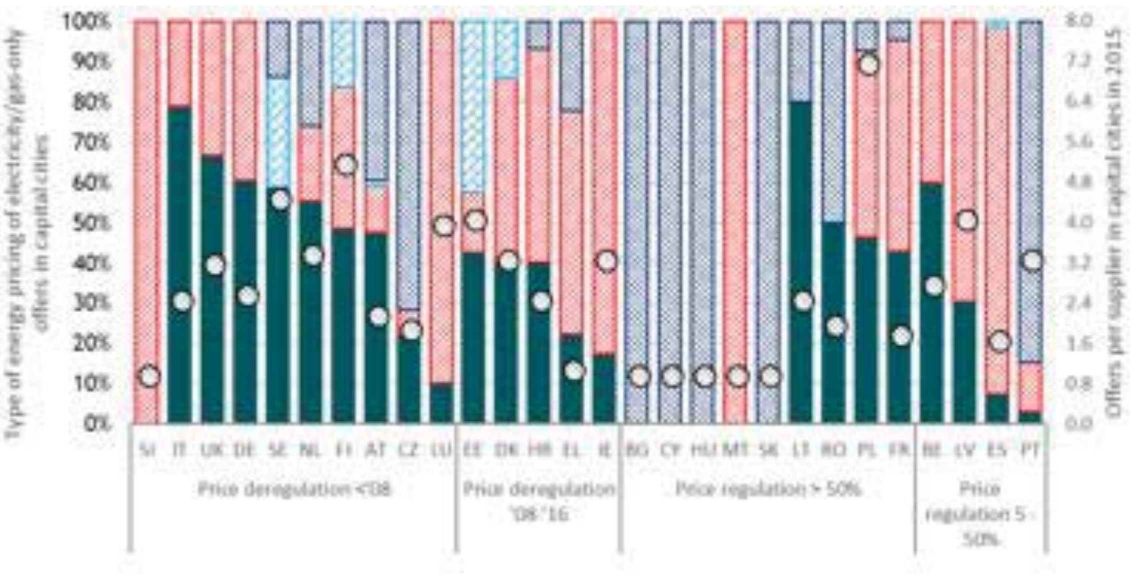
The choice of contracts available in Member States is an indicator for the level of consumer choice and the potential level of innovation in the markets. In markets without regulated prices or with a lower share of regulated prices, there are substantially more offers per supplier which could indicate a higher level of consumer choice.

For **electricity**, the distribution of the type of contract across Member States do not give clear indications on whether fixed or variable prices are prevalent in any of the groups of Member States. The exception is for dynamic electricity price contracts, which are only available in Member States that have either deregulated before 2008 or that have deregulated between 2008 and 2016. There also appears to be a correlation between the number of **electricity** offers per suppliers and the existence of regulated prices, as the groups without price regulation or the ones that have a minority share of households under regulated prices have more offers per supplier. The statistical outlier in terms of the offers per supplier is Poland, which has the highest share overall despite having a majority of households under regulated prices.

For **gas**, again the distribution of the type of contract across Member States does not give clear indications on whether fixed or variable prices are prevalent in any of the groups of Member States, while there is unclear data on contract types for many Member States with a majority of households under regulated prices. The exception is again for dynamic price offers, which for **gas** are contracts linked to wholesale market prices, which are only available in Member States that have either deregulated before 2008 or that have a minority share of households under regulated prices. There appears to be a correlation between the number of **gas** offers per supplier and the existence of regulated prices, as the groups without price regulation or the ones that have a minority share of households under regulated prices have significantly more offers per supplier.

Although the distribution between fixed and variable price contracts do not provide clear differences between the groups of countries, it is apparent that dynamic price contracts are only available in markets that have phased out regulated prices or are in the process of doing so. There are also significantly more offers available per supplier in most countries that have phased out regulated prices or that have a minority share of house under regulated prices. This is indicative of a greater of choice, innovation and competition in markets that are deregulated or with lower levels of regulated prices.

Electricity offers for households



Gas offers for households

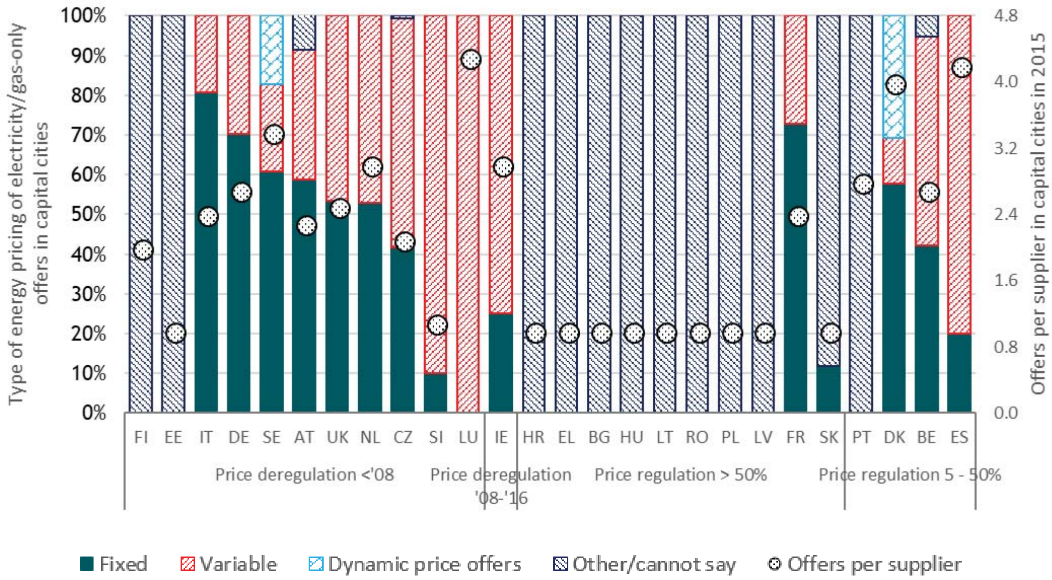


Figure 219 - Type of electricity and gas contracts available and offers per supplier

Source: ACER/CEER (2015) Annual Report on the Results of Monitoring the Internal Electricity and Gas Markets in 2015.

10.3.2 Market concentration

The level of market concentration is an indicator on the competitiveness of the market, as lower levels of concentration usually lead to improved competitive dynamics in the market.

The lower levels of market concentration are on average found in Member States that have deregulated prices historically, whereas there is little difference between other three groups.

For **electricity**, the average market share of the 3 largest suppliers is substantially lower in Member States that phased out price regulation before 2008. For Member States that either phased out regulated prices between 2008 and 2016, or which have a minority or majority share of households under regulated prices, the average market shares of the 3 largest **electricity** suppliers remain high.

For **gas,** again the average market share of the 3 largest suppliers is substantially lower in Member States that phased out price regulation before 2008. For Member States that either phased out regulated prices between 2008 and 2016, or which have a minority or majority share of households under regulated prices, the average market shares of the 3 largest **gas** suppliers remain high.

The data on market concentration indicates that we are observing the strongest competition dynamics in markets that have phased out regulated prices several years ago.

Electricity

Gas

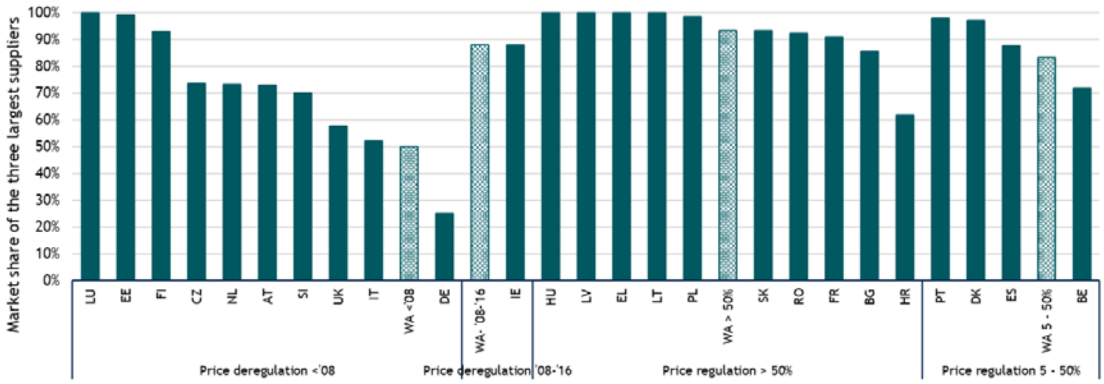


Figure 220 - Market share of the 3 largest suppliers

Source: CEER data and NRA representatives
No data available on electricity for the Czech Republic, Finland and Denmark and on gas for Cyprus, Malta and Sweden

Evolution in market concentration

The reduction of market shares of dominant suppliers needs time, as competitive dynamics gradually makes it more difficult for dominant suppliers to retain high markets shares as customers switch to competitors.

The most positive dynamics over time are observed in markets that have either phased out regulated prices or that have gradually phased out regulated prices but that had a minority share of households under regulated prices in 2016.

For **electricity**, the evolution in market concentration reveals a marked and sustained decrease in Member States that phased out regulated prices before 2008. Similarly in the Member States that either phased out regulated prices between 2008 and 2016 and those that have gradually been phasing out but had a minority share of households under regulated prices by 2016, there have been slight decreasing trends albeit from very high levels, in particular from 2012 onwards. For the Member States that have price regulation for a majority of households, the evolution in market concentration has been at a standstill at relatively high levels.

For **gas**, the evolution in market concentration reveal similar patterns, with a marked decrease over the period from 2009 to 2015 for the Member States that phased out price regulation before 2008. The Member State that phased out price regulation in the period from 2008 to 2016 saw a sustained but slight decrease from high levels from 2010 onwards. Member States that regulate prices for a majority of households saw a static and high market share for the three largest suppliers.

The data on market shares suggest that markets that have deregulated before 2008 are achieving the best results in terms of reducing market concentration, which suggests an increasing level of competition. It is also clear that the reduction of market shares of dominant suppliers is a gradual process that takes place over multiple years as customers switch suppliers. It is possible to observe the beginning of a reduction trend in market shares of dominant suppliers for Member States that deregulated between 2008 and 2016 and those that had a minority share under regulated prices in 2016, however this trend is moving slowly from relatively high levels of market concentration. Member States that had a majority of households under regulated prices show no signs of reducing the position of dominant suppliers in the market.

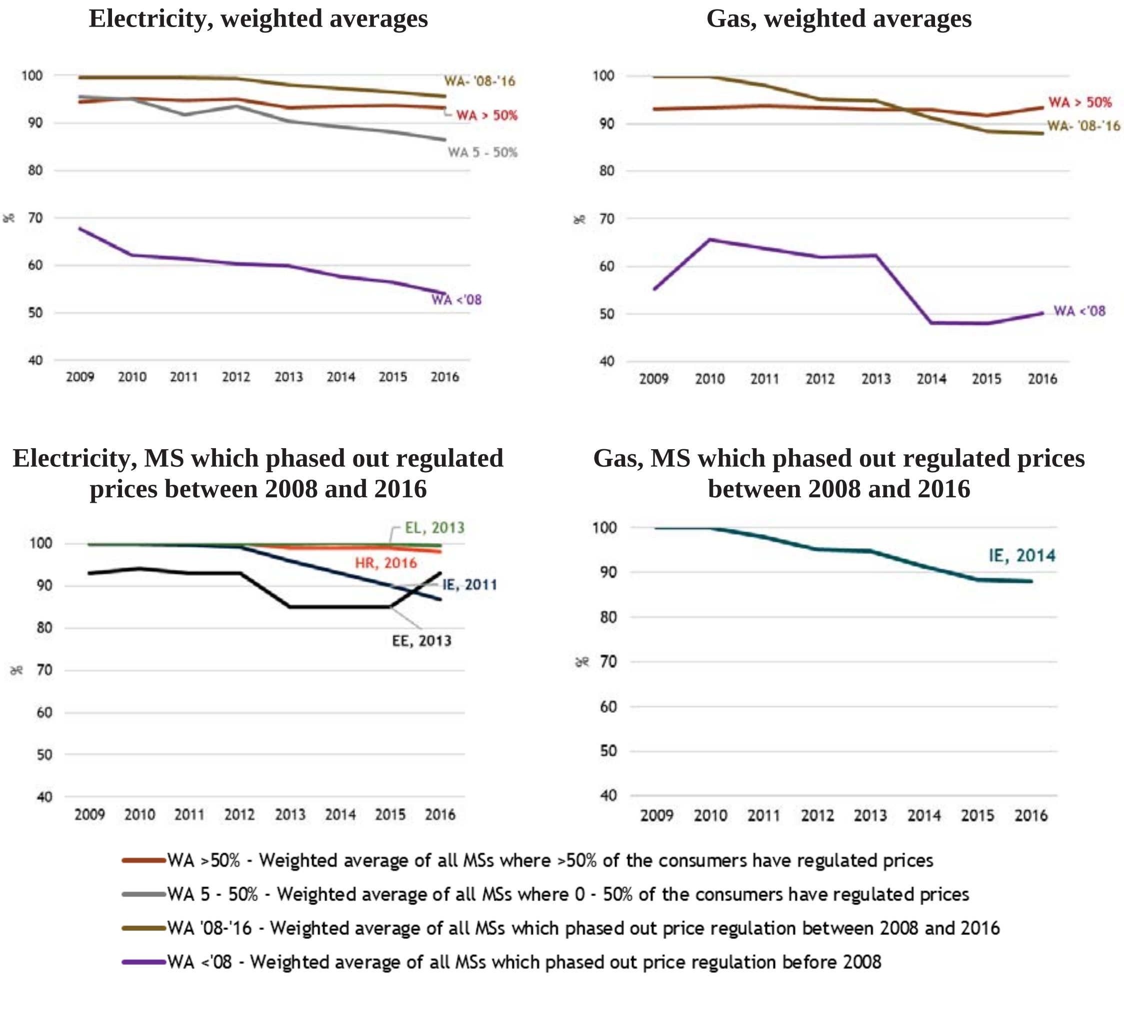


Figure 221 - Evolution in market concentration

Source: CEER data and NRA representatives
Note: Used weights are the total household consumption per country and per energy market.
The country label indicates the phase out year for regulated prices

10.3.3 Impact on prices and costs

The level of prices and the impact on costs are analysed across the groups of Member States to observe differences between markets with and without regulated prices. Markets with regulated prices tend to have lower prices and lower gross margins than markets without price regulation, which may partially be due to prices that are set below net cost levels. As we will see later in this section, there are no particular benefits of regulated prices in terms of lowering household expenditure on energy. Although many factors impact energy poverty, a policy of price regulation for electricity does not seem to be more effective in terms of alleviating energy poverty.

Price levels

For **electricity**, energy component prices are on average slightly higher in Member States that have phased out regulated prices either before 2008 or before 2016, when compared with Member States that maintained regulated prices for a majority and a minority of household consumers.

For **gas**, energy component prices were higher in Member States that deregulated prices before 2008 and in Member States with a minority of consumers under regulated prices, when compared with Member States that had a majority of households under regulated prices.

The data on energy component prices suggest that prices are slightly lower in markets that have a majority of households under regulated prices, as opposed to those groups of Member States that have phased out or have fewer households under regulated prices.

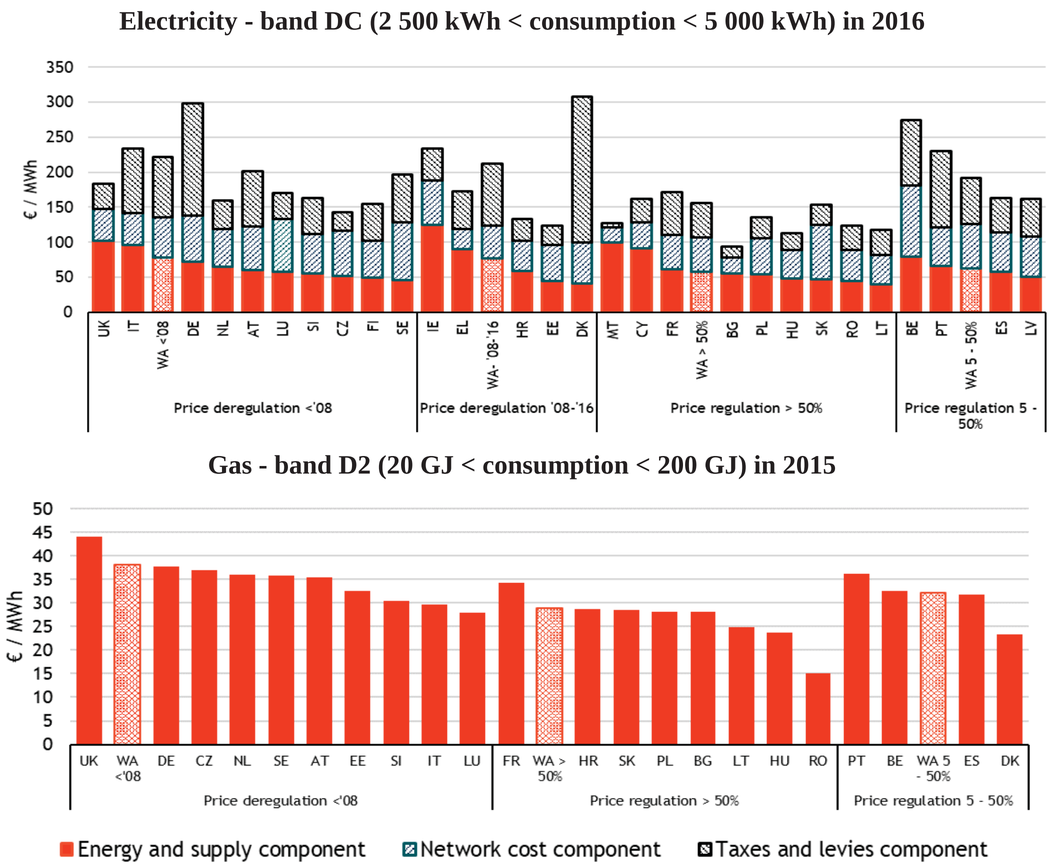


Figure 222 - Prices for electricity (2016) and gas (2015) on household markets

Source: Eurostat (and EC ad-hoc data for Spain for the electricity energy and supply component) for electricity data and EC ad-hoc data for gas

Note that for gas, no data is available for Finland, Ireland, Greece and Latvia.

Used weights are the total household consumption per country and per energy market.

Evolution in price levels

Looking at the evolution of prices is particularly pertinent for the markets that have phased out regulated prices during the period from 2008 to 2016, because as opposed to other indicators, one could expect an immediate impact of deregulation on prices.

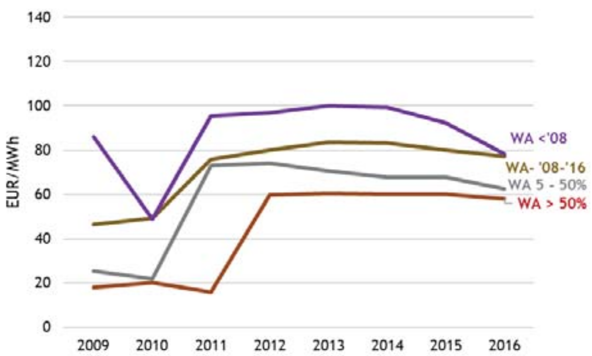
For **electricity**, prices have remained at higher levels for Member States that have phased out regulated prices before 2008, although a marked decrease is observed for this group from 2014 to 2016. Prices have remained relatively stable over the period for Member States that phased out regulated prices between 2008 and 2016, while those Member States that had minority and majority shares of consumers under regulated prices have seen slightly lower and stable price level in the period.

For the specific assessment of Member States that phased out regulated prices between 2008 and 2016, there is no indication that the event of phasing out regulated prices have a dramatic impact on price levels, which appear to remain steady following deregulation.

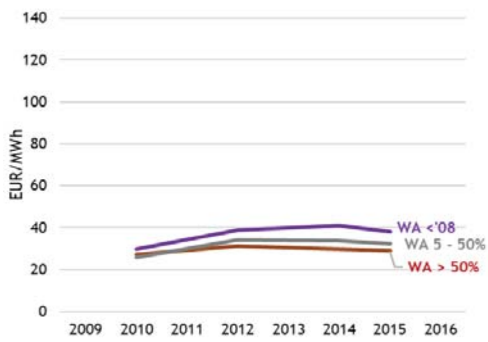
For **gas**, prices remained steady with no significant differences between the groups of Member States.

The evolution of prices do not reveal large differences on average between regulated and deregulated markets in terms the movement of prices over time, with the groups of Member States all remaining relatively stable over the period of analysis. This includes recently liberalised markets, which suggests that Member States that phase out regulated prices are not at risk of increased volatility or price levels as a result of this.

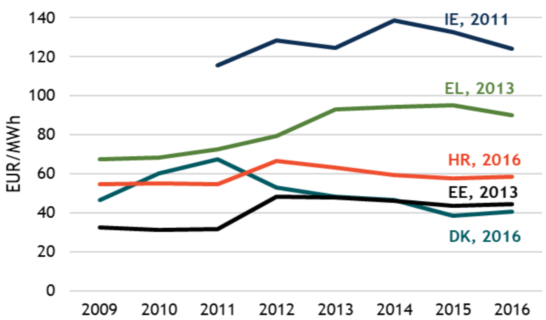
Electricity (2016), weighted averages



Gas (2015), weighted averages



Electricity (2016), MS which phased out regulated prices between 2008 and 2016



Gas (2015), MS which phased out regulated prices between 2008 and 2016

No data for Ireland which is the only MS in this category

Figure 223 - Evolution in prices for electricity (2016) and gas (2015) on household markets

Source: Eurostat (and EC ad-hoc data for Spain for the electricity energy and supply component) for electricity data and EC ad-hoc data for gas.
Note: no data for Ireland (which is the only country in the WA '08-'16 group for gas). Used weights are the total household consumption per country and per energy market.
The country label indicates the phase out year for regulated prices

Energy component mark-ups

The level of mark-ups is an indicator for the health of competition within a market and also reveals the differences between underlying wholesale prices and the final retail prices that consumers pay. It is difficult to assess the right level of mark-ups, as it depends on the level of margins that suppliers are able to competitively operate with, in terms of a deregulated market. In regulated markets, the mark-ups are determined by regulation and hence run the risk of being set at too low levels that are effectively below net costs, once supplier operating costs are factored in. Therefore despite mark-ups being positive in Member States with price regulation, they may still be set at a level that is too low to enable effective competition.

For **electricity**, we observe the lowest mark-ups in markets that have gradually phased out but that had a minority of consumers under regulated prices in 2016, at €14/MWh. The second lowest mark-ups were observed in Member States that regulated prices for a majority of household customers, at €21/MWh. The mark ups for Member States that deregulated before 2008 were on average €39/MWh, while those that deregulated between 2008 and 2016 had €41 on average.

For **gas**, the Member States that regulated prices for a majority of households in 2016 had the lowest level of mark-ups at an average of €7/MWh. The figure for Member States that had a minority share of households under regulated prices was €12/MWh, while it was €18/MWh for Member States that phased out regulated prices before 2008.

It is apparent that mark-ups on average are lower in markets where a majority or minority share of consumers is under regulated prices. The intra-group differences are, however, large.

Electricity - band DC (2 500 kWh < consumption < 5 000 kWh) in 2016

Gas - band D2 (20 GJ < consumption < 200 GJ) in 2015

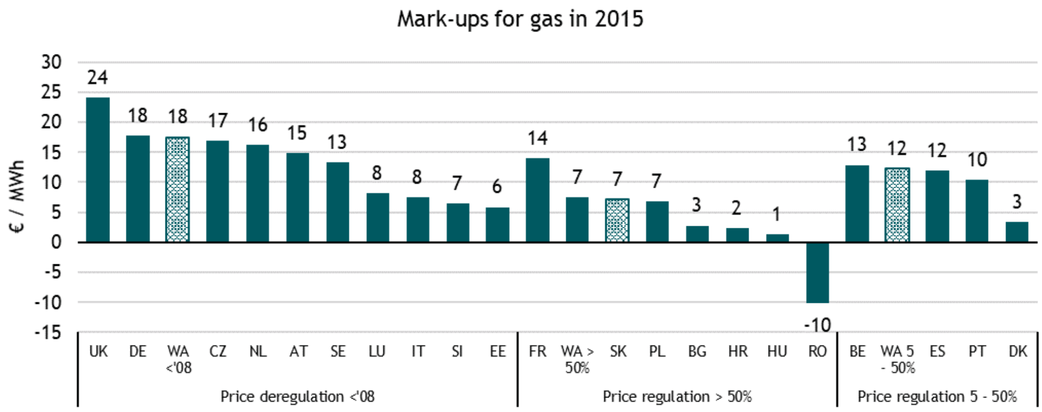


Figure 224 - Energy component mark-ups

Source: Own calculations based on Eurostat and Task 1 of this report for wholesale prices.

Note: No data available for Finland, Croatia, Cyprus for electricity and no data for Finland, Ireland, Greece, Lithuania and Latvia for gas. Mark-ups are calculated by subtracting the wholesale price from the energy and supply component of the retail price.
Used weights are the total household consumption per country and per energy market.

Evolution of energy component mark-ups

The evolution in the energy component mark-up over time allows us to observe the changes in competitive dynamics over time. There are higher mark-ups in markets without regulated prices, than for those that still maintain a policy of price regulation. In the case of regulated markets, average mark-ups have moved up from historical levels that were close to being below gross costs.

For **electricity**, average mark-ups have seen both the largest increases and decreases for the group of Member States that phased out regulated prices before 2008, with marked increases up until 2014 and significant decreases from 2014 to 2016. For Member States that phased out regulated prices between 2008 and 2016, mark-ups saw a steady increase from 2010 to 2016, while the same was observed since 2011 for markets with a majority of households under price regulation when average mark-ups began increasing from almost non-existing levels. The Member States which have gradually phased out regulated prices but which still had a minority share under regulated prices by 2016 have seen gradual declines in average mark-ups since 2012 in conjunction with the phase out.

The specific assessment of Member States that phased out regulated prices between 2008 and 2016 reveal that there were no dramatic increases in mark-ups following the event of deregulation. Mark-ups increased at the fastest rate in Ireland, which later saw a reduction between 2015 and 2016. In Greece the mark-up remains at the same level as at deregulation, while Estonia has had a mostly flat evolution since 2013. Denmark displays no significant change in 2016.

For **gas**, average mark-ups were slightly higher for markets that phased out regulated prices before 2008 compared to the other groups, although all groups remained on a flat trend between 2009 and 2016 with small average differences in mark-ups.

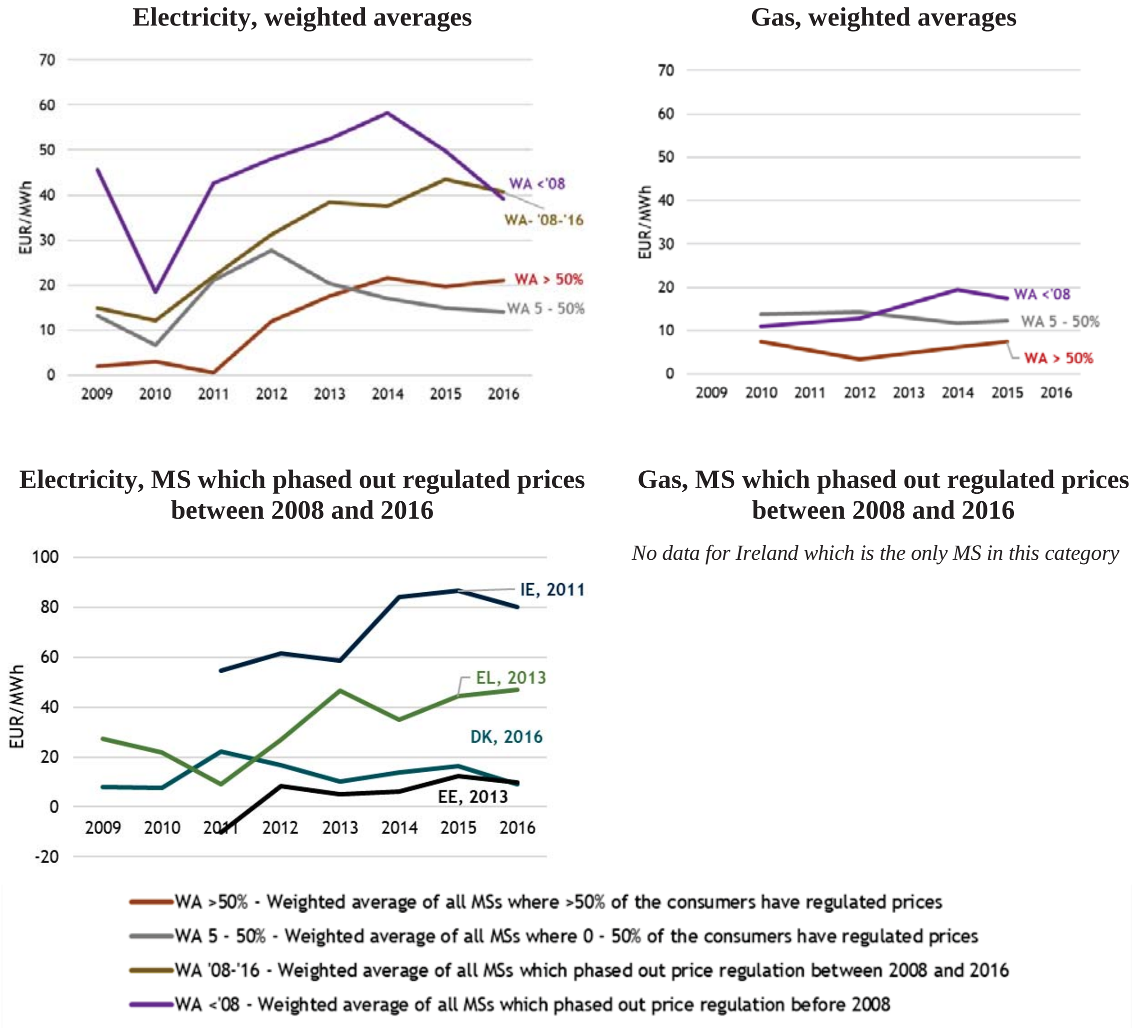


Figure 225 - Evolution in energy component mark-ups

Source: Own calculations based on Eurostat and Task 1 of this report for wholesale prices.
Note: no data for Ireland (which is the only country in the WA '08-'16 group for gas).Used weights are the total household consumption per country and per energy market. The country label indicates the phase out year for regulated prices

Energy expenditure as share of disposable income

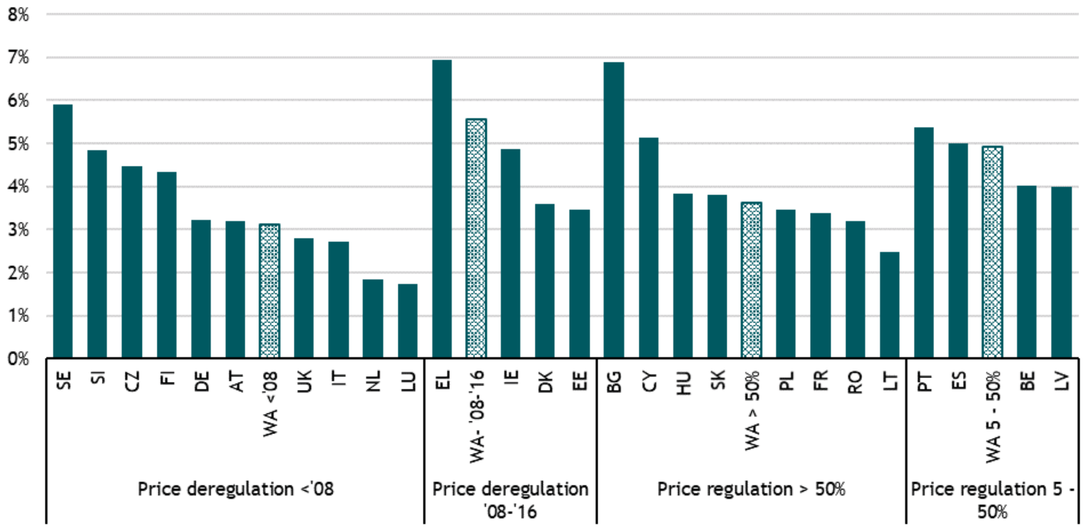
Energy expenditure as a share of disposable income is an indicator about the affordability of energy. In terms of differences between Member States that regulate prices and those that do not, there is no apparent advantage of regulating prices in terms of achieving better affordability for energy.

For **electricity**, the average household expenditure was the lowest in Member States that phased out regulated prices before 2008, while the Member States that phased out regulated prices between 2008 and 2016 had the highest level of expenditure. The latter group is impacted greatly by the impact of the economic crisis in Greece. The second lowest average household expenditure was in Member States that regulated prices for a majority of households, while the Member States with a minority share under regulated prices were slightly higher.

For **gas**, the level of expenditure is the highest in Member States that phased out regulated prices before 2008, while the lowest levels are in Member States that either phased out between 2008 and 2016 or that maintained a minority share of households under regulated prices. The Member States that regulated prices for a majority of households had a slightly higher level of average gas expenditure than the minority price regulators.

The data on **electricity** expenditure as a share of disposable income reveal no apparent advantage of regulating for protecting consumers from high energy costs. When discounting for Greece, the figures for recently deregulated markets are supportive of this, as these Member States do not see exorbitant expenditures as a result of deregulating prices. The same generally also holds true for **gas** where the differences between the groups are relatively small.

Electricity



Gas

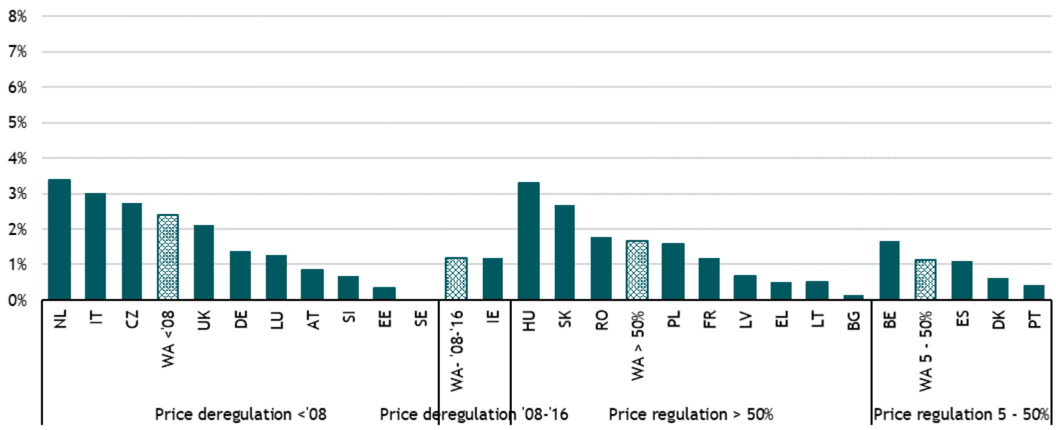


Figure 226 - Energy expenditure as share of disposable income

Source: Own calculations based on Eurostat

Note: The most recent data available data was used in the calculations. For Hungary, Romania and the UK this was 2015, for all others 2016. No data is available for Croatia and Malta. Average yearly household expenditures may deviate with other sources due to factors such as differences between numbers of households and actual connection points.

Used weights are the total household consumers per country and per energy market.

Energy poverty

Indicators for energy poverty are mapped across the groups of Member States in order to look at the relationship between regulated prices and energy poverty.

In the data there are no observations that suggest that regulated prices lead to lower levels of energy poverty. Moreover, the lowest levels of energy poverty are found in markets without price regulation (**Figure 226**).

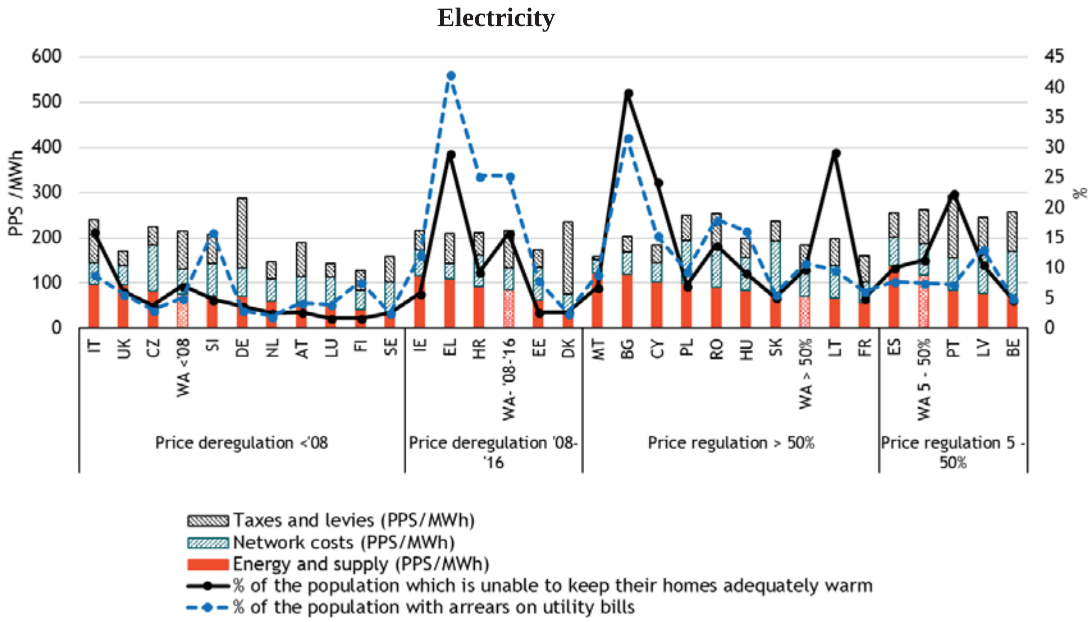


Figure 227 - Energy poverty

Source: Eurostat
Note that the % of the population which is unable to keep their homes adequately warm and the % of the population with arrears on the utility bills are not separated for the gas and electricity market.
Used weights are the total household consumers per country and per energy market.

Evolution of energy poverty

The evolution of energy poverty indicators makes possible to assess the observed trajectories in Member States between 2009 and 2016.

In terms of the *share of the population that is arrears on energy bills*, the lowest and also decreasing levels are observed in the Member States that phased out price regulation before 2008. The Member States that have gradually phased out regulated prices but maintained a minority share of households under regulated prices by 2016 also display a low level of households being arrears on utility bills. The share has also been falling in the Member States with a majority of households under regulated prices, albeit from higher levels.

The specific analysis of the countries that deregulated between 2008 and 2016 reveal large differences between countries, largely due to differences in the economic situation: Greece saw a large increase in households that are arrears on utility bills, which can be attributed to the effects of the economic crisis. In Croatia, Ireland, Estonia and Denmark, the share of consumers being arrears on utility bills have been stable or falling when seeing the period from 2009 to 2016 as a whole.

In terms of the *share of the population which is unable to keep their homes warm*, the lowest levels are again observed in the Member States that phased out regulated prices before 2008.

The Member States that have a majority share of households under regulated prices have the second lowest levels, having seen sharp decreases between 2009 and 2011. The Member States with a minority share of households under regulated prices have seen a mostly flat evolution during the period.

The specific analysis for the countries that deregulated between 2008 and 2016 reveal differences between the countries, with Greece again seeing a large increasing in households unable to keep their house warm, which can be attributed to the effects of the economic crisis.

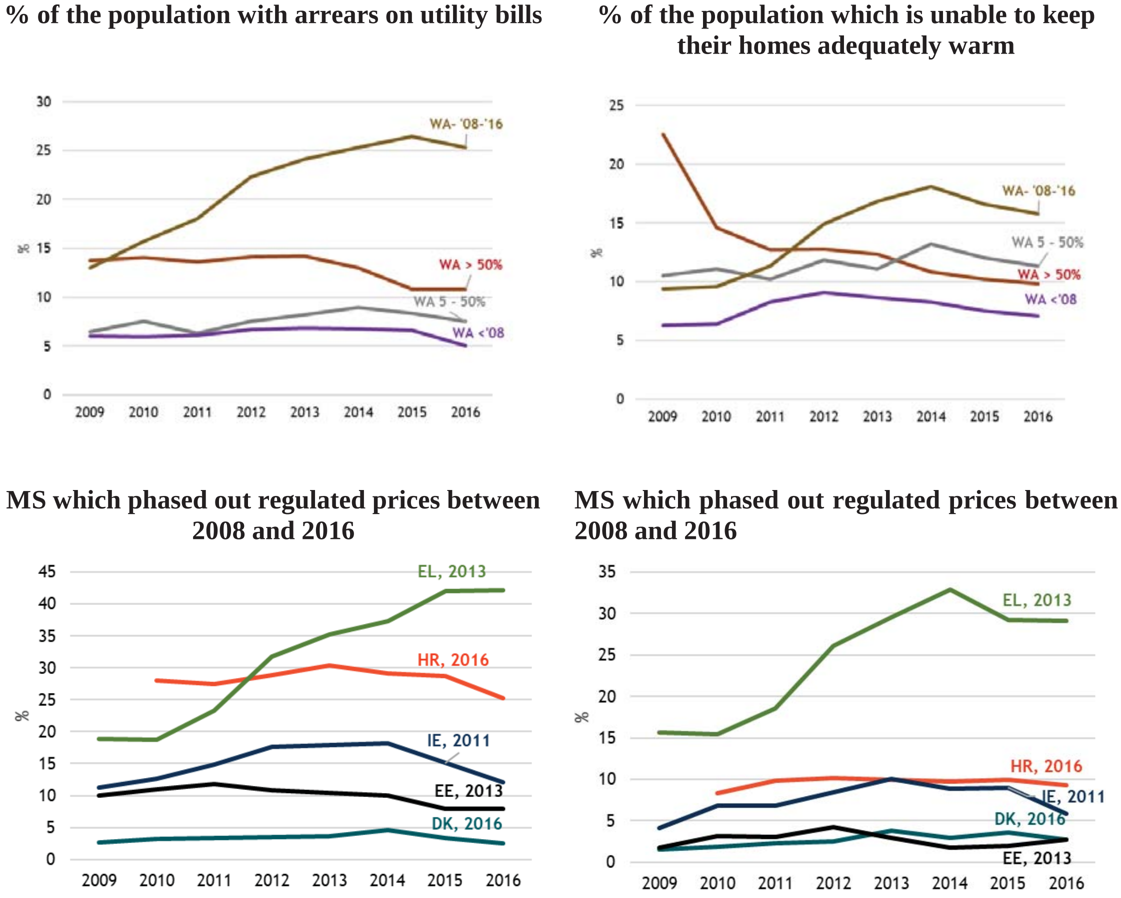


Figure 228 - Evolution of energy poverty

Source: Eurostat

Used weights are the total household consumers per country and per energy market. The country label indicates the phase out year for regulated prices

10.3.4 Impact on consumer perception

The consumer experience of the market and their reported satisfaction is an indicator of whether the market works for consumers. Households are on average reporting high levels of satisfaction across several groups.

For **electricity**, consumers in the Member States that phased out price regulation before 2008 report the highest average level of satisfaction, marginally above the Member States that had a majority share of households under regulated prices. The Member States that phased out regulated prices in the period from 2008 to 2016 also score well in terms of how consumers perceive the market, while the Member States with a minority share of households under regulated prices report a markedly lower average level of consumer satisfaction, which is impacted greatly by the perception among consumers in Spain. It appears that for **electricity** the share of consumers that experienced a problem was consistently higher in Member States that had regulated prices.

For **gas**, consumers in Member States that had a majority share of households under regulated prices in 2016 report the highest average level of satisfaction, marginally above the Member States that phased out regulated prices in the period from 2008 to 2016. Member States that phased out regulated prices before 2008 also score well in terms of consumer perception relative to the other groups, and the same do the Member States that had a minority share of households under regulated prices in 2016. There is no clear evidence that **gas** consumers experienced more problems in any particular group.

There are no clear observations pointing to say that consumers have a better experience with the market with or without regulated prices. We see that in both groups of Member States, consumers are generally well satisfied; although in **electricity** markets consumers reported fewer problems in markets without price regulation. The least positive consumer experiences appear to be in the Member States which have a minority share of households under regulated prices.

Electricity

Gas

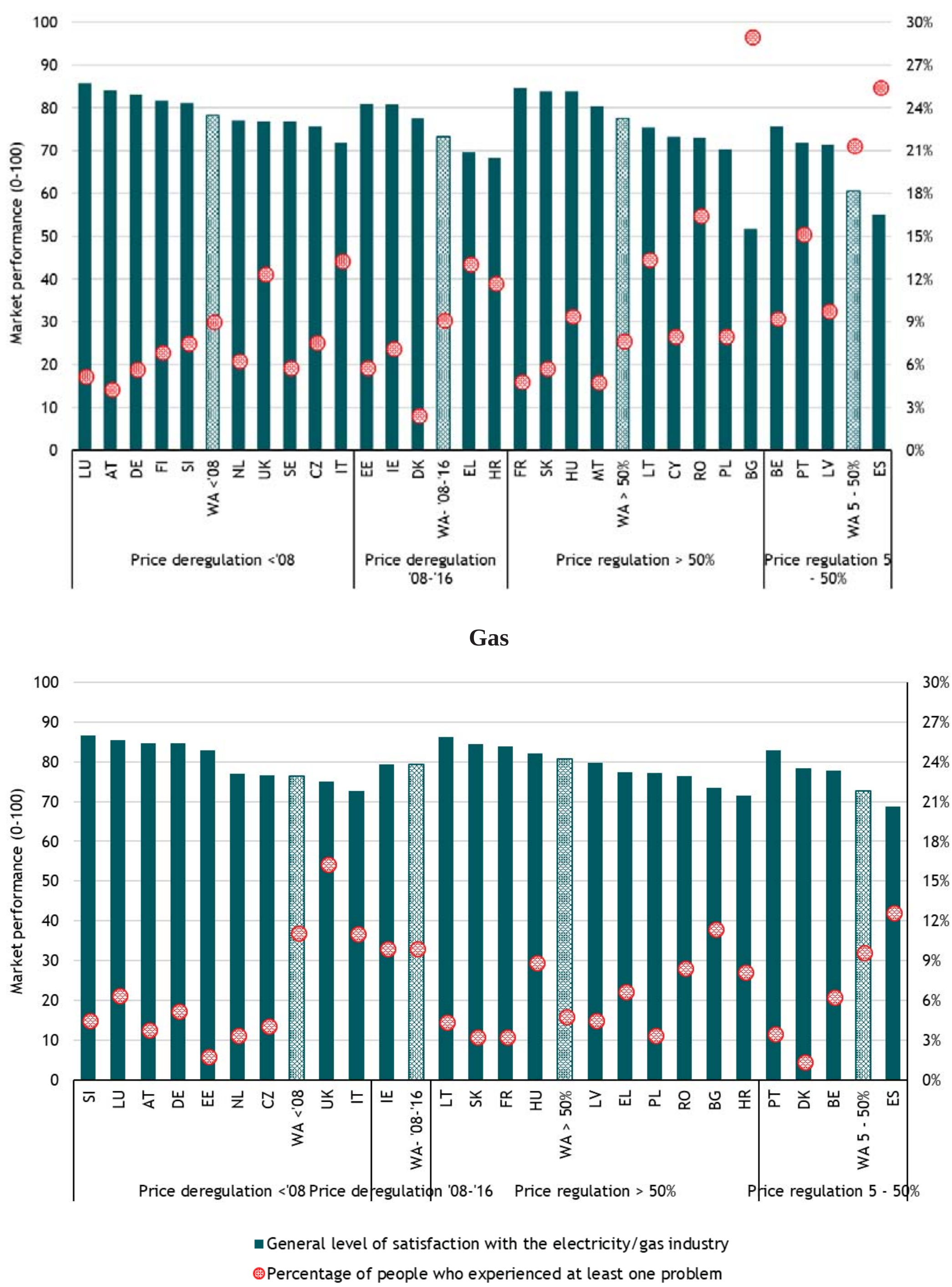


Figure 229 - Consumer perception of the market in 2015

Source: Consumer Market Scoreboard data.

Note: Used weights are the total household consumers per country and per energy market.

10.4 Impact of regulated prices on non-household retail markets

A study commissioned by EC[149] confirms that by 2016 the majority of EU non-household consumers[150] have essentially moved away from regulated, administered pricing schemes, as shown in **Figure 229** in the case of business consumers of electricity and natural gas. Most of the Member States that applied price regulation for non-household consumers in 2016 were transitioning towards markets with fewer administrative interventions.

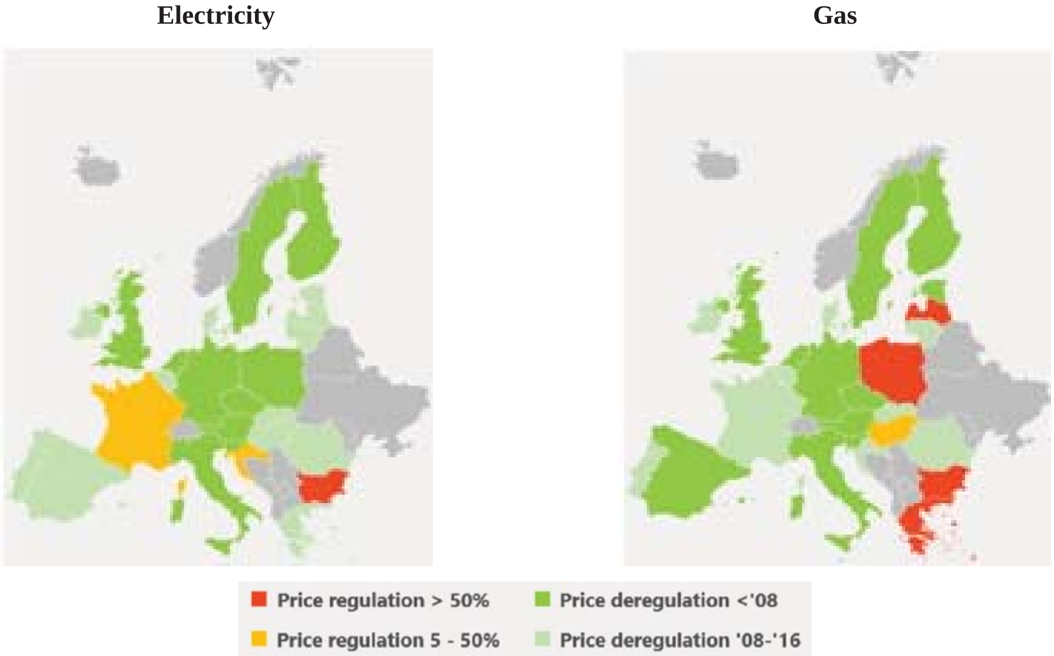


Figure 230 - Non-household price regulation from a geographical perspective

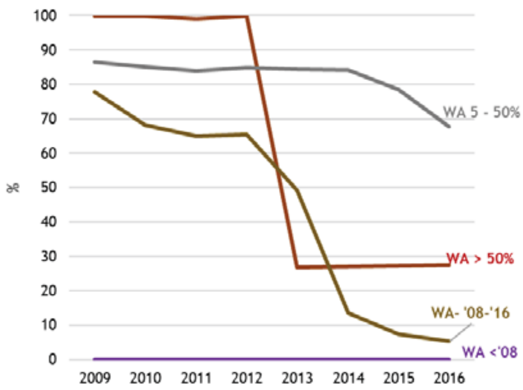
Source: CEER data and NRA representatives

As a rule, businesses are embracing competitive price schemes for electricity and natural gas faster than residential consumers. Recent ACER and CEER reports indicate that in the electricity market in 2016, in nine Member States the share of household consumers paying regulated prices was above 50%. Only three Member States (Bulgaria, Cyprus and Malta) had such a share for non-household consumers. In gas, the corresponding numbers of Member States were respectively 10 for residential and 4 for business (Bulgaria, Greece, Latvia and Poland.

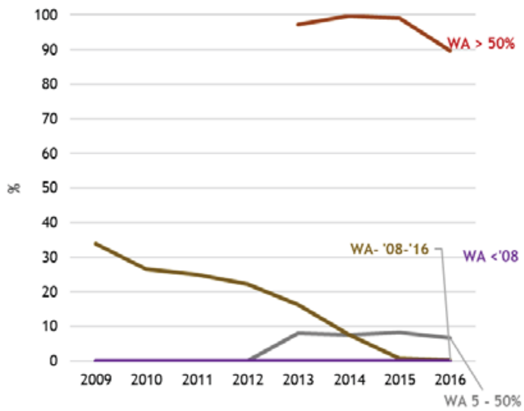
Inside the group of non-household consumers, the decline of the relative importance of price regulation is confirmed both in terms of absolute number of consumers who were paying regulated prices and in terms of a steadily decreasing share of consumption under price regulation. This is a common development for electricity and natural gas, even if the pace of transition varies across energy products and Member States (**Figure 230**).

[149] Study on Energy Prices, Costs and Subsidies and their Impact on Industry and Households, Trinomics (2018)
[150] The Eurostat group of non-households consumers of electricity and natural gas include end-users from a large variety of sectors, including but not limited to: industry, services, transport, other non-residential, etc.

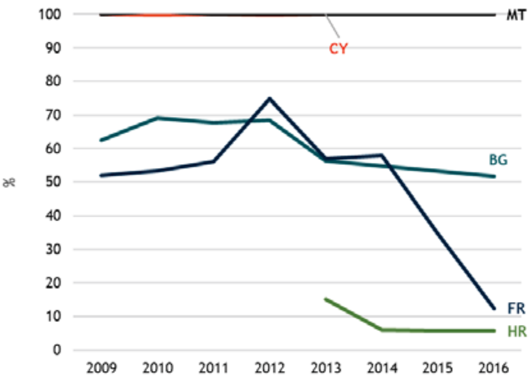
Electricity non-household, weighted averages



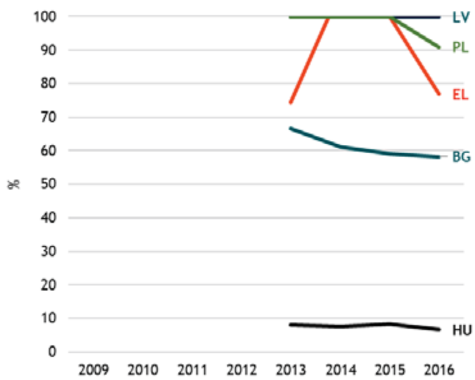
Gas non-household, weighted averages



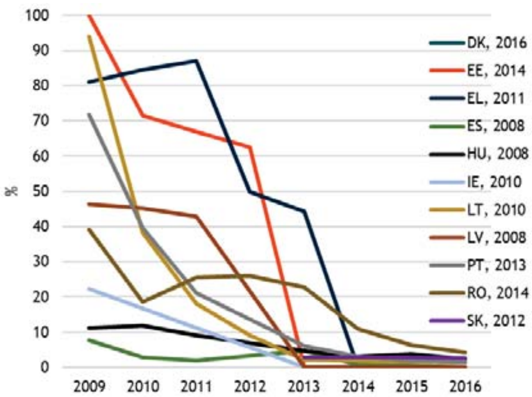
Electricity non-household, MS with price regulation



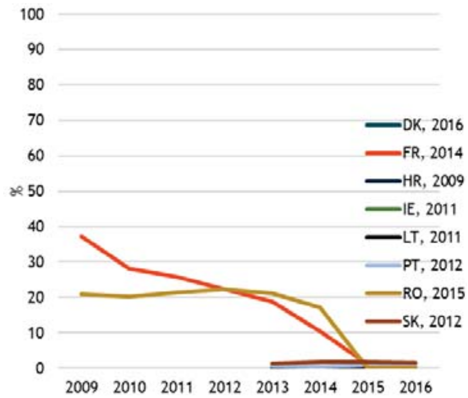
Gas non-household, MS with price regulation



Electricity non-household, MS which phased out regulated prices between 2008 and 2016



Gas non-household, MS which phased out regulated prices between 2008 and 2016



WA >50% - Weighted average of all MSs where >50% of the consumers have regulated prices
WA 5 - 50% - Weighted average of all MSs where 5 - 50% of the consumers have regulated prices
WA '08-'16 - Weighted average of all MSs which phased out price regulation between 2008 and 2016
WA <'08 - Weighted average of all MSs which phased out price regulation before 2008

Figure 231 - Share of non-household consumption under regulated prices

Source: CEER data and NRA representatives
Used weights are the total non-household consumption per country and per energy market. A description of the weighted averages' groups is provided in section 10.1.
The country label indicates the phase out year for regulated prices

Price levels in the non-household market

Figure 231 also based on the Trinomics et altri study, provides an indication that could explain why businesses were keen to adopt the change of pricing methods. More attractive contract conditions (price level, flexibility, avoiding cross-subsidization of other consumer groups, etc.) have facilitated the transition to competitive pricing.

The two panels report on the price level of the energy component in the bill for electricity and natural gas. Member States are assembled in 4 groups indicating the level of price regulation, starting from the group of countries that have deregulated their non-household sector prior to 2008, then those that did so after 2008 but before 2016, then 2 groups of Member States where price regulation is still present, according to the size of the regulated segment.

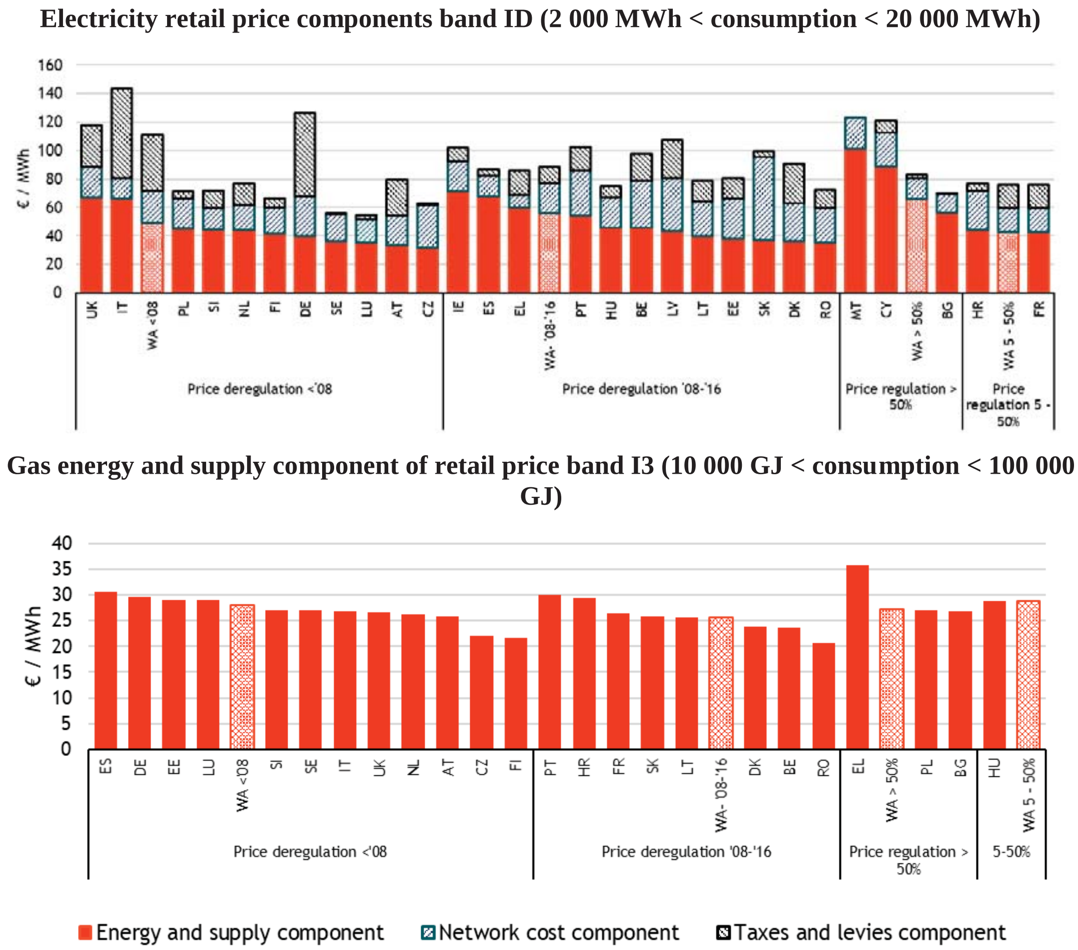


Figure 232 - Energy and supply component for electricity (2016) and gas (2015) on the non-household consumer market

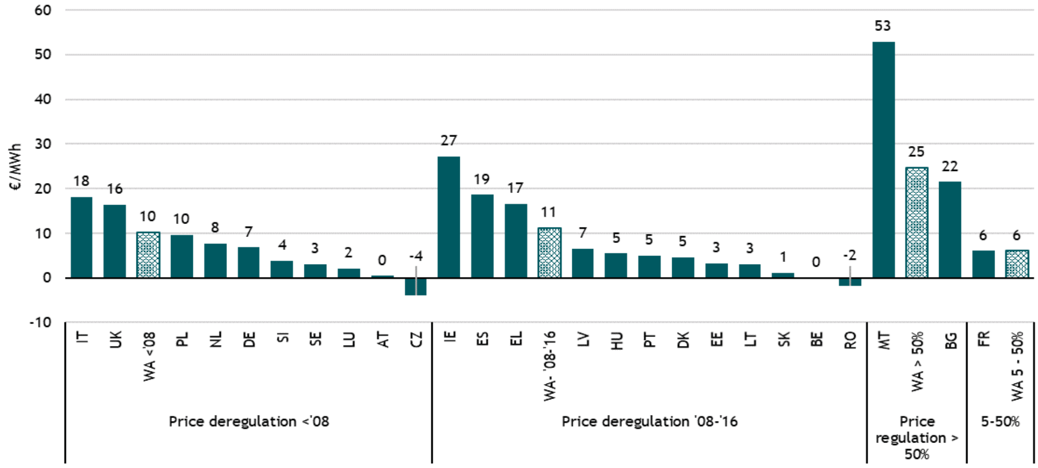
Source: Eurostat (and EC ad-hoc data for Spain for the electricity energy and supply component) for electricity data and EC ad-hoc data for gas.
Note that the scale of the y-axis is different in each panel. No data is available on the gas market for IE and LV
Used weights are the total household consumption per country and per energy market.

The group of Member States where the regulated part of the market is above 50% paid on average the highest cost for the supply of electricity. Likewise for gas, Member States practicing price regulation over some portion of the non-household market paid on average a higher cost for the supply of natural gas. It is also interesting to observe that the variability of pricing conditions is much higher in electricity than in gas.

Similar conclusions in terms of the attractiveness of competitive over regulated pricing schemes are emerging when the cost of energy supply is compared to the wholesale price of electricity and natural gas: from 2009 to 2016 the mark ups[151] for business consumers in Member States that have open and competitive retail markets tend to be smaller and more responsive of price conditions.

The level of mark-ups is an indicator for the health of competition within a market and also reveals the differences between underlying wholesale prices and the final retail prices that non-households pay. Non-household retail markets have progressed further in terms of liberalisation and we there should be a higher level of competitive dynamics at play in determining gross-mark ups. It is evident that non-households in markets without price regulation on average face lower mark-ups than those that are under regulated prices, the exception being one Member State which still retains a minority share under regulated prices.

Electricity based on band ID (2 000 MWh < consumption < 20 000 MWh)



Gas based on band I3 (10 000 GJ < consumption < 100 000 GJ)

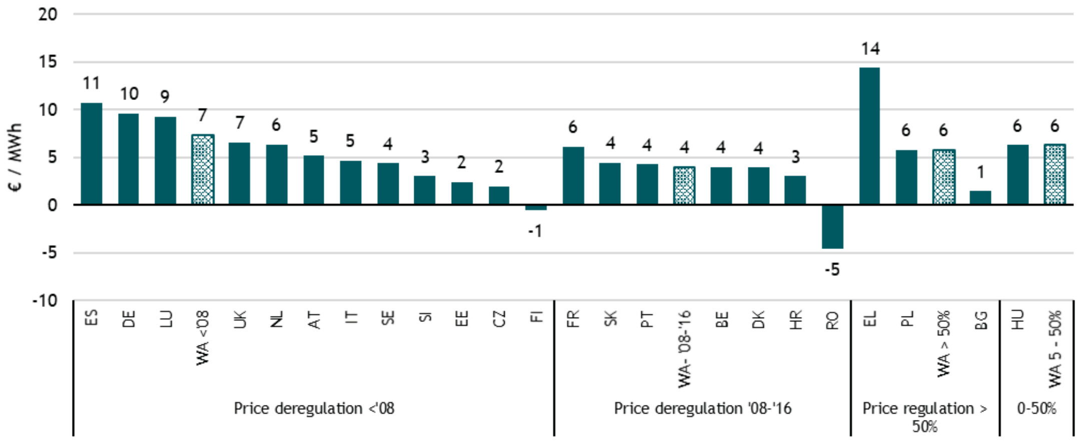


Figure 233 - Energy and supply component for electricity (2016) and gas (2015) on the non-household consumer market

Source: Own calculations based on Eurostat and Task 1 of this report for wholesale prices.
Note: Mark-ups are calculated by subtracting the wholesale price from the energy and supply component of the retail price. Used weights are the total household consumption per country and per energy market.

[151] Mark-ups are defined as the differences between the wholesale price and retail energy price component. The estimated mark-ups are not meant to assess retail margins of suppliers, but serve rather as an "indication of the level of retail competition and the 'responsiveness' of retail to wholesale prices over time"

Evolution of energy component mark-ups

The evolution in the energy component mark-up over time allows us to observe the changes in competitive dynamics over time. It is clear that markets that have phased out regulated prices have seen a positive trajectory, in particular between 2013 and 2016. The group that maintains regulated prices for a majority of non-household customers saw steeply rising margins in 2016.

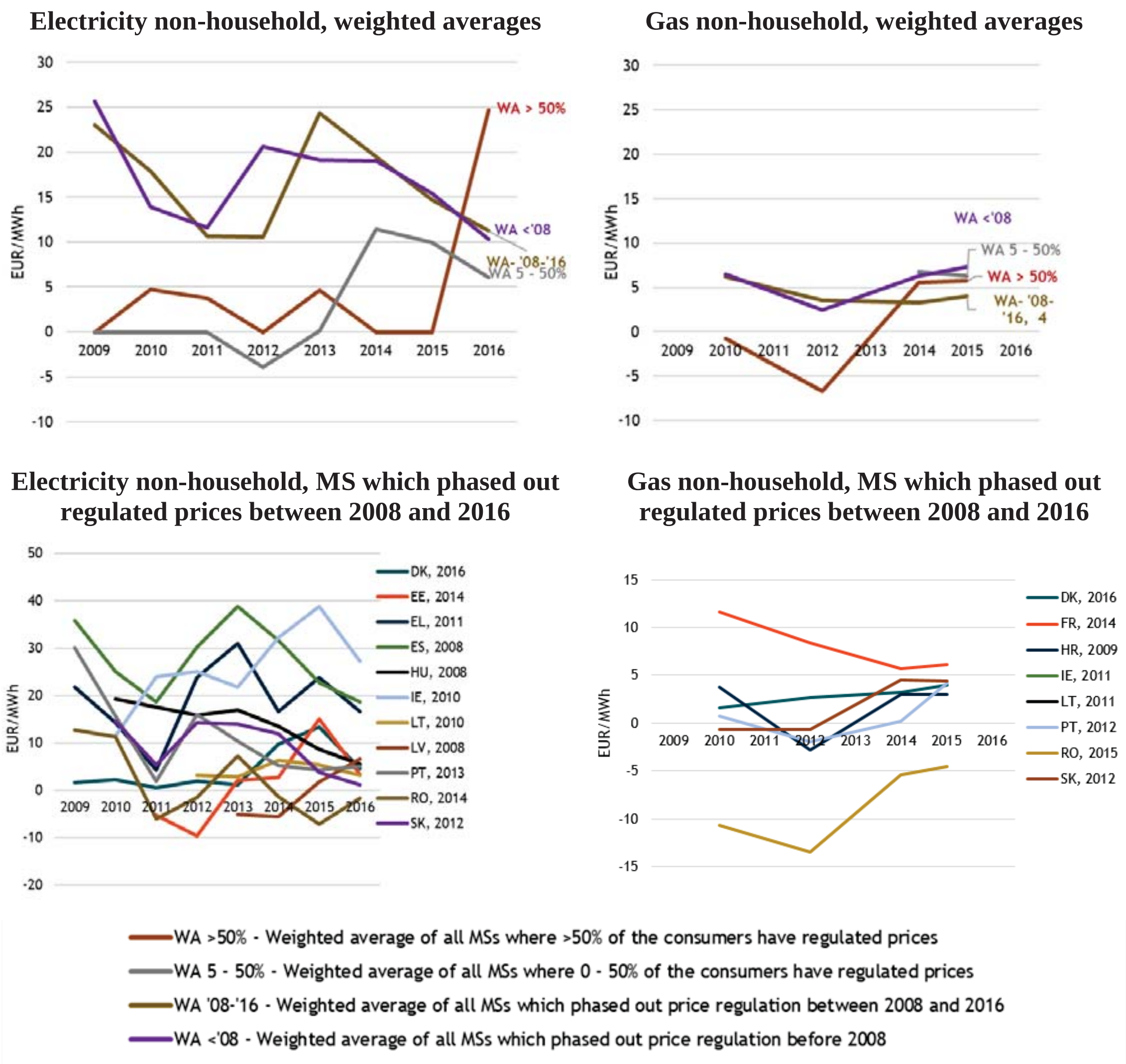


Figure 234 - Energy and supply component for electricity (2016) and gas (2015) on the non-household consumer market

Source: Own calculations based on Eurostat and Task 1 of this report for wholesale prices.
Note: no data for Ireland (which is the only country in the WA ’08-’16 group for gas).
Used weights are the total household consumption per country and per energy market.
The country label indicates the phase out year for regulated prices

10.5 Impact of regulated prices on tariff deficits and investments

The data on the existence of tariffs deficits from 2008 to 2016 suggests that the existence of tariff deficits is more frequent in Member States that regulate retail energy prices. This is likely connected with the difficulty of establishing cost-reflective price levels through regulation, as opposed to allowing the market to handle this function. This suggests that even though prices and mark-ups are lower in regulated markets, the downside risk is that prices are set at a level where they are not cost reflective, which is detrimental to the development of competitive markets.

Table 20 - Overview of tariff deficits in Member States between 2008-2016

MS	Existence of price regulation: Electricity, households	Existence of price regulation: Electricity, non-households	Tariff deficit between 2008-2016
AT	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
CZ	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
DE	Phased out (pre-2008)	Phased out (pre-2008)	Temporary tariff deficit[152]
FI	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
IT	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
LU	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
NL	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
SE	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
SI	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
UK	Phased out (pre-2008)	Phased out (pre-2008)	No tariff deficit
DK	Phased out (2016)	Phased out (2016)	No tariff deficit
EE	Phased out (2013)	Phased out (2014)	No tariff deficit
EL	Phased out (2013)	Phased out (2011)	Electricity tariff deficit (2014)[153]
HR	Phased out (2016)	5 - 50%	No tariff deficit
IE	Phased out (2011)	Phased out (2010)	No tariff deficit
BE	5 - 50%	Phased out (pre-2008)	No tariff deficit
ES	5 - 50%	Phased out (2008)	Electricity tariff deficit (2000s-2015)
LV	5 - 50%	Phased out (2008)	Potential electricity tariff deficit (until 2010-2011)
PT	5 - 50%	Phased out (2013)	Electricity tariff deficit (since 2006)
BG	> 50%	> 50%	Electricity tariff deficit
CY	> 50%	> 50%	No tariff deficit
FR	> 50%	5 - 50%	Electricity tariff deficit[154]
HU	> 50%	Phased out (2008)	Gas and electricity tariff deficit (2011-2012)[155]
LT	> 50%	Phased out (2010)	No tariff deficit
MT	> 50%	> 50%	Electricity tariff deficit (up to 2014)
PL	> 50%	Phased out (pre-2008)	No tariff deficit
RO	> 50%	Phased out (2014)	Potential electricity tariff deficit
SK	> 50%	Phased out (2012)	No tariff deficit

Source: Trinomics et altri study (country fact-sheets in Annex I).

[152] Paid of the subsequent year

[153] Greece faced a deficit in their special account for renewable energy in early 2014, caused by the large investment in RES. Electricity bills include a RES levy, but due to the economic crisis, it was not possible to increase the RES levy to cover the deficit. A suppliers' charge was introduced in 2016 (charge that suppliers pay to offset the cheaper electricity they buy due to RES integration), resulting in an expected surplus of €256 million by end 2018 in the special account for RES.

[154] Not a tariff deficit per se, as the applied regulated tariffs do cover the costs. However, the CSPE (Contribution to the Public Service of Electricity) is sometimes considered tariff deficit. The CSPE is a contribution which covers the costs of support to renewables, support to co-generation, subsidies to electricity costs in Corse and other French overseas territories, as well as the social tariff for vulnerable consumers.

[155] There is also mention of potential losses in 2013, but they are not quantified.

10.6 Dynamic pricing

The dynamic price contract (DPC) is defined as a contract between a Supplier and a Customer (Final Consumer) of electricity or natural gas that links the price of the service provided directly to the relevant wholesale market price(s).

Under DPC, price conditions can change dynamically every hour, half-hour or 15 minutes if the Supplier procures at least[156] part of the energy for his/her Customers on the day-ahead market. Suppliers usually charge an annual fee (mark-up / margin) on top of the wholesale price for the services related to the delivery of the energy to the final consumer. All changes of the wholesale price are automatically passed through and Suppliers are not facing any risk related to price. This is also reflected in a lower fee they offer to Consumers. Consumers are equipped with smart reading devices and can react to price signals by adapting their consumption level manually or through automated devices.

DPCs were firstly introduced in the Nordic markets and are known to be among the most competitive contract types available. DPCs are even recommended by regulators and consumer bodies. DPCs are treated as ordinary market offers which do not require any additional regulatory safeguards. Suppliers tend to be clear in their communication that DPCs are based on "moving prices" and also offer add-ons such as winter price insurances.

10.6.1 Objective, methodological approach and assumptions

This section will estimate potential benefits of introducing dynamic pricing to groups of consumers in the retail markets of the EU; it will also assess the possibility of setting up DPC as a market measure and compare its performance against established pricing methods.

The main objective is to assess if DPC can bring benefits to different group of consumers. The assessment is based on a comparison of the energy supply component across two sets of price data, as explained below:

[A] **Current pricing scheme (counterfactual)**, where the energy component is taken as reported by MS for the 5 ESTAT bands of household consumers, as reported in Eurostat table [nrg_pc_204_c].

[B] **Dynamic pricing**, where the energy supply component is built under the following assumptions:

i. an active group of individual household consumers procures on the day-ahead market the energy needed for each hour and for each member of the group; the group is big enough to participate on the wholesale market;

ii. the group is paying a fixed mark-up for such expenses as: distribution of the energy and related administrative costs; costs related to the participation on the power exchange, etc...; the mark-up is added directly to the cost of procuring energy on the day-ahead

To build DPC, we use anonymized smart meter data readings for a representative group of real consumers and analyse historical price evolutions and cost effects down to the level of

[156] The Supplier can also buy energy in advance from the forward and future markets of electricity or natural gas.

individual customers. The data is sourced from National Regulators, Suppliers, data providers or researchers. Dynamic pricing can be also built from synthetic data as a potential source, providing an additional layer of anonymization.

Box 10.6-1 –Methodological approach

1. Process the data and prepare it for analysis;

2. Build a user group that is representative of the composition of consumer bands in each Member State

3. Regroup consumers by their annual consumption along the 5 ESTAT bands;

4. For each ESTAT band, and for each consumer belonging to that band, calculate aggregators on the consumption, including: total, average, median, min and max consumption (again, checking for outliers).

5. Construct hourly costs series as a product of individual hourly consumption data and hourly day-ahead price data.

6. For each ESTAT band, and for each consumer belonging to that band, calculate cost aggregators, including: individual and total annual cost; the cost for the average consumer; the price of procuring energy;

7. Add up a pre-defined mark-up and compare prices of energy supply by consumer band to those of the current pricing scheme;

8. For each individual consumer, compare prices of energy supply, as defined by current pricing scheme and DPC. Assess if switching to dynamic pricing is in the interest of each member of the group by estimating parameters related to a switch, such as: number of consumers that would lose out; individual and average group savings in EUR and as share of the annual cost of energy supply.

9. Build aggregate consumer profiles and analyse patterns by type of consumer, consumption timestamp and interlinkages with potential explanatory variables (market-related, meteorological, others).

A standard data set would cover consumption data, as recorded by smart meter devices of around 1 000 individual consumers. The consumption data would be recorded each 15 minutes for at least one full year.

The assumptions underlying our approach and assessment are described in Box 10.6-2 below.

Box 10.6-2 – Main underlying assumptions of the approach

- The network and taxation components of the energy bill are not impacted by the switch to dynamic pricing. Any realised saving or diseconomy is attributable entirely to the energy component.
- The DPC Supplier is procuring the entire amount of energy on the day-ahead market[157], irrespective of the actual level of the day ahead hourly prices. All costs of procurement are passed on to Customers.
- All DPC Customers have price-inelastic consumption profiles; for each period, their level of consumption is not impacted by what the price might be at that point of time. The DPC Supplier knows the total amount needed by the group a day before the energy is actually consumed.
- The DPC Supplier recovers all expenses on energy supply services related to the actual delivery of energy to each one of its DPC Customers. For this service, DPC Customers are charged with a mark-up fee on top of the price paid for the energy they consume.
- The mark-up fee is set per unit of consumption and not per period. It is expressed as euro cents per Kilowatt-hour consumed and has the same value for each DPC Customer. It is equal to the ratio of the total cost of energy supply services over the total number of Kilowatt-hours consumed by the entire group of DPC customers.
- The mark-up fee remains stable throughout the period under analysis covering 2011 – 2016. It is fixed at 0.007 EUR/kWh, a very conservative level compared to actual mark-ups from the 5 countries with active DPCs.
- In cases where consumer data was missing for a given year; existing data from other years was used instead.
- For the case of the current pricing scheme (counterfactual), it is assumed that all consumers belonging to a given Eurostat band are paying exactly the same price, as reported in Eurostat table [nrg_pc_204_c]; the standard deviation is equal to zero.

The majority of the assumptions in Box 10.6-2 are made to reduce complexity and computation time and make the building of the case easier; section 10.6.3 discusses how some of the assumptions can be redefined more realistically and what would be the impact on results. Many of those elements relate to the design options for DPCs and would require further analysis.

[157] This also implies that either the portfolio of DPC Customers is big enough to match minimal contractual size requirements of the power exchanges or that the Supplier can buy fractions of contracts on the day-ahead..

10.6.2 Preliminary results

Obtaining anonymised individual consumer data has been challenging for many Member States. So far, partial information has been collected for 12 countries (Bulgaria, Denmark, Finland, Germany, Greece, Hungary, Ireland, Italy, Norway, Portugal, Spain and the United Kingdom). Complete, fully-processed and analysis-ready data was available by the time of writing for only 7 of those countries (Finland, Hungary, Italy, Norway, the United Kingdom, Spain and Ireland). The findings below are based on information from the seven countries. The reported results are marked as preliminary as further analysis is needed to ensure robustness and applicability for all EU retail markets.

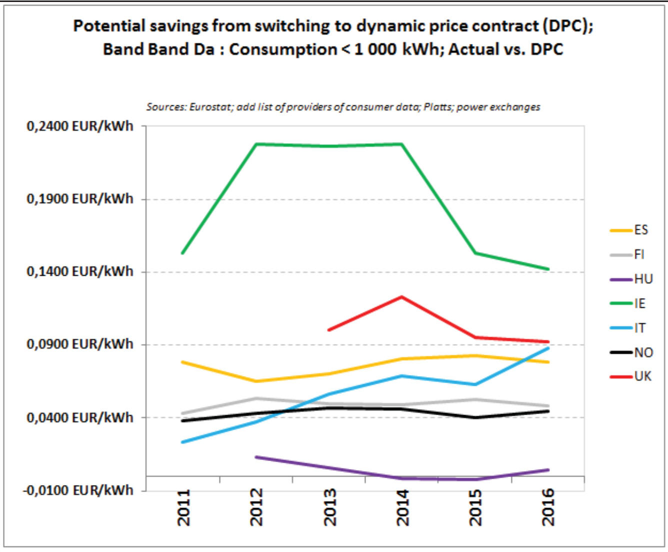
Some forms of DPCs are already marketed in Finland, Norway and Spain. For those countries, the current pricing scheme already integrates elements of DPC and this should be kept in mind when looking at **Figure 234** that reports on the difference of the energy component price for the current pricing scheme (counterfactual) and for DPC.

In Hungary, Italy, UK and Ireland DPCs are not yet widely spread. It can be assumed that the counterfactual is mainly composed of pricing schemes that are static in nature, exhibiting few price variations per year and not taking into account dynamic price information from the wholesale markets.

The assessment of price of energy supply under DPC for all of the 7 countries was build following the procedure described in Box 10.6-1 and under the assumptions laid out in Box 10.6-2.

Figure 234 presents the price differences between the current pricing scheme and under DPC for the aggregated user sub-groups along the Eurostat consumer bands.

The potential savings to be realised appear greater for the lower consumption bands. This is linked to the fact that in the majority of cases DPC levels are lower and less variable than those of the current pricing schemes.


Potential savings from switching to dynamic price contract (DPC);
Band Band Da : Consumption < 1 000 kWh; Actual vs. DPC
Sources: Eurostat; add list of providers of consumer data; Platts; power exchanges
0,2400 EUR/kWh
0,1900 EUR/kWh
0,1400 EUR/kWh
0,0900 EUR/kWh
0,0400 EUR/kWh
-0,0100 EUR/kWh
2011
2012
2013
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2016
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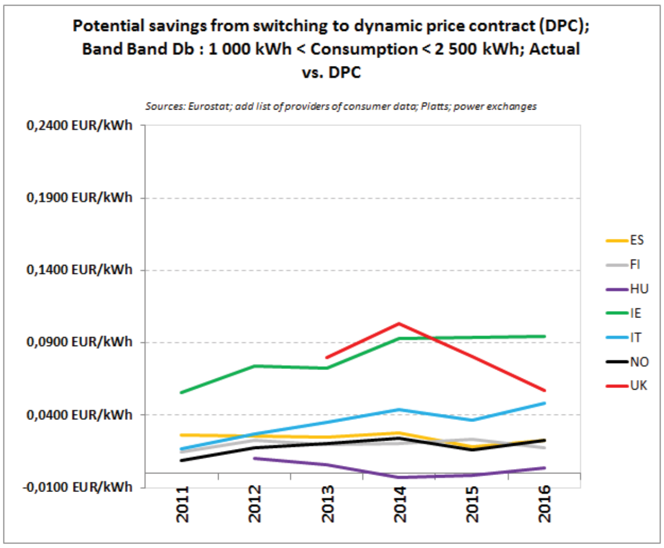
Potential savings from switching to dynamic price contract (DPC);
Band Band Db : 1 000 kWh < Consumption < 2 500 kWh; Actual vs. DPC
Sources: Eurostat; add list of providers of consumer data; Platts; power exchanges
0,2400 EUR/kWh
0,1900 EUR/kWh
0,1400 EUR/kWh
0,0900 EUR/kWh
0,0400 EUR/kWh
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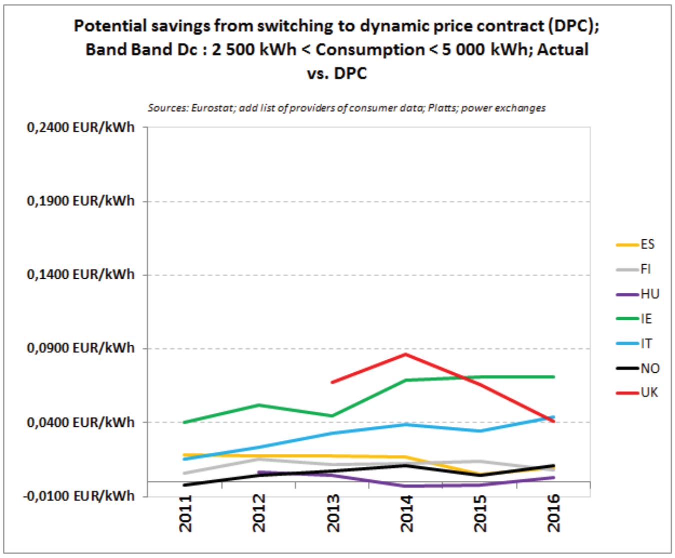
Potential savings from switching to dynamic price contract (DPC);
Band Band Dc : 2 500 kWh < Consumption < 5 000 kWh; Actual vs. DPC
Sources: Eurostat; add list of providers of consumer data; Platts; power exchanges
0,2400 EUR/kWh
0,1900 EUR/kWh
0,1400 EUR/kWh
0,0900 EUR/kWh
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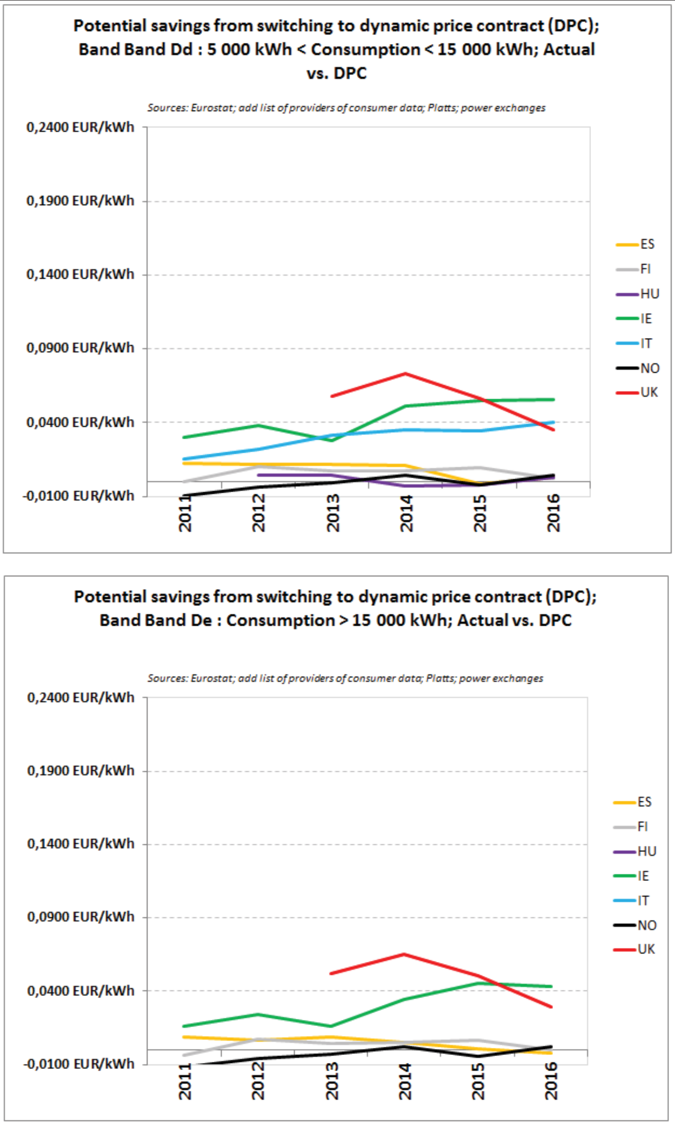

Figure 235 - Potential savings for households from switching to dynamic pricing in selected Member States ; by consumption band

Sources: Price data: S&P Global Platts; Consumption data: Elenia Oy (Finland), Vaasa ETT and EDF-DEMASZ (Hungary); Regulatory Authority for Electricity, Water and Gas (Italy); Norgesnett (Norway); UK Data Archive - Centre for Sustainable Energy - EDRP project (UK); ENEL Group - Endesa Distribución Eléctrica (Spain); Irish Social Science Data Archive - Commission for Energy Regulation (CER) - CER Smart Metering Project (Ireland)

The difference between the current pricing scheme and DPC appears insignificant for the case of Hungarian consumers, mostly because the counterfactual was reduced by administrative non-market measures which reduced the absolute level of price for the final consumers. As it turns out, similar effect would have been achieved if Hungarian consumers were allowed to use DPCs instead of relying on administered prices.

The spread between the current pricing scheme and DPC seems quite high for the case of UK and Ireland. This is most probably related to the fact those countries report in the energy component other types of costs in addition to those related to the supply of energy. Those costs are concentrated mainly on modest consumers (Band DA) as the spread becomes much smaller for the higher consumer bands.

The next four tables provide details on: group composition, estimated average annual savings per consumer band in absolute and relative terms, as well as the number of consumers that would lose out from the switch to DPC from the current pricing scheme.

Again, caution should be exerted when looking at data for Hungarian consumers, where the counterfactual was influenced by non-market measures.

In addition, the current assumption on the mark-up level[158] impacts the realised level of savings. When more competitive level of mark-ups is chosen[159], the realised savings appear much higher and all consumers from all bands appear to be benefitting or not being worse-off from the switch.

Irish and Spanish data for the high consumer bands most probably contain non-household consumers and as such the calculated savings are overestimated.

Table 21 - Composition of user group for estimating the DPC

ESTAT Band	FI	HU	IT	NO	UK	ES	IE
DA	98	166	12	9	94	395	40
DB	93	351	191	11	228	350	202
DC	130	206	185	34	482	213	410
DD	496	54	8	378	189	38	245
DE	478	n.a.	n.a.	563	9	7	12

Sources: Price data: S&P Global Platts; Consumption data: Elenia Oy (Finland), Vaasa ETT and EDF-DEMASZ (Hungary); Regulatory Authority for Electricity, Water and Gas (Italy); Norgesnett (Norway); UK Data Archive - Centre for Sustainable Energy - EDRP project (UK); ENEL Group - Endesa Distribución Eléctrica (Spain); Irish Social Science Data Archive - Commission for Energy Regulation (CER) - CER Smart Metering Project (Ireland)

Table 22 - Estimated average annual savings per Band, EUR, 2016

ESTAT Band	FI	HU	IT	NO	UK	ES	IE
DA	19,94	2,93	18,81	20,54	69,19	30,70	84,63
DB	30,11	5,94	31,26	42,19	110,14	39,33	180,61
DC	30,84	10,78	52,49	41,30	147,76	35,29	278,33
DD	25,33	20,37	89,98	46,10	256,38	20,48	526,16
DE	1,60	n.a.	n.a.	58,02	573,12	-77,41	1534,68

Sources: Price data: S&P Global Platts; Consumption data: Elenia Oy (Finland), Vaasa ETT and EDF-DEMASZ (Hungary); Regulatory Authority for Electricity, Water and Gas (Italy); Norgesnett (Norway); UK Data Archive - Centre for Sustainable Energy - EDRP project (UK); ENEL Group - Endesa Distribución Eléctrica (Spain); Irish Social Science Data Archive - Commission for Energy Regulation (CER) - CER Smart Metering Project (Ireland)

[158] Mark-up set at 0.007 EUR/kWh).
[159] For example, 0.0016 EUR/kWh which corresponds to the top 25% percentile mark-up based on all commercial offers with DPC in the 5 countries who are using it)

Table 23 - Estimated average annual savings per Band, share of energy supply component, 2016

ESTAT Band	FI	HU	IT	NO	UK	ES	IE
DA	51,34%	9,47%	22,28%	58,16%	60,58%	65,25%	73,98%
DB	30,07%	7,49%	16,80%	41,03%	48,77%	31,96%	64,59%
DC	16,97%	6,75%	15,94%	24,46%	40,14%	17,04%	57,48%
DD	5,76%	6,56%	15,61%	11,15%	36,56%	5,30%	51,21%
DE	0,15%	n.a.	n.a.	6,69%	8,28%	-5,93%	44,82%

Sources: Price data: S&P Global Platts; Consumption data: Elenia Oy (Finland), Vaasa ETT and EDF-DEMASZ (Hungary); Regulatory Authority for Electricity, Water and Gas (Italy); Norgesnett (Norway); UK Data Archive - Centre for Sustainable Energy - EDRP project (UK); ENEL Group - Endesa Distribución Eléctrica (Spain); Irish Social Science Data Archive - Commission for Energy Regulation (CER) - CER Smart Metering Project (Ireland)

Table 24 - Estimated number of consumers losing out from the switch to DPC

ESTAT Band	FI	HU	IT	NO	UK	ES	IE
DA	0	1	0	0	0	0	0
DB	0	3	0	0	0	0	0
DC	0	1	0	0	0	0	0
DD	9	0	0	0	0	3	0
DE	223	n.a.	n.a.	1	0	7	0

Sources: Price data: S&P Global Platts; Consumption data: Elenia Oy (Finland), Vaasa ETT and EDF-DEMASZ (Hungary); Regulatory Authority for Electricity, Water and Gas (Italy); Norgesnett (Norway); UK Data Archive - Centre for Sustainable Energy - EDRP project (UK); ENEL Group - Endesa Distribución Eléctrica (Spain); Irish Social Science Data Archive - Commission for Energy Regulation (CER) - CER Smart Metering Project (Ireland)

Figure 235 provides an example for organising and grouping of aggregate data that can be suitable for analysing different aspects of aggregate consumer profiles. The charts are mainly illustrating time-related patterns.

More generally, analytical tools relying on data from the constructed user groups can be useful in providing elements to better understand consumer behaviour and the drivers that are influencing it.

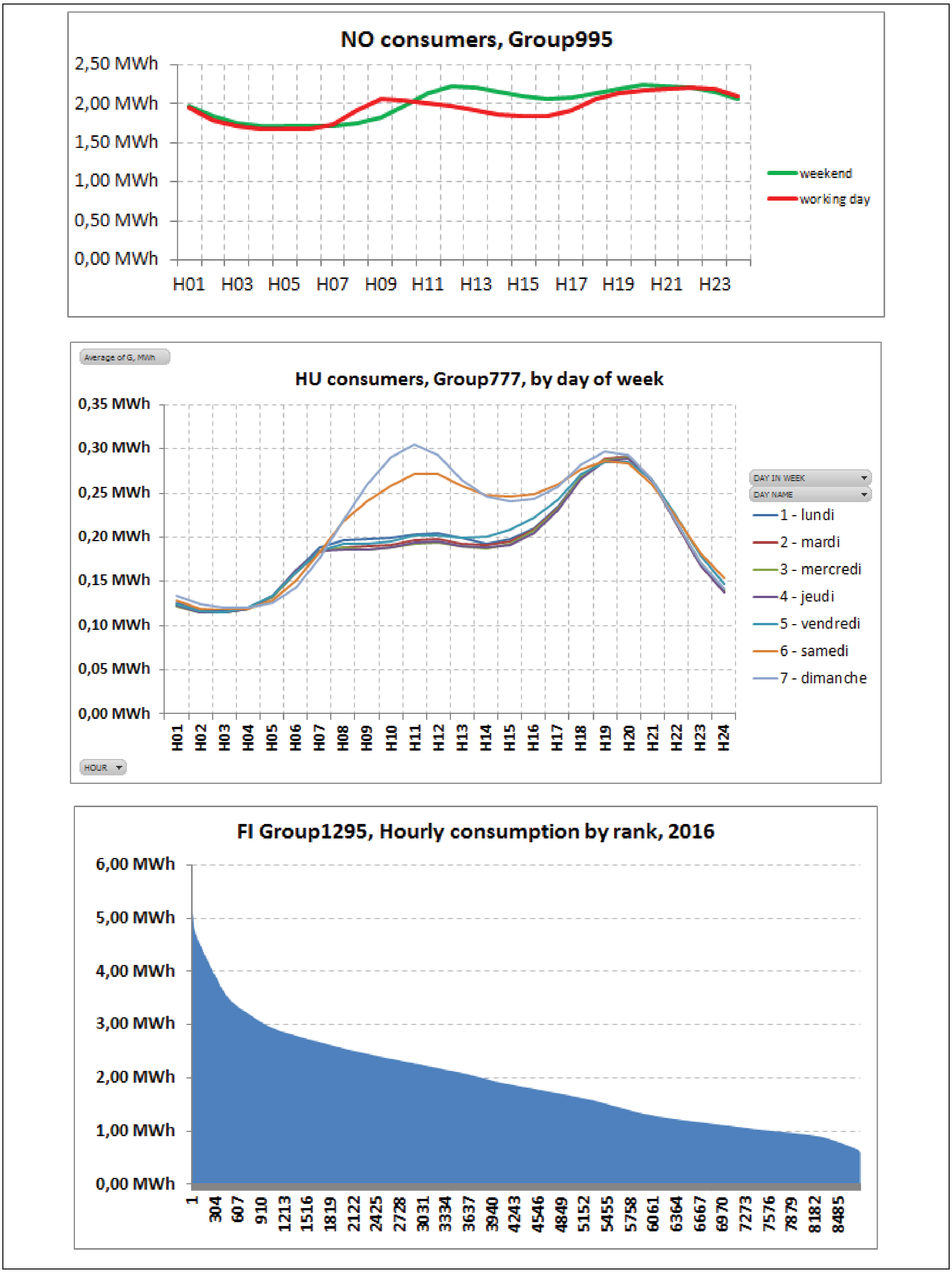

Figure 236 - Elements to understand consumer behaviour and agregation for analysis

Sources: Price data: S&P Global Platts; Consumption data: Elenia Oy (Finland), Vaasa ETT and EDF-DEMASZ (Hungary); Regulatory Authority for Electricity, Water and Gas (Italy); Norgesnett (Norway); UK Data Archive - Centre for Sustainable Energy - EDRP project (UK); ENEL Group - Endesa Distribución Eléctrica (Spain); Irish Social Science Data Archive - Commission for Energy Regulation (CER) - CER Smart Metering Project (Ireland)

10.6.3 Robustness of results and further research

Several of the assumptions in Box 10.6-2 were introduced to facilitate the building of a test case and can be replaced with more realistic ones. The following discussion concentrates on the expected effect on price of energy supply under DPC or the current pricing scheme from releasing some of these assumptions.

The mark-up fee used so far was set up per unit of consumption and using the same level for all bands (Fixed Mark-Up, Uni-Band). It can be designed in alternative ways. For example, it can be introduced as a lump sum to pay per year, irrespective of the consumed level (Fixed Mark-Up, Lump Sum). Modest consumers will have to spread this lump sum over fewer kWh. When this mark-up fee is converted per kWh consumed, those consumers are paying up higher fees.

Alternatively, it can be set as a variable margin, trying to proxy consumer awareness and sophistication when selecting DPC offers (Variable Mark-Up).

The effect of the alternative mark-ups on DPC levels are illustrated in **Figure 236**. The "Fixed Mark-Up, Lump Sum" uses as ranges respectively 50 EUR/year and 120 EUR/year. The "Variable Mark-Up" builds on collected data for mark-up levels from the 5 countries that have introduced some form of DPC. Consumer awareness and sophistication is set to match the mark-up resulting from the top 25% percentile of all offers available. The low and high level of the top 25% percentile from the 5 countries is set as 0.0016 EUR/kWh and 0.0092 EUR / kWh respectively. Those levels are applied to the consumers from the most representative band; for consumers in other bands those ranges are rebased using the median consumption in each band.

Figure 236 shows results for Italy, consumer band DB, they are representative for the majority of cases. Lump sum mark-ups have opposite effect on consumers from different bands. Compared to a mark-up fee set per unit of kWh, lump sum fees tend to erase saving from DPC for modest consumers and increase savings further for larger consumers. The same effect, but to a lesser scale is observed for the variable mark-up design.

Overall, when alternative designs of mark-ups are introduced, the reported level of savings, especially for the modest consumer bands might appear as overestimated.

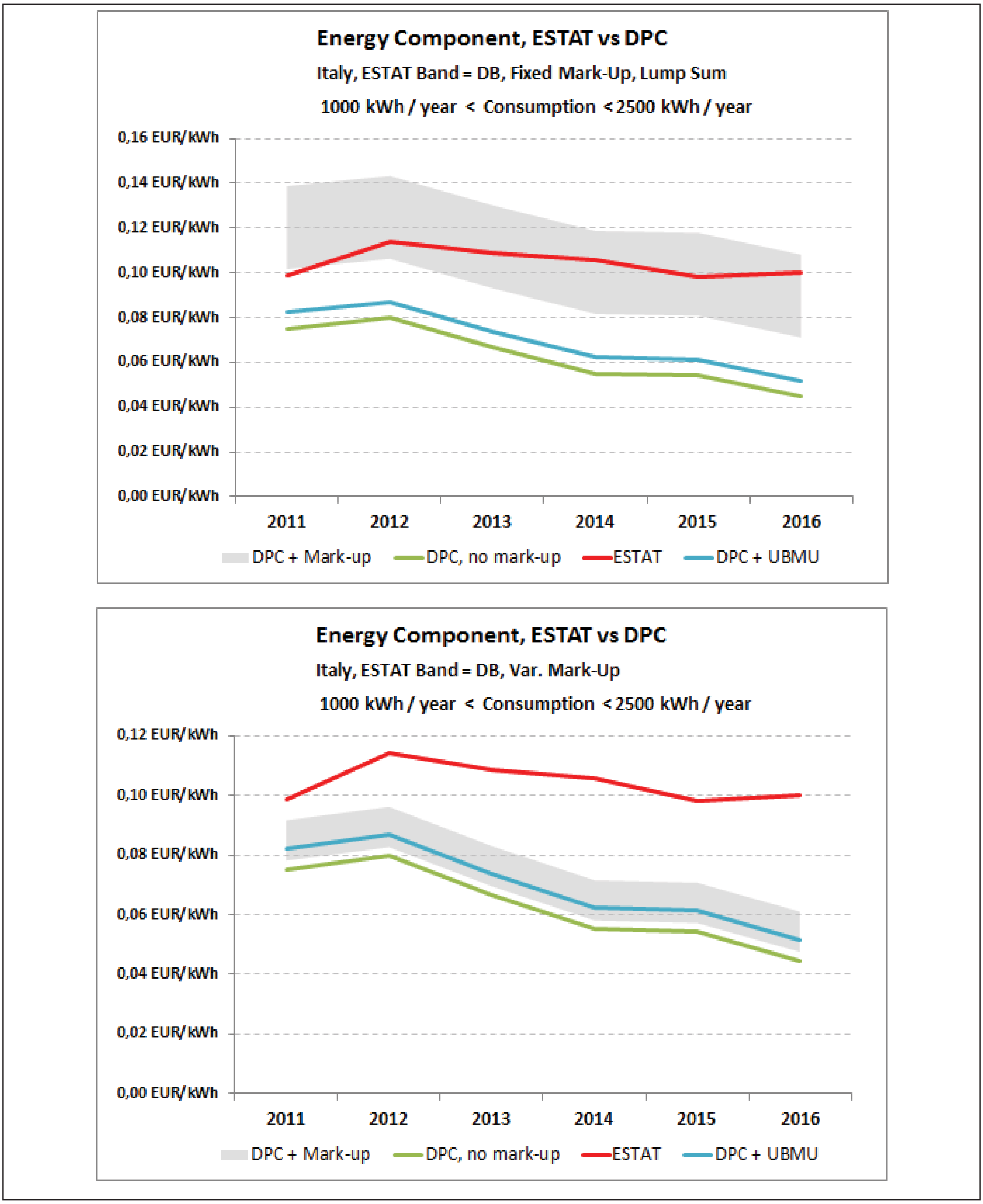

Figure 237 - Potential savings from switching to DPC with alternative mark-ups in Italy

Sources: Price data: S&P Global Platts; Consumption data: Elenia Oy (Finland), Vaasa ETT and EDF-DEMASZ (Hungary); Regulatory Authority for Electricity, Water and Gas (Italy); Norgesnett (Norway); UK Data Archive - Centre for Sustainable Energy - EDRP project (UK); ENEL Group - Endesa Distribución Eléctrica (Spain); Irish Social Science Data Archive - Commission for Energy Regulation (CER) - CER Smart Metering Project (Ireland)

On the other hand, replacing some of the assumptions of Box 10.6-2 with more reasonable ones might result in an underestimation of the potential savings from the switch to DPC.

For example, DPC suppliers will not purchase all of the required energy on the day-ahead market. They can manage better their price risk exposure by using derivative contracts in the wholesale market. This could reduce the overall price of purchased energy and some of the realised savings can be passed over to consumers.

Likewise, the absence of demand price response, especially for consumers equipped with smart meters and automated control systems might appear as a realistic assumption. When demand responsiveness is introduced, the DPC supplier will be better equipped to reduce its bill for procuring or producing of the needed energy and the amount of realised savings for each consumer in the group can be expected to increase.

EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 6/11

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(2019) 1 final}

EN EN

ANNEX 1 – SECTORIAL CASE STUDIES

Content

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A1.1 INTRODUCTION

A1.1.1 Overview

This annex presents the main results on energy prices and costs for the following sectors: iron and steel, aluminium, brick and roof tiles, wall and floor tiles, glass tableware, packaging glass, nitrogen fertilisers and refineries. For each sectorial case study, it presents:

- General information on the main characteristics of the sector, the recent trends, how it performs on international markets and the sample composition;
- Electricity prices, costs and intensity of the sector;
- Natural gas prices, costs and intensity of the sector;
- Wherever relevant for the sector, prices, costs and intensity of other fuels including feedstocks;
- Competitiveness indicators of the sector (share of energy costs in production costs and ratio of energy costs to EBITDA).

Table 1 defines the main indicators analysed.

Table 1. Main indicators

Indicators	**Definition**
Statistics	
Simple average	It is the arithmetic mean of the sample, computed as the sum of the individual observations divided by the number of observations in the sample.
Weighted average[1]	It is the weighted arithmetic mean of the sample, computed as the sum of weights times individual observations divided by the sum of the weights. A specific weight is assigned to each individual observation in the sample.
Median	It is the middle value of the sample, which separates the lower half from the higher half of the sample, when the observations are arranged in ascending order.
Electricity indicators	
Electricity price	It is the electricity unit price (in EUR/MWh), computed as total price paid to purchase electricity (net of recoverable taxes, such as VAT) divided by total amount of electricity purchased. Therefore, electricity price is net of any *ex ante* exemption, i.e. net of taxes and levies that are not paid by certain categories of energy intensive consumers. For instance, some energy intensive consumers do not pay RES levies or pay reduced rates for RES levies.
Components of the electricity price	They are classified in four groups: energy component, network costs (including costs of the capacity market), RES levies and other non-recoverable taxes/levies than RES levies.

[1] Note that the estimates for this statistical indicator are generally not reported in this annex but they are all available in the CEPS and Ecofys study.

Electricity costs	They are electricity unit costs measured in both EUR/MWh and EUR/tonne. Electricity costs in EUR/MWh are computed as follows: [Total price paid to purchase electricity – reimbursement – payment for flexibility schemes + total costs for self-generated electricity – revenues from self-generated electricity sold to the grid + taxes on self-generation] / [Total electricity purchased + total self-generated electricity – total self-generated electricity sold to the grid]. Electricity costs in EUR/tonne are computed by relying on the same formula but using as a denominator the total production output in tonnes.
Electricity intensity	It is the units of electricity used per unit of output produced (in MWh/tonne). Electricity intensity is computed as follows: [Total electricity purchased + total self-generated electricity – total self-generated electricity sold to the grid] / [Total production output].
Natural gas indicators	
Natural gas price	It is the natural gas unit price (in EUR/MWh), computed as total price paid to purchase natural gas (net of recoverable taxes, such as VAT) divided by total amount of natural gas purchased. Therefore, in principle, natural gas price is net of any *ex ante* exemption, i.e. net of taxes and levies that are not paid by certain categories of energy intensive consumers. However, based on desk research, *ex ante* exemptions seem to play a marginal role when it comes to natural gas prices.
Components of the natural gas price	They are classified in three groups: energy component, network costs and (other) non-recoverable taxes/levies (note that there are no RES levies for natural gas).
Natural gas costs	They are natural gas unit costs measured in EUR/tonne. Natural gas costs are computed as follows: [Total price paid to purchase natural gas – payment for flexibility schemes] / [Total production output]. Natural gas costs in EUR/MWh are not shown here, as payment for flexibility schemes are mostly irrelevant for natural gas and no significant difference between natural gas prices in EUR/MWh and natural gas costs in EUR/MWh was detected.
Natural gas intensity	It is the units of natural gas used per unit of output produced. Natural gas intensity is computed as follows: [Total natural gas purchased] / [Total production output].
Indicators for other fuels including feedstocks	
Total gas costs	They are total gas unit costs measured in EUR/tonne. Total gas costs are computed as follows: [Total price paid to purchase natural gas

	– payment for flexibility schemes + total costs for self-produced gas – revenues from self-produced gas sold to the grid + taxes on self-generation] / [Total production output].
Total gas intensity	It is the units of total gas (including natural gas and other gases) used per unit of output produced (in MWh/tonne). Total gas intensity is computed as follows: [Total natural gas purchased + total self-produced gas – self-produced gas sold to the grid] / [Total production output].
Price of other fuels including feedstocks (e.g. crude oil, fuel oil, petroleum coke)	It is the unit price of other fuels including feedstocks (in EUR/MWh), computed as total price paid to purchase other fuels including feedstocks divided by total amount of other fuels purchased including feedstocks.
Costs of other fuels including feedstocks (e.g. crude oil, fuel oil, petroleum coke)	They are the unit costs of other fuels including feedstocks measured in EUR/tonne. The costs of other fuels including feedstocks are computed as follows: [Total price paid to purchase other fuels including feedstocks] / [Total production output].
Intensity of other fuels including feedstocks (e.g. crude oil, fuel oil, petroleum coke)	It is the units of other fuels including feedstocks used per unit of output produced (in MWh/tonne). The intensity of other fuels including feedstocks is computed as follows: [Total other fuels purchased including feedstocks] / [Total production output].
Competitiveness indicators	
Total energy costs	It is the sum of electricity and natural gas unit costs measured in EUR/tonne. In the case of refineries, the costs of other fuels including feedstocks (crude oil, fuel oil, petroleum coke and refinery gases) are also included in the sum. Note that the costs of coking coal and coke (mainly relevant for iron and steel) are not included in total energy costs.
Share of electricity costs in total production costs	It is the ratio of electricity costs over total production costs (in %). Total production costs include all the costs (both OPEX, annual depreciation and amortisation of CAPEX, and other costs) borne by the plant and directly relating to the production process, while non-operating (e.g. interest expenses) and extraordinary cost items are not included.
Share of natural gas costs in total production costs	It is the ratio of natural gas costs over total production costs (in %). Total production costs include all the costs (both OPEX, annual depreciation and amortisation of CAPEX, and other costs) borne by the plant and directly relating to the production process, while non-operating (e.g. interest expenses) and extraordinary cost items are not included.

Share of costs of other fuels including feedstocks (e.g. crude oil, fuel oil, petroleum coke, refinery gases) in total production costs	It is the ratio of the costs of other fuels including feedstocks over total production costs (in %). Total production costs include all the costs (both OPEX, annual depreciation and amortisation of CAPEX, and other costs) borne by the plant and directly relating to the production process, while non-operating (e.g. interest expenses) and extraordinary cost items are not included.
Share of total energy costs in total production costs	It is the ratio of total energy costs over total production costs (in %). Total production costs include all the costs (both OPEX, annual depreciation and amortisation of CAPEX, and other costs) borne by the plant and directly relating to the production process, while non-operating (e.g. interest expenses) and extraordinary cost items are not included.
EBITDA (Earnings before interest, taxes, depreciation and amortisation)	They represent the earning per unit of output produced after paying costs for production inputs and labour costs.
Ratio of total energy costs to EBITDA	It is the ratio of total energy costs over EBITDA. If EBITDA is positive (normal case), the opposite of this ratio can be seen as the "elasticity" of EBITDA to total energy costs, i.e. the potential effect of 1% increase in total energy costs on EBITDA in %, all else being equal (note the potential effect is negative, i.e. a 1% increase in total energy costs leads to a decrease in EBITDA).

A1.1.2 Methodology of the analysis

Each sectorial case study relies on a bottom-up approach with plant level data collected through a questionnaire on a sample of ‘typical’ plants/companies, which reflect the average features of EU plants operating in the sector under consideration[2]. The samples include plants from as many Member States as possible to ensure broad geographical coverage. In order to respect confidentiality, sectorial data cannot be presented at Member State level but are aggregated at EU and, where possible, regional level with the following regions:

- North-Western Europe (NWE): Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden, the UK;
- Southern Europe (SE): Cyprus, Greece, Italy, Malta, Portugal, Spain;
- Central-Eastern Europe (CEE): Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia.

The time span of the analysis goes from 2008 to 2017[3]. A full time series of indicators was collected for the following sectors: fertilisers, glass tableware and packaging glass. For the other sectors (steel, aluminium, bricks and roof tiles, wall and floor tiles and refineries), data were collected for 2016 and

[2] The construction of a 'statistically representative' plant sample per sector was not feasible due to the constraints of the study. Instead, a sample of typical plants with a broad geographical coverage and which represents at least 10% of the sectoral turnover or production capacity was built for each sector. Result findings were further cross-checked through stakeholder consultation and secondary data validation.

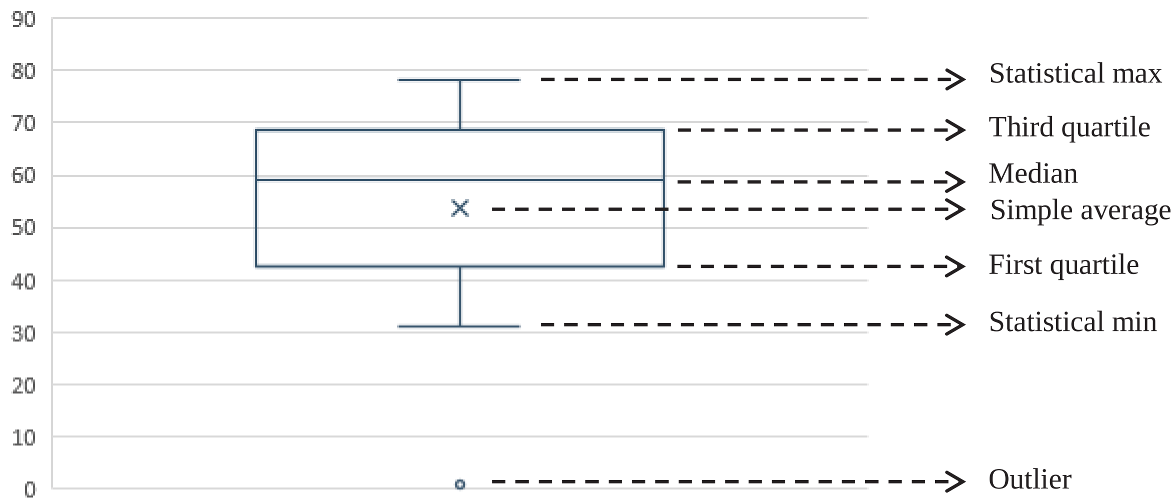
[3] For a given year, in a given sector, it may happen that data cannot be showed for confidentiality reasons.

2017 only while time series were completed by data available from the previous edition of the study[4]. In the latter case, the composition of the samples may differ for the 2008-2015 period compared to the 2016-2017 period.

We should always bear in mind that the sample includes only plants operating in the entire period under observation; results may therefore overestimate profitability indicators and underestimate production costs and energy costs, taking into consideration that between 2008 and 2017, a number of relatively less efficient plants and companies left the market.

The analysis presents both ranges and average values. Ranges are displayed via box plots, which show the statistical minimum, first quartile, median, third quartile, statistical maximum and, potentially, any outlier of the data set (Figure 1). The cross in each box represents the simple average (unweighted).

Figure 1. Example of box plot



To preserve confidentiality, averages are presented only when based on observations from at least three independent companies. Box plots are shown only when data are available from at least six plants belonging to three independent companies.

In addition to simple averages, weighted averages were also estimated but are not presented here. Unless specified, average values always refer to simple averages in the text, tables and figures below.

For full details on the methodology applied, including the composition of the samples, data collection and validation process, or the estimates of the weighted averages, we refer the reader to the report prepared by CEPS and Ecofys[5].

[4] CEPS et al. (2016). Composition and drivers of energy prices and costs: Case studies in selected energy-intensive industries.

[5] CEPS and Ecofys (2018). Study on composition and drivers of energy prices and costs: case studies in selected energy intensive industries – 2018.

A1.2 IRON AND STEEL

A1.2.1 General information and sample composition

Steelmaking covers all the processes required to transform raw materials into finished steel products and includes the activities from coke ovens, sinter and pellet plants, blast furnaces, steel furnaces and rolling and finishing mills. In terms of NACE Rev.2 classification, it includes sectors 24.1, 24.2, 24.31, 24.32, 24.51 and 24.52.

Steelmaking plants are usually classified into different groups:

- Integrated mills: these plants transform iron ore into sinter (sinter plant) or pellets (pellet plant) and coking coal into coke (coke ovens); sinter/pellets, coke and scrap are then transformed into steel through a blast furnace and basic oxygen furnace (BOF) and casted into semi-finished products, which are further processed in rolling and finishing facilities. All the production stages are generally performed on the same site. In the following, these plants are referred to as BOF plants.
- Minimills: these plants, much smaller than the integrated ones, recycle steel scrap in electric arc furnaces (EAF) to make steel. Semi-finished casting products are further processed in rolling and finishing facilities. In the following, these plants are referred to as EAF plants.
- Other steelworks: these steelmaking plants are based on other production route, such as smelting reduction (which avoids the coke making process of the integrated mills) or direct reduced iron (which is used as feedstock in EAF). These plants are, however, still marginal in Europe.
- Rolling and finishing mills: these plants only process casting products (ingots, slabs, billets or blooms) to transform them into finished steel products.

The analysis here focusses on EAF and BOF plants (other steelworks are marginal, while rolling and finishing plants are much less energy intensive). Electricity is the main energy source for EAF plants (around 10% of total production costs). In the case of BOF plants, main energy source is coking coal (or coke), but no reliable information could be gathered on this fuel. Electricity and natural gas are secondary fuels for BOF plants (their costs altogether represent on average less than 5% of total production costs).

The steel sector went through consolidation in the EU, where relatively few companies account for a large share of steel production. The sector is particularly characterised by high capital investments, high economies of scale and excess capacities (high entry and exit barriers). EU steel production has remained fairly stable since 2012 but is still far from the pre-crisis level. On average, BOF plants account for 60% of EU steel production whereas EAF plants account for 40%. Main EU producing countries (based on 2016 production value) include Germany (26%), Italy (14%), France (9%), Spain (8%), Poland (6%) and Belgium (5%).

Overall, the EU is a net importer of steel, importing in particular from Russia and China. Major EU export destinations include Turkey, closely followed by the United States.

In the EU there are 32 BOF plants and 170 EAF plants. A typical BOF plant has a capacity of 3.75 million tonnes/year whereas EAF plant capacity is around 0.5 million tonnes/year. The BOF sample includes 7 plants across Europe (three in CEE region and four in NWE region), representing around 26% of total EU BOF crude steel capacity (2016). The EAF sample includes 18 plants across Europe (three in CEE region, 13 in NWE region and two in SE region), representing around 14% of total EU EAF crude steel capacity (2016). The SE region is under-represented in both samples (no SE plant in the BOF sample).

BOF and EAF steelmaking plants differ greatly in terms of production technologies, regional distribution, capacities and energy consumption profiles and are therefore analysed separately in the following sections.

A1.2.2 BOF plants

A1.2.2.1 Electricity prices, costs and intensity

Key electricity indicators for BOF plants are presented in Table 2.

EU average electricity prices fluctuated in the range of 58-71 EUR/MWh between 2010 and 2017 (62 EUR/MWh in 2017). When looking at the EU average electricity price components (Figure 2), the energy component represented by far the highest share of the price, though this share decreased over time (85% in 2010 vs. 72% in 2017). Large consumers faced lower electricity prices (weighted average by purchased electricity is significantly below simple average) and actually paid less for all the price components, including energy but also network costs, RES levies and other non-recoverable taxes/levies.

EU average electricity costs in EUR/MWh (Figure 3) went down by 13% from 2010 (67 EUR/MWh) to 2017 (54 EUR/MWh). The difference between electricity price and electricity costs in EUR/MWh is mostly caused by plants producing self-generated electricity on site. EU average electricity costs in EUR/tonne (Figure 4) followed the same trend passing from 22 EUR/tonne in 2012 to 16 EUR/tonne in 2017. Better price conditions and economies of scale occurred for larger plants (weighted average – by production output – electricity costs are below simple average ones).

Electricity intensity of BOF plants (Figure 5) remained fairly stable between 2012 and 2017, around 0.35 MWh/tonne (the slight increase of the EU average is in fact mainly driven by a change in the sample). Larger plants were more electricity efficient than smaller ones (weighted average – by production output – electricity intensity is constantly below simple average one).

A1.2.2.2 Natural gas and total gas prices, costs and intensity

Key natural gas indicators for BOF plants are presented in Table 3.

EU average natural gas prices (Figure 6) show a clearly descending trend, which is quite visible from 2013 to 2016, when prices dropped by 37% from 30 to 17 EUR/MWh. In 2017, the average price was at 19 EUR/MWh. As shown in Figure 7, the natural gas price is made up mostly by the energy component (93% in 2017), the remaining coming from the network component (non-recoverable taxes/levies play here a very minor role). Overall, large consumers faced lower natural gas prices (weighted average by purchased natural gas is below simple average), though the differential compared to small consumers tends to be marginal in the most recent years. In fact, large consumers seem to pay less for the network component but not for the energy component.

EU average natural gas costs (in EUR/tonne) decreased by 27% from 2010 to 2017 (Figure 8). In 2017, the costs were at 6 EUR/tonne. Larger plants tend to bear lower unit costs (weighted average by production output is generally below simple average) due to lower natural gas prices and economies of scale.

EU average natural gas intensity (Figure 9) decreased from 2008 to 2012 but increased afterwards. Over the period, the average intensity decreased from 0.36 MWh/tonne in 2008 to 0.31 MWh/tonne in 2017. When including waste gas consumption, the EU average total gas intensity (Figure 10) also went down from 1.63 MWh/tonne in 2008 to 1.46 MWh/tonne in 2017. Unlike for electricity, it appears that larger plants do not seem to be more gas efficient than smaller ones.

A1.2.2.3 Competitiveness

Between 2008 and 2017, electricity and natural gas costs in BOF plants represented on average 3-4% and 1-2% of total production costs, respectively (Table 4). The share of electricity and natural gas costs altogether in production costs decreased from 5% in 2012 to 4% in 2017. However, it should be underlined that this energy share in production costs does not account for coking coal/coke which is the main energy source in BOF plants.

Between 2012 and 2017, EU average EBITDA per tonne (Figure 11) significantly increased from 1 to 34 EUR/tonne, while the costs of electricity and natural gas together went down from 28 to 23 EUR/tonne. It is not possible to draw firm conclusions on the impact of energy costs on profitability given the fact that coking coal/coke purchases are missing in these figures. Nevertheless, the opposite pattern of electricity and natural gas costs compared to EBITDA and the fact that these costs are higher than or in the same order of magnitude as, EBITDA shows the importance of electricity, natural gas and more generally energy costs and the potential direct impact they can have on margins of BOF steel production. The ratio of energy costs to EBITDA indicates that a 1 % reduction in electricity and natural gas costs would potentially lead, depending on the observation year (2012 excluded, as it is an atypical year), to around 0.7-3.3% increase in EBITDA.

A1.2.2.4 Tables and graphs

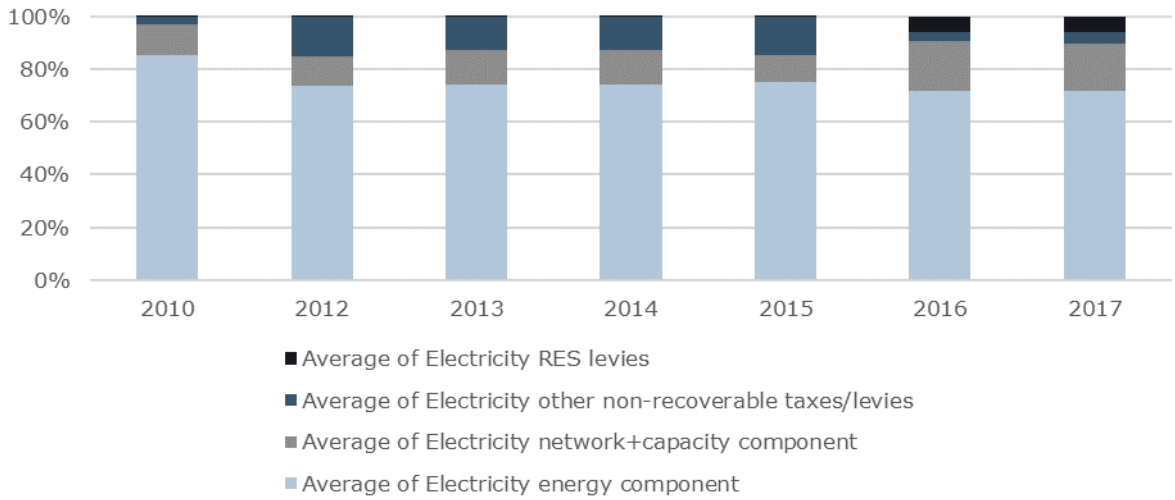
Electricity

Table 2. Key electricity indicators of BOF steel production (EU averages)

Indicator	2010	2011	2012	2013	2014	2016	2017
Electricity price (€/MWh)	64.0	57.5	70.6	62.7	59.5	57.6	62.4
Electricity costs (€/MWh)	62.6	92.2	73.7	64.8	64.0	52.1	54.3
Electricity costs (€/tonne)	n.a.	20.9	22.0	20.6	18.9	15.2	16.4
Electricity intensity (MWh/tonne)	n.a.	0.29	0.35	0.36	0.35	0.34	0.37

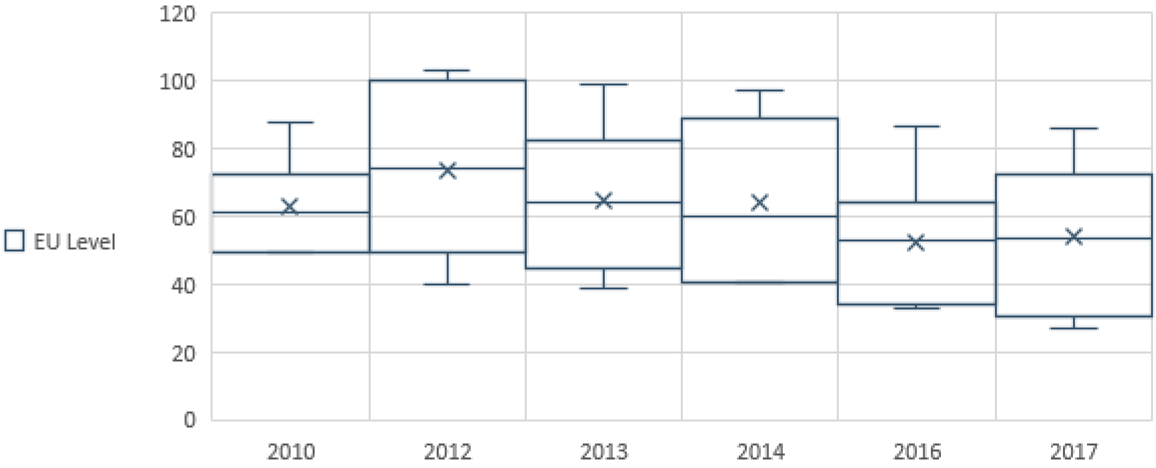
Source: CEPS/Ecofys.

Figure 2. Components of the EU average electricity price for BOF steel production (%)



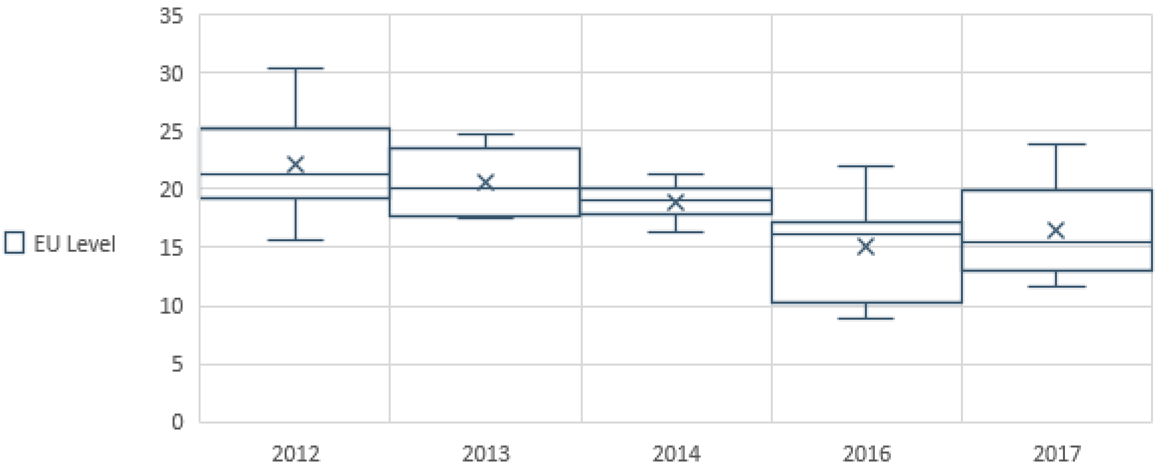
Source: CEPS/Ecofys.

Figure 3. Electricity costs of BOF steel production (€/MWh)



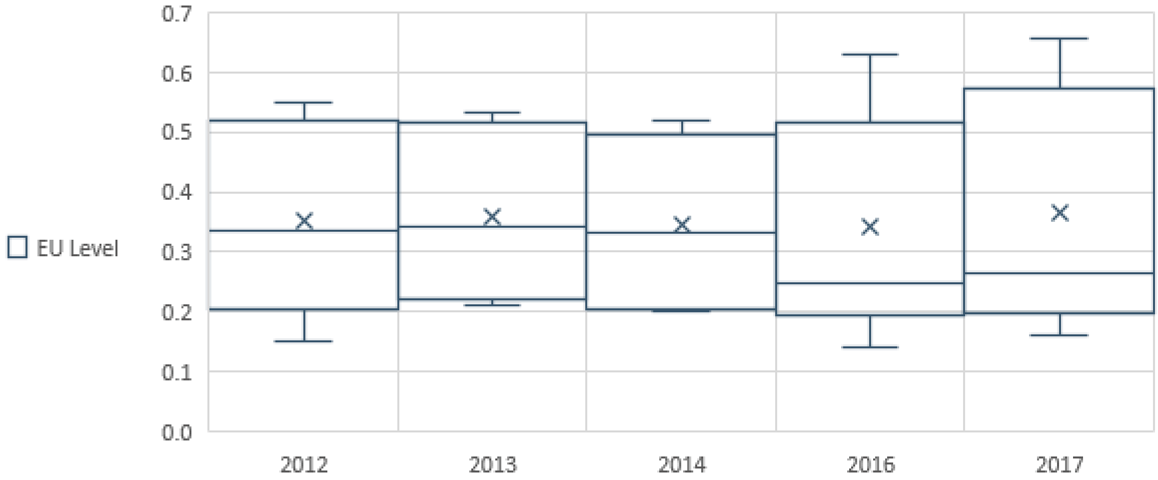
Source: CEPS/Ecofys.

Figure 4. Electricity costs of BOF steel production (€/tonne)



Source: CEPS/Ecofys.

Figure 5. Electricity intensity of BOF steel production (MWh/tonne)



Source: CEPS/Ecofys.

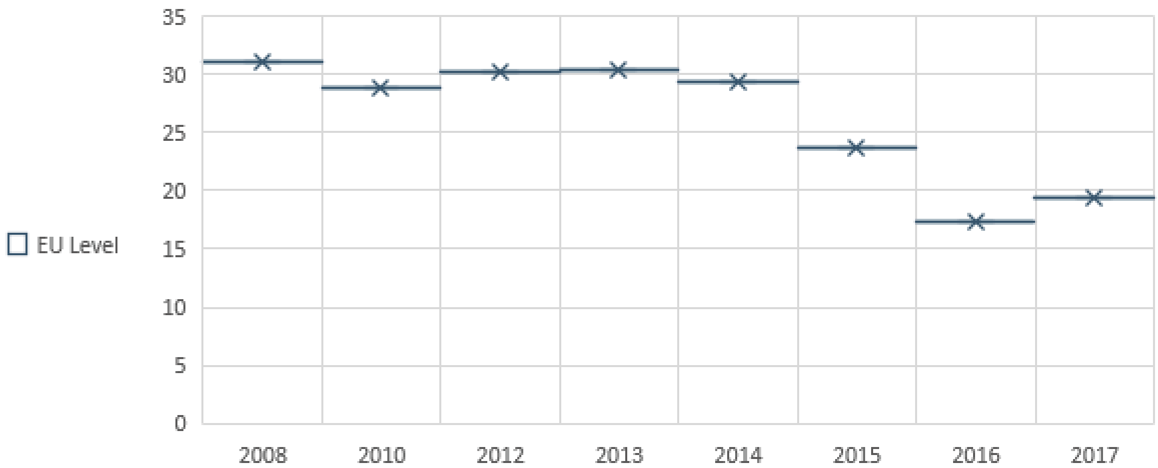
Natural gas

Table 3. Key natural gas indicators of BOF steel production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	31.1	28.9	30.3	30.4	29.3	23.6	17.2	19.3
Natural gas costs (€/tonne)	n.a.	8.8	6.4	7.5	7.0	6.7	5.1	6.4
Natural gas intensity (MWh/tonne)	0.36	0.32	0.22	0.25	0.25	0.29	0.27	0.31
Total gas intensity (MWh/tonne)	1.63	1.35	1.07	1.27	1.05	1.04	1.38	1.46

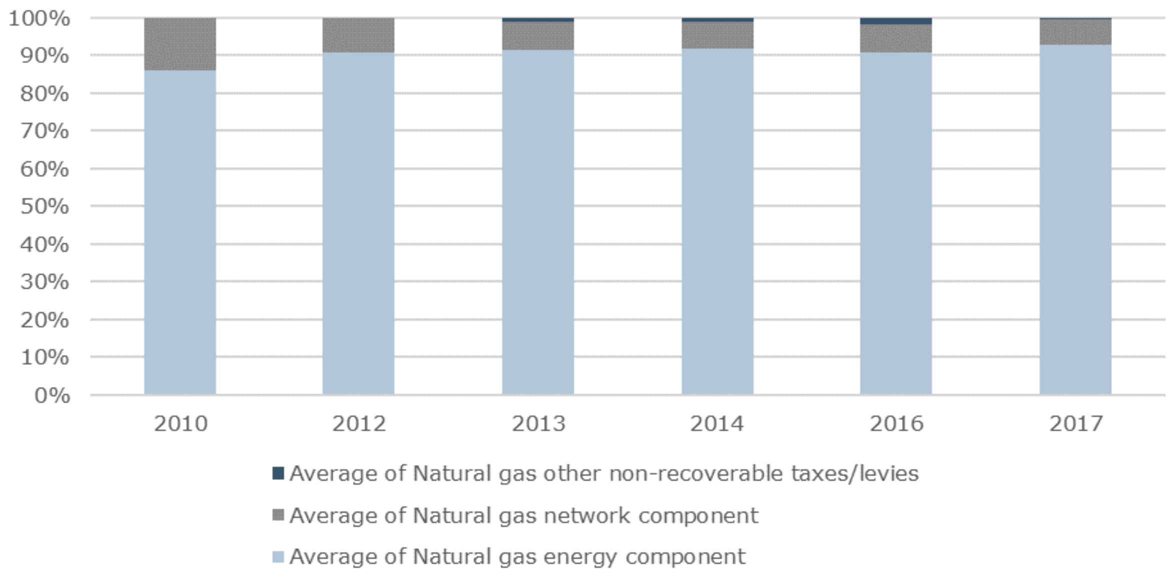
Source: CEPS/Ecofys.

Figure 6. Natural gas prices of BOF steel production (€/MWh)



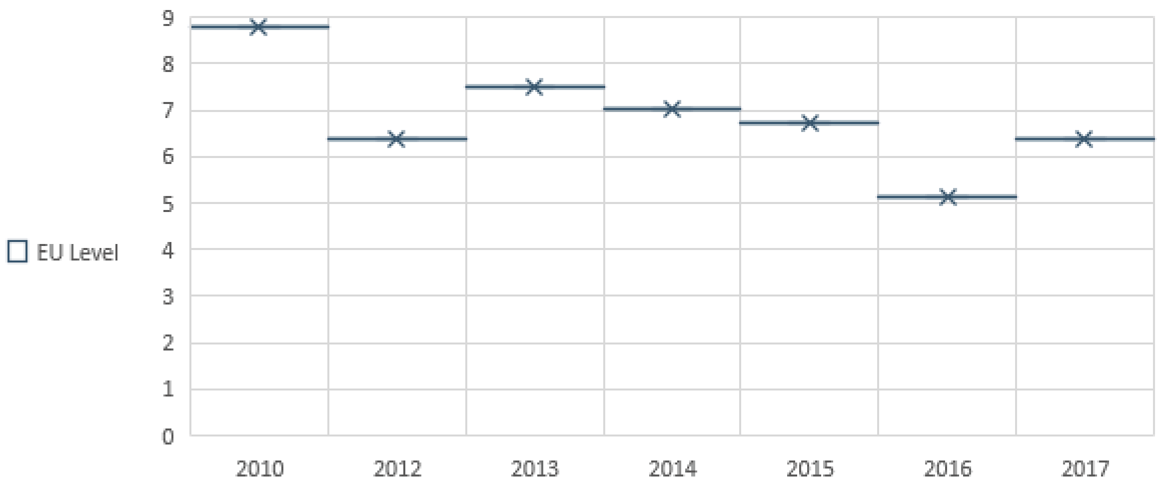
Source: CEPS/Ecofys.

Figure 7. Components of the EU average natural gas price for BOF steel production (%)



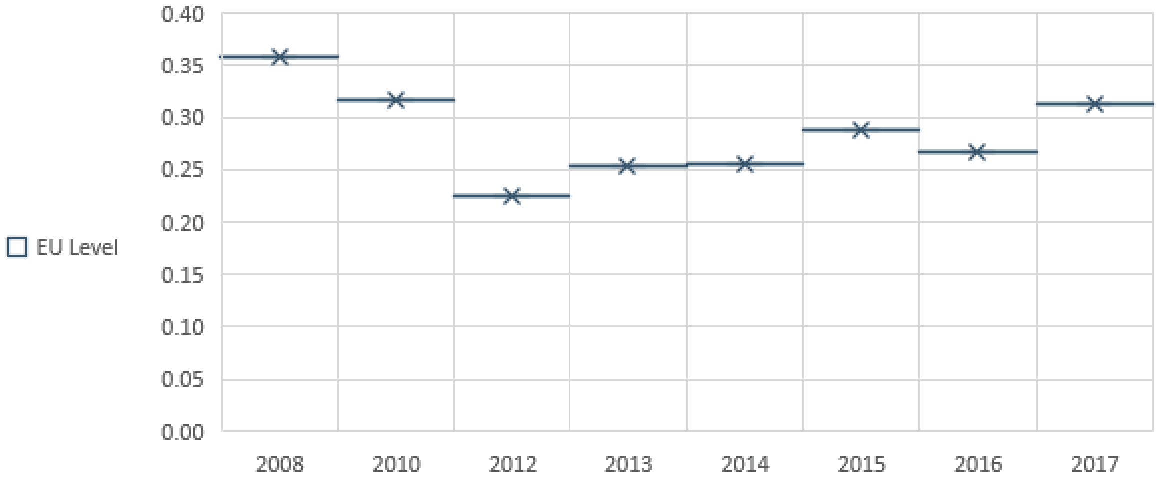
Source: CEPS/Ecofys.

Figure 8. Natural gas costs of BOF steel production (€/tonne)



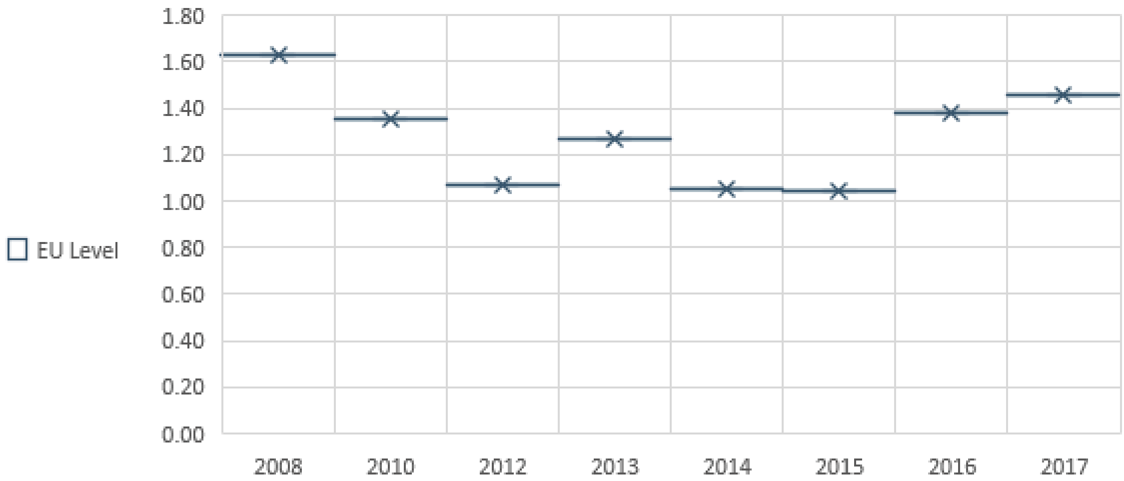
Source: CEPS/Ecofys.

Figure 9. Natural gas intensity of BOF steel production (MWh/tonne)



Source: CEPS/Ecofys.

Figure 10. Total gas intensity of BOF steel production (MWh/tonne)



Source: CEPS/Ecofys.

Competitiveness

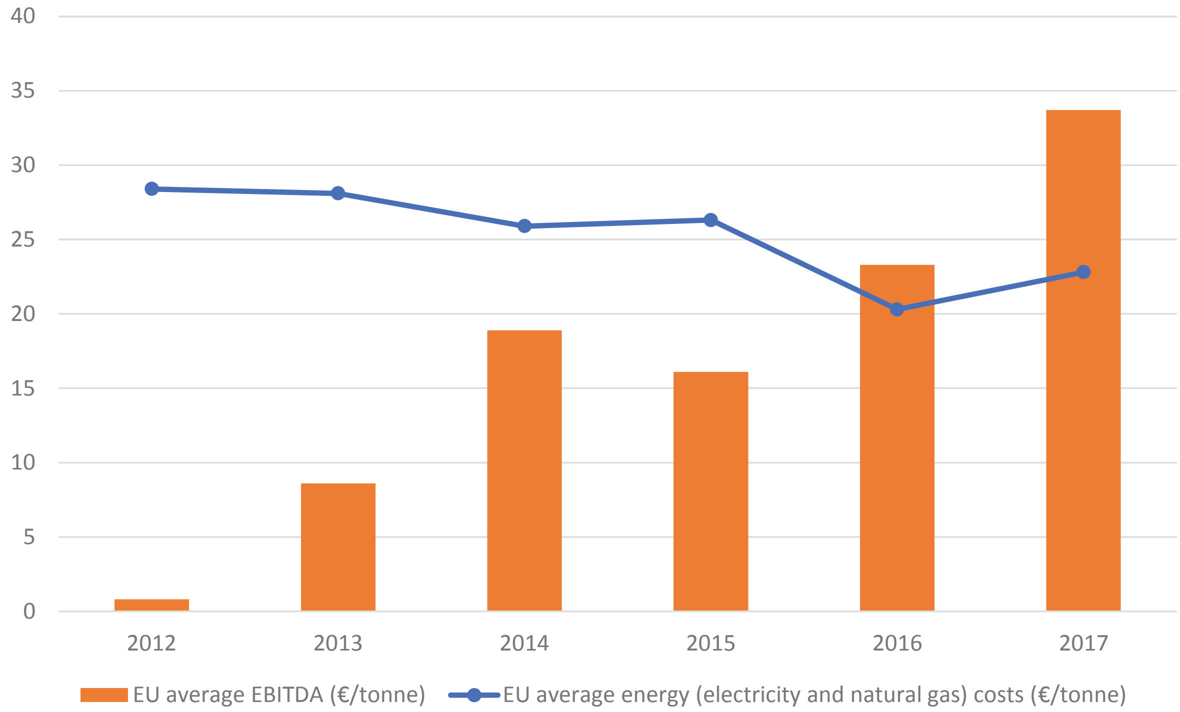
Table 4. Key competitiveness indicators of BOF steel production (EU averages)

Indicator	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	4.3	4.3	4.5	4.2	3.3	3.1
Share of natural gas costs in production costs (%)	1.2	1.6	1.7	1.4	1.1	1.2
Share of energy costs* in total production costs (%)	5.5	5.9	6.2	5.6	4.4	4.3
Energy costs* (€/tonne)	28.4	28.1	25.9	26.3	20.3	22.8
EBITDA (€/tonne)	0.8	8.6	18.9	16.1	23.3	33.7
Ratio of energy costs* to EBITDA	35.5	3.3	1.4	1.6	0.9	0.7

* Energy costs include the costs of electricity and natural gas but not the costs of coking coal and coke.

Source: CEPS/Ecofys.

Figure 11. Energy costs versus EBITDA of BOF steel production (€/tonne)



Source: CEPS/Ecofys.

A1.2.3 EAF plants

A1.2.3.1 Electricity prices, costs and intensity

Key electricity indicators for EAF plants are presented in Table 5.

The electricity prices and costs in EUR/MWh remained fairly stable between 2008 and 2013 but dropped afterwards.

EU average electricity prices decreased overall by around 13% over the period (61 EUR/MWh in 2008 vs. 53 EUR/MWh in 2017). When looking at the EU average electricity price components (Figure 12), the energy component still represents the main price component but has declined over time (from 86% in 2008 to 76% in 2017). In contrast, RES levies and other non-recoverable taxes/levies significantly increased over the period, both in relative and absolute terms. They represented altogether nearly 10% of the electricity price in 2016-2017 (compared to 2% in 2008). Larger consumers faced lower electricity prices (weighted average by purchased electricity is below simple average) and actually paid less for all the price components, including energy but also network costs, RES levies and other non-recoverable taxes/levies.

EU average electricity costs in EUR/MWh (Figure 13) went down from 61 EUR/MWh in 2008 to 50 EUR/MWh in 2017. The slight difference between electricity price and costs in EUR/MWh is caused by plants that received ex post reimbursements and compensations from an interruptibility scheme. It is interesting to note that on average EAF plants show slightly lower electricity costs (better deals) than BOF plants (e.g. 50 vs. 54 EUR/MWh in 2017, respectively), while in absolute terms their electricity consumption is less than half (around 330 GWh for an EAF compared to 820 GWh for a BOF plant based on 2016 median figures).

EU average electricity costs in EUR/tonne (Figure 14) followed the same trend as electricity costs in EUR/MWh and went downwards from 34 EUR/tonne in 2008 to 26 EUR/tonne in 2017 in EAF plants. Larger plants benefitted from better price conditions and economies of scale (weighted average – by production output – electricity costs are below simple average ones).

EU average electricity intensity of EAF plants (Figure 15) was around 0.55 MWh/tonne over the period (we can see a slight decrease over time from 0.56 MWh/tonne in 2008 to 0.53 MWh/tonne in 2017). Larger plants were more electricity efficient than smaller ones (weighted average – by production output – electricity efficiency is constantly below simple average one).

A1.2.3.2 Natural gas prices, costs and intensity

Key natural gas indicators for EAF plants are presented in Table 6.

EU average natural gas prices (Figure 16) dropped from 2008 to 2010, increased from 2010 to 2012 and then significantly decreased from 2012 to 2017. This is in line with international natural gas market price developments. The prices were at 26 EUR/MWh in 2008 and 20 EUR/MWh in 2017. As shown in Figure 17, the natural gas price is made up mostly by the energy component (86% in 2017), the remaining coming from the network component (non-recoverable taxes/levies play here a very minor role). Overall, large consumers faced lower natural gas prices (weighted average by purchased natural gas is generally below simple average). In fact, large consumers do not necessarily pay less for the energy component but do pay relatively less for the network costs and non-recoverable taxes/levies. Unlike for electricity, on average EAF plants faced since 2012 slightly higher gas prices than BOF plants (e.g. 20 vs. 19 EUR/MWh in 2017, respectively).

EU average natural gas costs (in EUR/tonne) were volatile throughout the 2008-2017 period (Figure 18). Overall, they still decreased by around 15% (9 EUR/tonne in 2008 vs. 8 EUR/tonne in 2017). Larger plants tend to bear lower unit costs due to lower natural gas prices and economies of scale (weighted average – by production output – natural gas costs are generally below simple average ones).

EU average natural gas intensity (Figure 19) remained fairly stable throughout the period, with a 2–3% overall decrease between 2008 (0.39 MWh/tonne) and 2017 (0.38 MWh/tonne). Larger plants are more natural gas efficient than smaller ones (weighted average by production output is below simple average).

A1.2.3.3 Competitiveness

As shown in Table 7, over the period, electricity and natural gas costs per tonne made up around 10% and 3% of total production costs per tonne, respectively. Overall, the share of total energy (electricity + natural gas) costs in production costs ranged around 12-13%.

EU average EBITDA per tonne (Figure 20) underwent a 63% decrease from 2008 to 2010. Since then, it has remained fairly stable at around 13-17 EUR/tonne. Larger plants showed higher margins (weighted average by production output is generally higher than simple average). The fact that total energy costs are higher than EBITDA shows the importance of electricity and natural gas costs and the potential direct impact they can have on margins of EAF steel production. The ratio of total energy costs to EBITDA indicates that a 1 % reduction in total energy costs would potentially lead, depending on the observation year (2008 excluded, as it is an atypical year), to around 2.4-2.9% increase in EBITDA. Nevertheless, we can also observe that despite lower total energy costs over time, EBITDA did not improve, which means that other major divers than electricity and natural gas costs play a role in EAF profitability as well.

A1.2.3.4 Tables and graphs

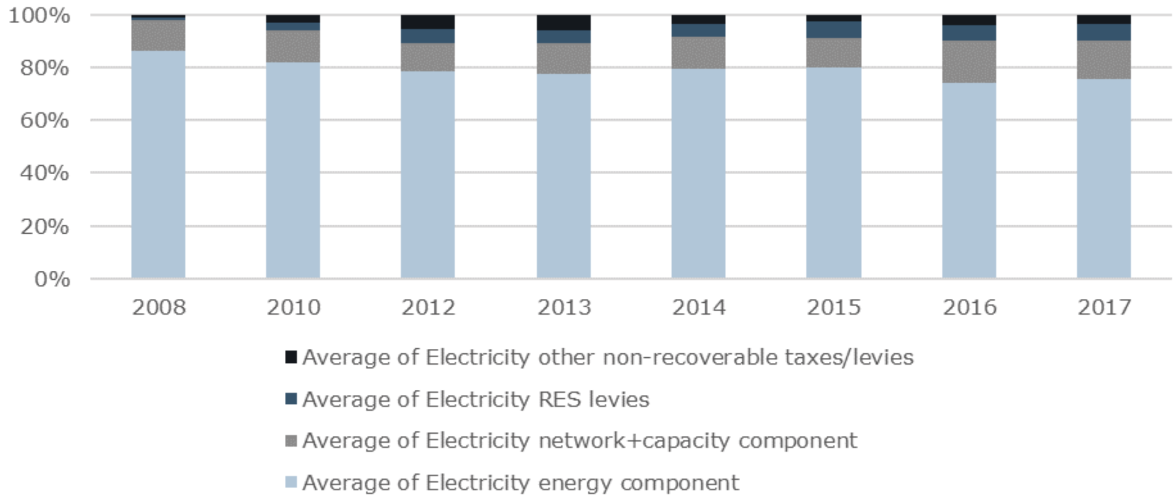
Electricity

Table 5. Key electricity indicators of EAF steel production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Electricity price (€/MWh)	61.4	58.7	61.5	63.8	58.7	57.9	53.7	53.2
Electricity costs (€/MWh)	61.3	58.4	61.1	63.5	58.4	56.1	50.6	50.1
Electricity costs (€/tonne)	34.1	32.4	33.8	34.3	29.8	30.9	25.8	25.9
Electricity intensity (MWh/tonne)	0.56	0.55	0.57	0.55	0.53	0.56	0.51	0.53

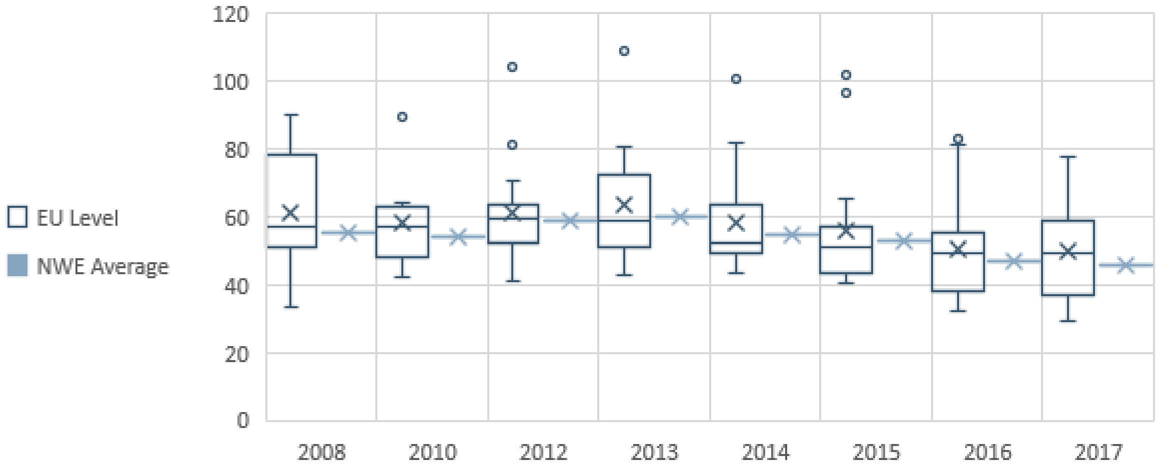
Source: CEPS/Ecofys.

Figure 12. Components of the EU average electricity price for EAF steel production (%)



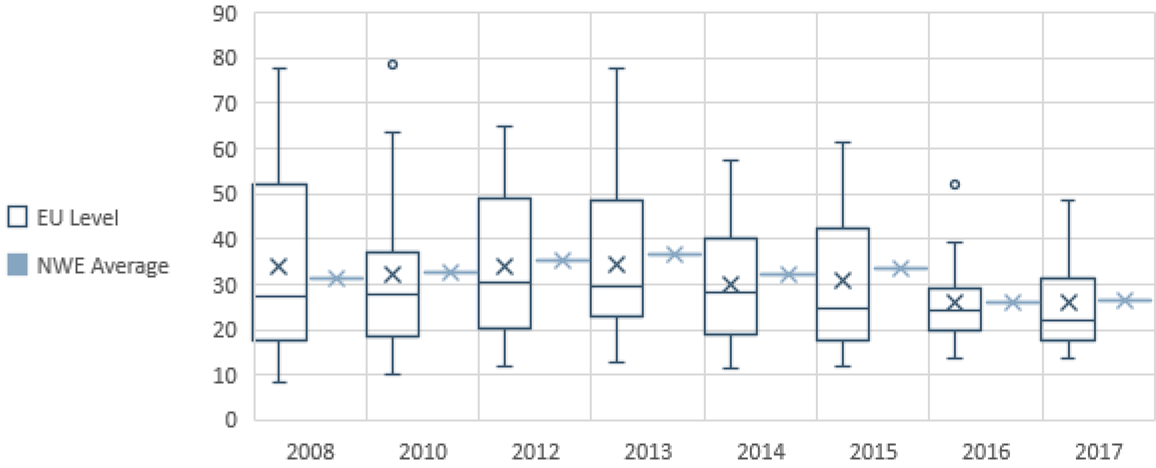
Source: CEPS/Ecofys.

Figure 13. Electricity costs of EAF steel production (€/MWh)



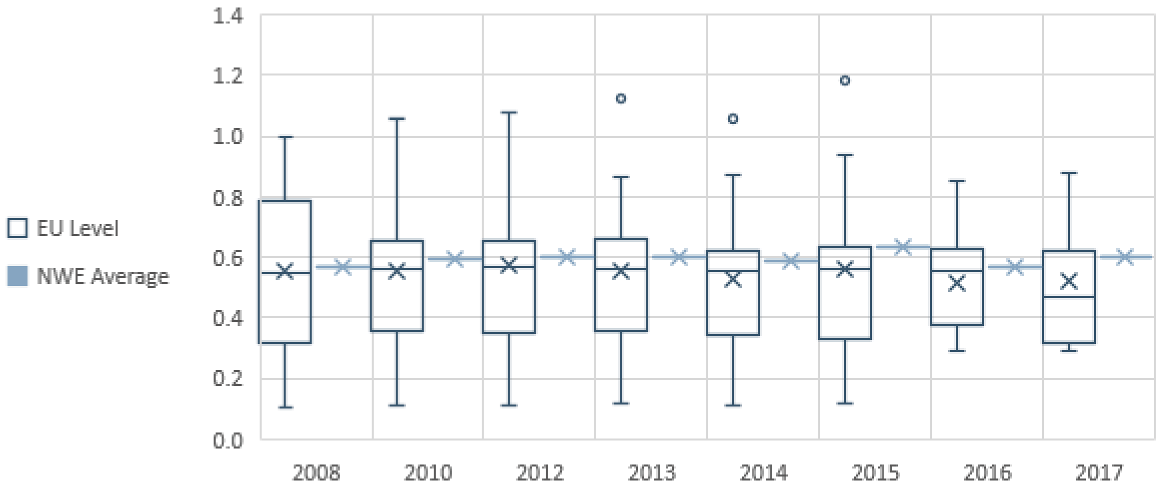
Source: CEPS/Ecofys.

Figure 14. Electricity costs of EAF steel production (€/tonne)



Source: CEPS/Ecofys.

Figure 15. Electricity intensity of EAF steel production (MWh/tonne)



Source: CEPS/Ecofys.

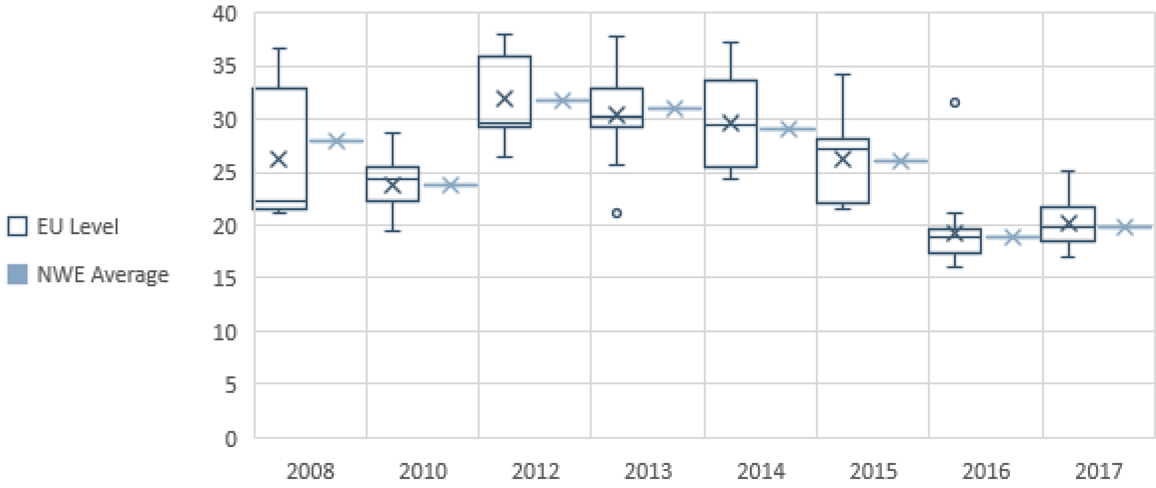
Natural gas

Table 6. Key natural gas indicators of EAF steel production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	26.3	23.9	31.8	30.4	29.6	26.3	19.2	20.2
Natural gas costs (€/tonne)	8.9	8.7	10.8	9.3	8.8	9.3	6.6	7.6
Natural gas intensity (MWh/tonne)	0.39	0.36	0.34	0.32	0.31	0.37	0.35	0.38

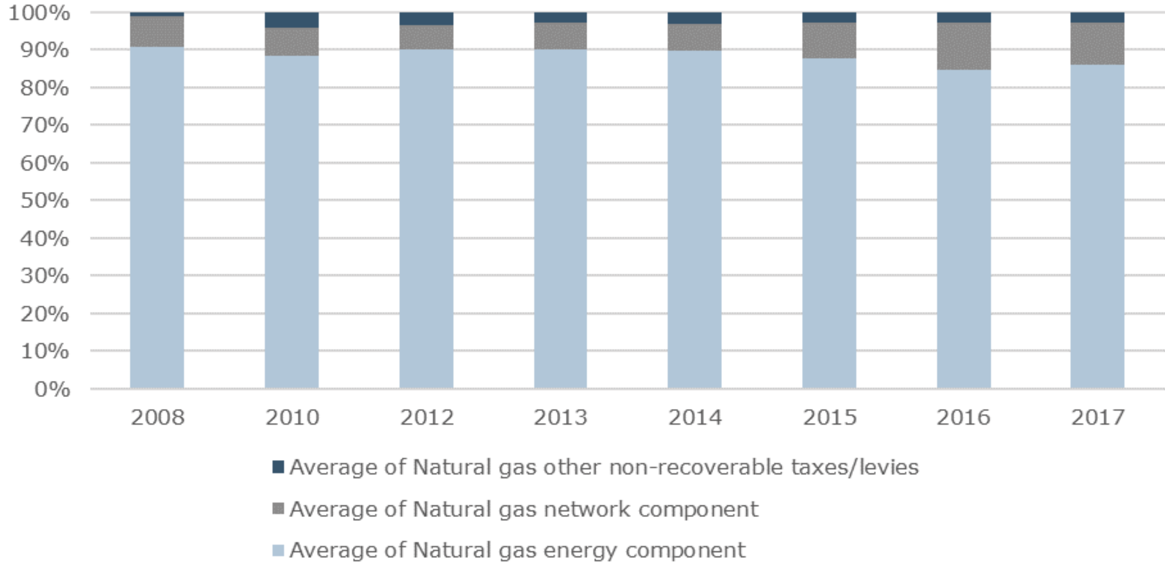
Source: CEPS/Ecofys.

Figure 16. Natural gas prices of EAF steel production (€/MWh)



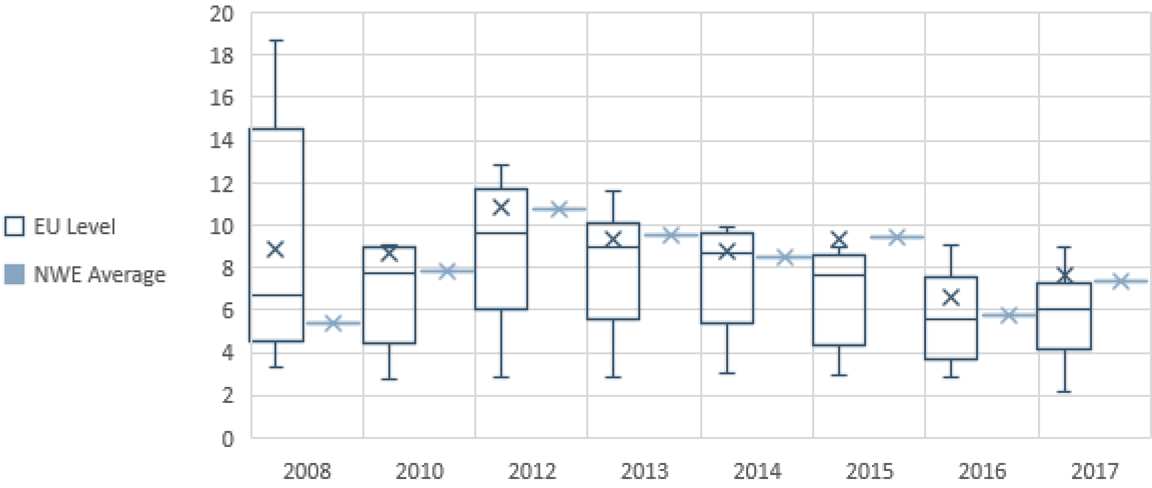
Source: CEPS/Ecofys.

Figure 17. Components of the EU average natural gas price for EAF steel production (%)



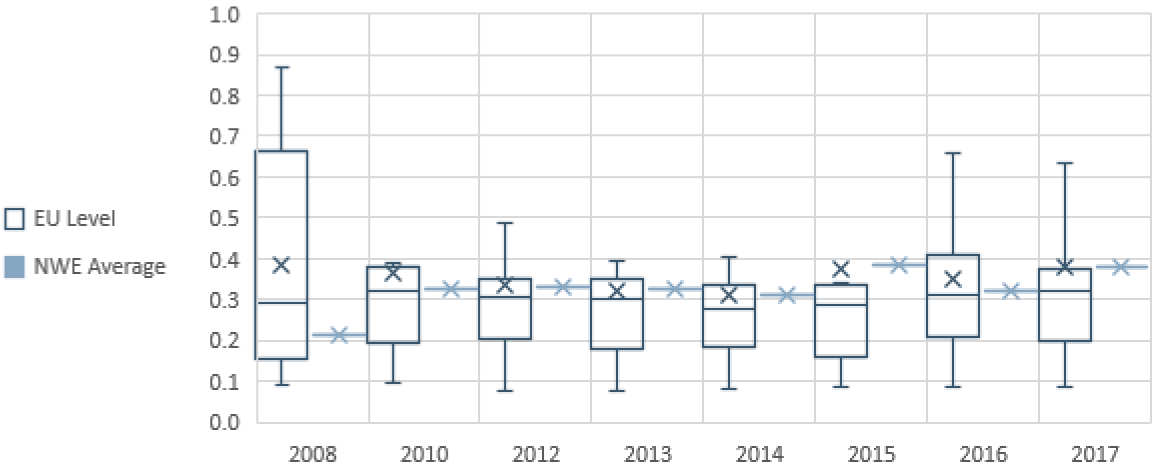
Source: CEPS/Ecofys.

Figure 18. Natural gas costs of EAF steel production (€/tonne)



Source: CEPS/Ecofys.

Figure 19. Natural gas intensity of EAF steel production (MWh/tonne)



Source: CEPS/Ecofys.

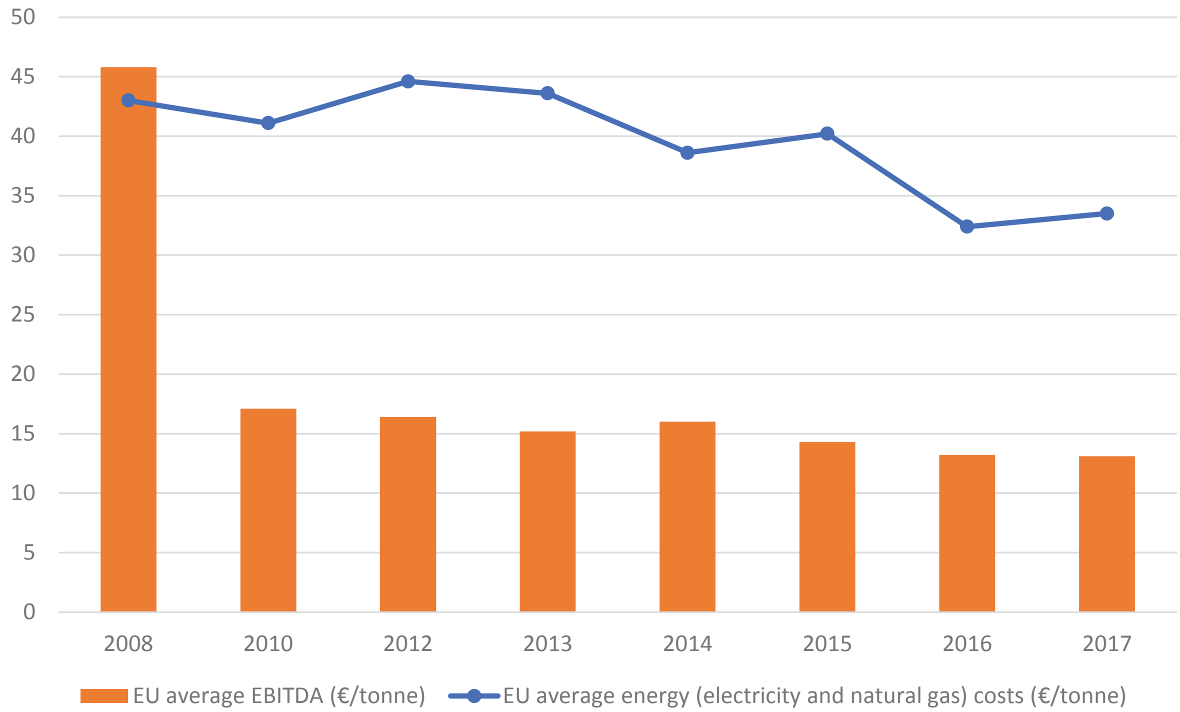
Competitiveness

Table 7. Key competitiveness indicators of EAF steel production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	9.0	9.8	9.8	10.7	10.2	11.8	9.8	9.6
Share of natural gas costs in production costs (%)	2.4	2.6	3.2	2.9	3.0	3.6	2.5	2.8
Share of total energy costs in total production costs (%)	11.4	12.5	13.0	13.6	13.2	15.4	12.3	12.4
Total energy costs (€/tonne)	43.0	41.1	44.6	43.6	38.6	40.2	32.4	33.5
EBITDA (€/tonne)	45.8	17.1	16.4	15.2	16.0	14.3	13.2	13.1
Ratio of total energy costs to EBITDA	0.9	2.4	2.7	2.9	2.4	2.8	2.5	2.6

Source: CEPS/Ecofys.

Figure 20. Energy costs versus EBITDA of EAF steel production (€/tonne)



Source: CEPS/Ecofys.

A1.3 ALUMINIUM

A1.3.1 General information and sample composition

The aluminium sector (sector 24.42 in NACE Rev. 2) includes primary and secondary aluminium production as well as semi-manufactured aluminium products.

Aluminium producers are usually classified into different groups, including:

- Primary aluminium smelters: these integrated plants smelt alumina into primary aluminium and then cast it into ingots. The smelting process requires three main inputs: alumina, electricity and carbon (in the form of anodes). In the following, these plants are referred to as primary aluminium plants.
- Aluminium refiners: these plants produce secondary aluminium by recycling very different types of aluminium scraps while tolerating a relatively high level of impurity (up to 15%). In the following, these plants are part of secondary aluminium plants.
- Aluminium remelters: these plants produce secondary aluminium by recycling relatively pure (2-3% maximum impurity tolerance) aluminium scraps (mostly industrial scraps). In the following, these plants are included in secondary aluminium plants as well.
- Rolling mills and extruders: these plants process and transform aluminium ingots into semi-finished or finished products. Rolling mills use hot, cold or foil rolling to produce different types of sheets, plates and foils. Extruders push through a die hot or cold aluminium alloys to make objects with a cross-sectional profile. In the following, these plants are referred to as downstream aluminium plants.

Note that further downstream plants, including casting and foil plants, are not part of the analysis.

Main energy source for primary and downstream aluminium production is electricity while secondary aluminium production uses both electricity and natural gas. Downstream aluminium production uses natural gas as a secondary energy source.

The aluminium sector went through a restructuration in Europe with some plant closures in the last decade. Primary and secondary production did not recover from the crisis. Since 2012, primary production has remained fairly stable while secondary production has increased, but both are still far from pre-crisis production levels. In 2015, primary and secondary aluminium production covered 17% and 37% of EU aluminium needs, respectively, while the rest (46%) was imported. Based on 2017 capacity, main EU primary aluminium producing countries include Germany, Spain, France, Romania and Greece, while major EU secondary aluminium producing countries include France, Italy, Spain, the UK and Poland. As regards downstream aluminium plants, most important EU producing countries include Germany, Italy, Spain, France and the UK.

Overall, the EU is a net importer of aluminium, importing in particular from Norway and Russia. Major EU export destinations include Switzerland and the United States, followed by China.

In the EU there were in 2017 16 primary aluminium plants, 214 secondary aluminium plants including 101 refining plants and 113 remelting facilities, and 368 downstream aluminium plants including 59 rolling mills and 309 extruders. A typical primary aluminium plant in the analysis has an electricity intensity of 12.4-16.2 MWh/tonne. Typical secondary aluminium plants have an electricity intensity of 0.12-0.95 MWh/tonne and a natural gas intensity of 1.1-2.8 MWh/tonne. Typical downstream aluminium plants have an electricity intensity of 0.5-1.3 MWh/tonne and a natural gas intensity of 0.9-1.7 MWh/tonne. The sample includes ten primary aluminium plants (representing about 60% of total primary aluminium production), nine secondary aluminium plants and eight downstream aluminium plants (representing around 13% of downstream aluminium production) across the EU. Note that the representativeness of the secondary aluminium sample cannot be assessed due to data unavailability. For confidentiality reasons, only an analysis at EU level is performed for this sector.

Primary aluminium, secondary aluminium and downstream aluminium production differ greatly in terms of technologies, regional distribution, capacities and energy consumption profiles and are therefore analysed separately in the following sections.

A1.3.2 Primary aluminium plants

A1.3.2.1 Electricity prices, costs and intensity

Key electricity indicators for primary aluminium plants are presented in Table 8.

EU average electricity prices increased over the period (34 EUR/MWh in 2008 vs. 40 EUR/MWh in 2017) with two peaks in 2012 and 2015 (44 EUR/MWh for both years). As shown in Figure 21, the electricity price is made up mostly by the energy component (above 85% in all years). Larger plants tend to face lower electricity prices (weighted average by purchased electricity is generally below simple average) by negotiating better deals on the energy component, though the difference with smaller plants is limited. It should be noted that the majority of primary aluminium plants buy electricity on the wholesale electricity market.

EU average electricity costs in EUR/MWh (Figure 22) rose from 34 EUR/MWh in 2008 to 36 EUR/MWh in 2017. Almost all primary aluminium plants took part in a flexibility scheme and some of them can associate on-site generation or self-generation from small hydro turbines or solar PVs, which explains the small difference between electricity prices and costs in EUR/MWh. EU average electricity costs in EUR/tonne (Figure 23) followed the same trend as electricity costs in EUR/MWh and rose from 461 EUR/tonne in 2008 to 542 EUR/tonne in 2017.

EU average electricity intensity of primary aluminium plants (Figure 24) went upwards in the sample (13.8 MWh/tonne in 2008 vs 15.4 MWh/tonne in 2017), but this is an apparent increase as it is mainly due to sample composition change. This sample change and the associated electricity intensity increase also explain why we can observe a significantly larger increase in costs in EUR/tonne than in EUR/MWh (17% vs. 5%, respectively, between 2008 and 2017).

A1.3.2.2 Natural gas prices, costs and intensity

Key natural gas indicators for primary aluminium plants are presented in Table 9.

EU average natural gas prices (Figure 25) dropped from 2008 to 2010, increased from 2010 to 2012 and then significantly decreased from 2012 to 2017. The prices were at 27 EUR/MWh in 2008 and 20 EUR/MWh in 2017. It is interesting to note that larger consumers did not face lower natural gas prices.

EU average natural gas costs (in EUR/tonne) fluctuated over the period under observation between 17 and 26 EUR/tonne (Figure 26). There was a sharp decrease from 2014 due to a reduction in the natural gas wholesale price, and an increase in 2017. The average natural gas costs were 22 EUR/tonne in 2017. Larger consumers bore slightly lower unit costs (weighted average is marginally below simple average), reflecting some very small economies of scale.

EU average natural gas intensity for primary aluminium producers (Figure 27) was around 1 MWh/tonne between 2008 and 2017 (variation is mainly explained by sample composition change).

A1.3.2.3 Competitiveness

As shown in Table 10, over the period, the share of electricity costs in total production costs increased from 29% to 38% while the share of natural gas costs in total production costs remained relatively stable (between 1% and 2%). As a result, the share of total energy (electricity + natural gas) costs in production costs increased from 30% in 2008 to 40% in 2017.

EU average EBITDA per tonne (Figure 28) fluctuated between 131 and 350 EUR/tonne. The high volatility in unit EBITDA and energy costs makes difficult to draw any firm conclusion. Nevertheless, we observe overall that total energy costs per output went upwards whereas EBITDA per output tended to go in the opposite direction. The ratio of total energy costs to EBITDA indicates that a 1 % reduction in total energy costs would potentially lead to an increase in EBITDA of 1.4% to 4.4%

(depending on the observation year). In addition, the unit electricity costs are always higher than unit EBITDA. All this shows the extreme importance of energy costs for primary aluminium producers, in particular electricity costs, and the potential direct impact they can have on their margins.

A1.3.2.4 Tables and graphs

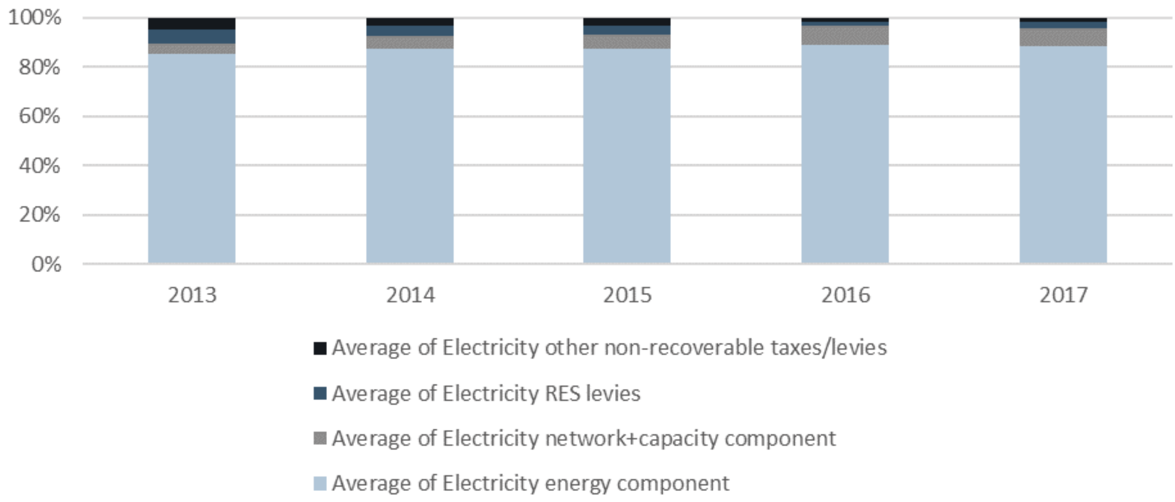
Electricity

Table 8. Key electricity indicators of primary aluminium production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Electricity prices (€/MWh)	34.2	38.0	43.6	38.4	38.1	43.5	39.4	39.6
Electricity costs (€/MWh)	34.2	38.0	43.6	37.9	37.3	42.4	37.0	35.8
Electricity costs (€/tonne)	461.3	496.6	609.6	554.1	536.4	587.6	544.1	541.9
Electricity intensity (MWh/tonne)	13.8	14.1	14.0	14.4	14.2	14.3	14.7	15.4

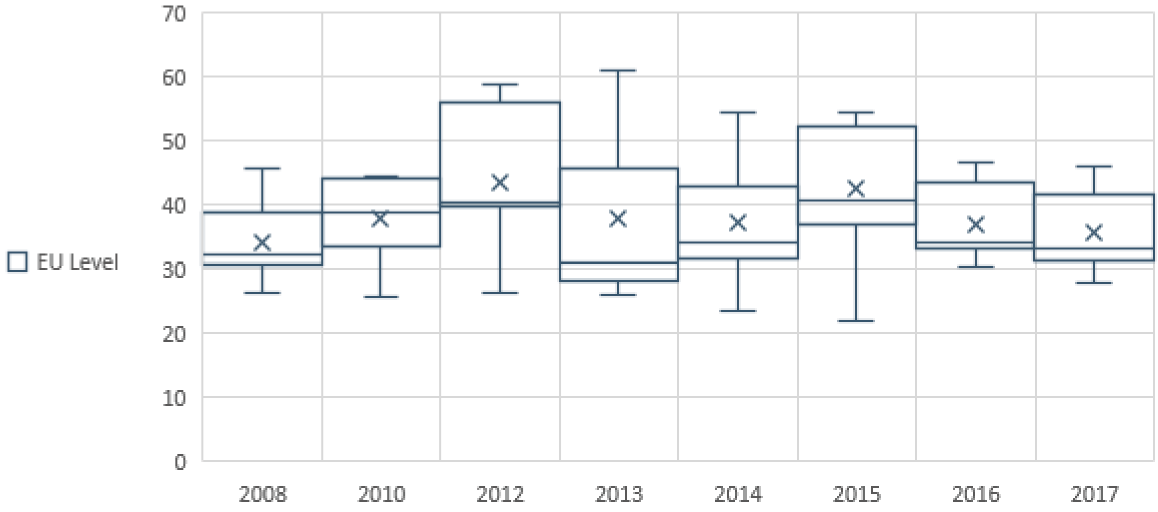
Source: CEPS/Ecofys.

Figure 21. Components of the EU average electricity price for primary aluminium production (%)



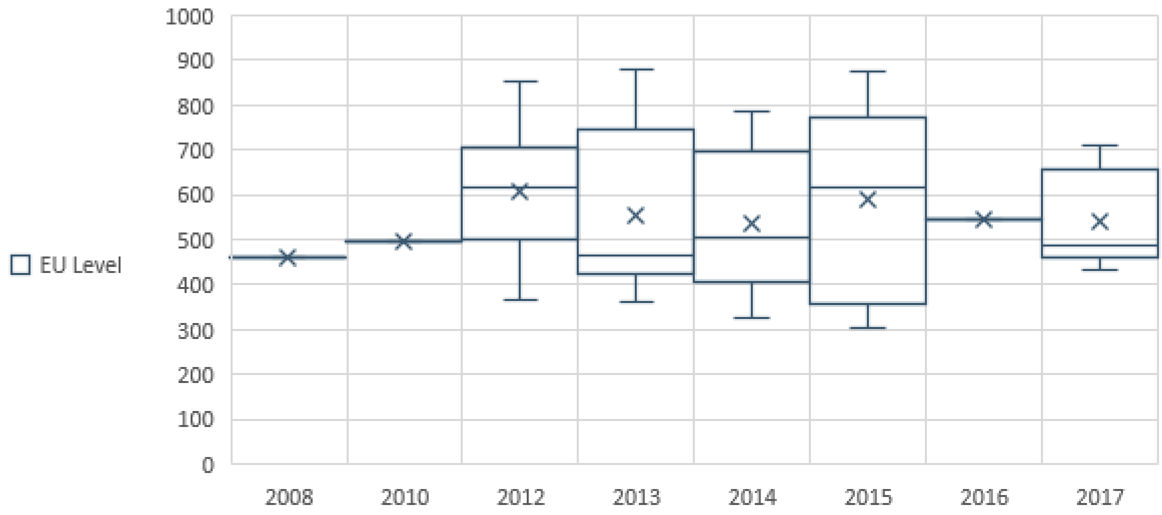
Source: CEPS/Ecofys.

Figure 22. Electricity costs of primary aluminium production (€/MWh)



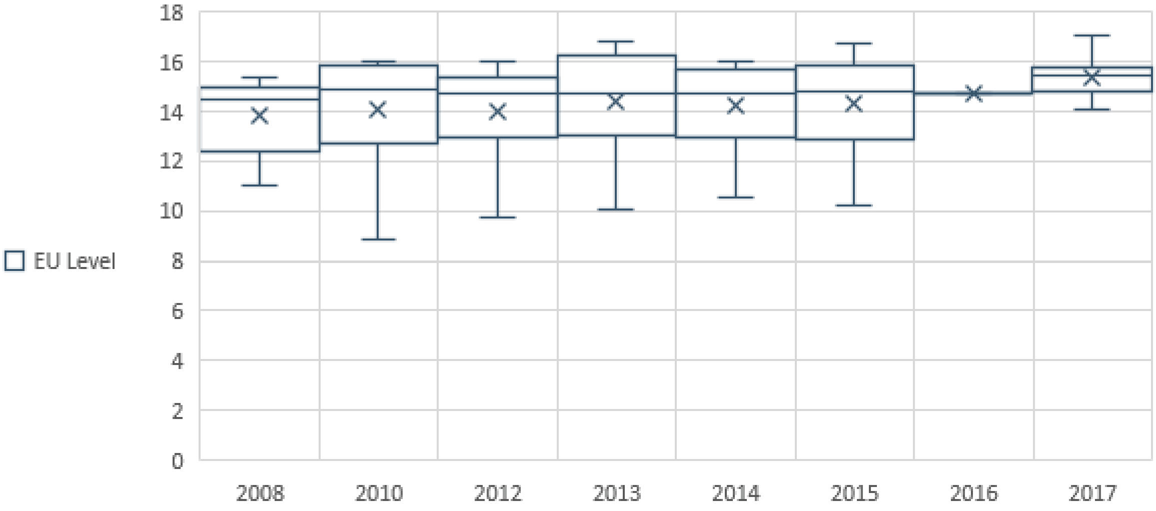
Source: CEPS/Ecofys.

Figure 23. Electricity costs of primary aluminium production (€/tonne)



Source: CEPS/Ecofys.

Figure 24. Electricity intensity of primary aluminium production (MWh/tonne)



Source: CEPS/Ecofys.

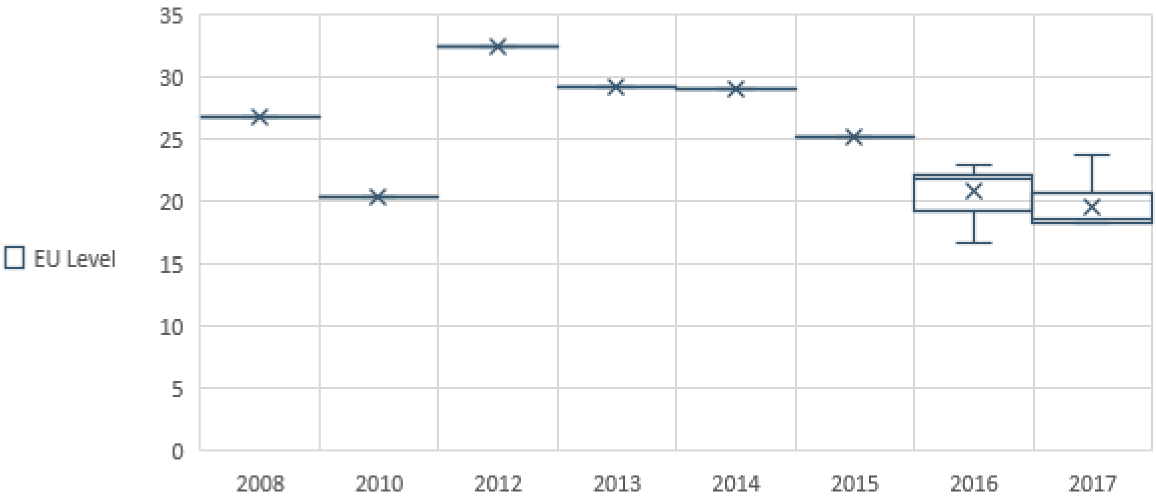
Natural gas

Table 9. Key natural gas indicators of primary aluminium production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Natural gas prices (€/MWh)	26.8	20.4	32.5	29.2	29.0	25.1	20.9	19.5
Natural gas costs (€/tonne)	25.5	20.1	25.8	23.5	25.9	22.5	17.1	21.7
Natural gas intensity (MWh/tonne)	1.00	1.01	0.97	0.94	1.00	0.95	0.88	1.15

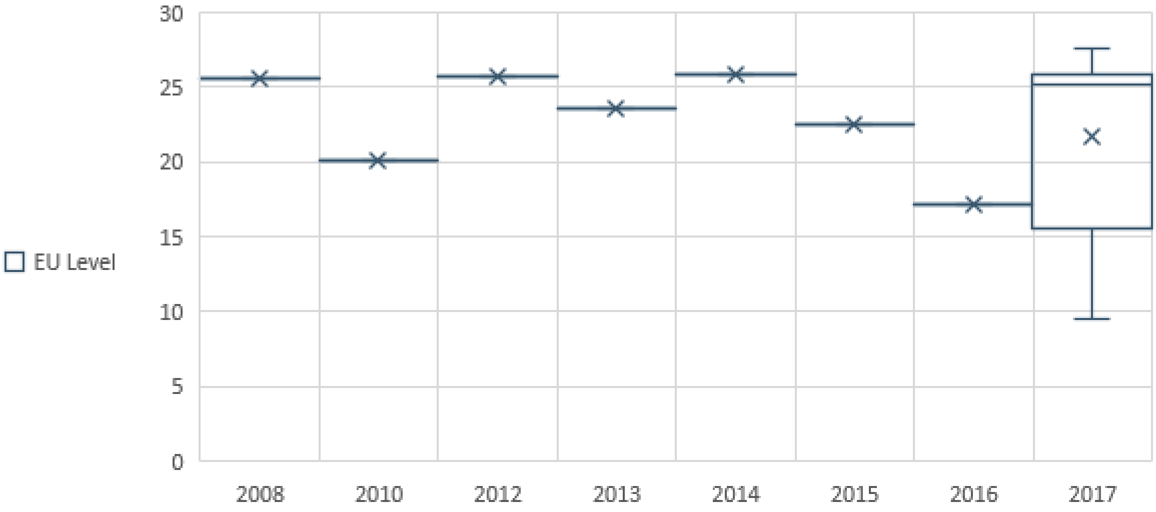
Source: CEPS/Ecofys.

Figure 25. Natural gas prices of primary aluminium production (€/MWh)



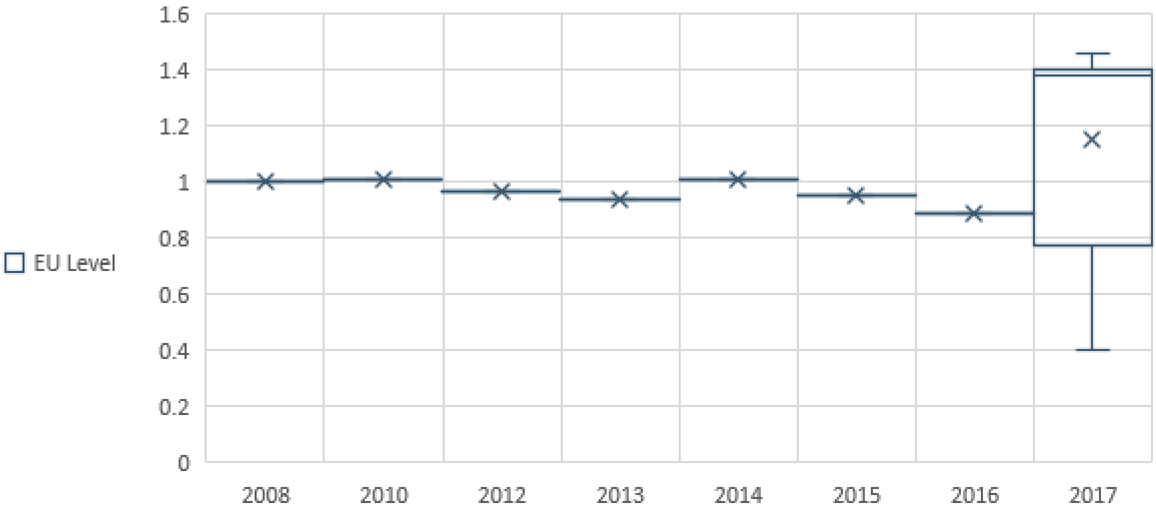
Source: CEPS/Ecofys.

Figure 26. Natural gas costs of primary aluminium production (€/tonne)



Source: CEPS/Ecofys.

Figure 27. Natural gas intensity of primary aluminium production (MWh/tonne)



Source: CEPS/Ecofys.

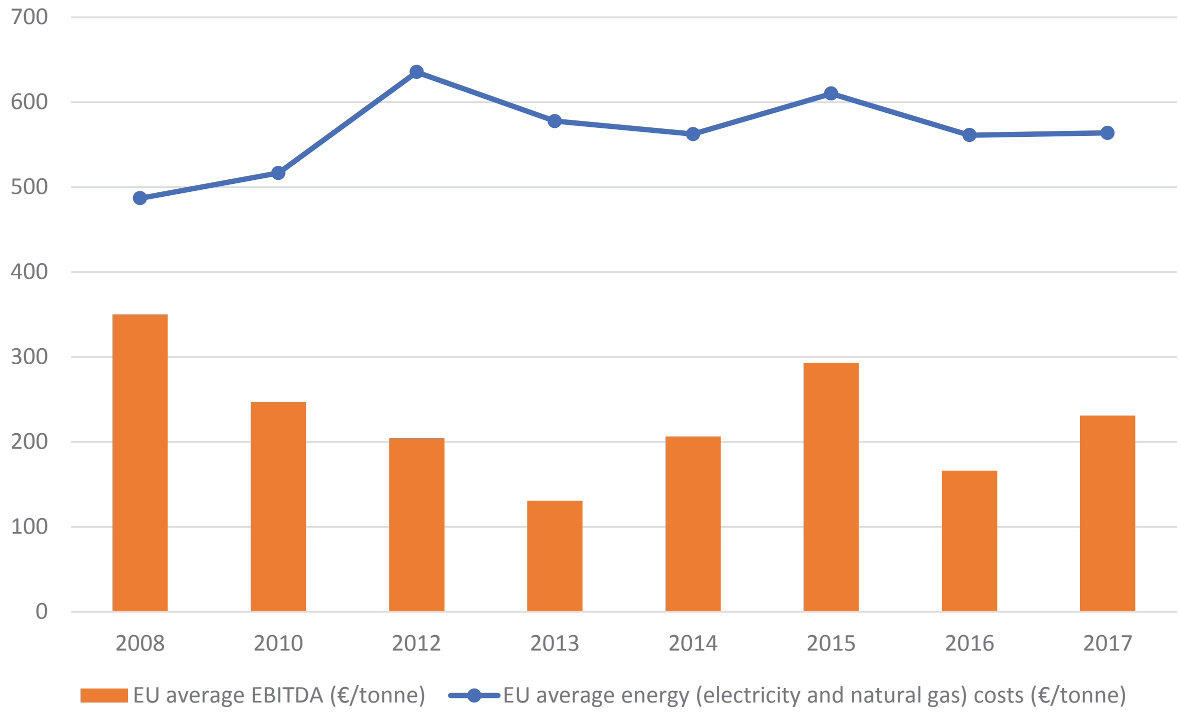
Competitiveness

Table 10. Key competitiveness indicators of primary aluminium production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	28.7	33.5	39.2	36.7	38.8	41.6	41.6	38.3
Share of natural gas costs in production costs (%)	1.6	1.4	1.7	1.6	1.9	1.6	1.3	1.5
Share of total energy costs in production costs (%)	30.3	34.8	40.9	38.2	40.7	43.2	42.9	39.8
Total energy costs (€/tonne)	486.8	516.6	635.4	577.6	562.3	610.1	561.2	563.6
EBITDA (€/tonne)	350.0	247.0	204.2	130.8	206.5	293.1	166.0	231.1
Ratio of total energy costs to EBITDA	1.4	2.1	3.1	4.4	2.7	2.1	3.4	2.4

Source: CEPS/Ecofys.

Figure 28. Energy costs versus EBITDA of primary aluminium production (€/tonne)



Source: CEPS/Ecofys.

A1.3.3 Secondary aluminium plants

A1.3.3.1 Electricity prices, costs and intensity

Key electricity indicators for secondary aluminium plants are presented in Table 11.

EU average electricity prices fluctuated over the period but decreased overall (101 EUR/MWh in 2008 vs. 90 EUR/MWh in 2017) with a peak in 2012 (129 EUR/MWh). In terms of price components (Figure 29), the energy component went down between 2008 and 2017 (both in absolute and relative terms) and accounted for 55% of the price in 2017, while the network component went up (both in absolute and relative terms) and accounted for 29% of the price in 2017. It is interesting to note that larger secondary aluminium plants do not benefit from lower prices. Unlike primary aluminium producers, secondary aluminium plants mostly buy electricity through providers, with a limited number sourcing a share of their electricity from the wholesale market.

EU average electricity costs in EUR/MWh (Figure 30) decreased from 101 EUR/MWh in 2008 to 86 EUR/MWh in 2017, with a sharper decrease between 2016 and 2017. The small difference between electricity prices and costs in EUR/MWh is due to ex post electricity price reimbursements granted to some producers. EU average electricity costs in EUR/tonne (Figure 31) fell from 42 EUR/tonne in 2008 to 27 EUR/tonne in 2017.

EU average electricity intensity of secondary aluminium plants (Figure 32) decreased from 0.49 MWh/tonne in 2008 to 0.37 MWh/tonne in 2017.

A1.3.3.2 Natural gas prices, costs and intensity

Key natural gas indicators for secondary aluminium plants are presented in Table 12.

EU average natural gas prices (Figure 33) dropped from 2008 to 2010, increased from 2010 to 2012 and then significantly decreased from 2012 to 2017. The prices were at 33 EUR/MWh in 2008 and 22 EUR/MWh in 2017. As shown in Figure 34, the natural gas price is made up mostly by the energy component (84% in 2017), though this share tends to decrease over time. Larger consumers bore slightly lower unit prices (weighted average is marginally below simple average).

EU average natural gas costs (in EUR/tonne) declined from 62 EUR/tonne in 2008 to 35 EUR/tonne in 2017 (Figure 35).

Overall, EU average natural gas intensity for secondary aluminium producers (Figure 36) decreased from 1.89 MWh/tonne in 2008 to 1.60 MWh/tonne in 2017. Larger plants tend to be more efficient than smaller ones (weighted average – by production output – natural gas intensity is constantly below simple average one).

A1.3.3.3 Competitiveness

As shown in Table 13 (data are available for 2016 and 2017 only), electricity and natural gas costs per tonne made up around 5-6% and 6-8% of total production costs per tonne, respectively. Overall, the share of total energy (electricity + natural gas) costs in production costs ranged around 12-14%.

Data on EBITDA per tonne are not available for this subsector and cannot be compared with energy costs. We can still note the relative significance of total energy costs in production costs, which underlines their importance when looking at competitiveness issues in secondary aluminium production.

A1.3.3.4 Tables and graphs

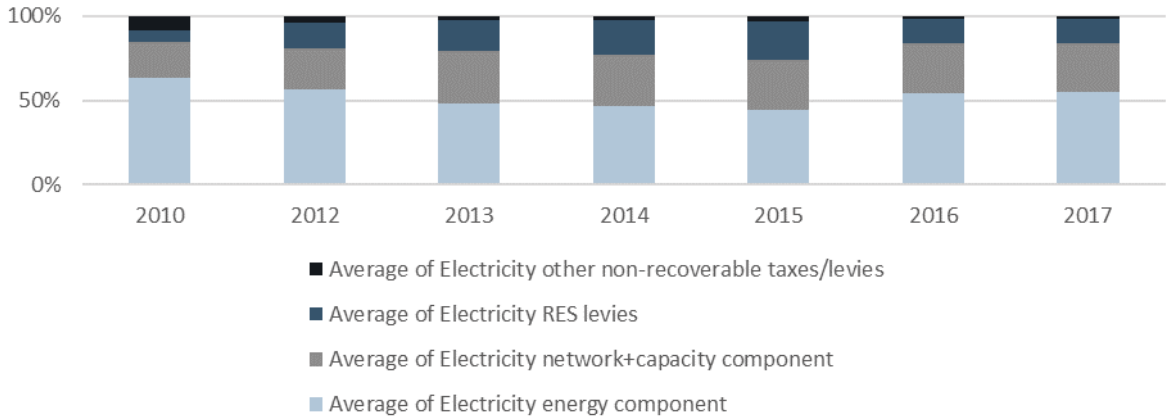
Electricity

Table 11. Key electricity indicators of secondary aluminium production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Electricity prices (€/MWh)	100.7	99.3	128.5	125.9	125.3	122.8	97.6	89.5
Electricity costs (€/MWh)	100.7	99.3	102.8	100.7	98.7	94.9	93.9	86.4
Electricity costs (€/tonne)	42.0	31.2	41.3	41.5	42.6	43.7	30.8	27.4
Electricity intensity (MWh/tonne)	0.49	0.50	0.63	0.52	0.55	0.58	0.39	0.37

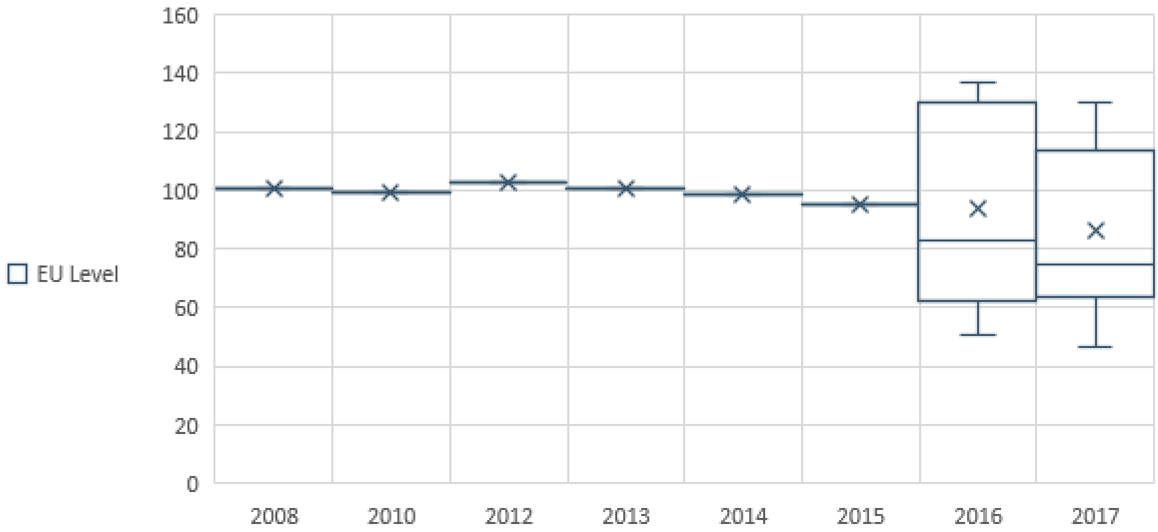
Source: CEPS/Ecofys.

Figure 29. Components of the EU average electricity price for secondary aluminium production (%)



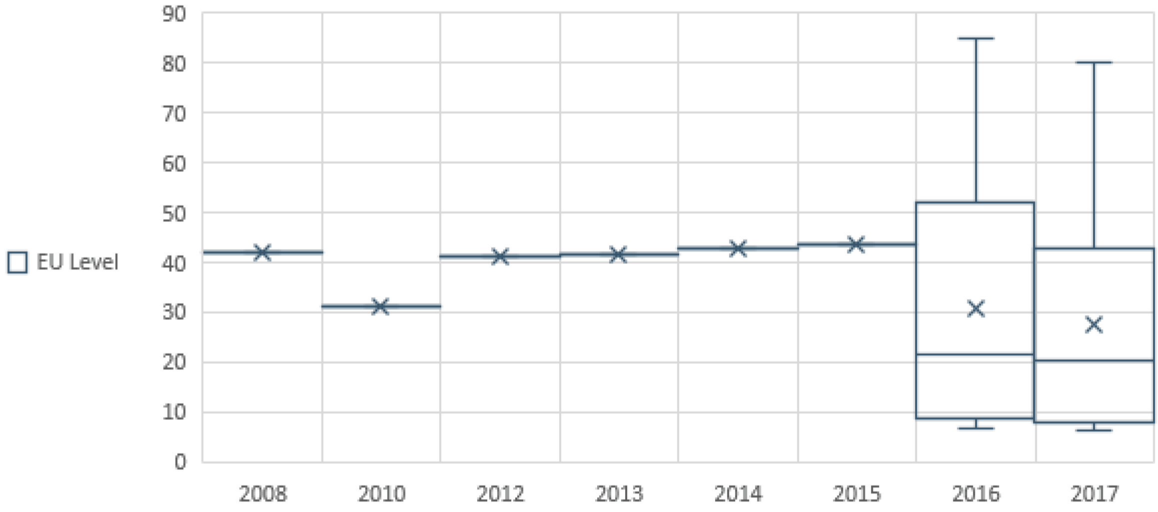
Source: CEPS/Ecofys.

Figure 30. Electricity costs of secondary aluminium production (€/MWh)



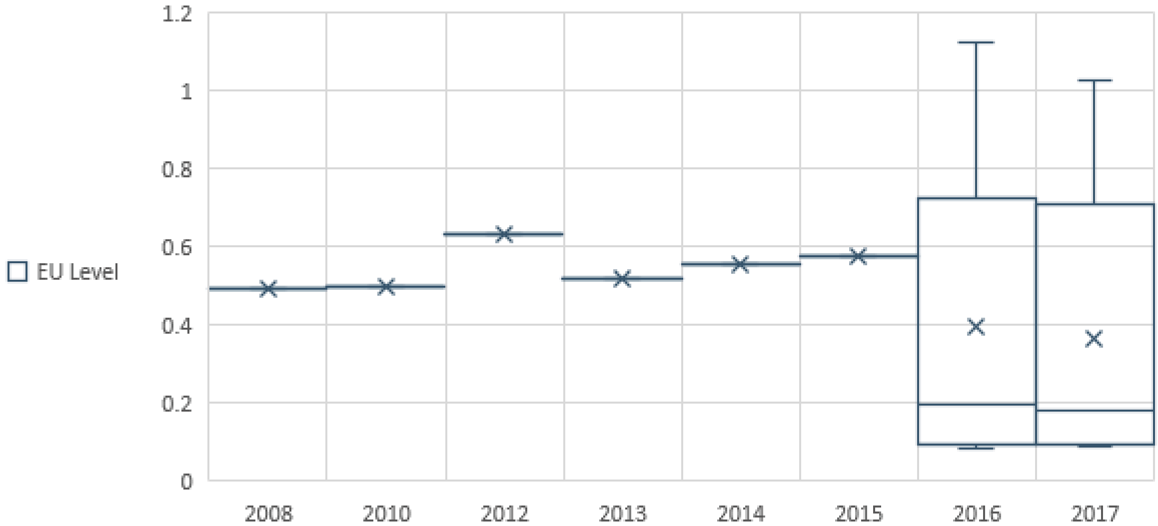
Source: CEPS/Ecofys.

Figure 31. Electricity costs of secondary aluminium production (€/tonne)



Source: CEPS/Ecofys.

Figure 32. Electricity intensity of secondary aluminium production (MWh/tonne)



Source: CEPS/Ecofys.

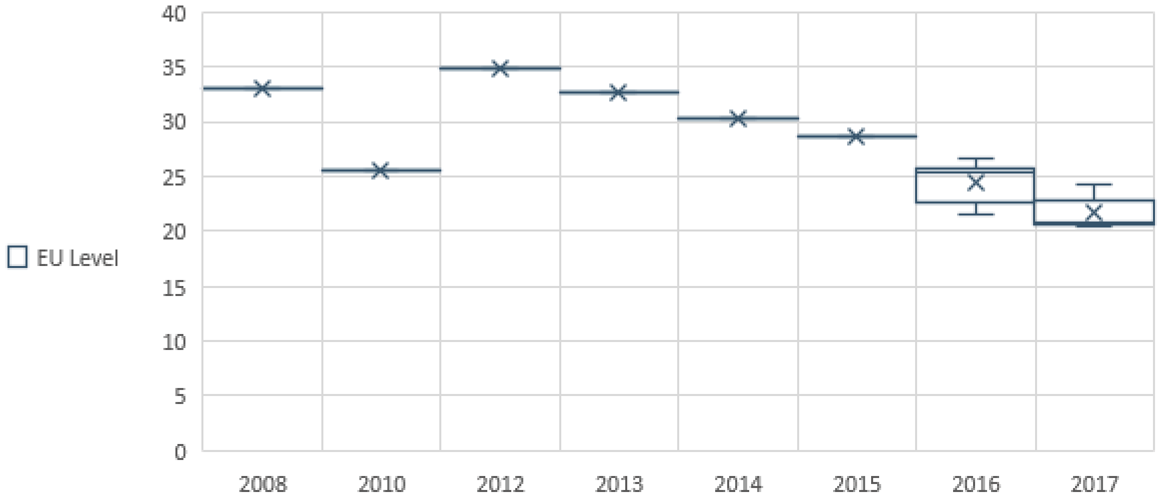
Natural gas

Table 12. Key natural gas indicators of secondary aluminium production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Natural gas prices (€/MWh)	33.0	25.7	34.9	32.8	30.3	28.7	24.4	21.6
Natural gas costs (€/tonne)	61.9	45.6	61.3	58.1	56.7	59.2	39.6	34.7
Natural gas intensity (MWh/tonne)	1.89	1.81	1.76	1.75	1.84	1.97	1.64	1.60

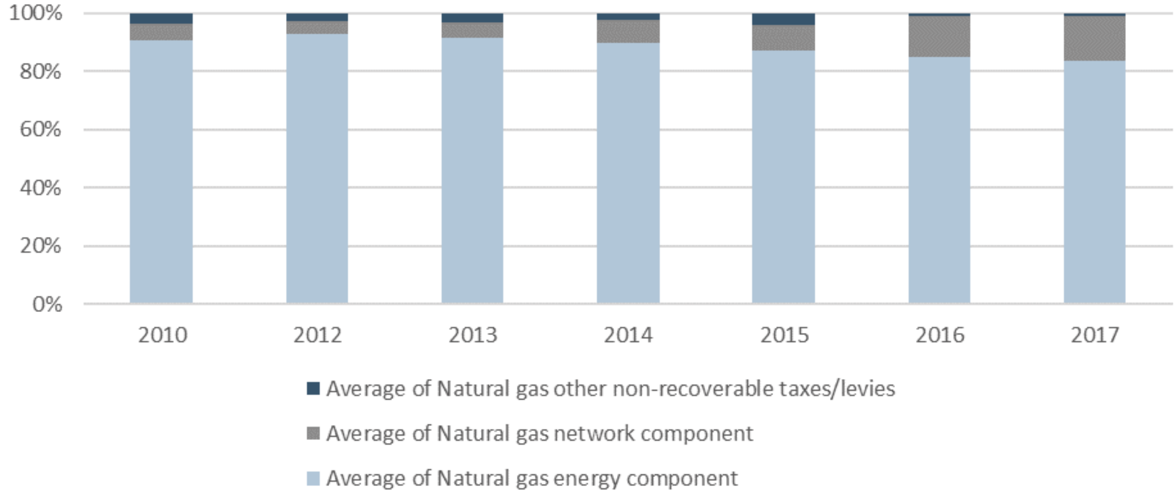
Source: CEPS/Ecofys.

Figure 33. Natural gas prices of secondary aluminium production (€/MWh)



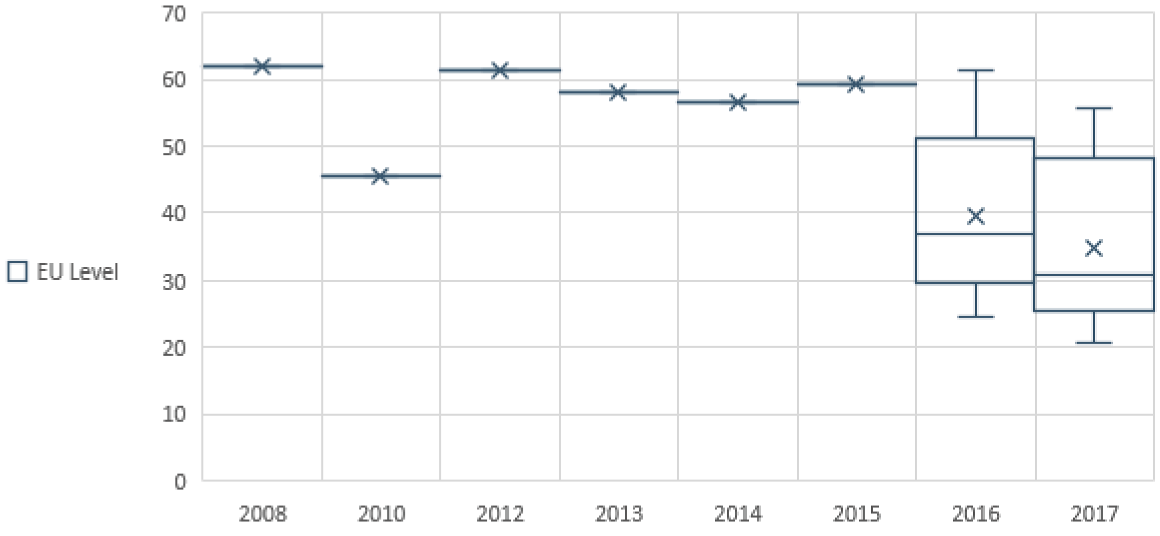
Source: CEPS/Ecofys.

Figure 34. Components of the EU average natural gas price for secondary aluminium production (%)



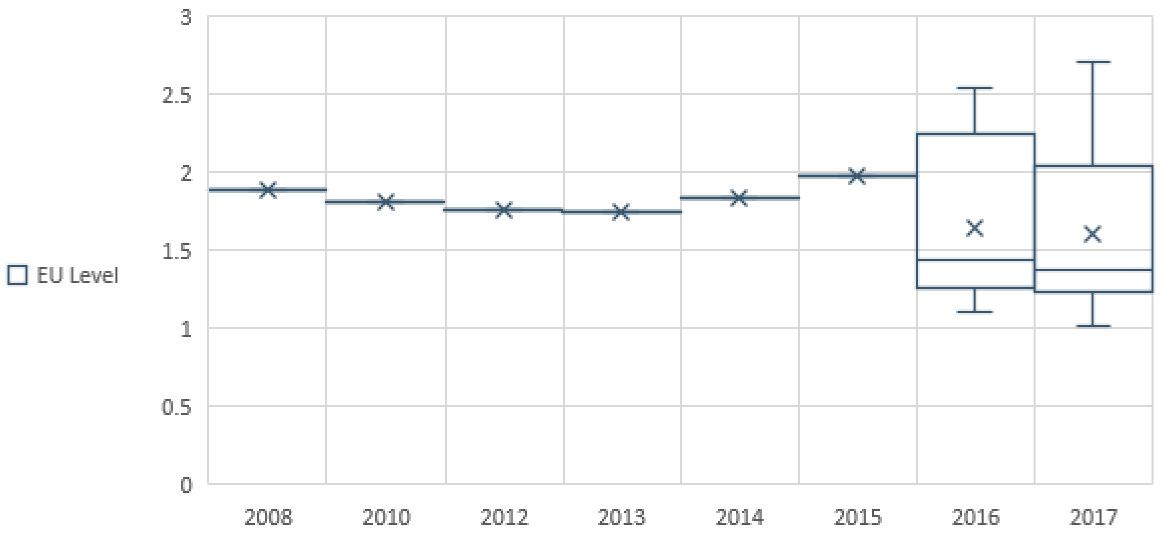
Source: CEPS/Ecofys.

Figure 35. Natural gas costs of secondary aluminium production (€/tonne)



Source: CEPS/Ecofys.

Figure 36. Natural gas intensity of secondary aluminium production (MWh/tonne)



Source: CEPS/Ecofys.

Competitiveness

Table 13. Key competitiveness indicators of secondary aluminium production (EU averages)

Indicator	2016	2017
Share of electricity costs in production costs (%)	6.1	5.1
Share of natural gas costs in production costs (%)	7.9	6.4
Share of total energy costs in production costs (%)	14.0	11.5
Total energy costs (€/tonne)	70.4	62.1

Source: CEPS/Ecofys.

A1.3.4 Downstream aluminium plants

A1.3.4.1 Electricity prices, costs and intensity

Key electricity indicators for downstream aluminium plants are presented in Table 14.

EU average electricity prices increased from 2010 to 2013 and decreased afterwards until 2016, but they were on the rise again in 2017. Over the period, prices increased overall (69 EUR/MWh in 2008 vs. 84 EUR/MWh in 2017). In terms of price components (Figure 37), the energy component remained fairly stable over the period in absolute terms but slightly decreased in relative terms and accounted for 65% of the price in 2017, while the network and RES levies components went up (both in absolute and relative terms) and accounted for 21% and 7% of the price in 2017, respectively. It is striking that larger consumers faced much lower electricity prices (weighted average by purchased electricity is well below simple average) by: i) benefitting from stronger bargaining power when negotiating electricity prices (lower energy component); and ii) paying relatively less for network costs and non-recoverable taxes/levies, including RES levies. Like secondary aluminium producers, downstream aluminium plants mostly buy electricity through providers, with a limited number sourcing a share of their electricity from the wholesale market.

EU average electricity costs in EUR/MWh (Figure 38) increased from 58 EUR/MWh in 2010 to 83 EUR/MWh in 2017. The difference between electricity prices and costs in EUR/MWh is due to ex post electricity price reimbursements granted to some producers. EU average electricity costs in EUR/tonne (Figure 39) have been on a decreasing trend since 2013, but over the period they slightly increased from 54 EUR/tonne in 2008 to 59 EUR/tonne in 2017.

EU average electricity intensity of downstream aluminium plants (Figure 40) decreased from 1.21 MWh/tonne in 2010 to 0.93 MWh/tonne in 2017.

A1.3.4.2 Natural gas prices, costs and intensity

Key natural gas indicators for downstream aluminium plants are presented in Table 15.

EU average natural gas prices (Figure 41) fell by more than half since 2012 (42 EUR/MWh in 2008 vs. 20 EUR/MWh in 2017). As shown in Figure 42, the natural gas price is made up mostly by the energy component (85% in 2017). Larger consumers bore lower unit prices (weighted average is below simple average), but this price differential between larger and smaller consumers tends to disappear in the most recent years.

As shown in Figure 43, EU average natural gas costs (in EUR/tonne) followed the same trend as natural gas prices and dropped by half between 2012 and 2017 (59 vs. 28 EUR/tonne, respectively)

EU average natural gas intensity (Figure 44) ranged between 1.2 and 1.5 MWh/tonne over the period. Unlike for secondary aluminium, downstream aluminium producers are not more efficient than smaller ones.

A1.3.4.3 Competitiveness

As shown in Table 16 (data are available for 2016 and 2017 only), electricity and natural gas costs per tonne made up around 1% and 0.5% of total production costs per tonne, respectively. Overall, the share of total energy (electricity + natural gas) costs in production costs ranged around 1-2%.

Data on EBITDA per tonne are not available for this subsector and cannot be compared with energy costs. We can nevertheless note that total energy costs represent a very small share of production costs and therefore seem less relevant for competitiveness issues in downstream aluminium production.

A1.3.4.4 Tables and graphs

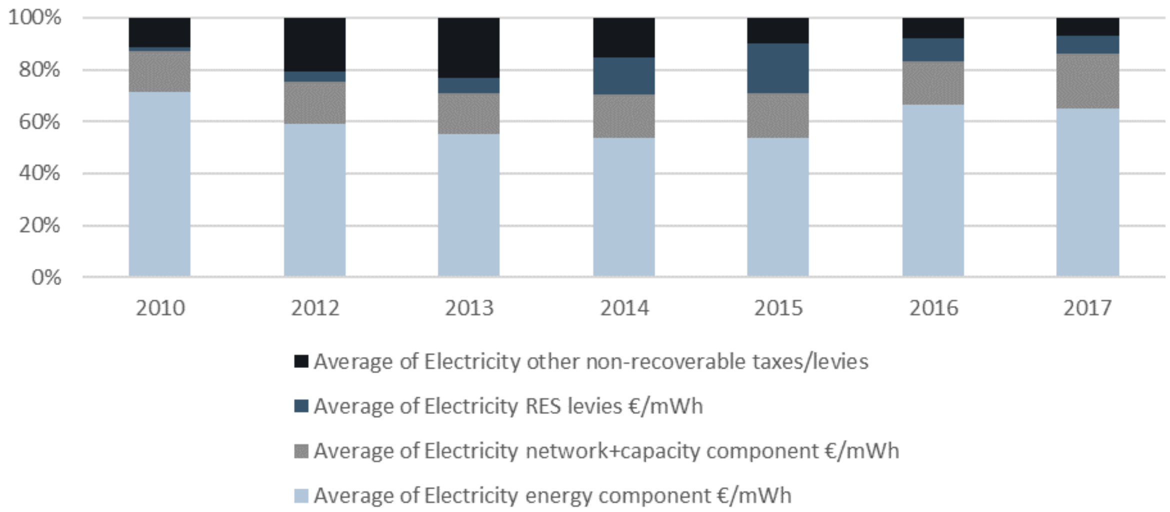
Electricity

Table 14. Key electricity indicators of downstream aluminium production (EU averages)

Indicator	2010	2012	2013	2014	2015	2016	2017
Electricity prices (€/MWh)	69.3	91.4	99.1	98.5	89.2	80.0	84.1
Electricity costs (€/MWh)	57.8	78.4	99.1	98.3	89.2	80.0	82.5
Electricity costs (€/tonne)	54.2	64.8	97.1	87.3	67.5	68.2	58.6
Electricity intensity (MWh/tonne)	1.21	1.08	1.11	1.05	0.93	1.04	0.93

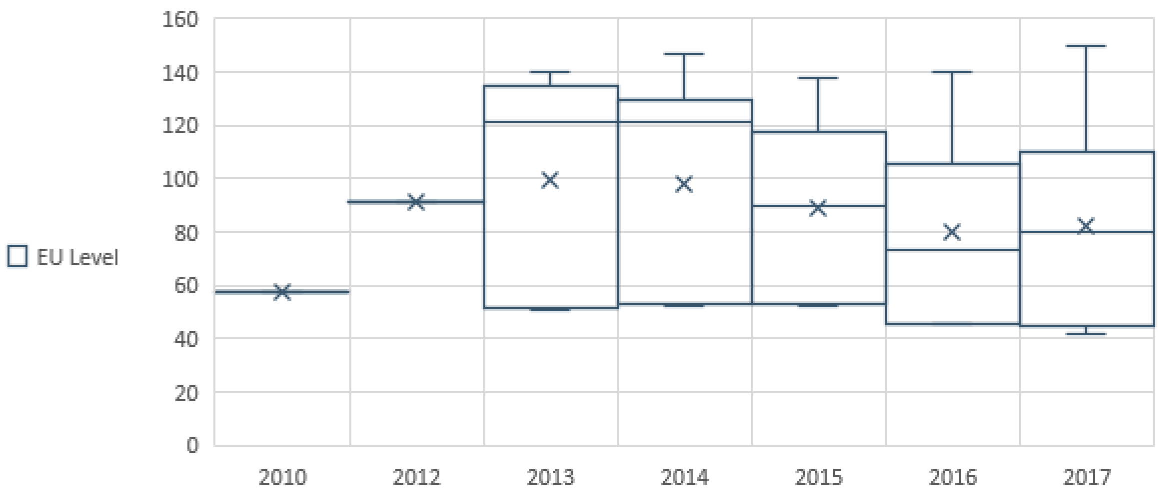
Source: CEPS/Ecofys.

Figure 37. Components of the EU average electricity price for downstream aluminium production (%)



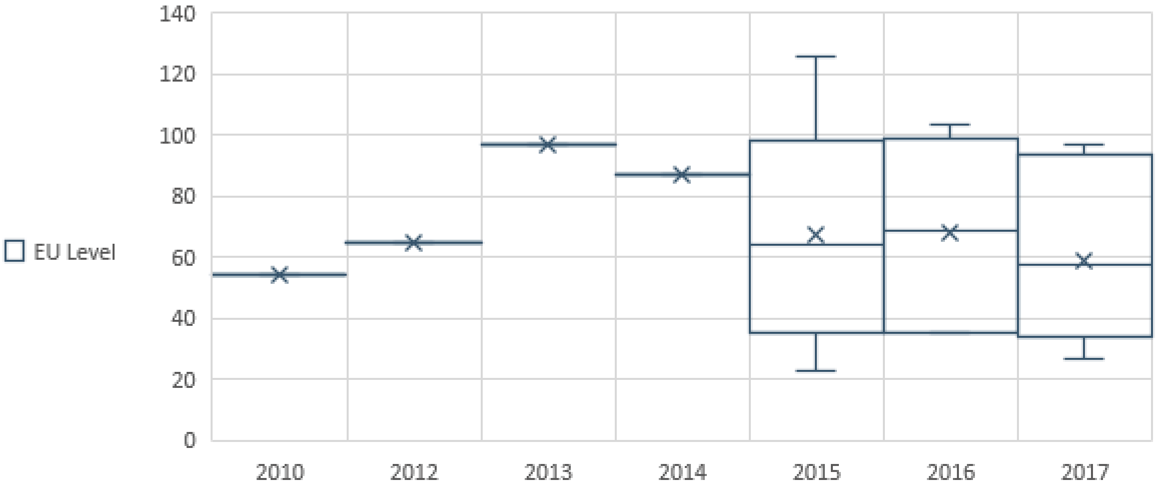
Source: CEPS/Ecofys.

Figure 38. Electricity costs of downstream aluminium production (€/MWh)



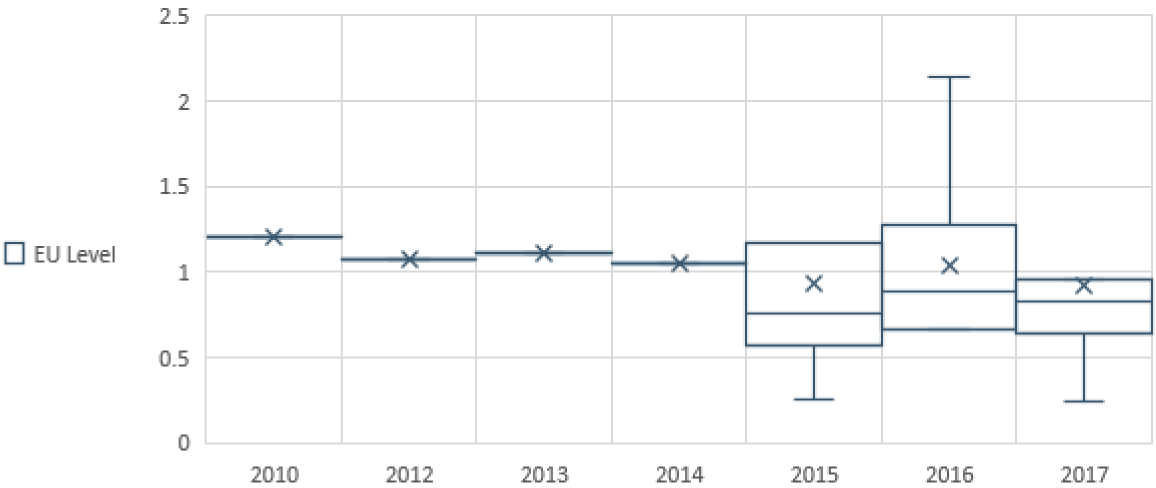
Source: CEPS/Ecofys.

Figure 39. Electricity costs of downstream aluminium production (€/tonne)



Source: CEPS/Ecofys.

Figure 40. Electricity intensity of downstream aluminium production (MWh/tonne)



Source: CEPS/Ecofys.

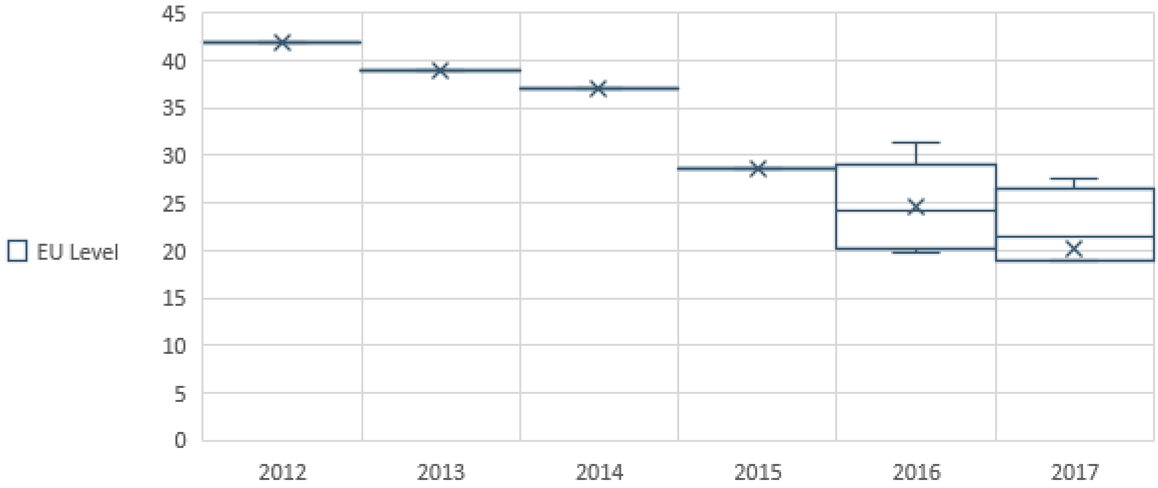
Natural gas

Table 15. Key natural gas indicators of downstream aluminium production (EU averages)

Indicator	2012	2013	2014	2015	2016	2017
Natural gas prices (€/MWh)	41.8	38.9	37.0	28.7	24.7	20.2
Natural gas costs (€/tonne)	58.6	68.8	58.3	42.0	32.2	28.0
Natural gas intensity (MWh/tonne)	1.33	1.48	1.32	1.21	1.32	1.30

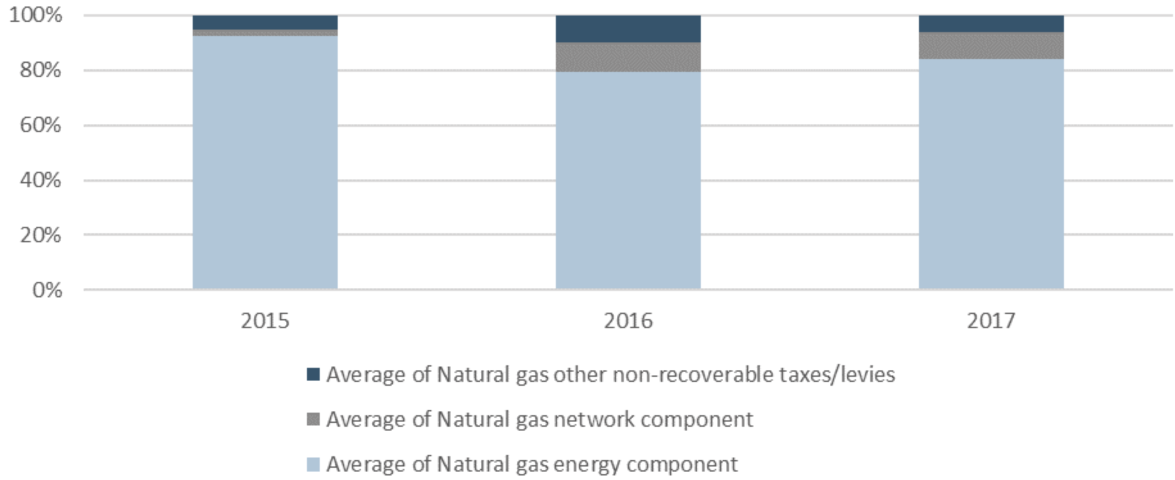
Source: CEPS/Ecofys.

Figure 41. Natural gas prices of downstream aluminium production (€/MWh)



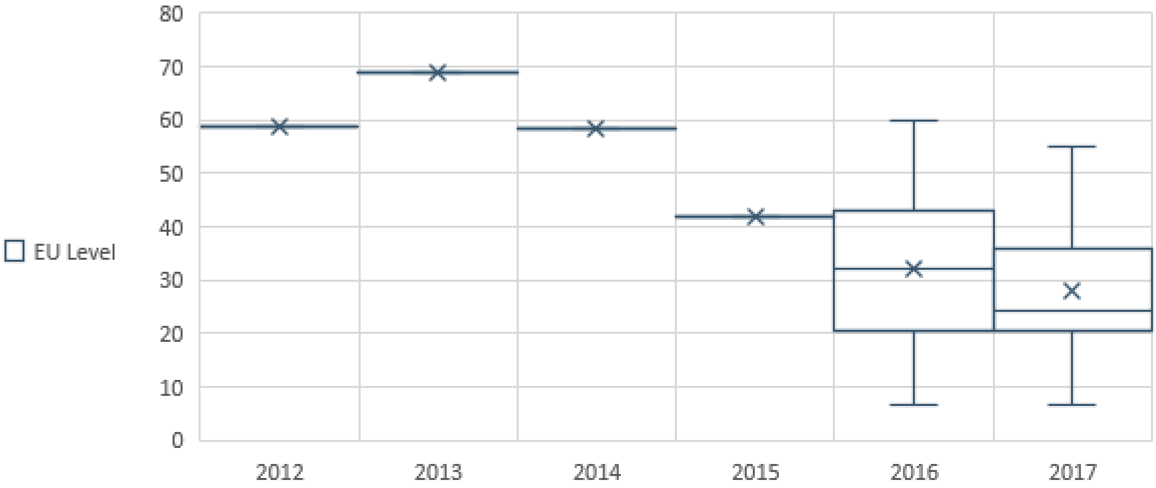
Source: CEPS/Ecofys.

Figure 42. Components of the EU average natural gas price for downstream aluminium production (%)



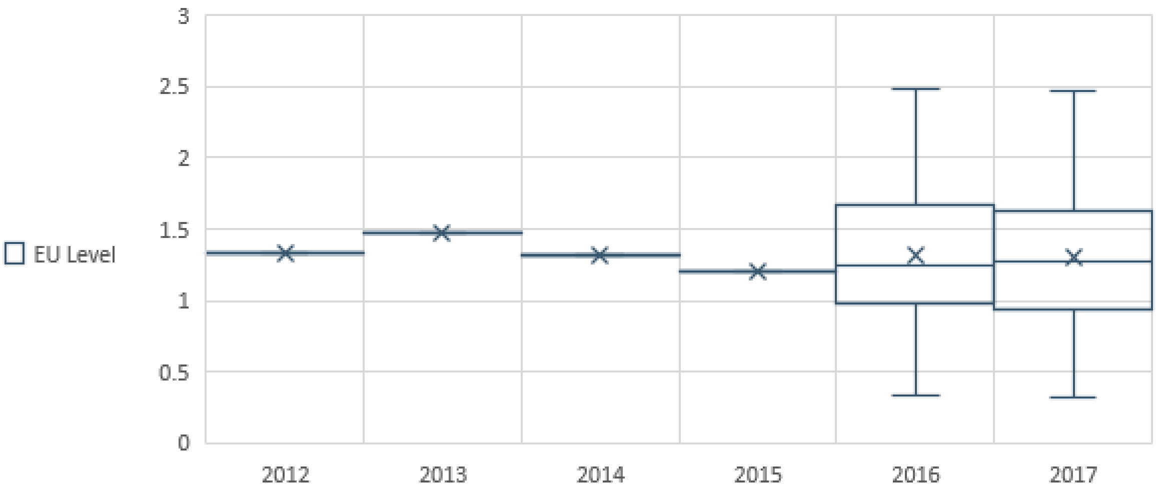
Source: CEPS/Ecofys.

Figure 43. Natural gas costs of downstream aluminium production (€/tonne)



Source: CEPS/Ecofys.

Figure 44. Natural gas intensity of downstream aluminium production (MWh/tonne)



Source: CEPS/Ecofys.

Competitiveness

Table 16. Key competitiveness indicators of downstream aluminium production (EU averages)

Indicator	2016	2017
Share of electricity costs in production costs (%)	1.3	0.9
Share of natural gas costs in production costs (%)	0.6	0.4
Share of total energy costs in production costs (%)	1.9	1.4
Total energy costs (€/tonne)	100.4	86.6

Source: CEPS/Ecofys.

A1.4 BRICKS AND ROOF TILES

A1.4.1 General information and sample composition

The bricks and roof tiles sector (sector 23.32 in NACE Rev. 2) includes manufacturers of products with diverse shapes and properties: i) building bricks, including both clay blocks and facing bricks; ii) roof tiles; iii) paving bricks; and iv) chimney bricks and other clay building products. In general, products are characterised by a low value-added and low tradability.

The most common energy source used in brick and roof tile production is natural gas. Electricity is used as a secondary energy source.

The sector, which closely follows the economic trend of the construction sector (its main customer), has been severely hit by the crisis. Its production value declined by about 25% between 2008 and 2015. In 2015, there were 1,810 brick and tile enterprises in the EU, amongst which around half are SMEs. It should be noted that the sector has gone through a consolidation phase (the number of enterprises fell by almost 35% between 2008 and 2015, which resulted in larger enterprises in terms of production value). Plants tend to be spread throughout Europe, usually near raw material extraction sites. Top five European producing countries are (based on 2016 production value): Germany (28%), the United Kingdom (20%), France (16%), Italy (10%) and Belgium (7%).

Overall, the EU is a net exporter of bricks and roof tiles. Major EU export destinations include Switzerland, Russia and Norway. EU imports come mainly from Serbia and, to a less extent, Turkey, China, Macedonia and Pakistan.

The analysis focusses on building brick and roof tile plants, which account for 96% of the sectoral output (flooring blocks and other clay construction products are marginal). These plants are homogeneous with similar production processes and products. A typical brick and roof tile plant in the analysis has a natural gas intensity of 0.31-0.86 MWh/tonne and an electricity intensity of 0.04-0.10 MWh/tonne. The sample for 2016-2017 includes 58 plants across Europe (11 in CEE region, 36 in NWE region and 11 in SE region), representing about 11% of total EU production. The sample for 2008-2015 includes 52 plants across Europe, representing 7-12% of the total EU production. In general, the CEE region tends to be slightly over-represented compared to the SE region and SMEs are under-represented in the sample.

A1.4.2 Electricity prices, costs and intensity

Key electricity indicators for bricks and roof tiles are presented in Table 17.

After recording a growing trend from 2008 to 2012, the electricity prices and costs (in EUR/MWh) borne by EU brick and roof tile producers decreased between 2012 and 2017.

EU average electricity prices rose from less than 80 EUR/MWh in 2008 to above 94 EUR/MWh in 2012 and then declined to 83 EUR/MWh in 2017. When looking at the price components (Figure 45), it appears that the energy component accounted for less than half (49%) of the price in 2017, which is comparatively lower than in any of the other sectors analysed. Conversely, the network component increased over time and represented 34% of the price in 2017. Larger consumers faced lower electricity prices (weighted average by purchased electricity is constantly below simple average), because they: i) benefitted from stronger bargaining power when negotiating electricity prices (lower energy component); and ii) paid relatively less for network costs and other non-recoverable taxes/levies (this was not the case for RES levies). Only a few plants relied on the wholesale market to purchase electricity and they did not necessarily coincide with the largest consumers.

EU average electricity costs in EUR/MWh (Figure 46) were largely aligned with electricity prices. After a peak in 2012, they sharply declined, from above 92 EUR/MWh in 2012 and 2013 to about 75 EUR/MWh in 2017. The very small difference between electricity prices and costs in EUR/MWh can be explained by the following factors: i) only a few plants participated in flexibility schemes (and the compensation they received is relatively small compared to their electricity costs); ii) only about 10% of the plants met part of their electricity demand via self-generation; and iii) whereas 20% of the plants were reimbursed *ex post* for part of their electricity price, reimbursements were small and only given in some years. EU average electricity costs in EUR/tonne (Figure 47) increased between 2008 and 2013 from less than 6 EUR/tonne to above 7 EUR/tonne, and then declined again (6 EUR/tonne in 2017). Larger producers experienced lower electricity costs (weighted average by production output is below simple average); this result can be explained by a combination of three factors: i) better bargaining power of larger electricity consumers; ii) relatively lower network costs and other non-recoverable taxes/levies; and iii) economies of scale.

EU average electricity intensity of the bricks and roof tiles sector (Figure 48) increased slightly in the last decade, from 0.07 to 0.08 MWh/tonne. Larger plants are more electricity efficient than smaller ones (weighted average – by production output – electricity intensity is constantly below simple average one).

A1.4.3 Natural gas prices, costs and intensity

Key natural gas indicators for bricks and roof tiles are presented in Table 18.

EU average natural gas prices and costs for brick and roof tile producers peaked in 2013 and then recorded a downwards trend, driven by a decrease (in absolute value) in the energy component of the gas price.

After peaking in 2013 (32 EUR/MWh), the natural gas price decreased sharply down to about 23 EUR/MWh in 2017 (Figure 49). As shown in Figure 50, the natural gas price is made up mostly by the energy component (82% in 2017), though this share tends to decrease over time. Larger consumers faced lower natural gas prices (weighted average by purchased natural gas is below simple average); in fact, they seem to pay less for the network component but not necessarily for the energy and non-recoverable taxes/levies components. Only a few plants relied on the wholesale market to purchase natural gas. There is no difference in this sector between natural gas prices and costs in EUR/MWh for two reasons: i) self-generation of natural gas is not relevant; ii) whereas 11% of the sampled plants participated in interruptibility schemes, no revenues stemmed from such schemes in the period under observation.

EU average natural gas costs (in EUR/tonne) ranged between 21 EUR/tonne in 2008 and 14 EUR/tonne in 2017 (Figure 51). Larger plants incurred lower costs (weighted average by production output is below simple average). This may be due to: i) quantity discount for larger consumers of natural gas; ii) lower network costs; and iii) economies of scale.

EU average natural gas intensity (Figure 52) was quite stable between 2008 and 2017 (ranging between 0.6 MWh/tonne and 0.7 MWh/tonne). Larger plants tend to be more natural gas efficient than smaller ones (weighted average – by production output – natural gas intensity is generally below simple average one).

A1.4.4 Competitiveness

Between 2008 and 2017, natural gas and electricity costs represented on average 14-22% and 5-9% of total production costs, respectively (Table 19). The share of total energy (natural gas + electricity) costs in production costs decreased from 28% in 2008 to 24% in 2017. Economies of scale play here a key role, as energy and total production costs per output incurred by larger plants were much lower than those experienced by smaller ones (weighted average – by production output – energy and total production costs per output are well below simple average ones, in the order of magnitude of 20%).

EBITDA per tonne declined between 2008 and 2015 and then increased in the last two years (Figure 53). We can note that energy costs are always higher than EBITDA and show an opposite pattern compared to EBITDA, which is particularly visible in the most recent years (decrease in energy costs while increase in EBIDTA). This shows the importance of energy costs and the potential direct impact it can have on margins of brick and roof tile production.

A1.4.5 Tables and graphs

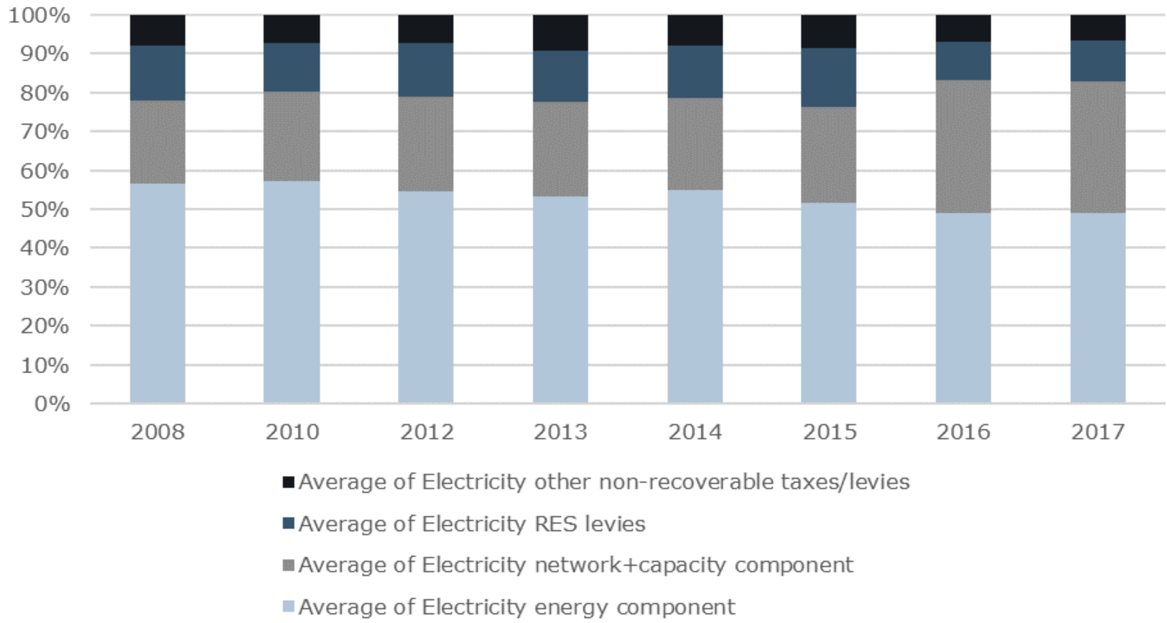
Electricity

Table 17. Key electricity indicators of brick and roof tile production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Electricity price (€/MWh)	79.0	82.2	94.3	91.7	90.4	90.1	86.3	83.1
Electricity costs (€/MWh)	77.8	80.8	92.5	92.4	89.2	88.4	79.3	75.1
Electricity costs (€/tonne)	5.9	5.4	6.7	7.1	6.9	6.5	6.2	6.0
Electricity intensity (MWh/tonne)	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08

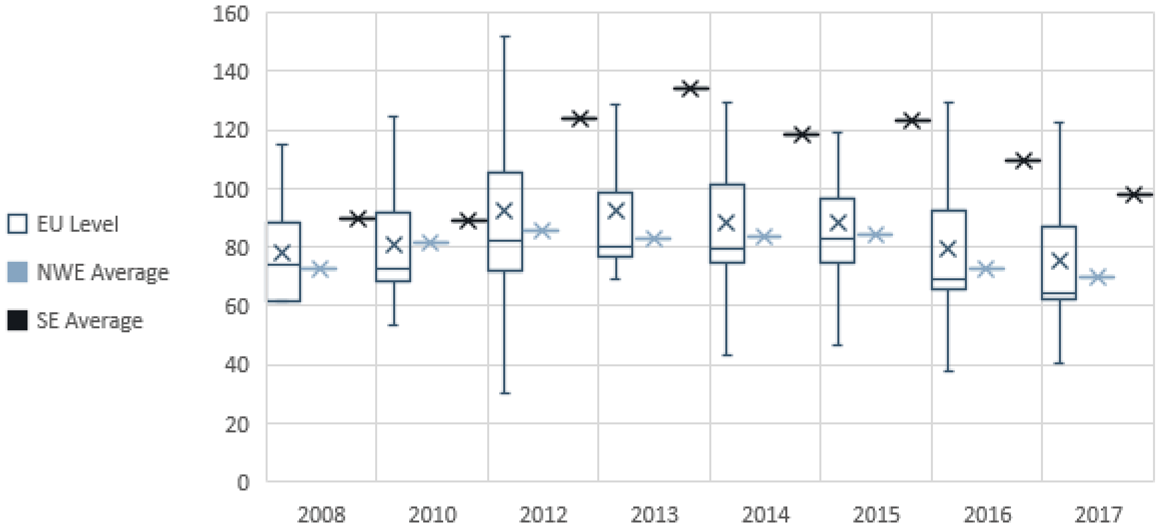
Source: CEPS/Ecofys.

Figure 45. Components of the EU average electricity price for brick and roof tile production (%)



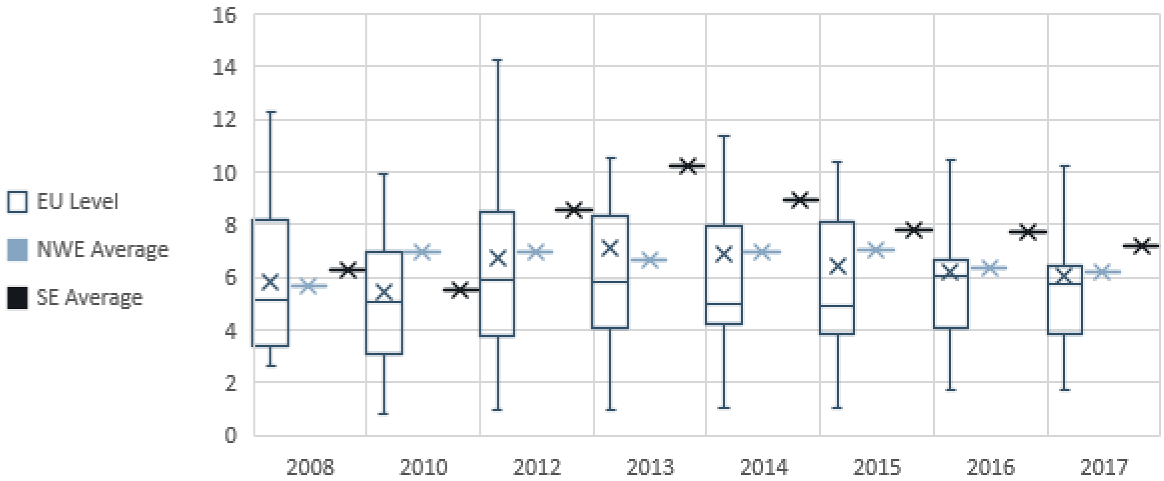
Source: CEPS/Ecofys.

Figure 46. Electricity costs of brick and roof tile production (€/MWh)



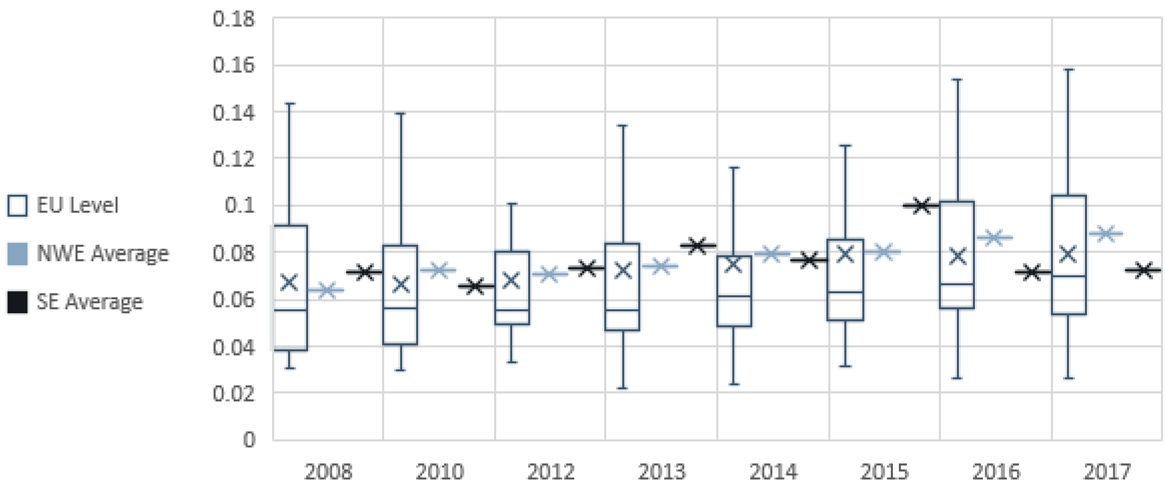
Source: CEPS/Ecofys.

Figure 47. Electricity costs of brick and roof tile production (€/tonne)



Source: CEPS/Ecofys.

Figure 48. Electricity intensity of brick and roof tile production (MWh/tonne)



Source: CEPS/Ecofys.

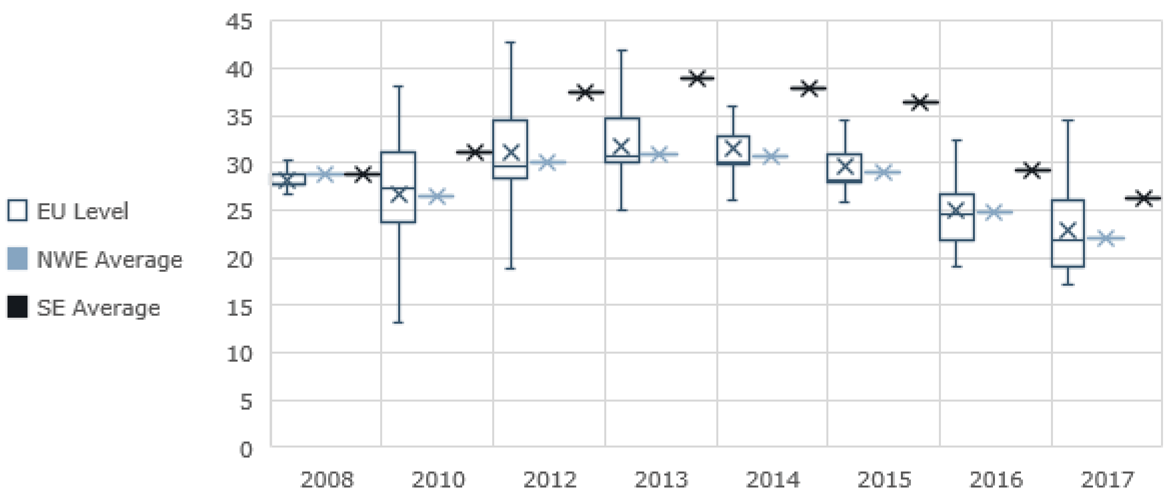
Natural gas

Table 18. Key natural gas indicators of brick and roof tile production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	28.2	26.8	31.1	31.8	31.6	29.6	25.1	22.9
Natural gas costs (€/tonne)	20.7	17.8	20.1	21.0	20.9	18.7	15.7	14.4
Natural gas intensity (MWh/tonne)	0.69	0.62	0.64	0.63	0.64	0.63	0.64	0.65

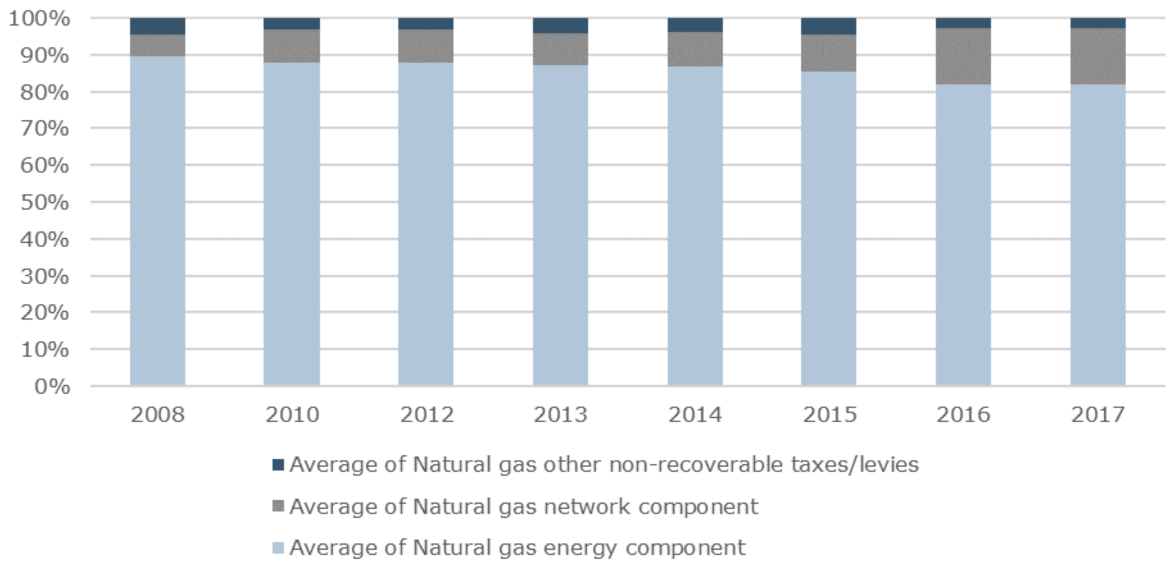
Source: CEPS/Ecofys.

Figure 49. Natural gas prices of brick and roof tile production (€/MWh)



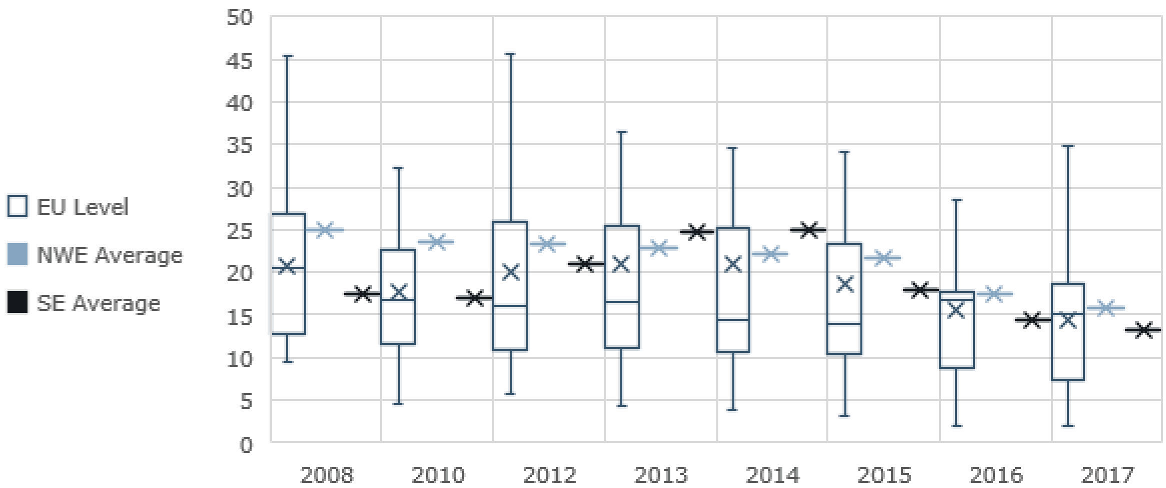
Source: CEPS/Ecofys.

Figure 50. Components of the EU average natural gas price for brick and roof tile production (%)



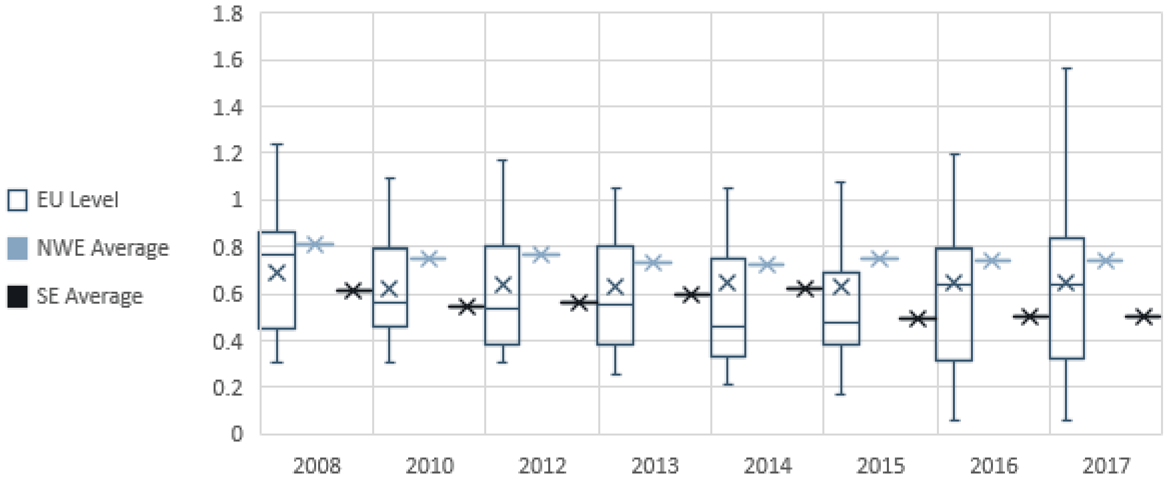
Source: CEPS/Ecofys.

Figure 51. Natural gas costs of brick and roof tile production (€/tonne)



Source: CEPS/Ecofys.

Figure 52. Natural gas intensity of brick and roof tile production (MWh/tonne)



Source: CEPS/Ecofys.

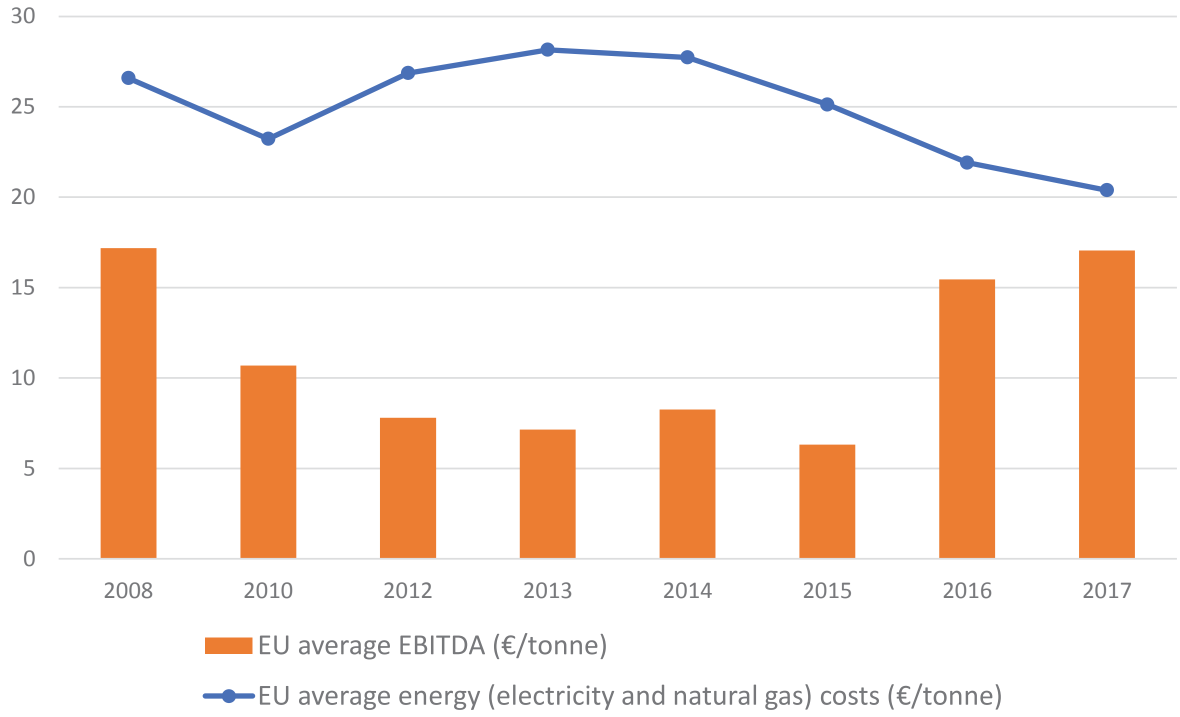
Competitiveness

Table 19. Key competitiveness indicators of brick and roof tile production (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	6.2	6.5	7.9	9.1	7.8	6.1	5.4	7.1
Share of natural gas costs in production costs (%)	21.9	21.3	23.6	27.0	23.5	17.6	13.6	17.0
Share of total energy costs in production costs (%)	28.1	27.7	31.4	36.1	31.2	23.7	19.0	24.1
Total energy costs (€/tonne)	26.6	23.2	26.9	28.2	27.7	25.1	21.9	20.4
EBITDA (€/tonne)	17.2	10.7	7.8	7.2	8.3	6.3	15.5	17.1
Ratio of total energy costs to EBITDA	1.5	2.2	3.4	3.9	3.4	4.0	1.4	1.2

Source: CEPS/Ecofys.

Figure 53. Energy costs versus EBITDA of brick and roof tile production (€/tonne)



Source: CEPS/Ecofys.

A1.5 WALL AND FLOOR TILES

A1.5.1 General information and sample composition

The wall and floor tiles sector (sector 23.31 in NACE Rev. 2) includes manufacturers of ceramics tiles. The production is heterogeneous in terms of physical composition, dimension, weight, shape, surface and colour as well as use (covering and/or decorating both internal, e.g. kitchen and bathrooms, and external surfaces, e.g. swimming pools and public areas). Unlike bricks and roof tiles, wall and floor tiles are high value-added and highly tradable goods, more subject to international competition.

The most common energy source used in wall and floor tile production is natural gas. Electricity is used as a secondary energy source.

The sector, which closely follows the economic trend of the construction sector (its main customer), has been severely hit by the crisis. Its production value declined by about 23% between 2008 and 2015. In 2015, there were 1,225 wall and floor tile enterprises in the EU, mostly SMEs (the number of enterprises fell by almost 30% between 2008 and 2015). A notable difference with the bricks and roof tiles sector is that most EU wall and floor tile production concentrates in two Member States only (based on 2016 production value): Italy (42%) and Spain (39%). Poland completes the top three (9%).

Overall, the EU is a net exporter of wall and floor tiles. Major EU export destinations include the United States, Switzerland, Saudi Arabia and Russia. EU imports come mainly from Turkey and, to a less extent, China and the United Arab Emirates.

A typical wall and floor tile plant in the analysis has a natural gas intensity of 1.1-2.3 MWh/tonne and an electricity intensity of 0.1-0.3 MWh/tonne. The sample for 2016-2017 includes 22 plants across Europe (8 in CEE region, 4 in NWE region and 10 in SE region), representing about 12% of total EU production. The sample for 2008-2015 includes 18 plants across Europe, representing about 8% of the total EU production. In general, the SE region and SMEs are under-represented in the sample.

A1.5.2 Electricity prices, costs and intensity

Key electricity indicators for wall and floor tiles are presented in Table 20.

EU average electricity prices and costs (in EUR/MWh) remained quite stable between 2008 and 2017.

EU average electricity prices fluctuated between 90 and 100 EUR/MWh. When looking at the price components (Figure 54), it appears that the energy component accounted for just half (50%) of the price in 2017, which is comparatively lower than in the other sectors analysed (except brick and roof tile production). Conversely, the network component increased over time and represented 25% of the price in 2017. Larger consumers faced lower electricity prices (weighted average by purchased electricity is significantly below simple average), because they: i) benefitted from stronger bargaining power when negotiating electricity prices (lower energy component); and ii) paid relatively less for network costs and other non-recoverable taxes/levies (this was not the case for RES levies). Only a few plants relied on the wholesale market to purchase electricity and these did not coincide with the largest consumers.

EU average electricity costs in EUR/MWh (Figure 55) went from 96 EUR/MWh in 2008 to 86 EUR/MWh in 2017, with a peak in 2013 (105 EUR/MWh). The small difference between electricity prices and costs in EUR/MWh is due to: i) compensation received by two plants only for participating in flexibility schemes; ii) ex post reimbursements granted to two other sampled plants; and ii) self-generation of electricity by five plants. It also appears that larger consumers benefitted the most from flexibility schemes, self-generation and ex post reimbursement. EU average electricity costs in EUR/tonne (Figure 56) were equal to 21 EUR/tonne in 2008 and 19 EUR/tonne in 2017 and registered a peak in 2013 (22 EUR/tonne). Plants with higher production output registered slightly lower costs per tonne (weighted average by production output is slightly lower than simple average), mainly linked to better bargaining power when negotiating the energy component of the electricity price and relatively lower network costs and other non-recoverable taxes/levies.

EU average electricity intensity of the production process (Figure 57) was quite stable throughout the period under observation, ranging between 0.21 and 0.25 MWh/tonne. In addition, economies of scale play a limited role for electricity (difference between simple and weighted average – by production output – electricity intensity is very limited).

A1.5.3 Natural gas prices, costs and intensity

Key natural gas indicators for wall and floor tiles are presented in Table 21.

Natural gas prices and costs fluctuated throughout the period under observation, declining significantly in 2016 and 2017 owing to a decrease (in absolute value) in the energy component of the gas price.

After peaking in 2013 (33 EUR/MWh), EU average natural gas prices (Figure 58) decreased sharply down to about 22 EUR/MWh (in 2017). As shown in Figure 59, the natural gas price is made up mostly by the energy component (81% in 2017), though this share tends to decrease over time. Unlike in the bricks and roof tiles sector, larger consumers did not face lower natural gas prices. Only a few plants relied on the wholesale market to purchase natural gas. Given that there is no natural gas self-generation and only few plants participated in interruptibility schemes, with very limited compensation compared to total natural gas costs, it results that natural gas prices and costs in EUR/MWh are the same.

EU average natural gas costs (in EUR/tonne) ranged between 36 and 51 EUR/tonne between 2008 and 2017 (Figure 60). They decreased sharply to less than 40 EUR/tonne in 2016 and 2017. It should be noted that larger plants actually incurred higher costs (weighted average by production output is slightly above simple average), which indicates that natural gas costs were mostly affected by plant-specific features (e.g. the type of output produced) rather than by economies of scale and/or bargaining power of larger consumers.

EU average natural gas intensity in the wall and floor tiles sector (Figure 61) decreased over the 10 years, declining from 1.8 MWh/tonne in 2008 to 1.6 MWh/tonne in 2017 (apparent efficiency gain of 14% over 10 years). We do not observe any difference between smaller and larger producers in terms or natural gas intensity (no economies of scale linked to natural gas usage in this sector).

A1.5.4 Competitiveness

Between 2008 and 2017, natural gas and electricity costs represented 7-17% and 4-7% of total production costs, respectively (Table 22). The share of total energy (natural gas + electricity) costs in production costs decreased from 25% in 2008 to 11% in 2017. This sharp decrease results from the fact that in absolute terms production costs per output followed a rising trend (+77%) whereas energy costs per output decreased (-23%) over the period. One key feature of this sector is that economies of scale play a limited role. Indeed the size of the wall and floor tile producers does not influence their energy costs per output (simple and weighted – by production output – averages are the same), whereas larger producers actually incur higher total production costs per output (weighted average by production output is higher than simple average). The output produced is quite diverse in this sector, leading to plant specific costs, which at the end may explain this counterintuitive result.

It is not possible to draw conclusions on the impact of electricity and natural gas costs on profitability. We can observe a sharp increase in EBITDA in 2016 and 2017 (Figure 62), but this margin increase is partially influenced by the different composition of the sample in those years compared to the 2008-2015 period. It is worth emphasising that except between 2015-2017, energy costs were higher than EBITDA, which shows the importance of energy costs in this sector as regards competitiveness issues.

A1.5.5 Tables and graphs

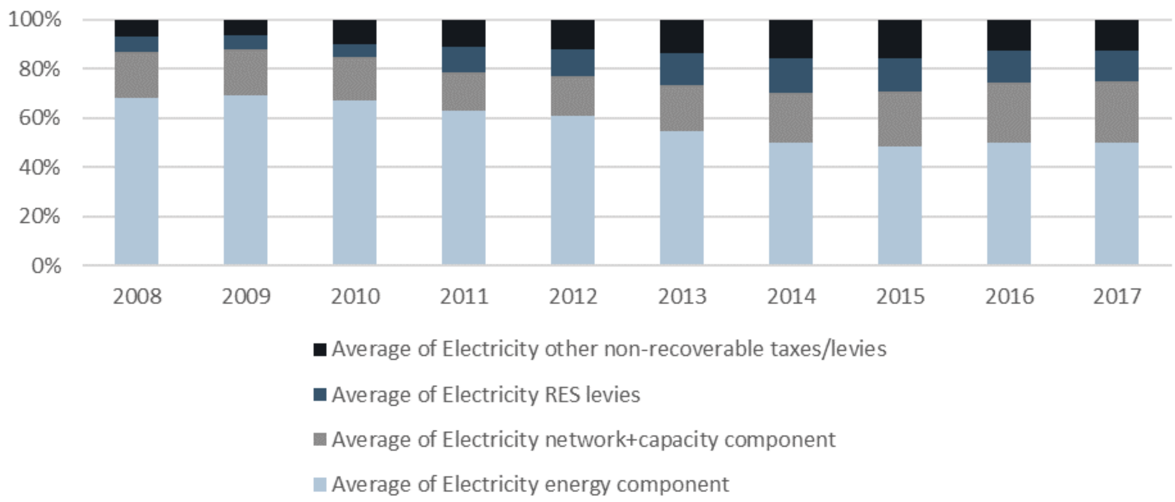
Electricity

Table 20. Key electricity indicators of wall and floor tile production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricity price (€/MWh)	67.4	68.9	67.9	91.7	83.1	77.1	69.7	72.0	66.5	69.3
Electricity costs (€/MWh)	64.0	67.9	66.3	73.4	70.0	75.0	65.2	64.7	60.3	65.2
Electricity costs (€/tonne)	12.0	12.1	11.1	12.3	11.8	13.4	11.3	11.0	11.4	10.7
Electricity intensity (MWh/tonne)	0.19	0.18	0.17	0.17	0.17	0.18	0.17	0.17	0.19	0.18

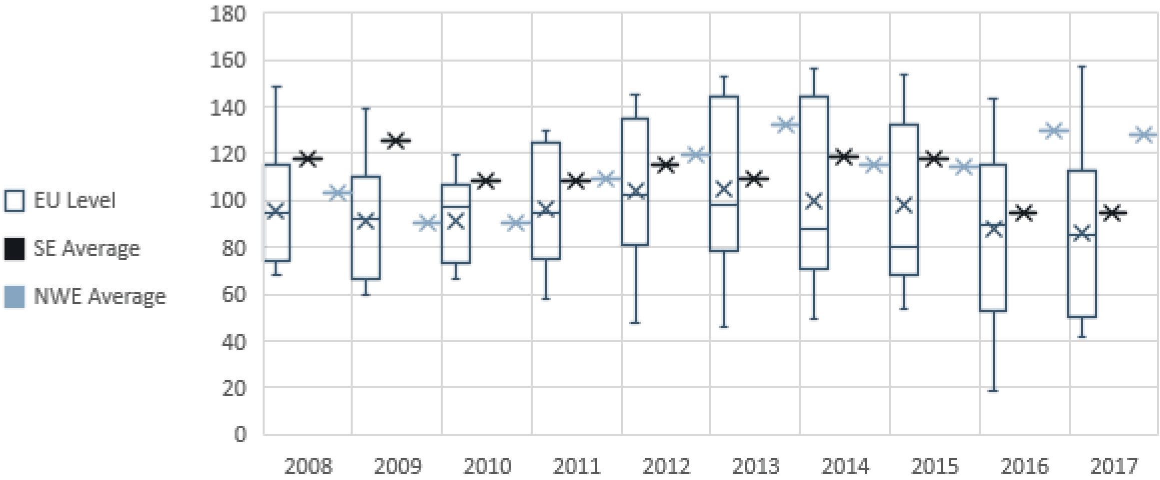
Source: CEPS/Ecofys.

Figure 54. Components of the EU average electricity price for wall and floor tile production (%)



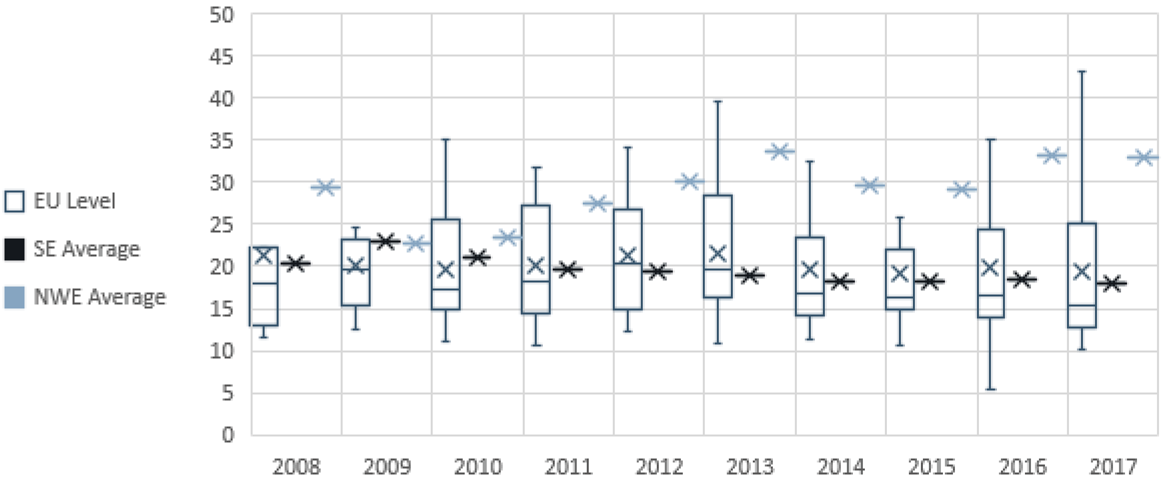
Source: CEPS/Ecofys.

Figure 55. Electricity costs of wall and floor tile production (€/MWh)



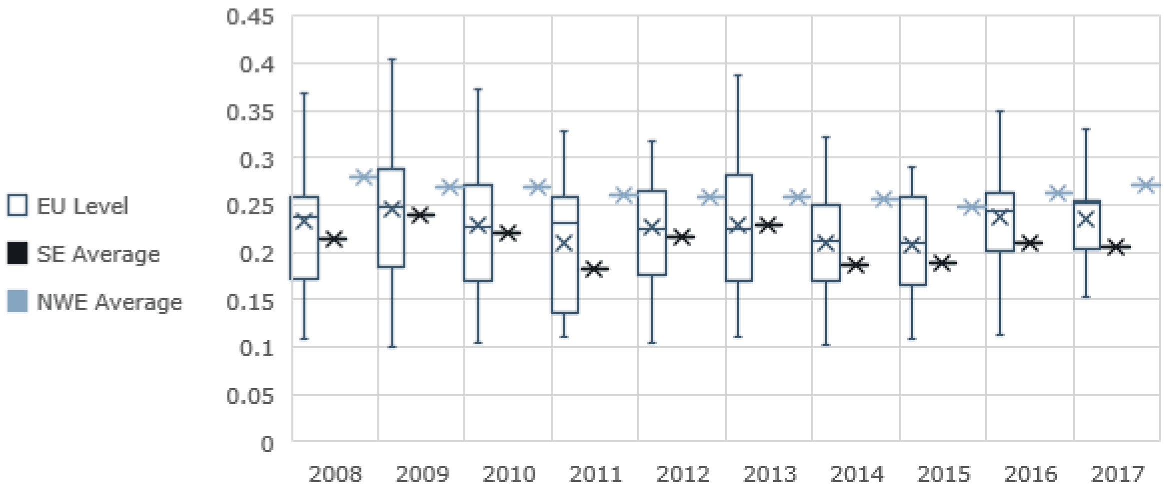
Source: CEPS/Ecofys.

Figure 56. Electricity costs of wall and floor tile production (€/tonne)



Source: CEPS/Ecofys.

Figure 57. Electricity intensity of wall and floor tile production (MWh/tonne)



Source: CEPS/Ecofys.

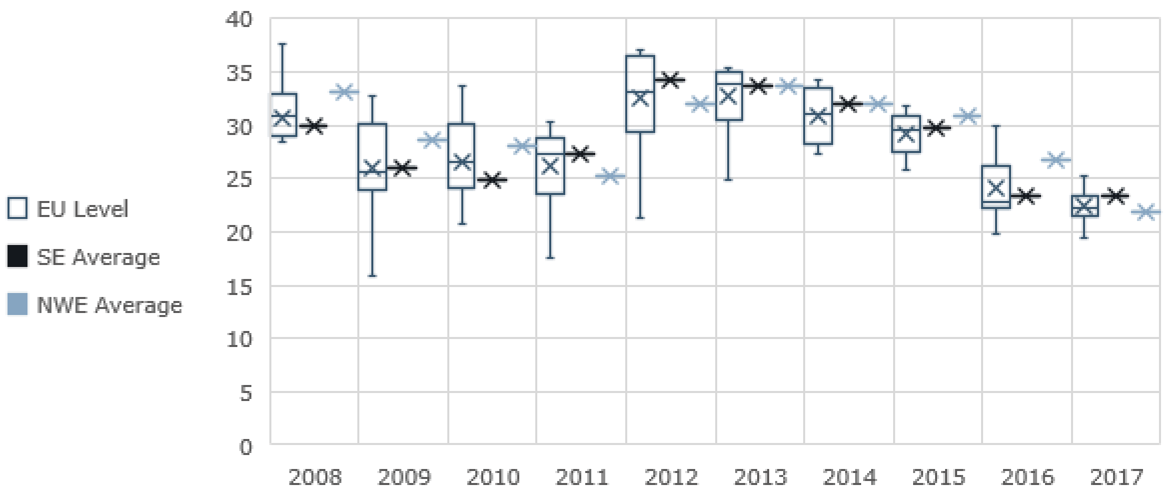
Natural gas

Table 21. Key natural gas indicators of wall and floor tile production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	30.7	26.1	26.5	26.1	32.5	32.7	30.9	29.2	24.1	22.4
Natural gas costs (€/tonne)	50.7	41.8	42.4	39.9	48.8	47.8	45.0	42.2	39.5	36.1
Natural gas intensity (MWh/tonne)	1.82	1.75	1.66	1.72	1.63	1.58	1.50	1.48	1.59	1.57

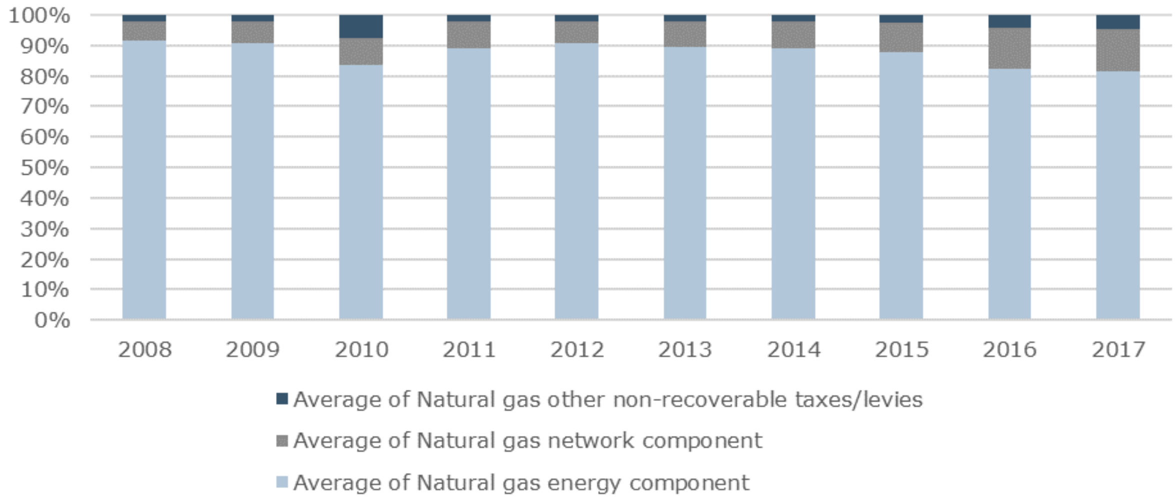
Source: CEPS/Ecofys.

Figure 58. Natural gas prices of wall and floor tile production (€/MWh)



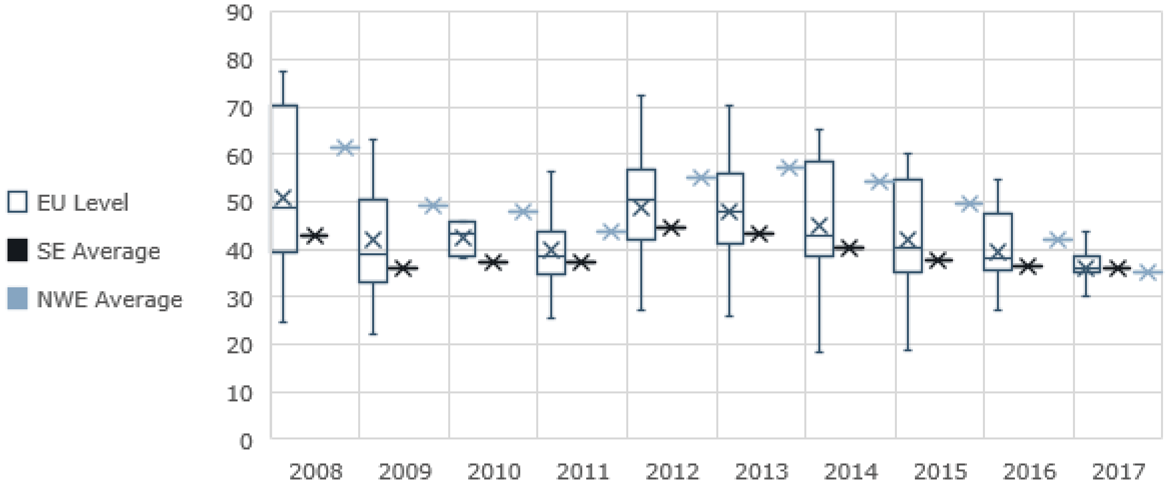
Source: CEPS/Ecofys.

Figure 59. Components of the EU average natural gas price for wall and floor tile production (%)



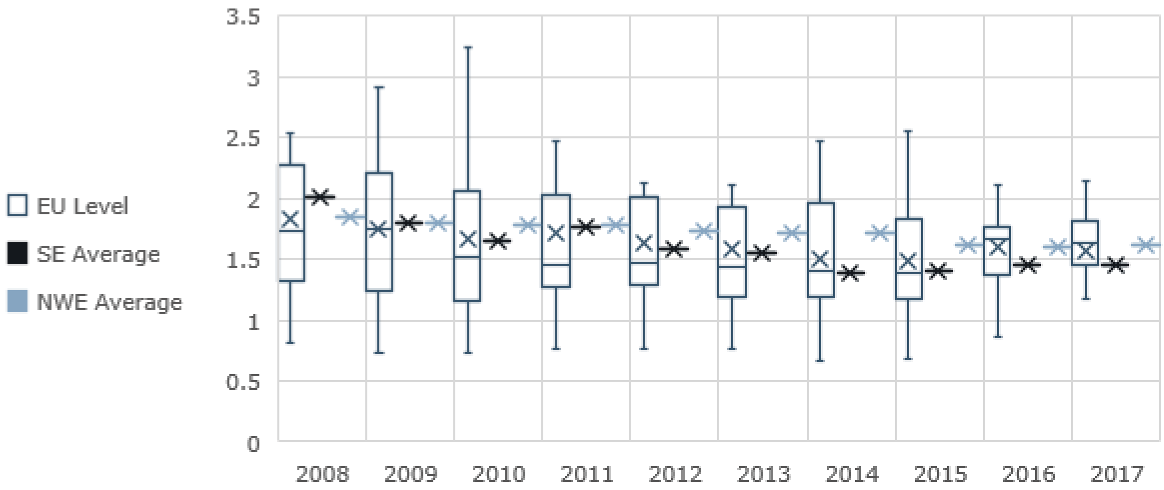
Source: CEPS/Ecofys.

Figure 60. Natural gas costs of wall and floor tile production (€/tonne)



Source: CEPS/Ecofys.

Figure 61. Natural gas intensity of wall and floor tile production (MWh/tonne)



Source: CEPS/Ecofys.

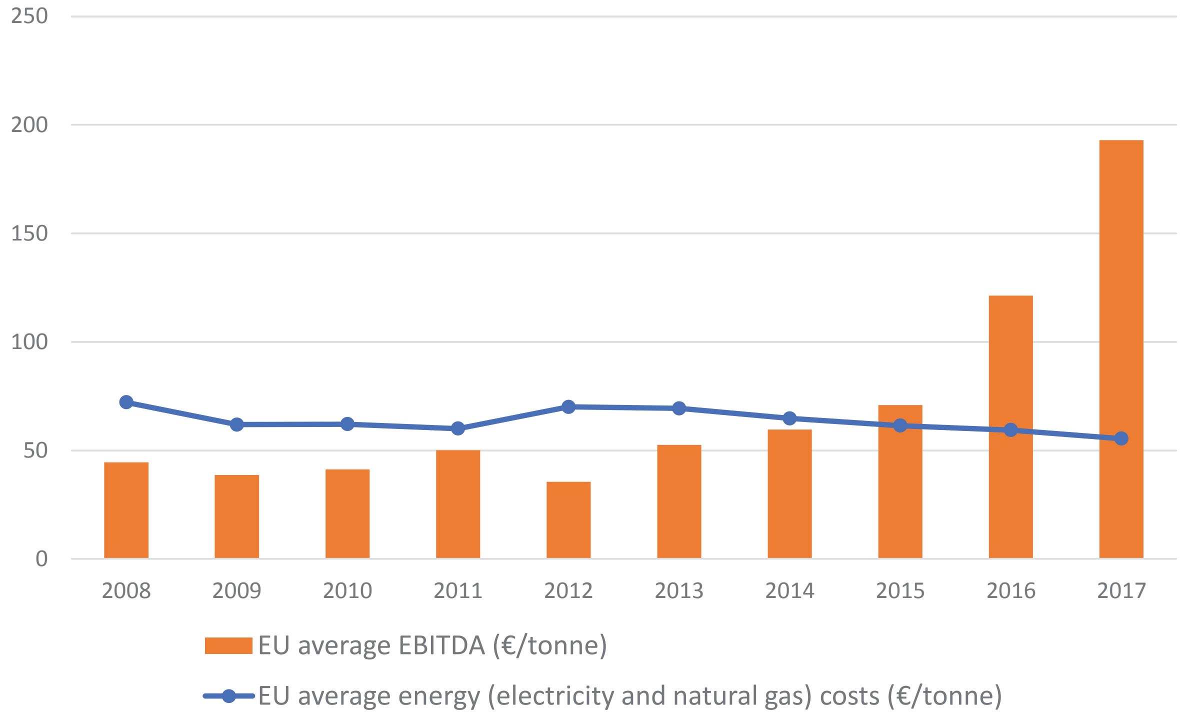
Competitiveness

Table 22. Key competitiveness indicators of wall and floor tile production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	7.3	5.4	6.9	6.3	6.4	7.0	6.3	6.1	5.2	3.8
Share of natural gas costs in production costs (%)	17.4	11.2	14.8	12.4	14.6	15.4	14.4	13.3	10.4	7.0
Share of total energy costs in production costs (%)	24.7	16.6	21.6	18.7	21.0	22.4	20.7	19.4	15.6	10.8
Total energy costs (€/tonne)	72.1	61.9	62.1	60.0	70.0	69.3	64.8	61.4	59.4	55.4
EBITDA (€/tonne)	44.5	38.7	41.2	50.1	35.5	52.6	59.7	70.8	121.4	192.9
Ratio of total energy costs to EBITDA	1.6	1.6	1.5	1.2	2.0	1.3	1.1	0.9	0.5	0.3

Source: CEPS/Ecofys.

Figure 62. Energy costs versus EBITDA of wall and floor tile production (€/tonne)



Source: CEPS/Ecofys.

A1.6 GLASS TABLEWARE

A1.6.1 General information and sample composition

Glass tableware, as packaging glass, is part of the hollow glass sector (sector 23.13 in NACE Rev. 2). Glass tableware production is quite heterogeneous: it includes a large variety of products (e.g. drinking glasses, pitchers, jugs, bowls, dishes, etc.), different qualities of products (e.g. champagne flute versus standard water glassware) and different types of production plants (small plants focusing on high value added products versus large plants focusing on mass production). It should be noted that glass tableware, in general, has a much higher value-to-weight ratio and is much more tradable than packaging glass.

The sector uses both electricity and natural gas as energy sources.

Unlike packaging glass, glass tableware production is still far from the pre-crisis level. After the 2009 crisis, it additionally registered a contraction between 2012 and 2015 and just started to partially recover in 2016. In 2015, there were 35 glass tableware plants, mostly part of large companies owning one or more production sites in the EU. Top five European producing countries are (based on 2016 production value): Italy (32%), France (17%), Poland (16%), Czech Republic (12%) and Spain (10%).

Overall, the EU is a net exporter of glass tableware. Major EU export destinations include the United States, Russia, China, Switzerland and Japan. EU imports come mostly from China and, to a less extent, Turkey.

A typical glass tableware plant in the analysis shows electricity and natural gas intensities in the range of 0.6-3.9 MWh/tonne and 3.4.-7.6 MWh/tonne, respectively. The sample includes 12 plants across Europe (two in CEE region, four in NWE region and six in SE region), representing more than 90% of total EU production (2016).

A1.6.2 Electricity prices, costs and intensity

Key electricity indicators for glass tableware are presented in Table 23.

Electricity prices and costs in EUR/MWh increased between 2008 and 2017, mainly due to a rise (in absolute value) in network costs and RES levies.

EU average electricity prices rose from 72 EUR/MWh in 2008 to 91 EUR/MWh in 2017, with a peak in 2013 (100 EUR/MWh). When looking at the price components (Figure 63), the energy component still represents the highest share of the price (59% in 2017), though this share has decreased over time. In contrast, network costs and RES levies significantly increased over the period, both in relative and absolute terms (they accounted in 2017 for 28% and 11% of the price, respectively). It is striking that in most recent years larger consumers faced much lower electricity prices (weighted average by purchased electricity is well below simple average) by: i) benefitting from stronger bargaining power when negotiating electricity prices (lower energy component); and ii) paying relatively less for network costs and non-recoverable taxes/levies, including RES levies. This gap between large consumers and small consumers increased recently, most likely because the former benefitted from larger exemptions on regulatory components than in previous years. Very few plants relied on the wholesale market to purchase electricity.

EU average electricity costs in EUR/MWh (Figure 64) increased from 69 EUR/MWh in 2008 to 85 EUR/MWh in 2017, with a peak in 2013 (99 EUR/MWh). The difference between electricity prices and costs in EUR/MWh can be explained by the following factors: i) a few plants participated in flexibility schemes (but the compensation is relatively small compared to their electricity costs); and ii) most of the plants were reimbursed ex post for some components of their electricity price (especially RES levies). There is not electricity self-generation in the sector. EU average electricity costs in EUR/tonne (Figure 65) halved over the last ten years, going from 205 EUR/tonne in 2008 to 108 EUR/tonne in 2017.

The sharp decrease in energy costs can be mainly explained by the significant reduction of electricity intensity (especially in smaller plants). EU average electricity intensity (Figure 66) fell from 2.1 MWh/tonne in 2008 to 1.3 MWh/tonne in 2017. It interesting to note that especially in this sector, besides facing lower electricity prices, larger producers were more electricity efficient (weighted average – by production output – electricity intensity is significantly below simple average one) by benefitting from economies of scale and not using electric heated/boosted furnaces (while smaller plants did).

A1.6.3 Natural gas prices, costs and intensity

Key natural gas indicators for glass tableware are presented in Table 24.

Natural gas prices and costs fluctuated between 2008 and 2015, before registering a sharp decline in 2016 and 2017, mainly due to a decrease (in absolute value) in the energy component of the gas price.

After peaking in 2013 (32 EUR/MWh), EU average natural gas prices (Figure 67) decreased sharply down to about 22 EUR/MWh (2017). As shown in Figure 68, the natural gas price is made up mostly by the energy component (90% in 2017), the remaining coming from the network component (non-recoverable taxes/levies play here a very minor role). Overall, larger plants tend to face lower natural gas prices (weighted average by purchased natural gas is generally below simple average), mostly because they paid relatively lower network costs and non-recoverable taxes/levies. But the natural gas price difference between larger and smaller plants is much less pronounced than in the case of electricity (quantity discounts and exemptions on regulatory components are less relevant for natural gas). Plants generally do not buy natural gas on the wholesale market. Natural gas costs in EUR/MWh are the same as prices (no natural gas self-generation and no plant taking part in interruptibility schemes).

EU average natural gas costs (in EUR/tonne) ranged between 144 and 170 EUR/tonne between 2008 and 2015 (Figure 69). They decreased in recent years, falling to around 130 EUR/tonne in 2016 and 2017. Larger plants incurred significant lower costs (weighted average by production output is well below simple average), which can be mainly due to economies of scale (quantity discounts and exemptions seem to play a minor role here).

EU average natural gas intensity (Figure 70) ranged between 5 and 6 MWh/tonne over the last ten years. We can see a growing trend from 2013 but this can be attributed to a switch from electricity to natural gas. When considering the overall energy (electricity + natural gas) consumption, the energy intensity of the production process actually decreased between 2008 and 2017, from about 8 MWh/tonne to about 7 MWh/tonne. It should also be noted that larger plants are more natural gas efficient (weighted average – by production output – natural gas intensity is below simple average one).

A1.6.4 Competitiveness

As shown in Table 25, over the period, the share of electricity costs in total production costs declined, from 9% (2008) to about 6% (2017), while the share of natural gas costs in total production costs increased from around 7% (2008) to about 8% (2017). Overall, the share of total energy (electricity + natural gas) costs in production costs slightly decreased from 16% in 2008 to 14% in 2017.

It is not possible to draw conclusions on the impact of electricity and natural gas costs on profitability. As shown in Figure 71, in absolute terms, EU average energy costs per tonne decreased significantly over the period, from 354 EUR/tonne (2008) to 235 EUR/tonne (2017), while EU average EBITDA per tonne was very volatile (range of 78-278 EUR/tonne), including some bad years (2009, 2015 and 2016) and better years (e.g. 2010 and 2011). It is still worth underlining that energy costs were always higher than EBITDA, which confirms the importance of energy costs in this sector as regards competitiveness issues.

A1.6.5 Tables and graphs

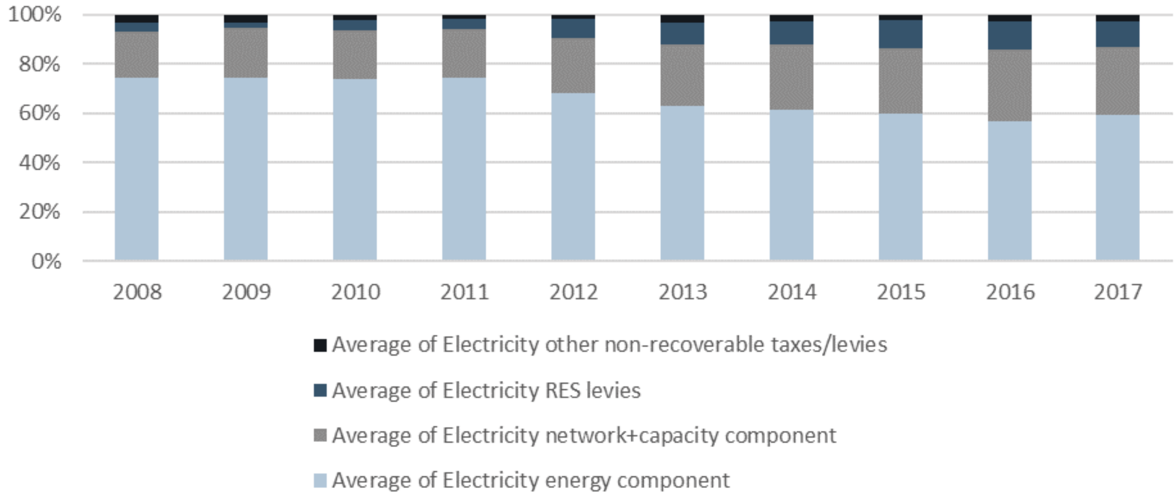
Electricity

Table 23. Key electricity indicators of glass tableware production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricity price (€/MWh)	71.5	77.7	79.3	83.1	94.4	100.1	97.4	96.6	92.4	91.3
Electricity costs (€/MWh)	69.2	76.2	77.7	81.8	93.2	98.9	92.6	90.1	85.8	85.1
Electricity costs (€/tonne)	204.8	203.2	140.8	140.9	161.4	152.3	119.4	120.4	108.5	107.7
Electricity intensity (MWh/tonne)	2.1	2.3	1.7	1.7	1.7	1.5	1.3	1.4	1.3	1.3

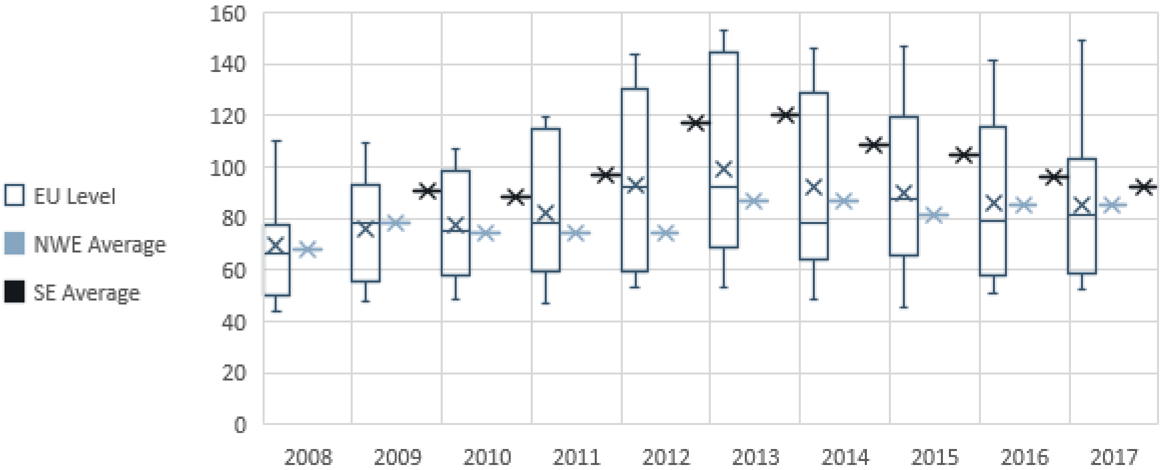
Source: CEPS/Ecofys.

Figure 63. Components of the EU average electricity price for glass tableware production (%)



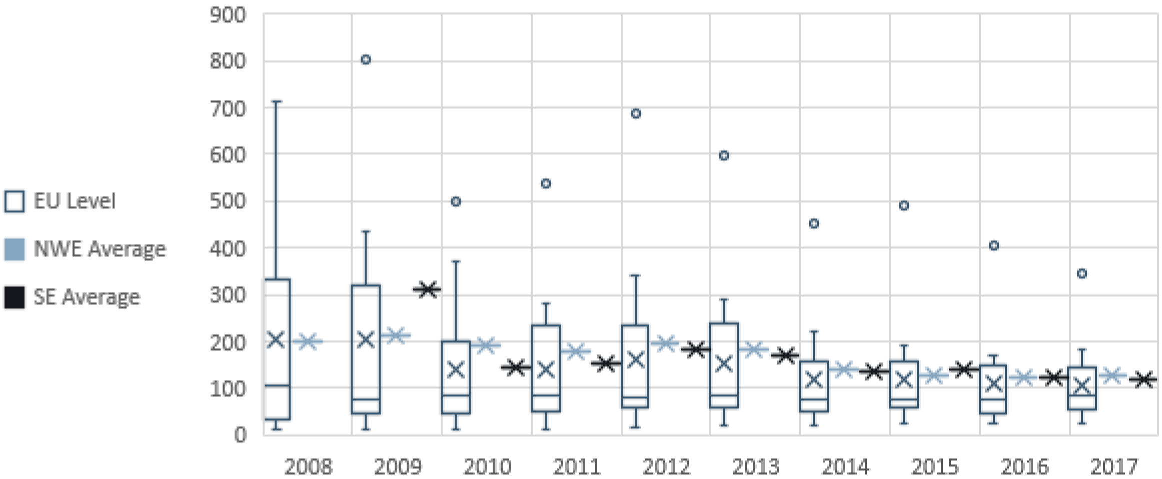
Source: CEPS/Ecofys.

Figure 64. Electricity costs of glass tableware production (€/MWh)



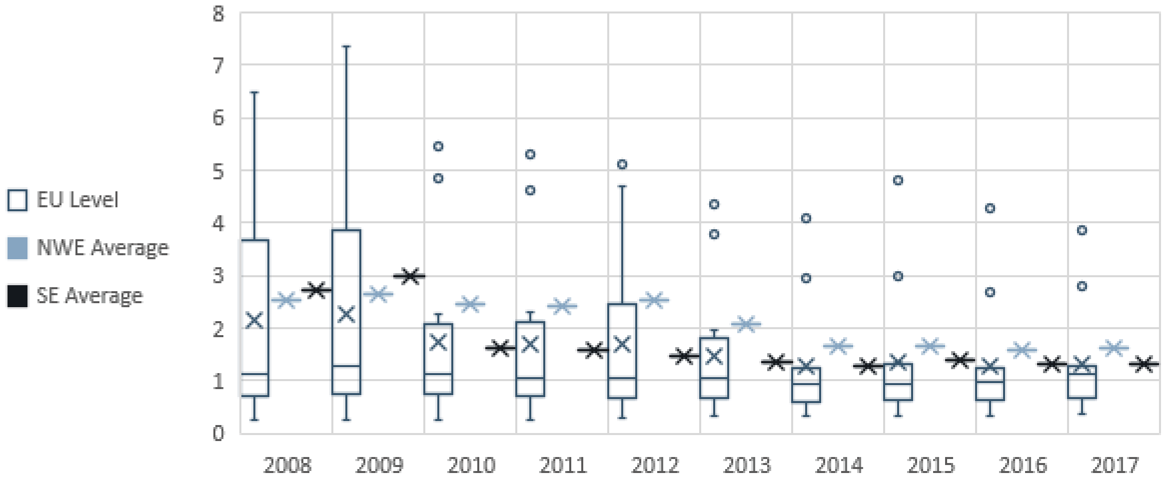
Source: CEPS/Ecofys.

Figure 65. Electricity costs of glass tableware production (€/tonne)



Source: CEPS/Ecofys.

Figure 66. Electricity intensity of glass tableware production (MWh/tonne)



Source: CEPS/Ecofys.

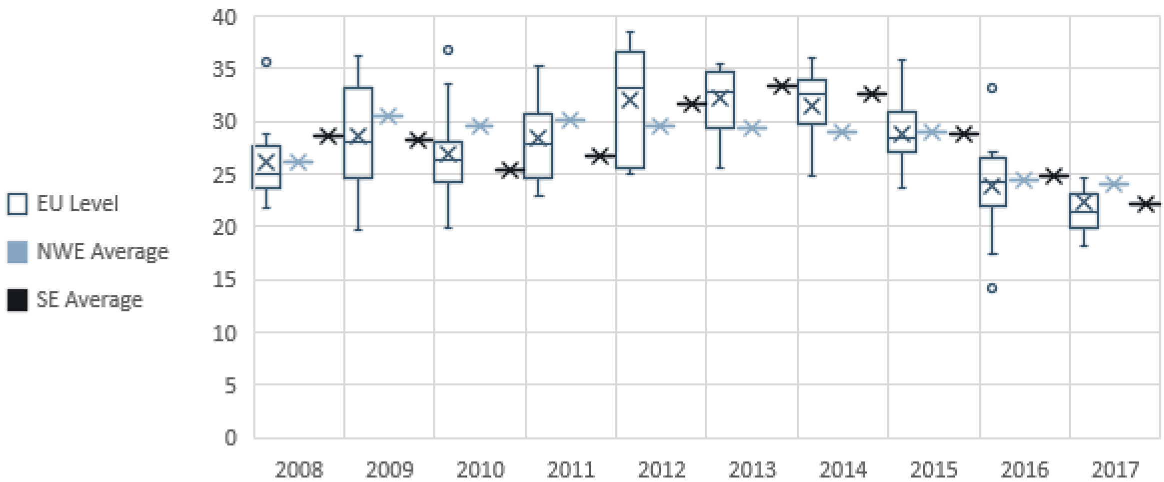
Natural gas

Table 24. Key natural gas indicators of glass tableware production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	26.2	28.6	26.9	28.4	32.0	32.2	31.5	28.7	23.8	22.3
Natural gas costs (€/tonne)	149.7	170.5	144.1	146.0	162.7	163.4	168.8	159.9	131.9	127.5
Natural gas intensity (MWh/tonne)	5.6	6.2	5.5	5.2	5.2	5.1	5.4	5.5	5.3	5.5

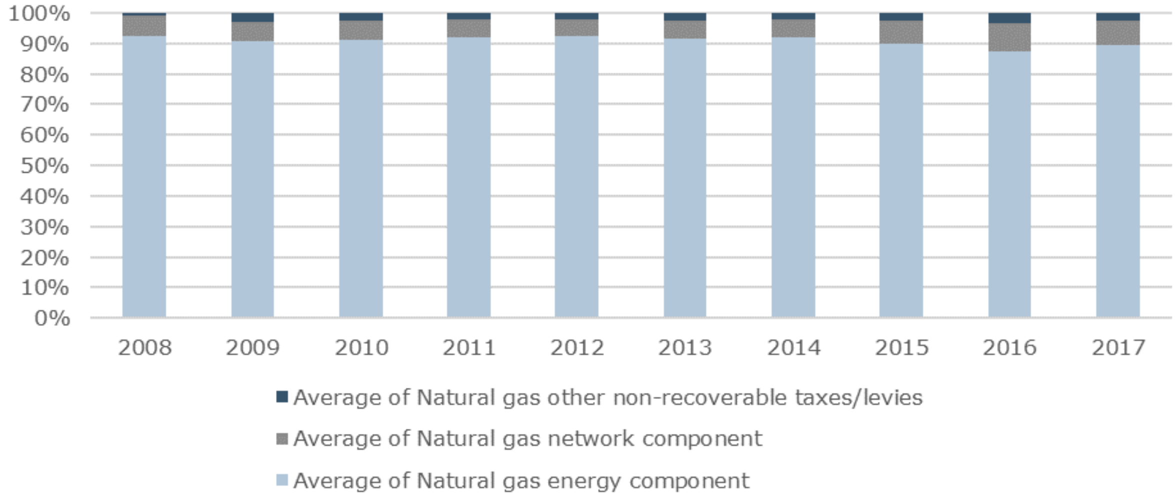
Source: CEPS/Ecofys.

Figure 67. Natural gas prices of glass tableware production (€/MWh)



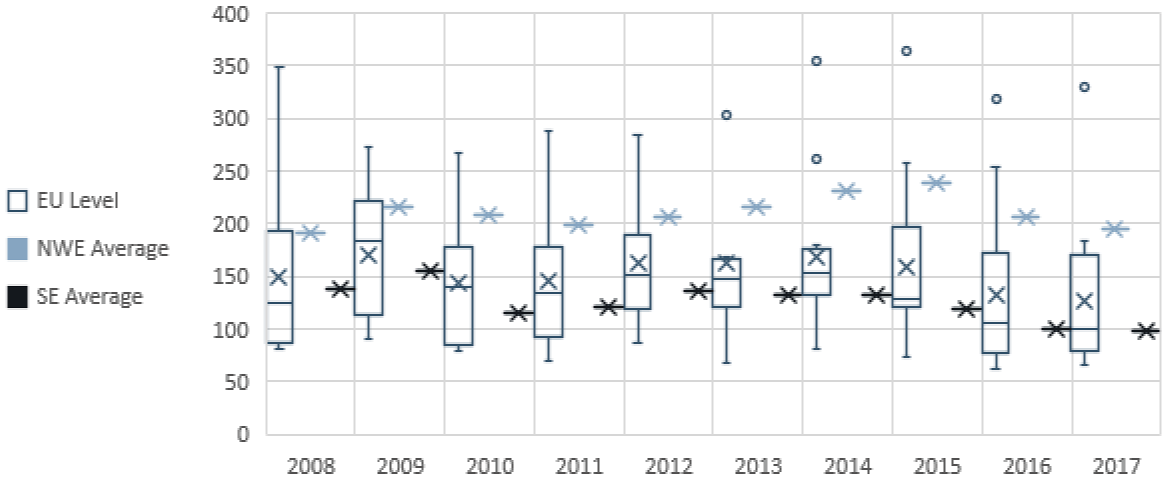
Source: CEPS/Ecofys.

Figure 68. Components of the EU average natural gas price for glass tableware production (%)



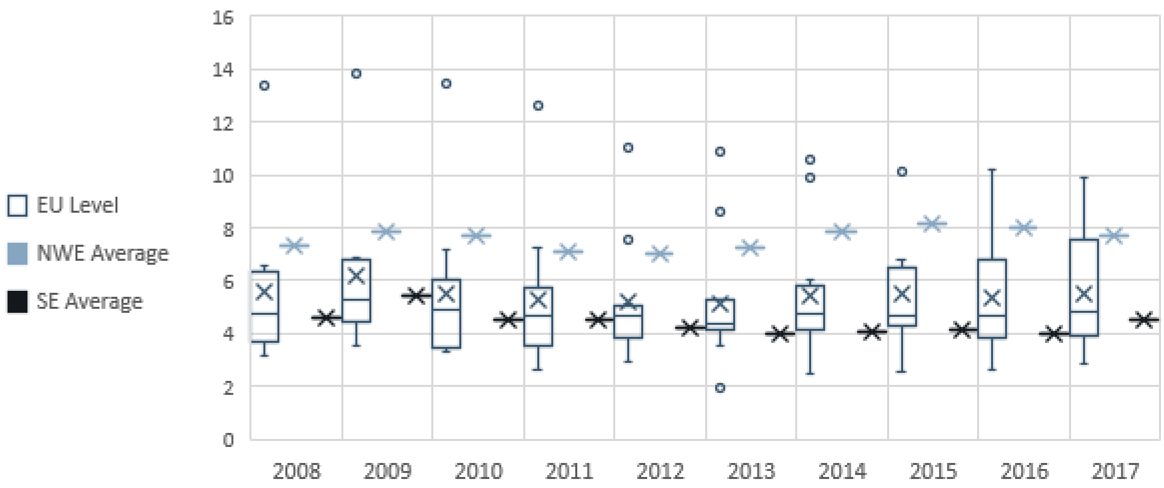
Source: CEPS/Ecofys.

Figure 69. Natural gas costs of glass tableware production (€/tonne)



Source: CEPS/Ecofys.

Figure 70. Natural gas intensity of glass tableware production (MWh/tonne)



Source: CEPS/Ecofys.

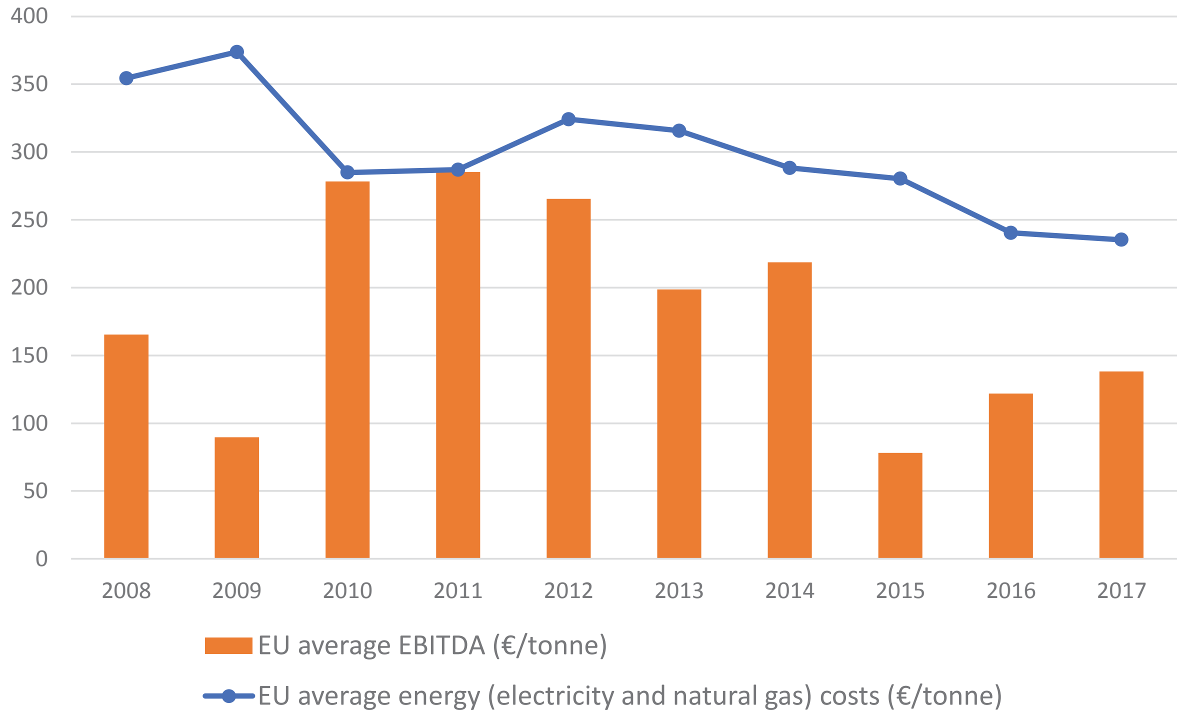
Competitiveness

Table 25. Key competitiveness indicators of glass tableware production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	9.3	8.6	6.2	6.8	7.2	7.8	6.7	6.4	6.2	6.5
Share of natural gas costs in production costs (%)	6.8	7.2	6.3	7.0	7.3	8.3	9.4	8.5	7.5	7.7
Share of total energy costs in production costs (%)	16.1	15.8	12.5	13.8	14.5	16.1	16.1	14.8	13.7	14.2
Total energy costs (€/tonne)	354.4	373.7	284.9	286.9	324.1	315.7	288.2	280.3	240.4	235.2
EBITDA (€/tonne)	165.4	89.8	278.2	285.2	265.6	198.6	218.6	78.2	121.8	138.2
Ratio of total energy costs to EBITDA	2.1	4.2	1.0	1.0	1.2	1.6	1.3	3.6	2.0	1.7

Source: CEPS/Ecofys.

Figure 71. Energy costs versus EBITDA of glass tableware production (€/tonne)



Source: CEPS/Ecofys.

A1.7 PACKAGING GLASS

A1.7.1 General information and sample composition

Packaging glass, as glass tableware, is part of the hollow glass sector (sector 23.13 in NACE Rev. 2). Packaging glass production includes bottles, jars and other containers, which come in different colours and shapes. Compared to glass tableware, packaging glass has low value-to-weight ratio and is less tradable.

The sector uses natural gas as main energy source and electricity as secondary source.

Unlike glass tableware, EU packaging glass production has recovered pre-crisis level. In 2016, there were a bit less than 200 plants in Europe, mostly composed of large companies owning multiple production sites in the EU and third countries. Top five European producing countries are (based on 2016 production value): Italy (21%), France (21%), Germany (19%), the United Kingdom (11%) and Spain (11%).

Overall, the EU is a net exporter of packaging glass. Major EU export destinations include the United States and Switzerland. EU imports come mainly from China and, to a less extent, Ukraine, Switzerland, India and the United Arab Emirates.

A typical packaging glass plant in the analysis has a natural gas intensity of 1.4-2.1 MWh/tonne and an electricity intensity of 0.3-0.4 MWh/tonne. The sample includes 24 plants across Europe (eight in each region), representing around 17% of total EU production.

A1.7.2 Electricity prices, costs and intensity

Key electricity indicators for packaging glass are presented in Table 26.

Electricity prices and costs in EUR/MWh saw a fluctuating trend between 2008 and 2015, before registering a decrease in 2016 and 2017, mainly due to a decline (in absolute value) in the energy component of the electricity price.

EU average electricity prices went from 77 EUR/MWh in 2008 to 75 EUR/MWh in 2017, with a peak in 2012 at 83 EUR/MWh. When looking at the price components (Figure 72), the energy component still represents the highest share of the price (56% in 2017), though this share has decreased over time. In contrast, network costs and RES levies significantly increased over the period, both in relative and absolute terms (they accounted in 2017 for 25% and 17% of the price, respectively). Larger consumers faced lower electricity prices (weighted average by purchased electricity is below simple average) by paying relatively less for network costs and RES levies (note that they did not pay less for the other price components, i.e. network costs and other non-recoverable taxes/levies). This gap between large consumers and small consumers increased recently, most likely because the former benefitted from larger exemptions on regulatory components than in previous years. No plant bought electricity directly on the wholesale market.

EU average electricity costs in EUR/MWh (Figure 73) increased from 75 EUR/MWh in 2008 to 79 EUR/MWh in 2012 and then decreased to 65 EUR/MWh in 2017. The increasing difference between electricity prices and costs (rising up to 10 EUR/MWh in 2017) can be explained by the participation of plants in flexibility schemes and ex post reimbursement for some components of their electricity price (mainly RES levies and other non-recoverable taxes/levies). Both compensation for flexibility schemes and ex post reimbursement grew in the most recent years. There is not electricity self-generation in the sector. EU average electricity costs in EUR/tonne (Figure 74) also increased from 24 EUR/tonne in 2008 to 26 EUR/tonne in 2012 and, subsequently, declined to 21 EUR/tonne in 2017.

EU average electricity intensity (Figure 75) remained stable over the 10-year period, ranging between 0.32-0.34 MWh/tonne. Larger producers benefitted from small economies of scale (weighted average – by production output – electricity intensity is slightly below simple average one).

A1.7.3 Natural gas prices, costs and intensity

Key natural gas indicators for packaging glass are presented in Table 27.

Natural gas prices and costs fluctuated between 2008 and 2015, before registering a sharp decline in 2016 and 2017, mainly due to a decrease (in absolute value) in the energy component of the gas price.

After peaking in 2012 (32 EUR/MWh), EU average natural gas prices (Figure 76) decreased sharply down to 21 EUR/MWh in 2017. As shown in Figure 77, the natural gas price is made up mostly by the energy component (88% in 2017), the remaining coming from the network component (note that non-recoverable taxes/levies are marginal, less than 1% in 2017). Large and small consumers paid the same price (weighted average by purchased natural gas and simple average are the same).

EU average natural gas costs (in EUR/tonne) ranged between 44 and 53 EUR/tonne between 2008 and 2015 (Figure 78). They decreased in recent years, falling to around 35 EUR/tonne in 2016 and 2017.

EU average natural gas intensity (Figure 79) recorded a decreasing trend from above 1.8 MWh/tonne (in 2008) to below 1.7 MWh/tonne (in 2017), indicating increased energy efficiency in the production process. Larger producers benefitted from small economies of scale (weighted average – by production output – natural gas intensity is slightly below simple average one).

A1.7.4 Competitiveness

As shown in Table 28, over the period, the share of electricity costs in total production costs declined, from 8% (2008) to about 7% (2017). The share of natural gas costs in total production costs ranged between 16% and 17% from 2008 to 2014, but decreased significantly thereafter, falling from 15% in 2015 to 11% in 2017. Overall, the share of total energy (natural gas + electricity) costs in production costs decreased from 25% in 2008 to 18% in 2017.

It is not possible to draw firm conclusions on the impact of electricity and natural gas costs on profitability. As shown in Figure 80, in absolute terms, EU average energy costs per tonne were in the range of 70-80 EUR/tonne until 2015 and then significantly decreased (56 EUR/tonne in 2017), while EU average EBITDA per tonne fluctuated over the period (between 63 and 78 EUR/tonne). We can still note that EBITDA and energy costs per tonne were always in the same order of magnitude (ratio of total energy costs to EBITDA close to 1) and in the most recent years, when energy costs significantly fell down, EBITDA improved. Energy costs are then an important element to be considered when looking at competitiveness issues in this sector.

A1.7.5 Tables and graphs

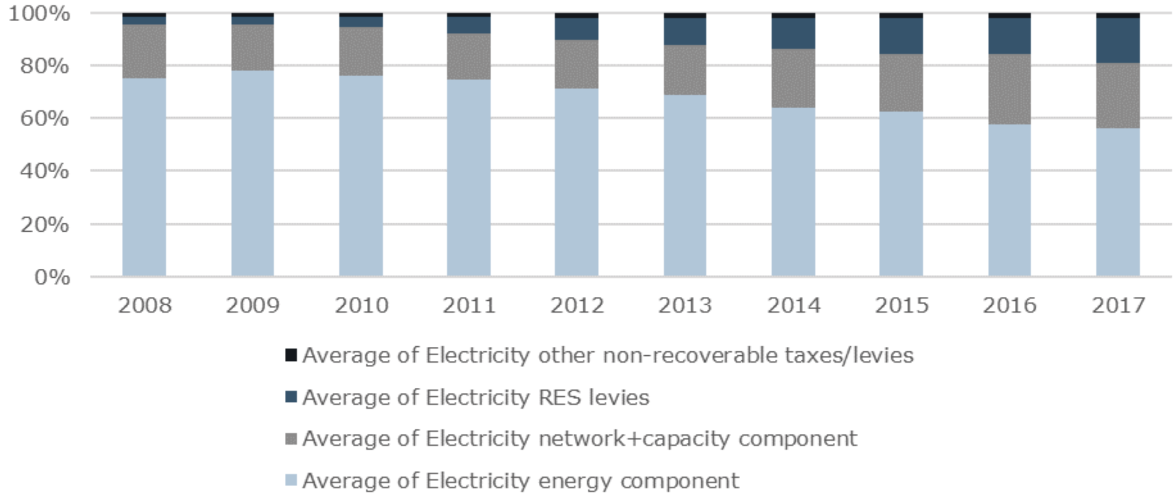
Electricity

Table 26. Key electricity indicators of packaging glass production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricity price (€/MWh)	77.0	79.0	75.8	77.7	83.3	82.5	80.3	82.6	75.4	75.0
Electricity costs (€/MWh)	75.3	77.3	74.1	73.5	79.1	77.0	73.1	76.0	68.9	64.8
Electricity costs (€/tonne)	24.3	26.0	24.5	24.2	26.2	25.6	23.2	24.5	22.1	20.6
Electricity intensity (MWh/tonne)	0.32	0.34	0.33	0.33	0.33	0.33	0.32	0.32	0.32	0.32

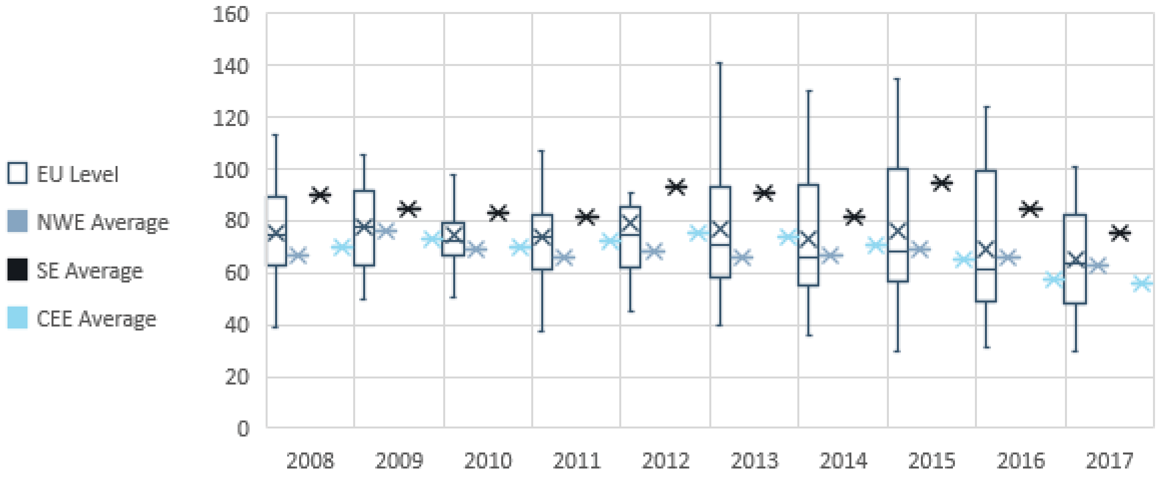
Source: CEPS/Ecofys.

Figure 72. Components of the EU average electricity price for packaging glass production (%)



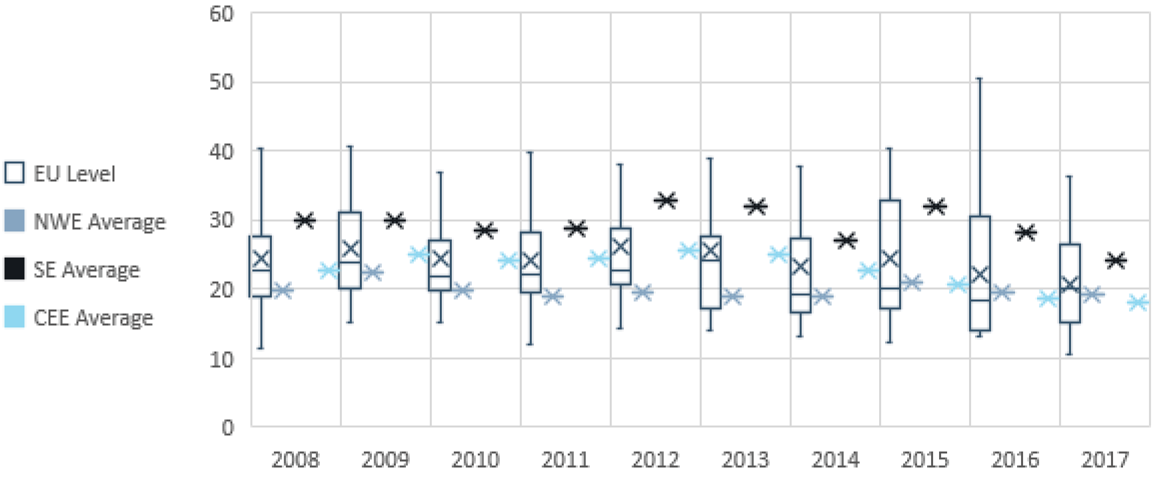
Source: CEPS/Ecofys.

Figure 73. Electricity costs of packaging glass production (€/MWh)



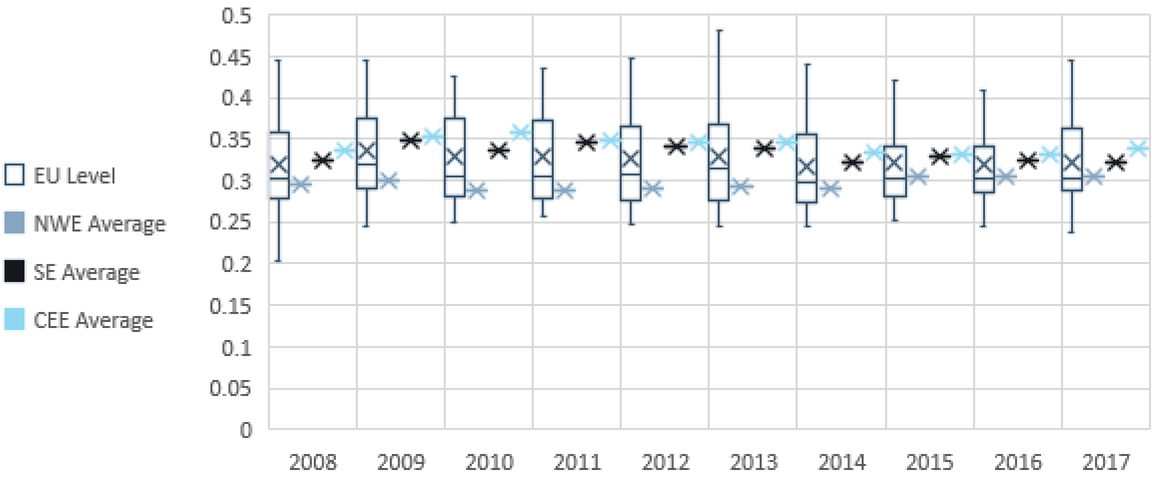
Source: CEPS/Ecofys.

Figure 74. Electricity costs of packaging glass production (€/tonne)



Source: CEPS/Ecofys.

Figure 75. Electricity intensity of packaging glass production (MWh/tonne)



Source: CEPS/Ecofys.

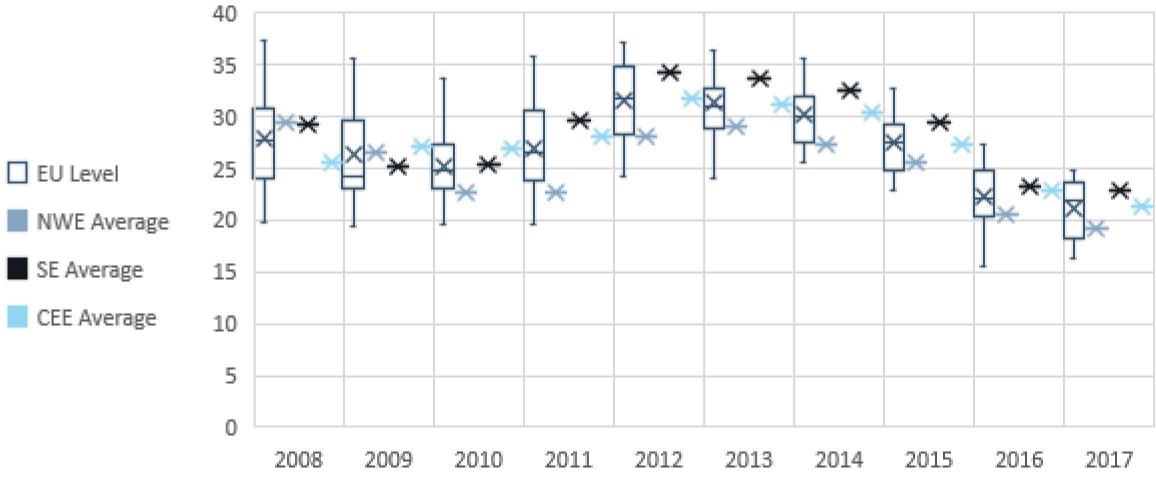
Natural gas

Table 27. Key natural gas indicators of packaging glass production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	27.8	26.3	25.1	26.9	31.5	31.3	30.1	27.5	22.3	21.2
Natural gas costs (€/tonne)	50.0	47.4	44.1	46.2	52.2	52.5	50.7	45.9	36.1	35.2
Natural gas intensity (MWh/tonne)	1.8	1.8	1.8	1.7	1.7	1.7	1.7	1.7	1.6	1.7

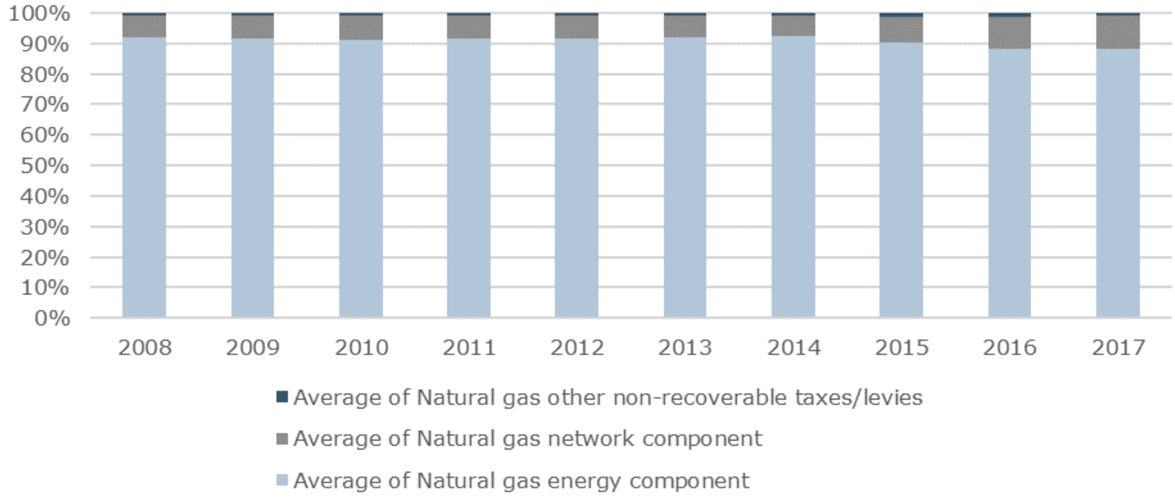
Source: CEPS/Ecofys.

Figure 76. Natural gas prices of packaging glass production (€/MWh)



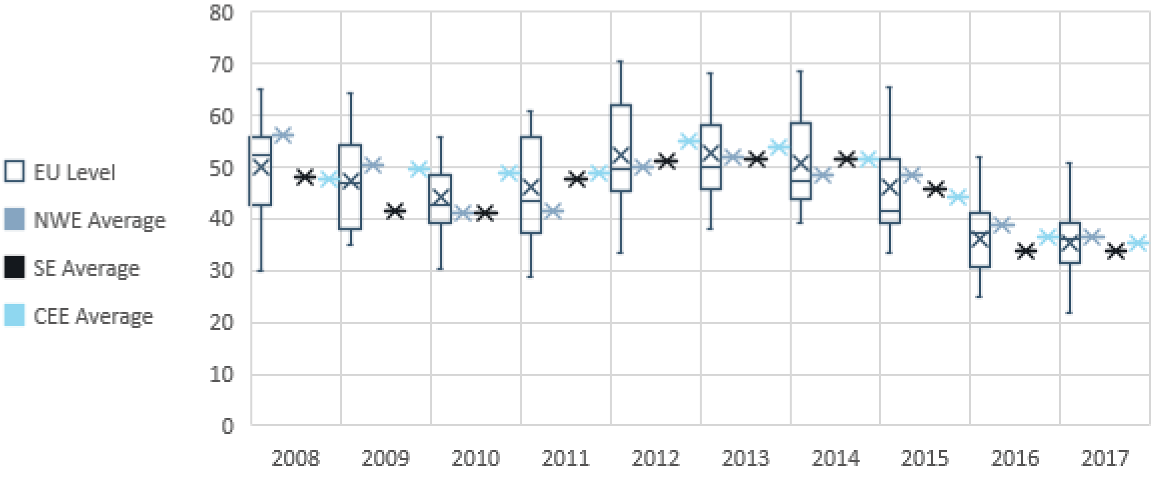
Source: CEPS/Ecofys.

Figure 77. Components of the EU average natural gas price for packaging glass production (%)



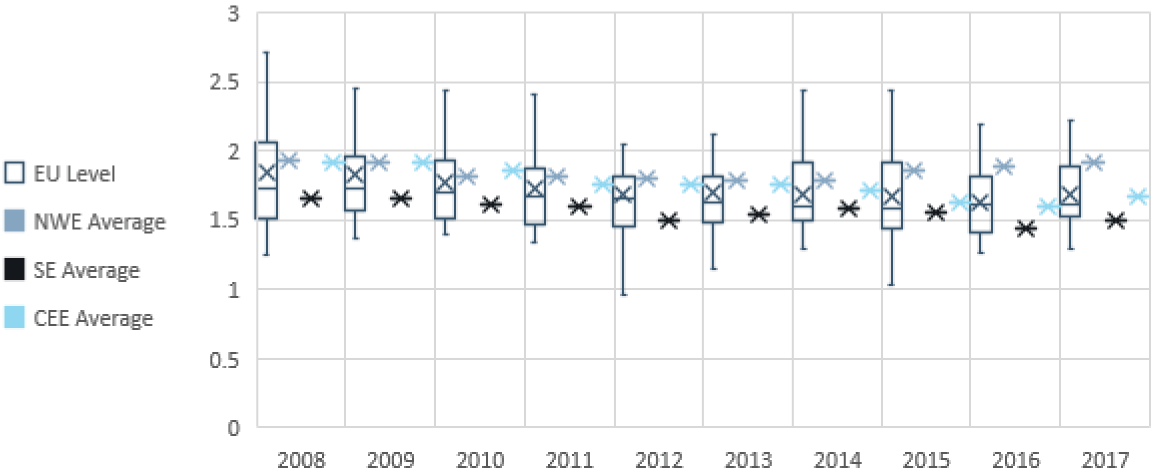
Source: CEPS/Ecofys.

Figure 78. Natural gas costs of packaging glass production (€/tonne)



Source: CEPS/Ecofys.

Figure 79. Natural gas intensity of packaging glass production (MWh/tonne)



Source: CEPS/Ecofys.

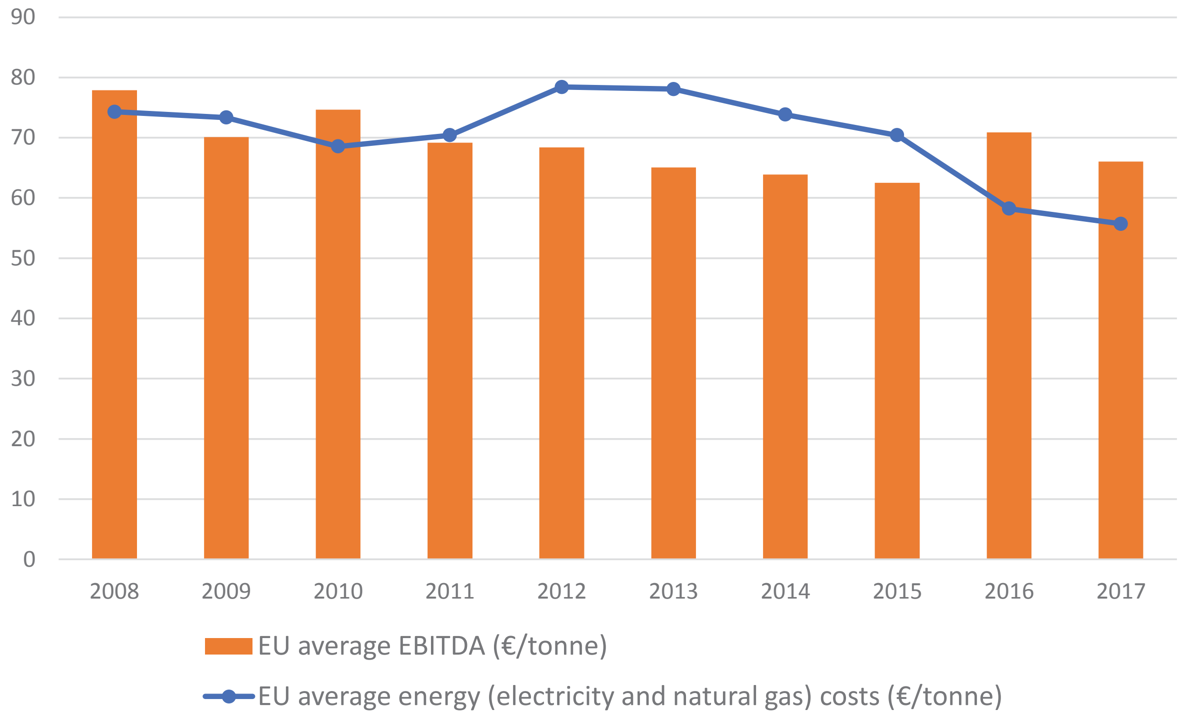
Competitiveness

Table 28. Key competitiveness indicators of packaging glass production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	8.3	8.7	8.8	8.2	8.3	7.9	7.4	7.9	7.5	6.6
Share of natural gas costs in production costs (%)	17.1	15.9	15.8	15.6	16.6	16.1	16.2	14.9	12.2	11.4
Share of total energy costs in production costs (%)	25.4	24.6	24.5	23.8	25.0	24.0	23.6	22.8	19.6	18.0
Total energy costs (€/tonne)	74.3	73.4	68.6	70.4	78.4	78.1	73.8	70.4	58.2	55.7
EBITDA (€/tonne)	77.9	70.1	74.7	69.2	68.4	65.1	63.9	62.5	70.9	66.0
Ratio of total energy costs to EBITDA	1.0	1.0	0.9	1.0	1.1	1.2	1.2	1.1	0.8	0.8

Source: CEPS/Ecofys.

Figure 80. Energy costs versus EBITDA of packaging glass production (€/tonne)



Source: CEPS/Ecofys.

A1.8 NITROGEN FERTILISERS

A1.8.1 General information and sample composition

Nitrogen fertilisers are part of sector 20.15 in NACE Rev.2.

For nitrogen fertilisers, ammonia production is the key building block, which requires by far the largest share of energy in the whole production process. The most common fuel used in ammonia production is natural gas, which mainly serves as a feedstock. In the nitrogen fertiliser sector, natural gas costs can represent around 60% of total production costs.

In the last few years, the European fertiliser industry has experienced a slowdown due to less demand of fertilisers from farmers. As farmers experience lower commodity prices (i.e. less revenue on their produce), they have tended to reduce fertiliser intake or purchase fertilisers from non-EU markets. The latter can offer cheaper fertilisers than those produced in the EU. Top five European producing countries are (based on 2017 capacity): Germany (16%), Poland (15%), the Netherlands (15%), France (8%) and the United Kingdom (6%).

Overall, the EU is a net importer of fertilisers and nitrogen compounds, importing most of it from Russia. The EU also exports some of its production, mostly to Brazil, Turkey and the United States.

The analysis focusses on ammonia plants. There are 47 ammonia plants in the EU, where a typical plant has an average capacity of 400 kilo tonnes/year, an average natural gas intensity of 10.8 MWh/tonne and an average electricity intensity of 0.18 MWh/tonne. The sample in the analysis includes eight EU plants (four in CEE region, one in NWE region and three in SE region), representing about 19% of total ammonia capacity in the EU.

A1.8.2 Electricity prices, costs and intensity

Key electricity indicators for nitrogen fertilisers are presented in Table 29.

EU average electricity price in 2017 was at a similar level as in 2008 (69 EUR/MWh). Price peaked in 2011 at 92 EUR/MWh and then continuously decreased again. As shown in Figure 81, in every year, the energy component accounted for the largest share in the electricity price (74% in 2008, 69% in 2017), followed by the network component (18% in 2008, 17% in 2017). Overall, large consumers faced lower electricity prices (weighted average by purchased electricity is generally below simple average) because they were able to negotiate more favourable deals on the energy component (note that they did not pay less for the regulatory components, including network costs, RES levies and other non-recoverable taxes/levies).

EU average electricity costs in EUR/MWh (Figure 82) were on a slightly upward trend from 2008 to 2013, followed by a decrease from 2013 to 2017. In 2017, the average electricity costs at the EU level were 65 EUR/MWh. The difference between electricity price and electricity costs in EUR/MWh is caused by plants that received some form of reimbursement (mainly tax reimbursements) and/or used self-generated electricity on site. The weighted average (by electricity consumption) for this indicator was lower than the simple average, confirming better bargaining power for larger electricity consumers. From 2008 to 2017, EU average electricity costs in EUR/tonne (Figure 83) decreased, ranging between 11 and 13 EUR/tonne. In 2017, the electricity costs per tonne were at their lowest level of 11 EUR/tonne.

EU average electricity intensity (Figure 84) ranged from 0.17 to 0.19 MWh/tonne, decreasing slightly from 2008 (0.19 MWh/tonne) to 2017 (0.18 MWh/tonne). There is no indication that larger plants are less electricity intensive than smaller plants.

A1.8.3 Natural gas prices, costs and intensity

Key natural gas indicators for nitrogen fertilisers are presented in Table 30.

EU average natural gas prices for ammonia plants (Figure 85) show a volatile trend between 2008 and 2017 (lowest value in 2009 and highest in 2013). Prices followed the international natural gas price developments. In 2017, the average price was 21 EUR/MWh. As shown in Figure 86, the energy component made up the lion's share of the natural gas price in every year (always above 85%). We can, however, observe that the share of the regulatory components (network costs + non-recoverable taxes/levies) increased between 2008 and 2017 (4% in 2008 vs. 11% in 2017). Larger consumers faced lower natural gas prices (weighted average by purchased natural gas is below simple average) and actually paid less for all the price components (energy, network costs and non-recoverable taxes/levies).

EU average natural gas costs (in EUR/tonne) followed a similar trend to the natural gas prices (Figure 87). The costs increased from 2009 to 2013 and decreased from 2013 to 2017. In 2017, they were at around 99 EUR/tonne, while in 2008 costs were around 133 EUR/tonne.

EU average natural gas intensity (Figure 88) ranged from 4.6 to 5.1 MWh/tonne, decreasing slightly from 2008 (5.1 MWh/tonne) to 2017 (5.0 MWh/tonne). Overall, efficiency thus increased slightly. There is no indication that larger plants are less natural gas intensive than smaller plants.

A1.8.4 Competitiveness

Over the period, natural gas and electricity costs accounted for 51–66% and 5–7% of total production costs, respectively (Table 31). The share of total energy (natural gas + electricity) costs in production costs increased from 67% in 2008 to 73% in 2017.

EBITDA per tonne underwent a volatile trend from 2008 to 2017 (Figure 89). Comparing 2008 and 2017, EBITDA per tonne decreased by almost 50% from 49 EUR/tonne in 2008 to 25 EUR/tonne in 2017. By looking at trends in costs and margins, it is not possible to draw conclusions about the impact of electricity and natural gas costs on profitability. Nevertheless, it should be emphasised that energy costs are always much higher than EBITDA (ratio of total energy costs to EBITDA ranges between 1.9 and 7.7), which shows the high importance of energy costs for the competitiveness of nitrogen fertiliser production.

A1.8.5 Tables and graphs

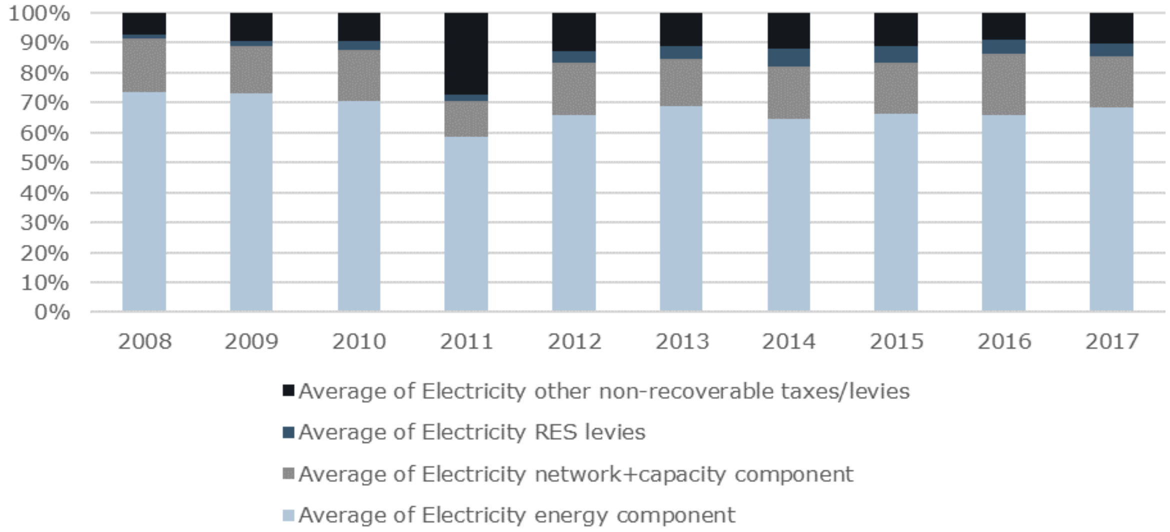
Electricity

Table 29. Key electricity indicators of nitrogen fertiliser production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricity price (€/MWh)	67.4	68.9	67.9	91.7	83.1	77.1	69.7	72.0	66.5	69.3
Electricity costs (€/MWh)	64.0	67.9	66.3	73.4	70.0	75.0	65.2	64.7	60.3	65.2
Electricity costs (€/tonne)	12.0	12.1	11.1	12.3	11.8	13.4	11.3	11.0	11.4	10.7
Electricity intensity (MWh/tonne)	0.19	0.18	0.17	0.17	0.17	0.18	0.17	0.17	0.19	0.18

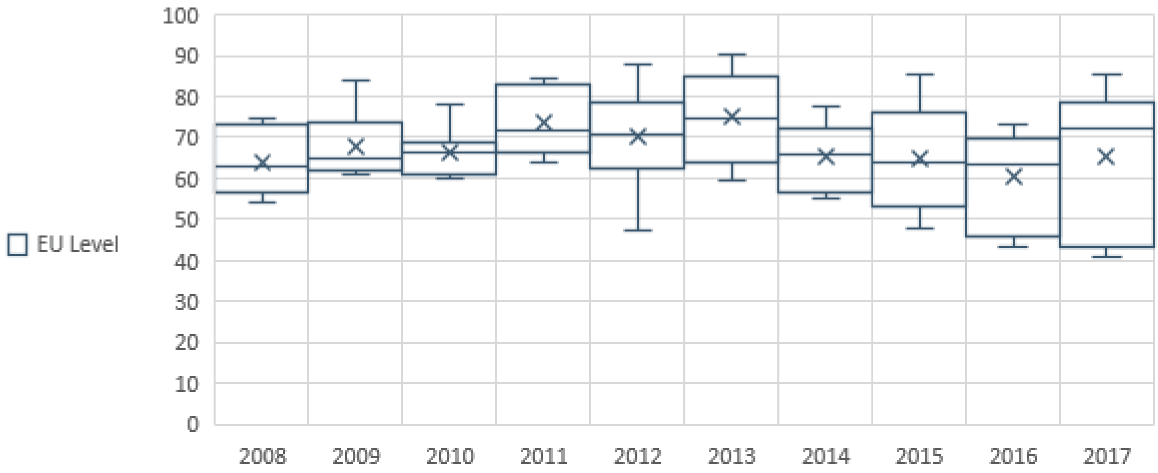
Source: CEPS/Ecofys.

Figure 81. Components of the EU average electricity price for nitrogen fertiliser production (%)



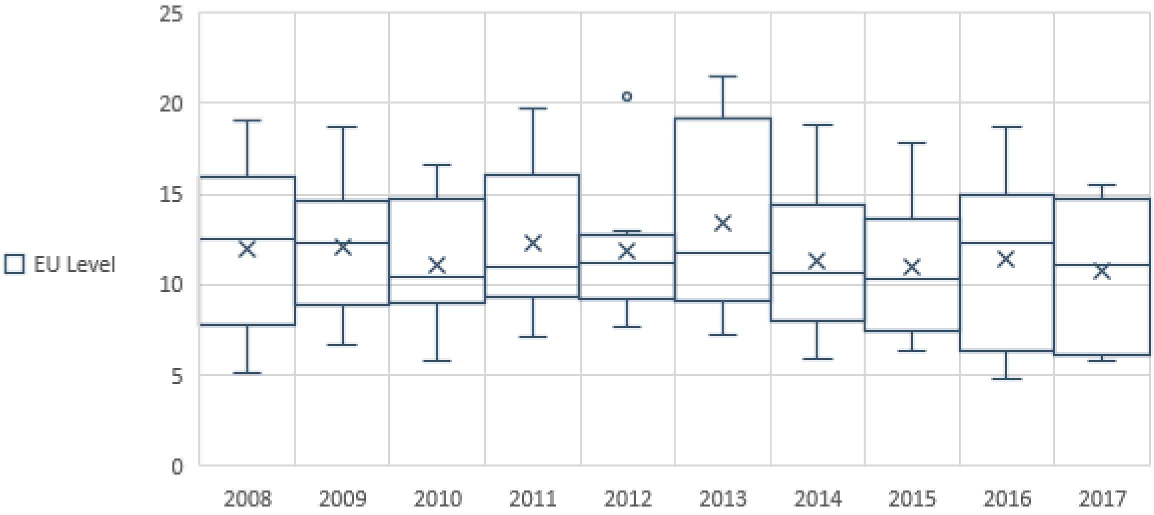
Source: CEPS/Ecofys.

Figure 82. Electricity costs of nitrogen fertiliser production (€/MWh)



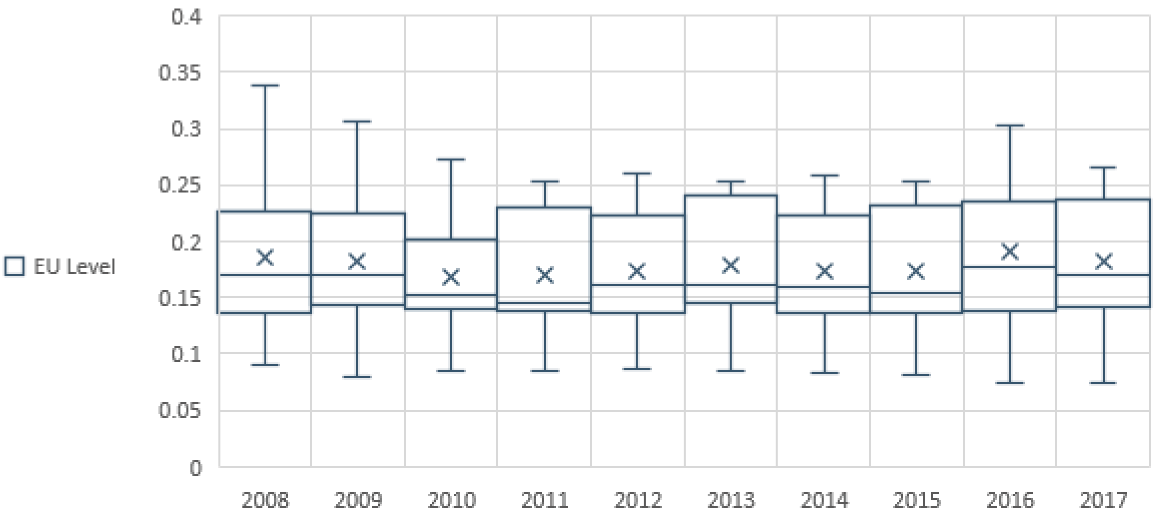
Source: CEPS/Ecofys.

Figure 83. Electricity costs of nitrogen fertiliser production (€/tonne)



Source: CEPS/Ecofys.

Figure 84. Electricity intensity of nitrogen fertiliser production (MWh/tonne)



Source: CEPS/Ecofys.

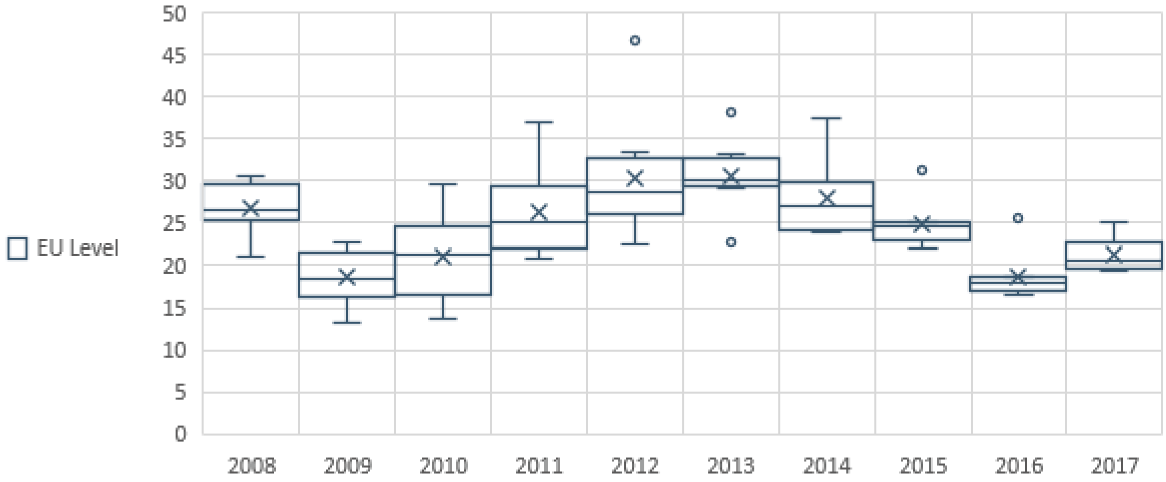
Natural gas

Table 30. Key natural gas indicators of nitrogen fertiliser production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	26.7	18.6	46.5	26.3	30.4	30.5	28.0	24.8	18.8	21.2
Natural gas costs (€/tonne)	132.9	84.7	90.1	124.5	144.5	146.6	134.2	119.2	89.8	99.2
Natural gas intensity (MWh/tonne)	5.1	4.8	4.6	5.0	5.0	4.9	5.0	4.9	5.0	5.0

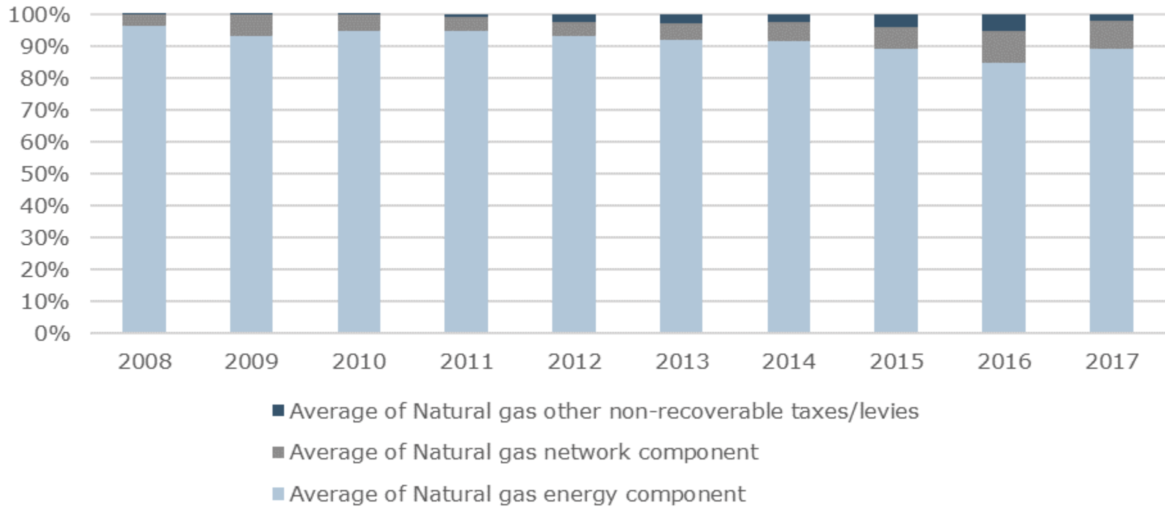
Source: CEPS/Ecofys.

Figure 85. Natural gas prices of nitrogen fertiliser production (€/MWh)



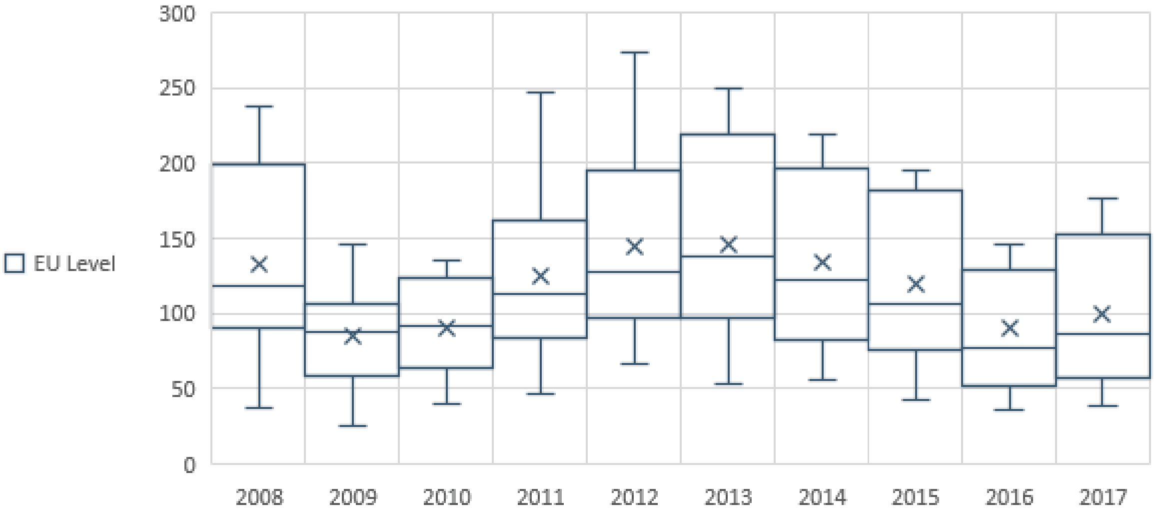
Source: CEPS/Ecofys.

Figure 86. Components of the EU average natural gas price for nitrogen fertiliser production (%)



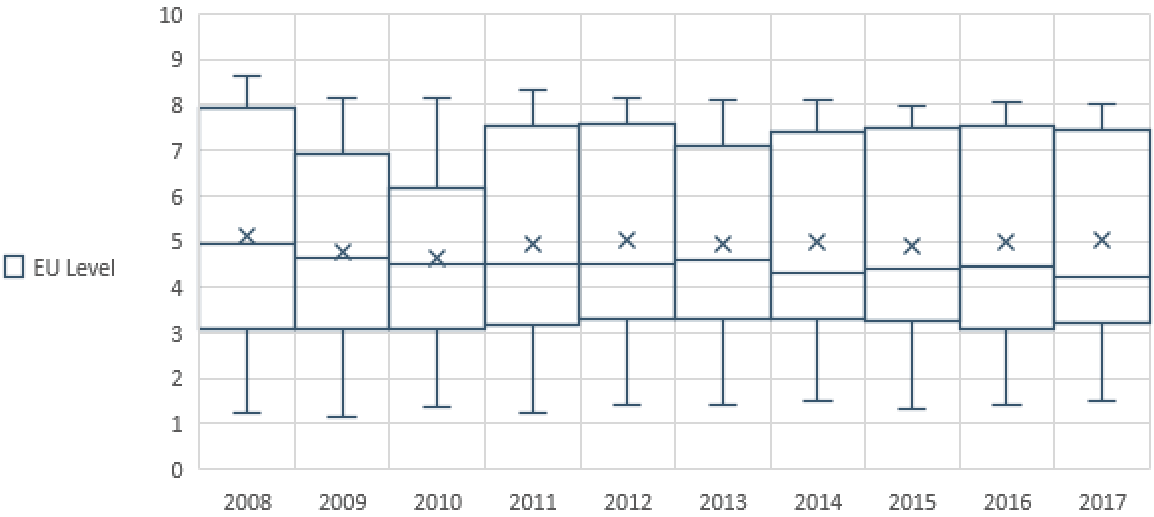
Source: CEPS/Ecofys.

Figure 87. Natural gas costs of nitrogen fertiliser production (€/tonne)



Source: CEPS/Ecofys.

Figure 88. Natural gas intensity of nitrogen fertiliser production (MWh/tonne)



Source: CEPS/Ecofys.

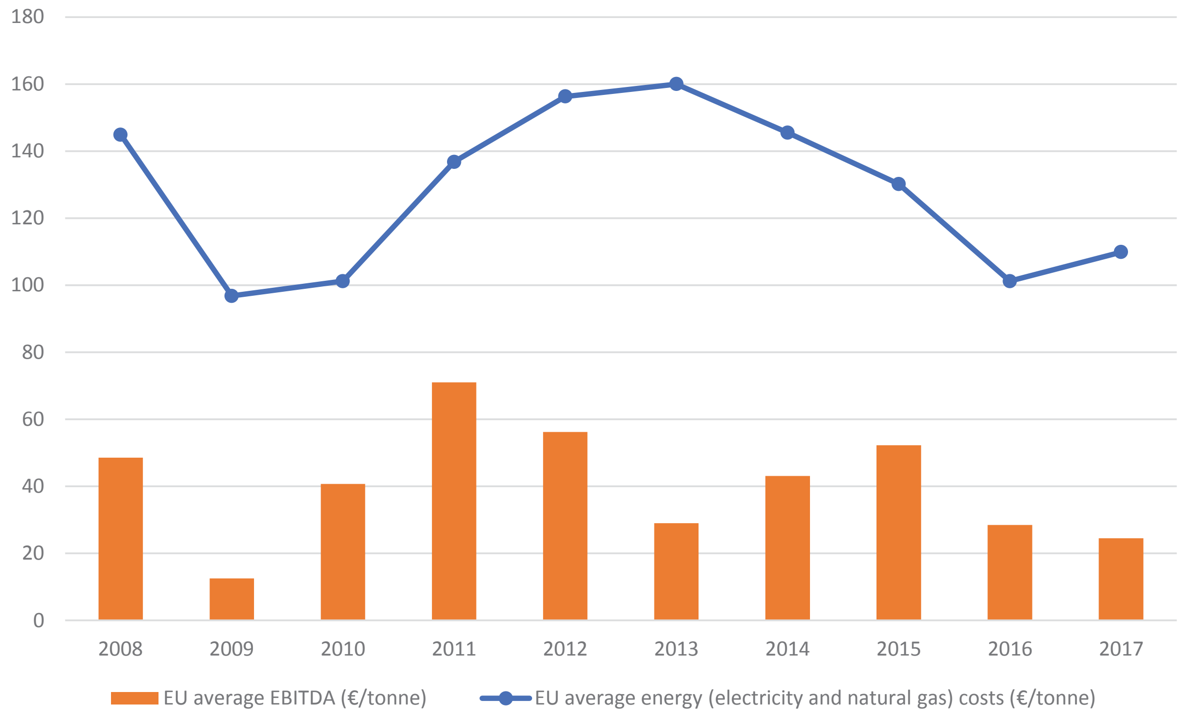
Competitiveness

Table 31. Key competitiveness indicators of nitrogen fertiliser production (EU averages)

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Share of electricity costs in production costs (%)	5.5	7.3	6.4	6.1	5.1	5.7	5.2	5.2	6.6	7.1
Share of natural gas costs in production costs (%)	61.2	51.1	51.6	61.3	63.0	62.2	61.6	55.8	52.1	66.2
Share of total energy costs in production costs (%)	66.7	58.4	58.0	67.4	68.1	67.9	66.8	61.0	58.7	73.3
Total energy costs (€/tonne)	144.9	96.8	101.2	136.8	156.3	160.0	145.5	130.2	101.2	109.9
EBITDA (€/tonne)	48.6	12.5	40.7	71.0	56.2	29.0	43.1	52.3	28.5	24.5
Ratio of total energy costs to EBITDA	3.0	7.7	2.5	1.9	2.8	5.5	3.4	2.5	3.6	4.5

Source: CEPS/Ecofys.

Figure 89. Energy costs versus EBITDA of nitrogen fertiliser production (€/tonne)



Source: CEPS/Ecofys.

A1.9 REFINERIES

A1.9.1 General information and sample composition

Refineries (sector 19.20 in NACE Rev.2) separate (distillate) and transform (convert and blend) crude oil to manufacture a wide variety of refined petroleum products, including transportation fuels, residual fuel oils and lubricants.

In the refinery sector crude oil – used as feedstock – represents, by far, the most prominent costs (more than 80% of total production costs). Electricity and natural gas costs play only a marginal role (they represent altogether around 2% of total production costs[6]).

Refineries in Europe have been going through a restructuring process. Several EU oil companies are divesting from refining capacity in Europe and expanding in other parts of the world, while non-European companies are emerging as potential investors. Nevertheless, the balance is negative and refining activity is decreasing in Europe. Most refineries are found in NWE or SE regions. Top five oil refining Member States are (based on 2017 capacity): Germany (14%), Italy (13%), the Spain (11%), the United Kingdom (10%) and France (10%).

Overall, the trade of refined petroleum products is fairly balanced for Europe (EU import and export are of the same order of magnitude). Europe exports mainly to the United States and, to a less extent, Turkey and imports mostly from Russia and, to a less extent, the United States and Saudi Arabia.

The analysis focusses on mainstream refineries (small petroleum oil sites producing specialised products such as bitumen and lube oil are excluded). There are 81 mainstream refineries in the EU. A typical refinery in the sample has an average capacity of around 6.5 Mt/year and covers oil distillation and conversion (through thermal or catalytic processes). The sample includes 13 plants across Europe (one in CEE region, eight in NWE region and four in SE region), representing around 20% of total EU capacity.

A1.9.2 Electricity prices, costs and intensity

Key electricity indicators for refineries are presented in Table 32.

EU average electricity prices decreased over the last decade (78 EUR/MWh in 2008 vs. 71 EUR/MWh in 2017). In most years, electricity prices in NWE were higher than in SE. In terms of price components (Figure 90), the energy component underwent a downward trend between 2008 and 2017 (both in absolute and relative terms) but still represents the lion's share of the electricity price (63% in 2017). Large consumers paid less for any of the price components, including energy but also network costs, RES levies and other non-recoverable taxes/levies (for each component, weighted average by purchased electricity is below simple average) and therefore faced significantly lower electricity prices.

Similarly, EU average electricity costs in EUR/MWh (Figure 91) were on a downward trend from 2008 (92 EUR/MWh) to 2017 (66 EUR/MWh). It should be underlined that there is a break in the time series between 2015 and 2016 due to sample composition variation (between 2008-2015 and 2016-2017). Except in the SE region, larger consumers benefited from better conditions for electricity costs (weighted average by electricity consumption is lower than simple average). In the same way, EU average electricity costs in EUR/tonne (Figure 92) decreased, from above 6 EUR/tonne in 2008 to below 4 EUR/tonne in 2017.

EU average electricity intensity (Figure 93) ranged from 0.06 to 0.08 MWh/tonne, decreasing slightly from 2008 (0.07 MWh/tonne) to 2017 (0.06 MWh/tonne). There is no indication that larger plants are less electricity intensive than smaller plants.

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[6] This ratio includes both operational and capital costs. It would be bigger if only operational productions costs were considered.

A1.9.3 Natural gas and total gas prices, costs and intensity

In the case of refineries, it is relevant to analyse the consumption of both natural gas and self-produced gases (i.e. refinery fuel gases). Table 33 presents key indicators for natural gas, refinery fuel gases and total gases (i.e. the sum of the two) in refineries.

EU average natural gas prices (Figure 94) show a general descending trend, with a sharp decrease between 2013 to 2016 when prices dropped from 30 to 20 EUR/MWh. In 2017, the price was, though, on the rise (22 EUR/MWh). Like for electricity, the energy component of natural gas prices (Figure 95) decreased between 2008 and 2017 (both in absolute and relative terms) but still represented 89% of the natural gas price in 2017. Larger consumers faced lower natural gas prices (weighted average by purchased natural gas is constantly below simple average); in fact, they do not necessarily pay less for the energy and network component but do pay relatively less for non-recoverable taxes/levies.

EU average natural gas costs in EUR/tonne (Figure 96) decreased by 52% from 2008 (11 EUR/tonne) to 2017 (5 EUR/tonne). Larger consumers experienced smaller natural gas costs per unit (weighted average by production output is below simple average) due to economies of scale and the lower natural gas prices they faced. However, when looking at the EU average total gas costs in EUR/tonne (Figure 97), i.e. including refinery fuel gases as well, the results then appear rather volatile throughout the 2008 to 2017 period without any clear trend (range between 11 and 20 EUR/tonne).

EU average natural gas intensity (Figure 98) decreased from 0.35 MWh/tonne in 2008 to 0.24 MWh/tonne in 2017. When including refinery fuel gases, EU average total gas intensity showed the same pattern and decreased from 0.77 MWh/tonne in 2008 to 0.68 MWh/tonne in 2017. There is no indication that larger plants are less gas intensive than smaller plants.

A1.9.4 Prices, costs and intensity of other fuels including feedstocks

In the case of refineries, other fuels (including feedstocks) than electricity and gas play a key role in their production costs. Some information could be gathered for 2016 and 2017 and is presented in Table 34.

Major input in refinery activity is crude oil used as feedstock. EU average crude oil price increased from about 24 EUR/MWh in 2016 to 29 EUR/MWh in 2017. In the same way, EU average crude oil costs in EUR/tonne rose from about 332 EUR/tonne in 2016 to 396 EUR/tonne in 2017. We can note that EU average crude oil intensity in refineries slightly decreased (around 1%) from 2016 to 2017 (from 13.76 to 13.62 MWh/tonne, respectively).

Fuel oil and petroleum coke follow the same pattern as crude oil. EU average price increased between 2016 and 2017, respectively, from about 15 to 20 EUR/MWh for fuel oil and from about 15 to 21 EUR/MWh for petroleum coke. In terms of costs in EUR/tonne, they rose between 2016 and 2017, respectively, from about 2.2 to 2.5 EUR/tonne for fuel oil and from 2.0 to 2.4 EUR/tonne for petroleum coke. In parallel, EU average petroleum coke intensity in refineries dropped by 8% (0.13 MWh/tonne in 2016 vs. 0.12 MWh/tonne in 2017) and more than 20% for fuel oil (0.14 MWh/tonne in 2016 vs. 0.11 MWh/tonne in 2017).

A1.9.5 Competitiveness

Table 35 presents the respective share of fuel costs and total energy (sum of electricity, natural gas, refinery fuel gases, crude oil, fuel oil and petroleum coke) costs in total production costs. Full data set is available for 2016 and 2017 only. The total energy costs amount between 84 and 86% in total production costs, mostly attributable to crude oil (crude oil makes up about 95% of total energy costs).

EBITDA per tonne (Figure 100) slightly increased between 2016 and 2017 (37 vs. 44 EUR/tonne, respectively). It is not possible to analyse the impact of total energy costs on profitability from a trend perspective, as data are available for two years only (2016 and 2017). Nevertheless, the ratio of total energy costs to EBITDA still indicates that a 1 % reduction in total energy costs would potentially lead to an increase of 9.3% in EBITDA, which shows the extreme importance of energy costs and the huge potential impact they can have on margins of refineries.

A1.9.6 Tables and graphs

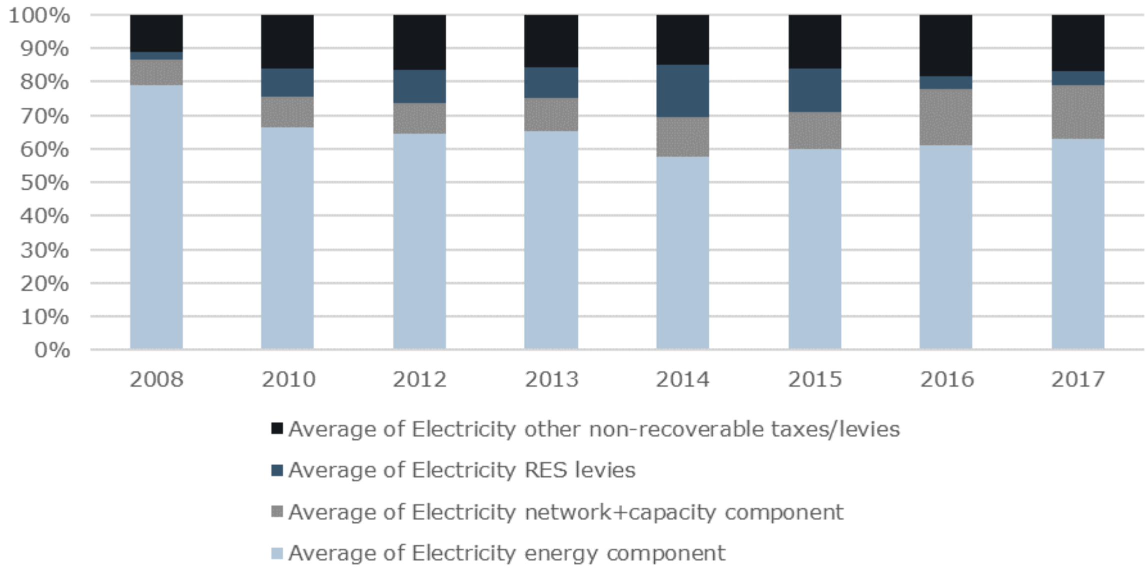
Electricity

Table 32. Key electricity indicators of refineries (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Electricity price (€/MWh)	77.6	69.2	75.5	72.4	76.9	73.6	69.0	70.5
Electricity costs (€/MWh)	92.4	89.2	92.0	92.6	89.2	83.6	62.9	65.9
Electricity costs (€/tonne)	6.2	6.7	6.9	6.8	7.1	6.1	3.5	3.8
Electricity intensity (MWh/tonne)	0.07	0.08	0.07	0.07	0.07	0.07	0.06	0.06

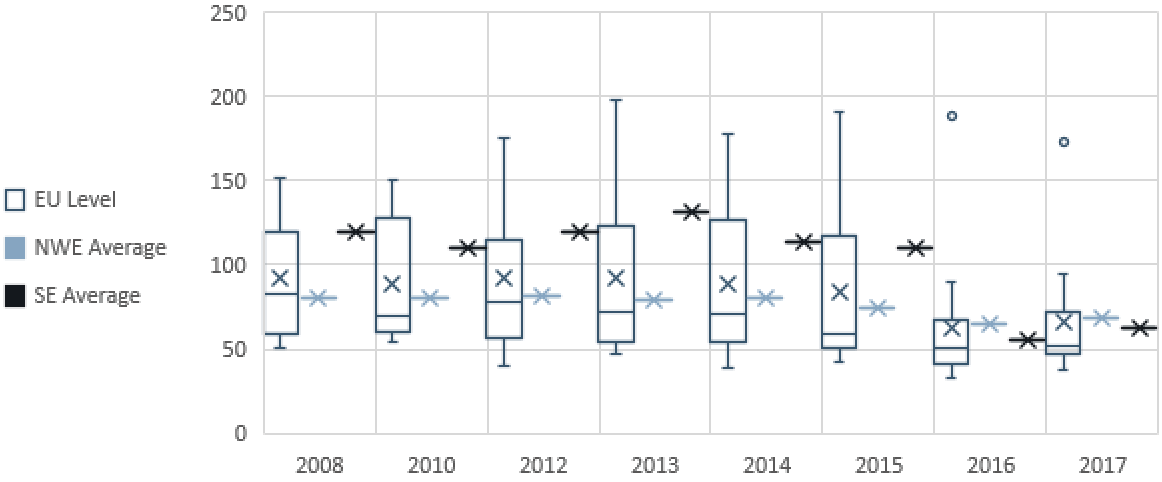
Source: CEPS/Ecofys.

Figure 90. Components of the EU average electricity price for refineries (%)



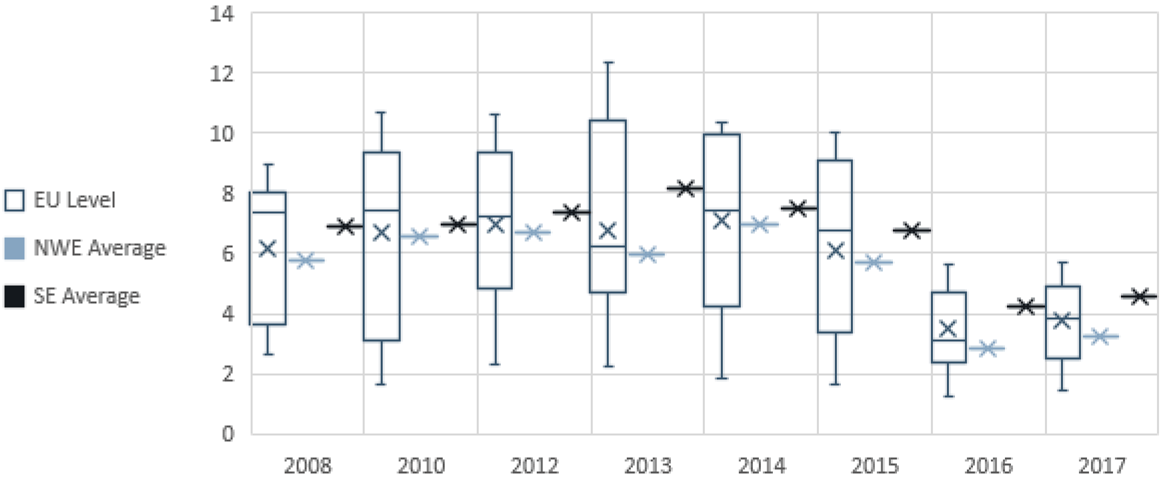
Source: CEPS/Ecofys.

Figure 91. Electricity costs of refineries (€/MWh)



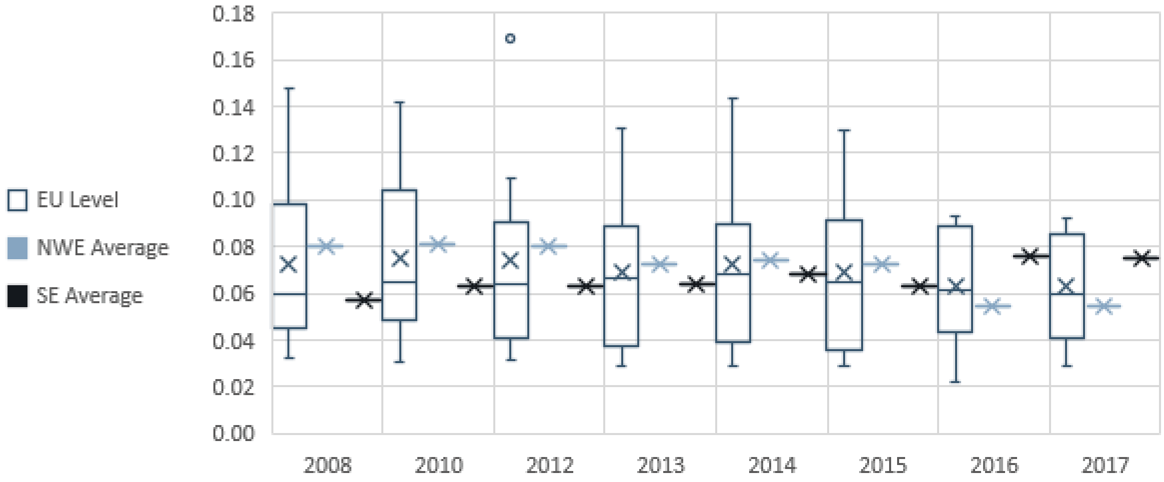
Source: CEPS/Ecofys.

Figure 92. Electricity costs of refineries (€/tonne)



Source: CEPS/Ecofys.

Figure 93. Electricity intensity of refineries (MWh/tonne)



Source: CEPS/Ecofys.

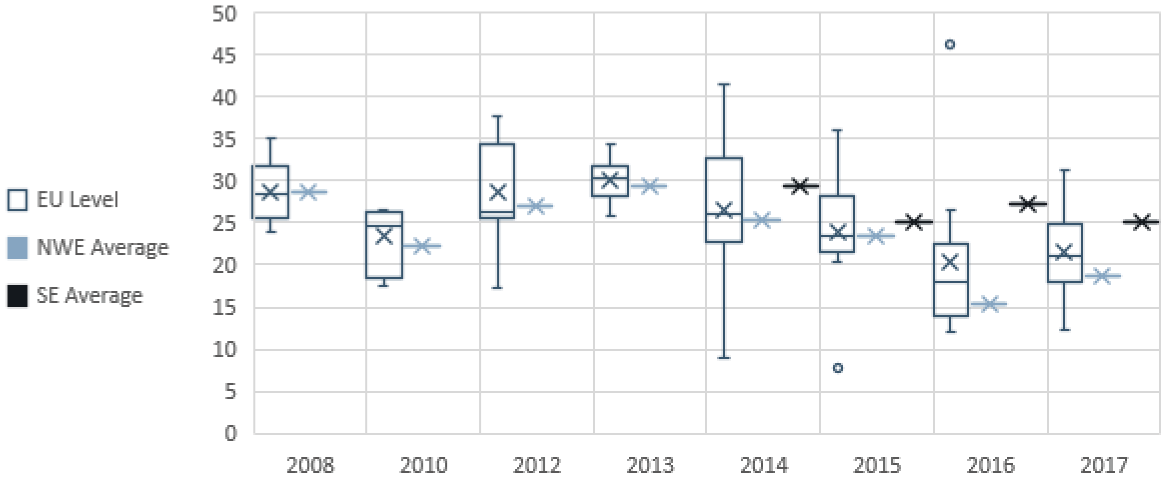
Natural gas and refinery fuel gases

Table 33. Key gas indicators of refineries (EU averages)

Indicator	2008	2010	2012	2013	2014	2015	2016	2017
Natural gas price (€/MWh)	28.6	23.4	28.6	30.1	26.4	23.8	20.3	21.6
Natural gas costs (€/tonne)	10.7	9.3	11.7	12.0	8.2	5.9	4.6	5.1
Refinery fuel gases costs (€/tonne)	2.4	4.4	7.9	6.5	6.1	4.6	7.3	9
Total gas costs (€/tonne)	**13.1**	**13.7**	**19.6**	**18.5**	**14.3**	**10.5**	**11.9**	**14.1**
Natural gas intensity (MWh/tonne)	0.35	0.34	0.36	0.38	0.31	0.26	0.24	0.24
Refinery fuel gases intensity (MWh/tonne)	0.5	0.5	0.48	0.46	0.55	0.57	0.45	0.44
Total gas intensity (MWh/tonne)	**0.77**	**0.83**	**0.89**	**0.88**	**0.91**	**0.86**	**0.69**	**0.68**

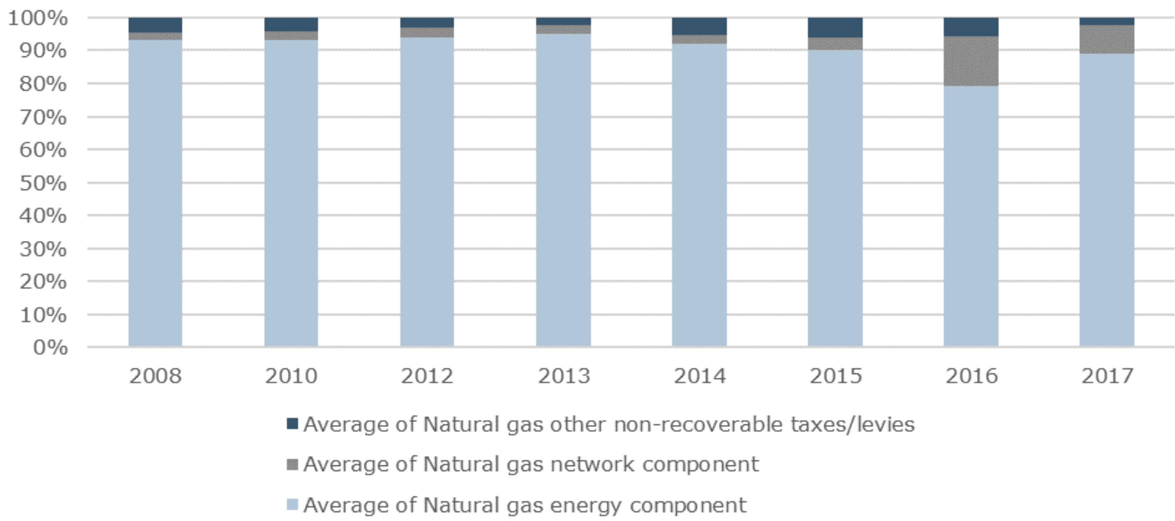
Source: CEPS/Ecofys.

Figure 94. Natural gas prices of refineries (€/MWh)



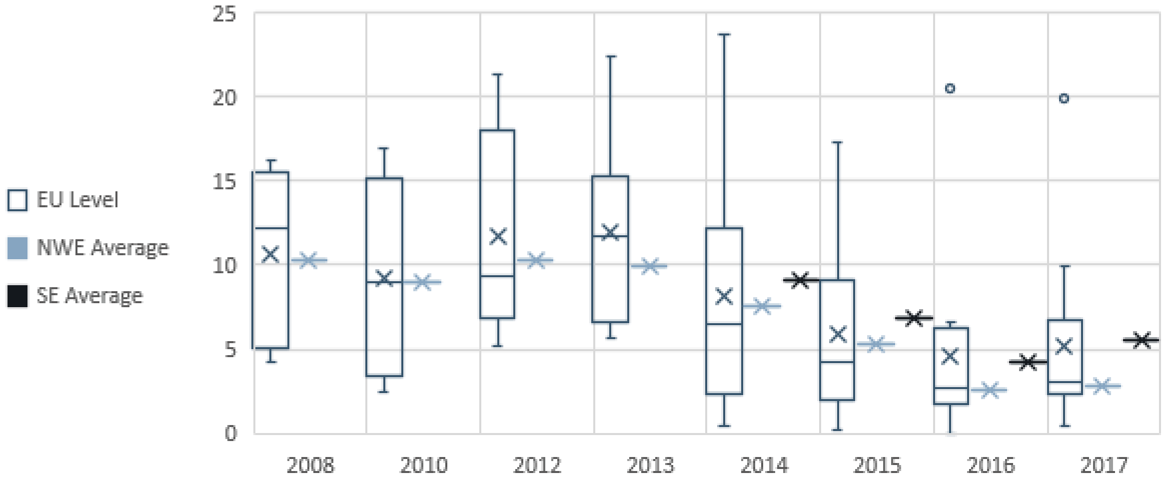
Source: CEPS/Ecofys.

Figure 95. Components of the EU average natural gas price for refineries (%)



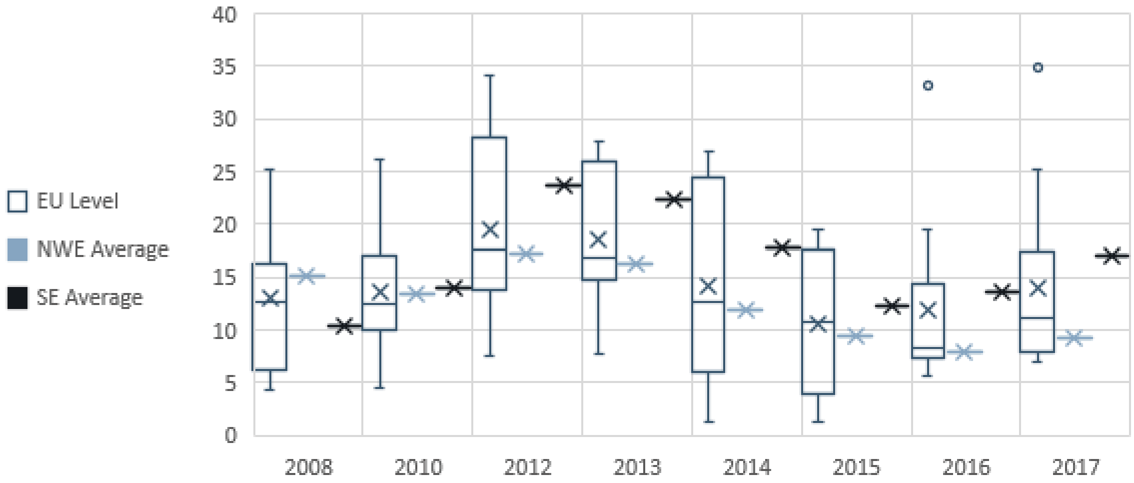
Source: CEPS/Ecofys.

Figure 96. Natural gas costs of refineries (€/tonne)



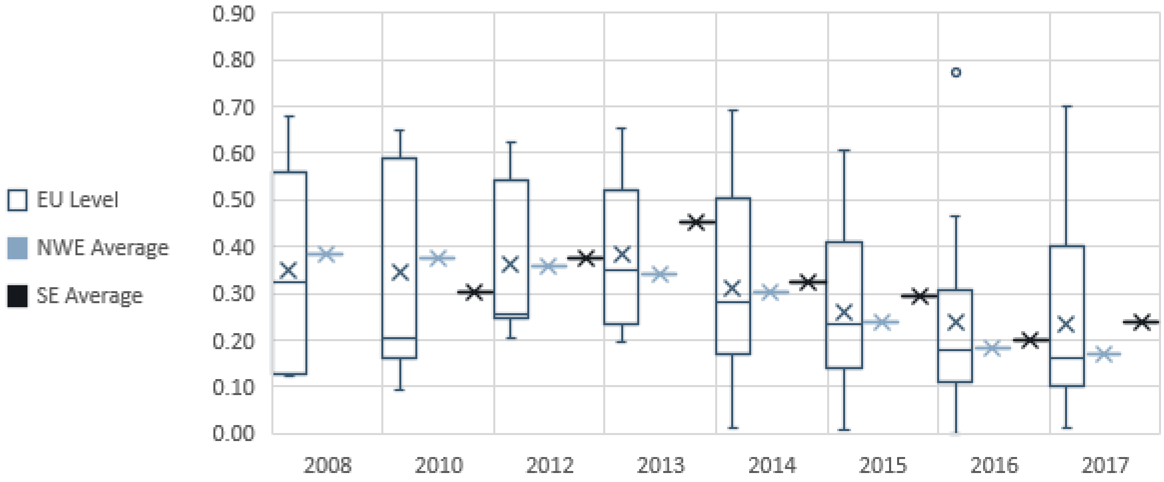
Source: CEPS/Ecofys.

Figure 97. Total gas costs of refineries (€/tonne)



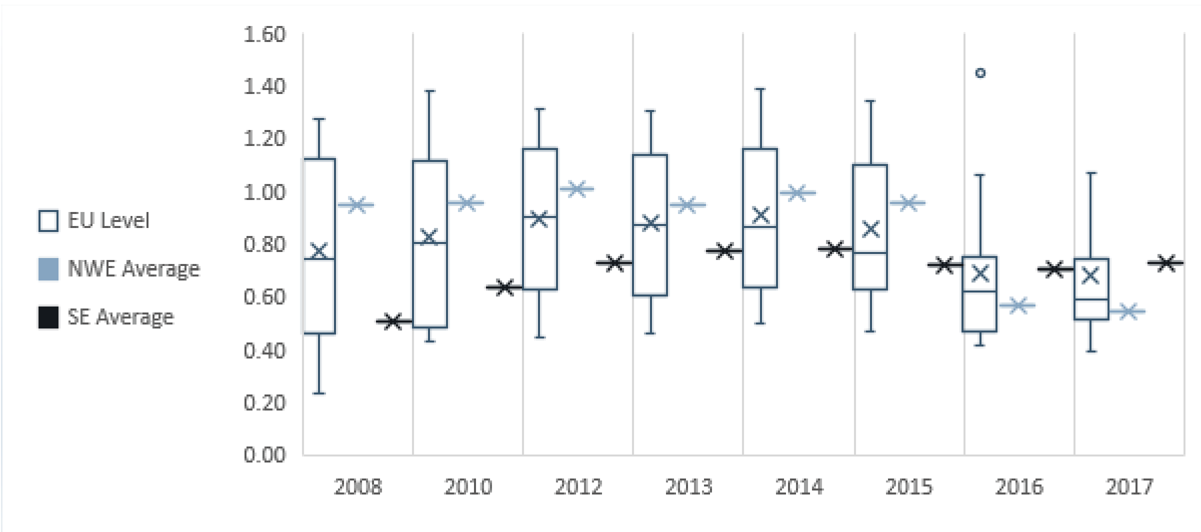
Source: CEPS/Ecofys.

Figure 98. Natural gas intensity of refineries (MWh/tonne)



Source: CEPS/Ecofys.

Figure 99. Total gas intensity of refineries (MWh/tonne)



Source: CEPS/Ecofys.

Other fuels including feedstocks

Table 34. Key other fuel indicators of refineries (EU averages)

Indicator	2016	2017
Crude oil price (€/MWh)	24.4	29.3
Crude oil costs (€/tonne)	331.5	395.8
Crude oil intensity (MWh/tonne)	13.76	13.62
Fuel oil price (€/MWh)	14.9	19.9
Fuel oil costs (€/tonne)	2.2	2.5
Fuel oil intensity (MWh/tonne)	0.14	0.11
Coke price (€/MWh)	15.3	20.7
Coke costs (€/tonne)	2.0	2.4
Coke intensity (MWh/tonne)	0.13	0.12

Source: CEPS/Ecofys.

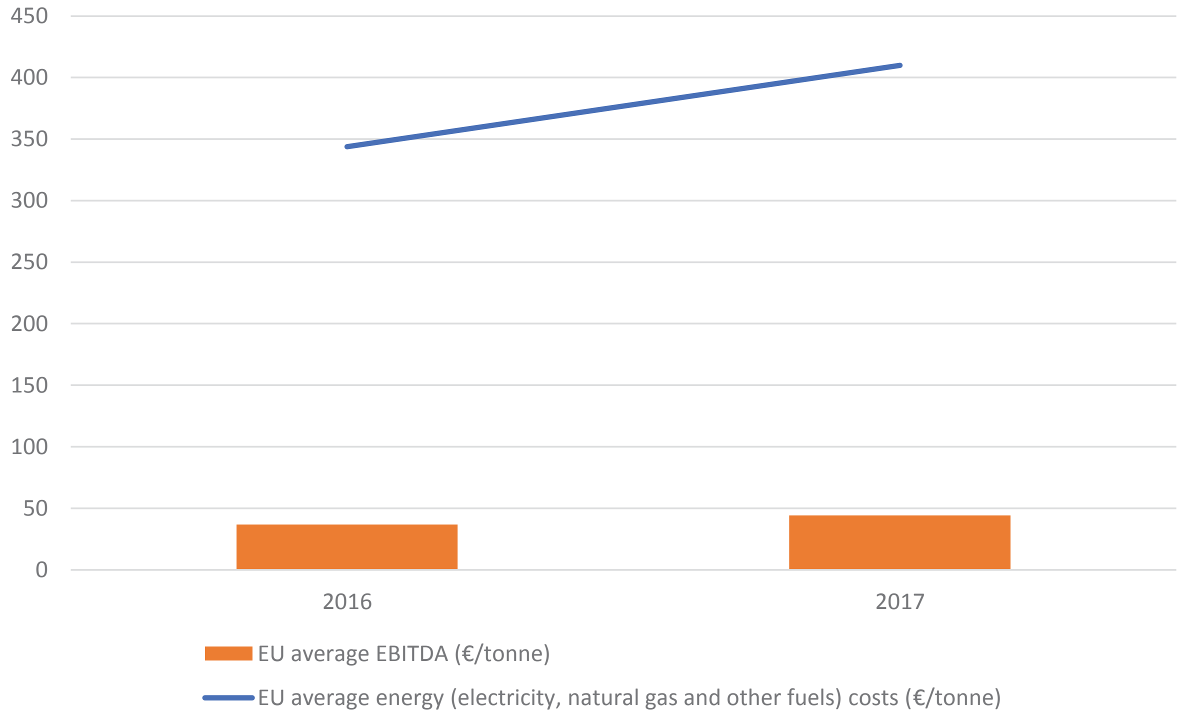
Competitiveness

Table 35. Key competitiveness indicators of refineries (EU averages)

Indicator	2016	2017
Share of electricity costs in production costs (%)	0.8	0.8
Share of natural gas costs in production costs (%)	1.1	1.1
Share of other gases costs in production costs (%)	1.7	1.7
Share of crude oil costs in production costs (%)	79.8	81.1
Share of fuel oil costs in production costs (%)	0.5	0.5
Share of petroleum coke costs in production costs (%)	0.5	0.5
Share of total energy costs in production costs (%)	84.4	85.6
Total energy costs (€/tonne)	343.9	409.8
EBITDA (€/tonne)	36.9	44.2
Ratio of total energy costs to EBITDA	9.3	9.3

Source: CEPS/Ecofys.

Figure 100. Energy costs versus EBITDA of refineries (€/tonne)



Source: CEPS/Ecofys.

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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

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ANNEX 2 – FACTORS DRIVING ENERGY COSTS IN MANUFACTURING IN THE EU SECTORS

This annex contains the results of the energy costs decomposition analysis of the various sectors analysed between 2010 and 2015 in the Staff Working Document (see section 6.4).

The decomposition of energy costs is following the formula below:

$$\Delta Energy\ Costs = (real)\ output\ effect + (real)\ energy\ intensity\ effect + price\ effect + residual$$

Where

— **(real) Output effect:** the effect of changes in real production (GVA),

— **(real) Energy intensity effect:** the effect of changes in energy per unit of real output (GVA) over time due to energy efficiency measures, behavioural changes and industry structural change;

— **Price effects:** the effect of changes in coal, gas and electricity prices.

— The **residual,** which includes the effect of unexplained data discrepancy with Eurostat SBS data on 'purchases of energy'.

Be aware that the residual can be rather significant in some specific cases for which the results of the analysis should be taken with precaution.

List of figures

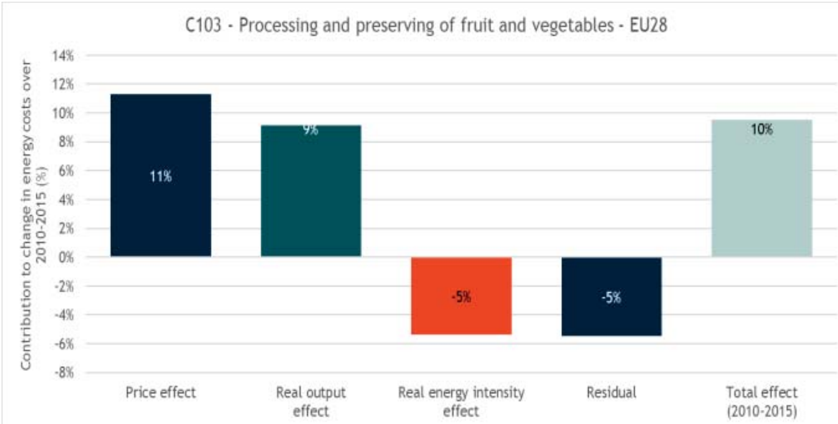


Figure 1: Fruit and vegetables

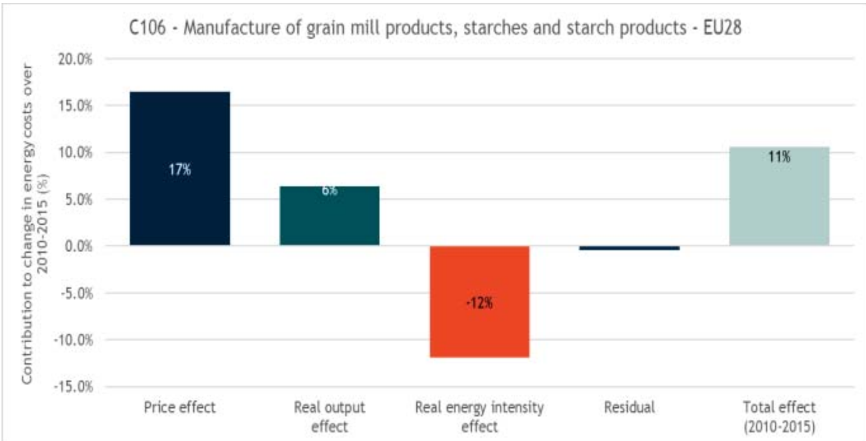


Figure 2: Grain mill and starch products

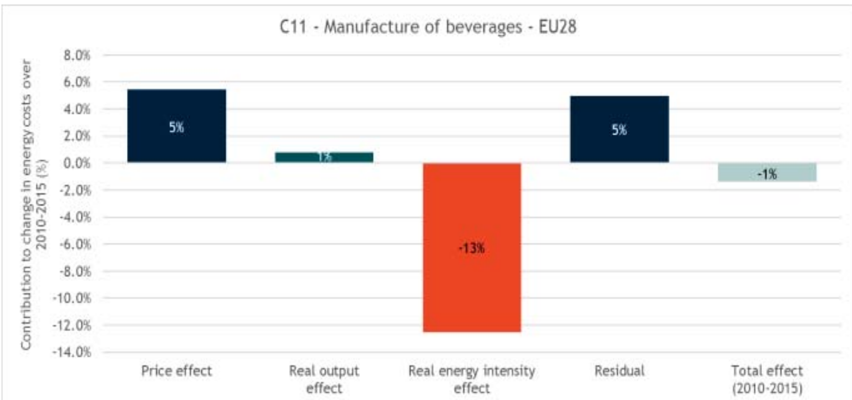
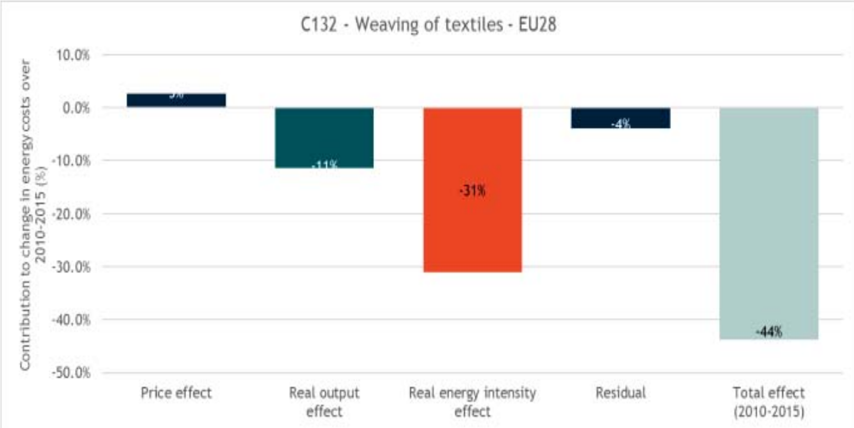


Figure 3: Manufacture of beverages



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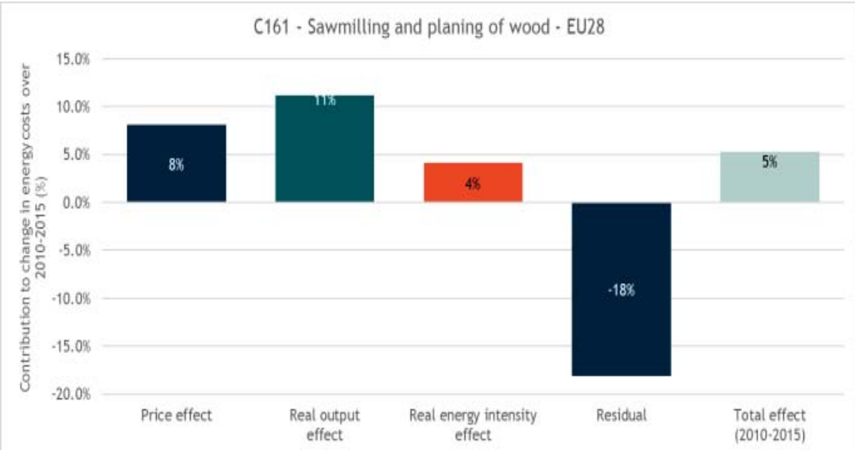


Figure 5: Wood

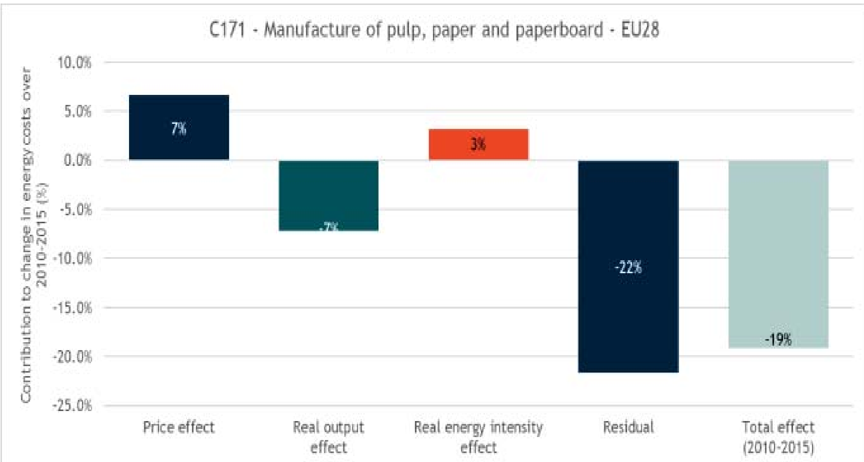


Figure 6: Pulp, paper and paperboard manufacture

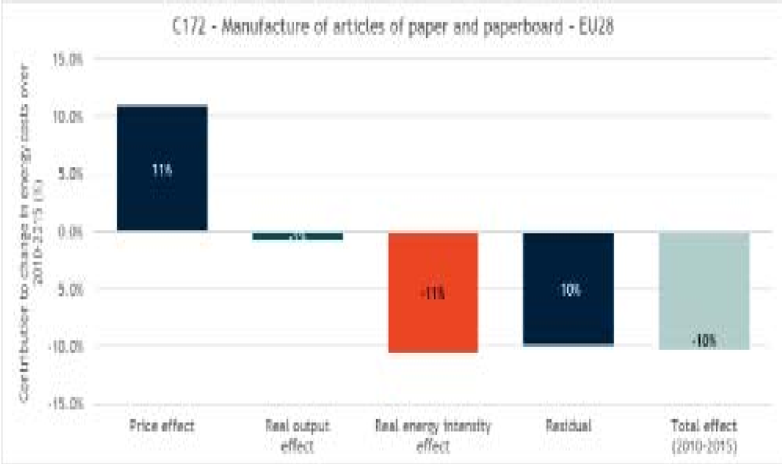


Figure 7: Paper and paperboard articles

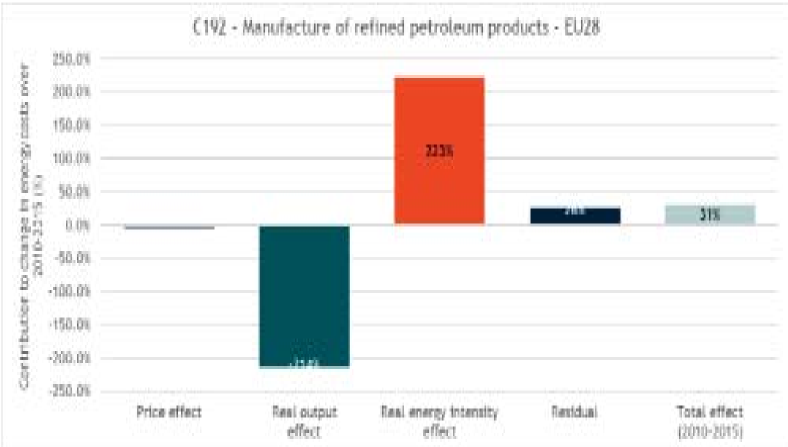


Figure 8: Refineries

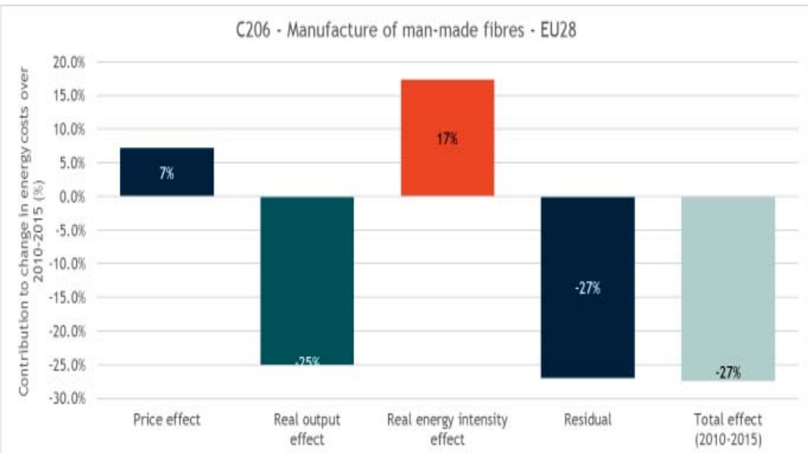


Figure 9: Man-made fibres

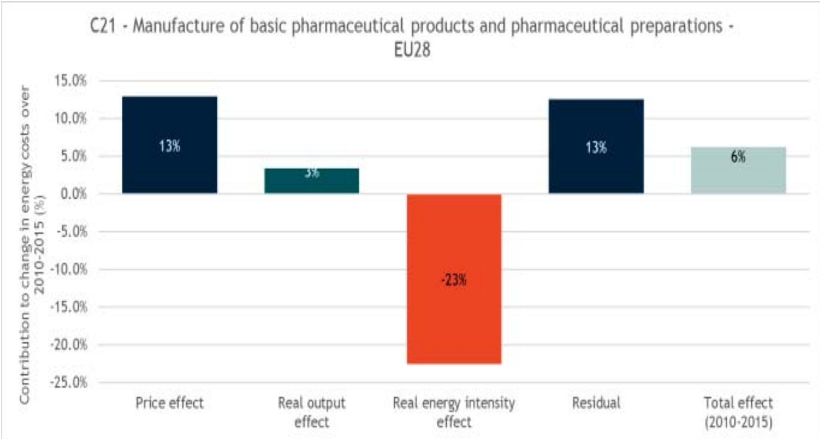
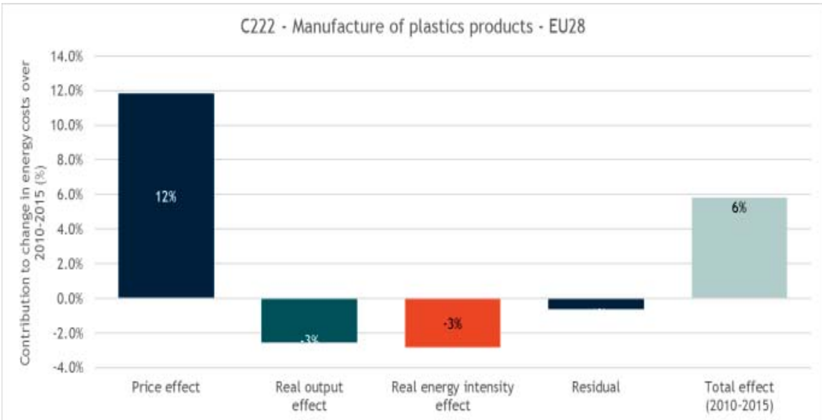


Figure 10: Pharmaceutical products



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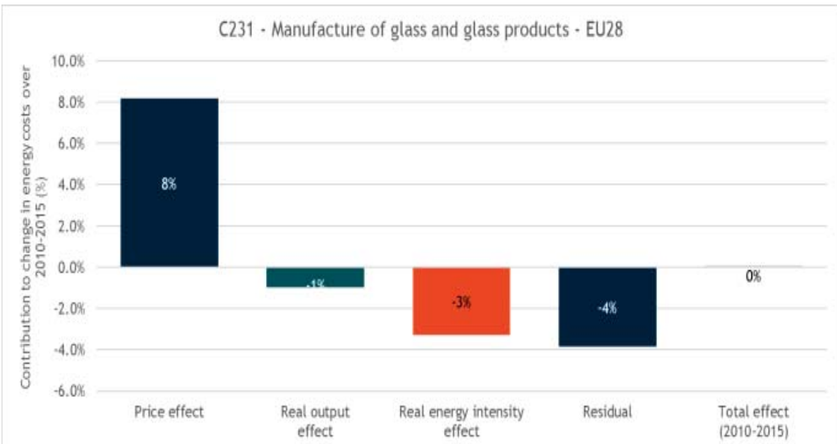

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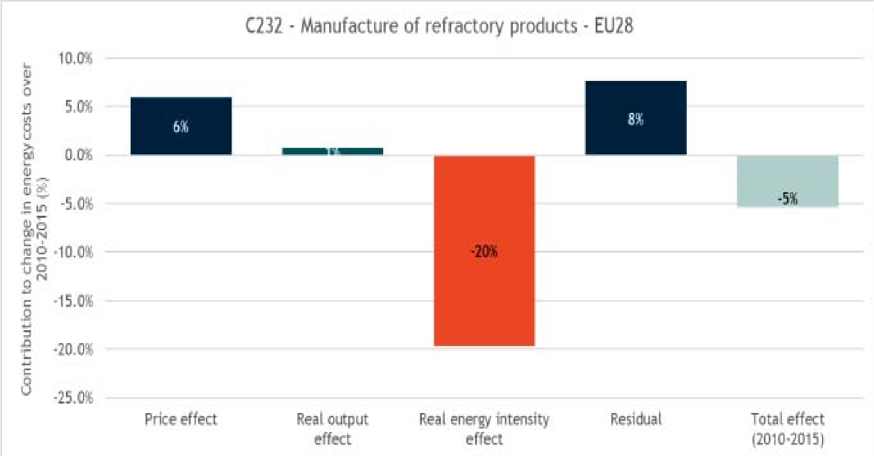

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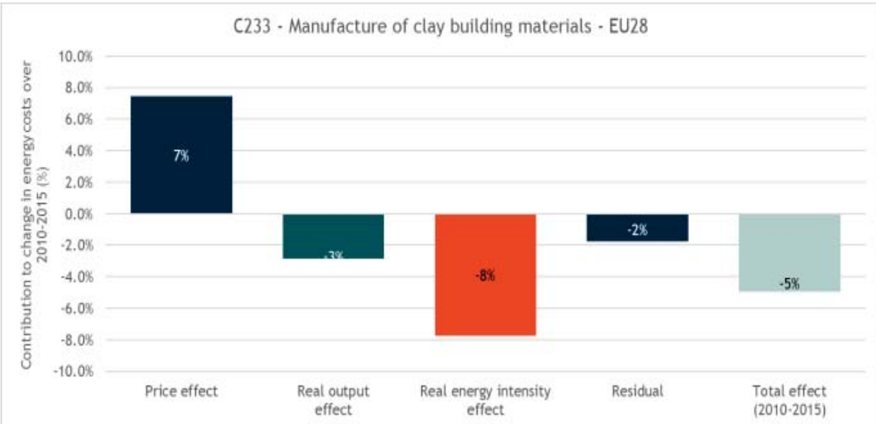

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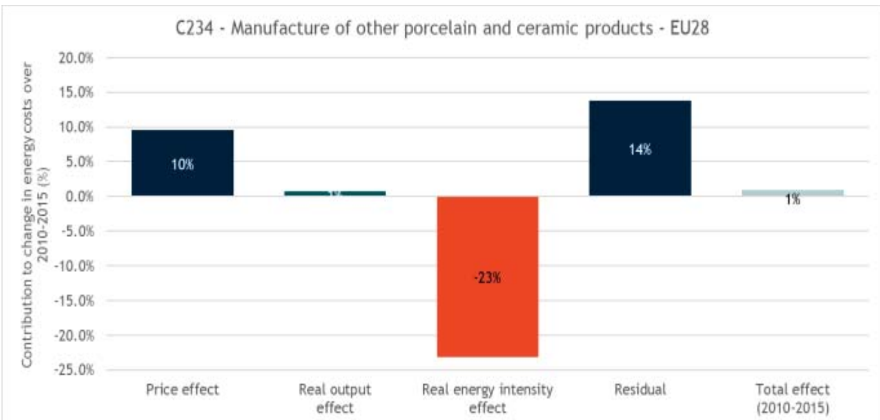

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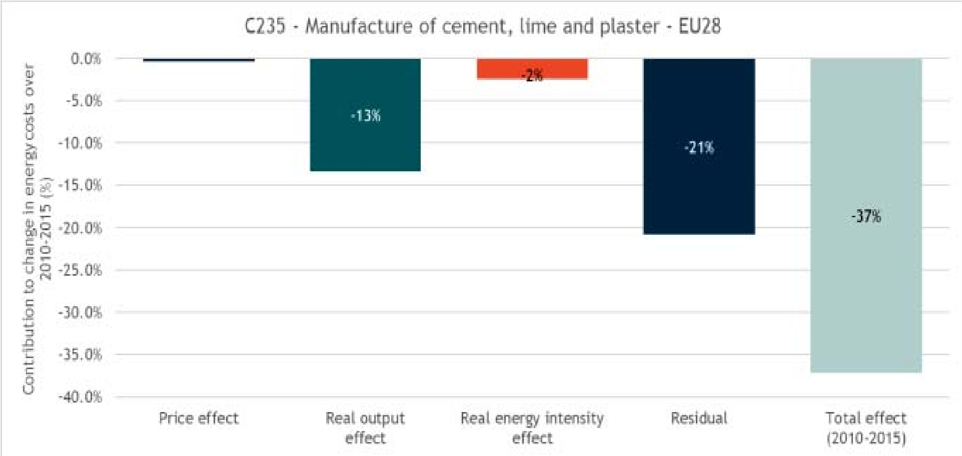

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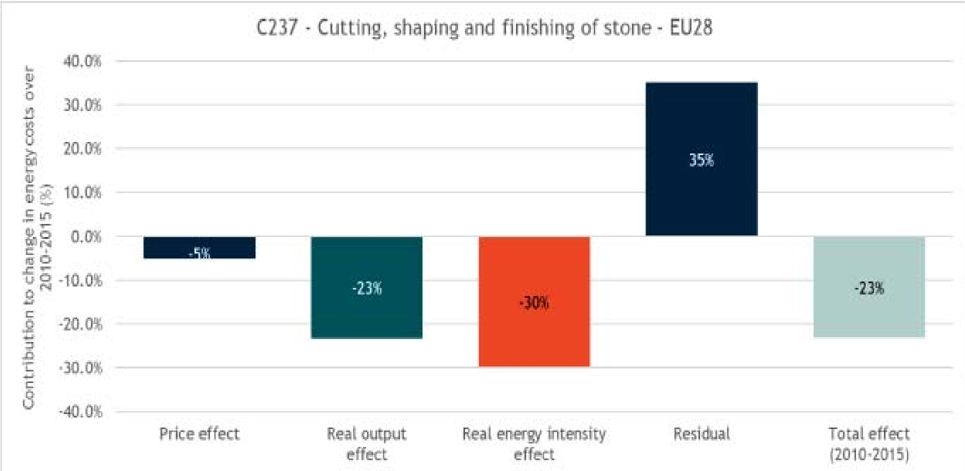


Figure 17: Stone

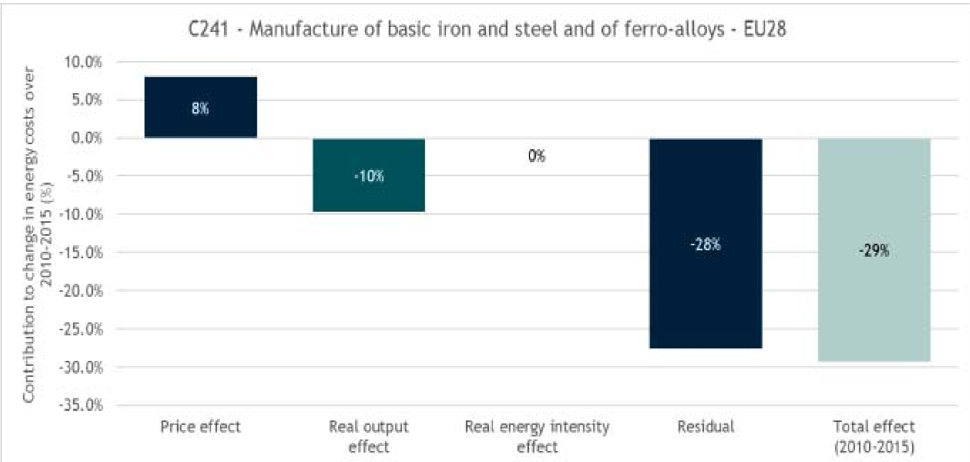
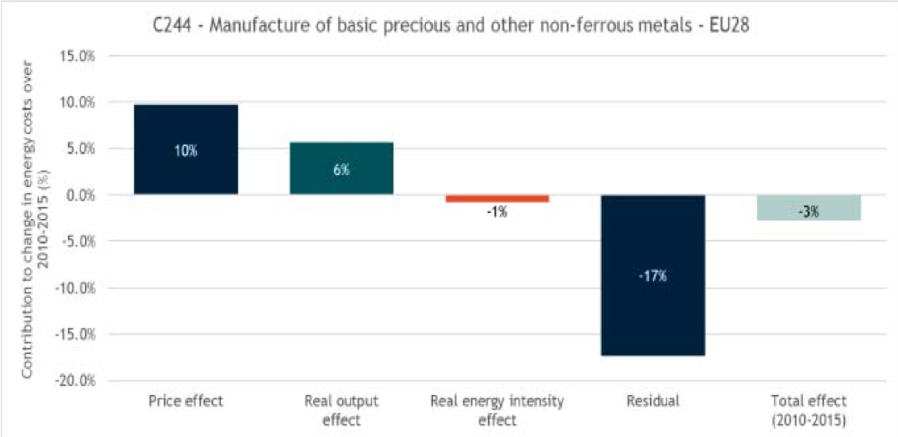


Figure 18: Basic iron and steel



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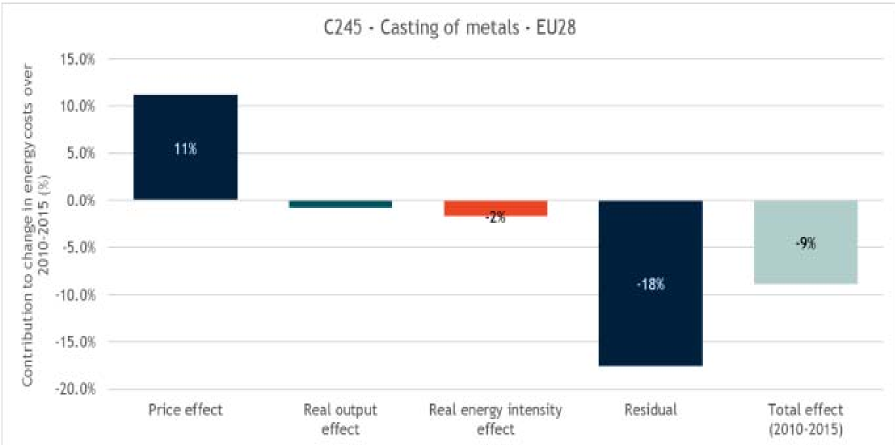

Figure 20: Casting of Metals

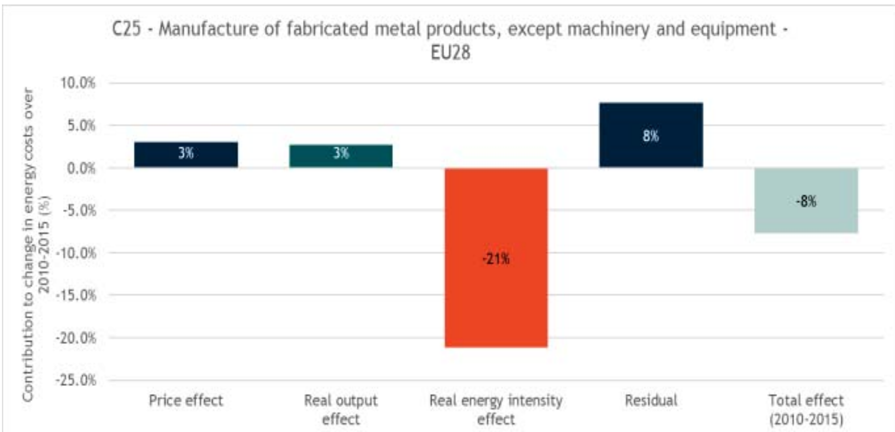

Figure 21: Fabricated metal products

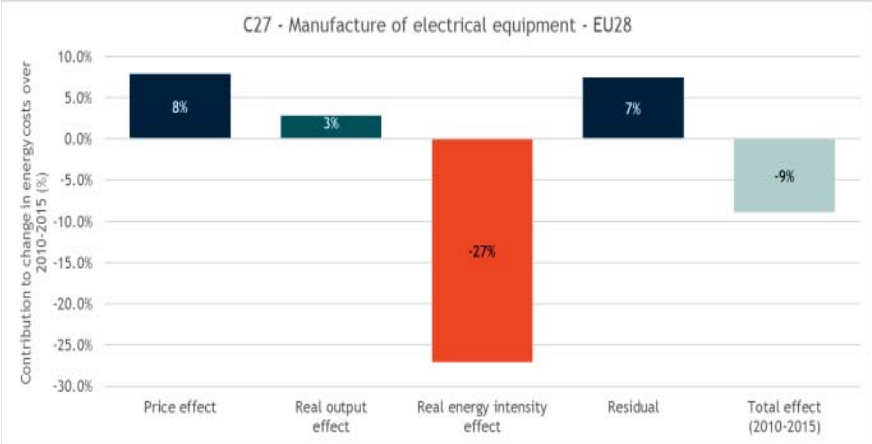

Figure 22: Electrical equipment

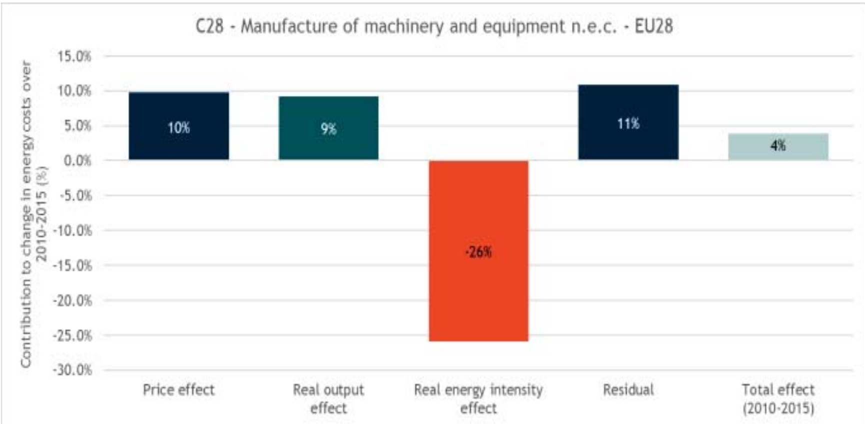

Figure 23: Machinery and equipment

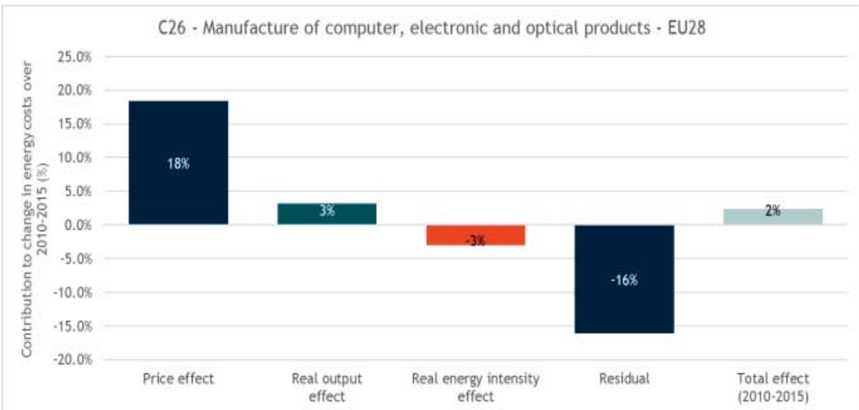

Figure 24: Computer and electronic products

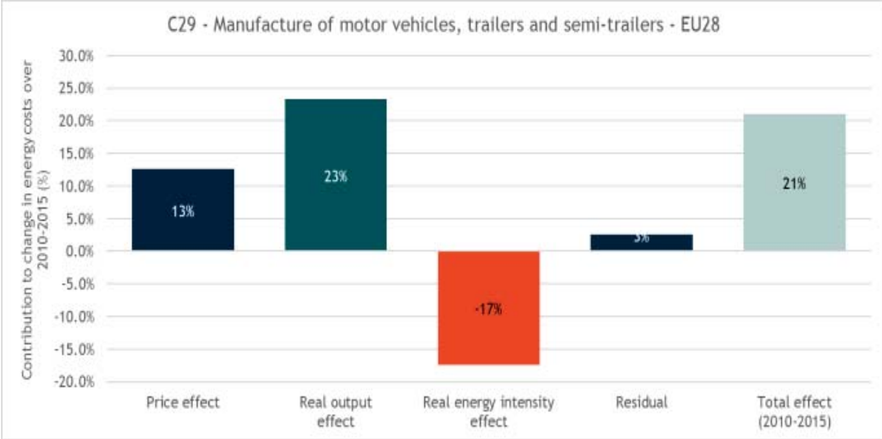

Figure 25: Motor vehicles and trailers

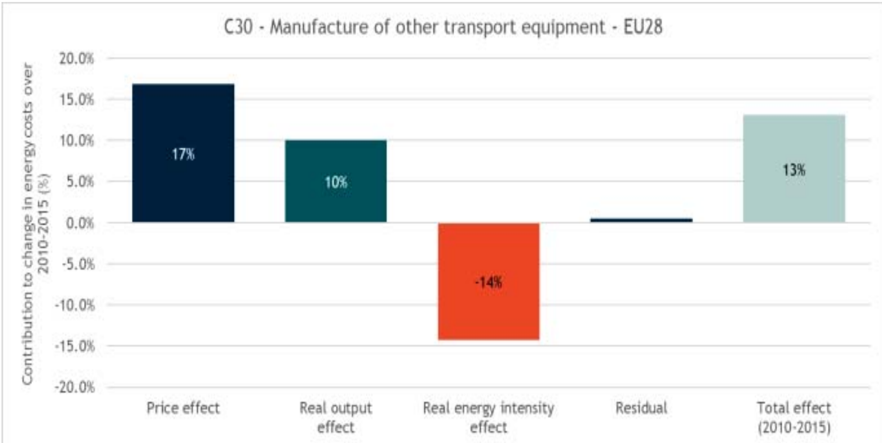

Figure 26: Transport equipment

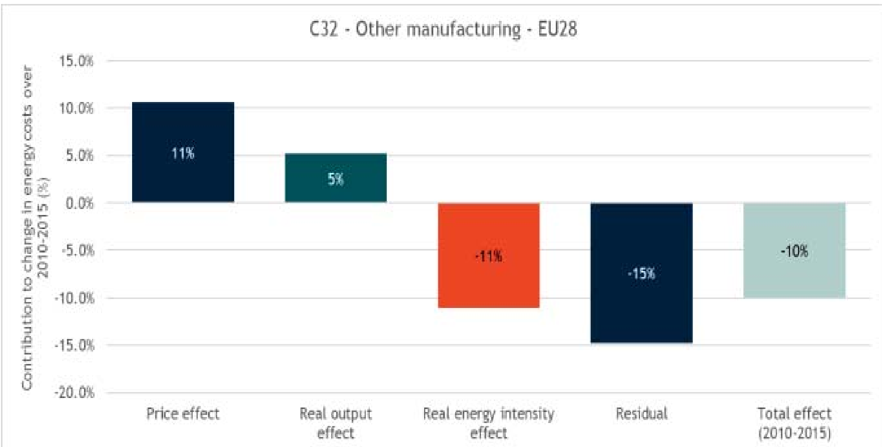

Figure 27: Other Manufacturing

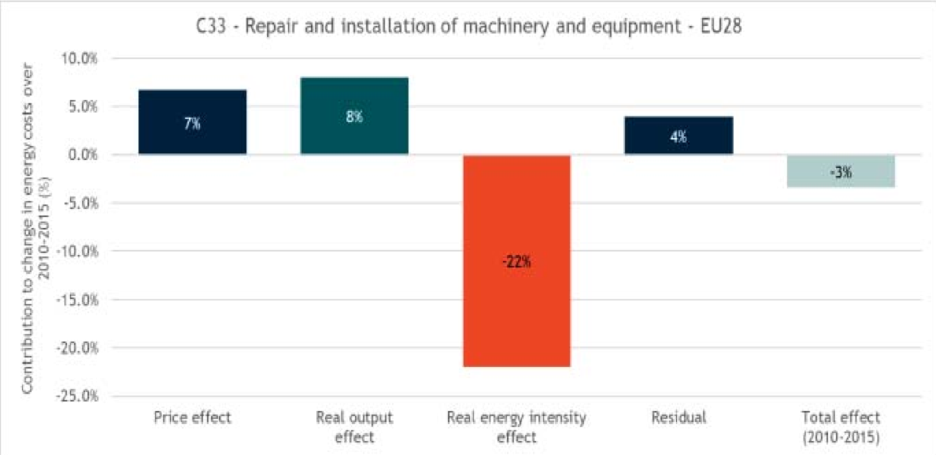

Figure 28: Machinery repair and installation

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Energy prices and costs in Europe

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List of Country sheets

Content

This annex contains country *energy prices and costs* factsheets of the 28 EU Member States, Norway, Montenegro and Turkey. Where available, each factsheet displays information about the level of electricity, gas and oil prices in 2017 as well as about the main components of such prices, including a detailed breakdown of the taxes and levies charged to gas and electricity prices. Information about the presence of price regulation and social tariffs in each country are also included in the price section of the factsheet.

The factsheets also contain an account of the relative importance of energy costs in production costs for industry and services for the EU Member States over 2008-2016. Finally, financial support interventions to energy products across countries are also presented with a breakdown indicating the economic sectors and energy technologies that receive that support.

Details

The purpose of annex 3 is to provide an overview of gas and electricity prices and costs for each country analysed.

In the first page, electricity and gas prices in 2017 are shown at national level in comparison with their respective neighbour countries and the EU average. Electricity and Gas prices for Households are shown first, followed by electricity and gas prices for Industry. Then the evolution of electricity and gas prices from 2008 to 2017 is presented.

In the second page, the amount of the taxes and levies included in electricity and natural gas prices across consumption bands in 2017 are listed for each country analysed. The state of play of price regulation is then presented for EU Member States. Some have already liberalised prices before 2008 and not even social tariffs were identified. For some others, the factsheet shows the relative importance of price regulation and social tariffs for households for electricity and gas (shares of consumers/consumption under price regulation and social tariffs).

In the third page, oil prices (in €/litre) are presented, showing the evolution for gasoline, diesel and heating oil prices at national level from 2008 to the first half of 2018 and compared to the EU average. VAT and other indirect taxes affecting the country's total prices are also displayed. Subsequently, energy costs shares in total production value costs for industry and services from 2008 to 2016 are shown and compared to the EU average.

The last page of each factsheet (usually page 4) includes (where available) the country's financial support interventions to energy products from 2008 to 2016. First, it shows the financial support by energy technology (electricity, renewable energy sources, heating and cooling sector, fossil fuels and all other energies) and then by the economic sectors the received the support (households, non-households, public, transport, manufacturing, energy industry, agriculture and cross sectors).

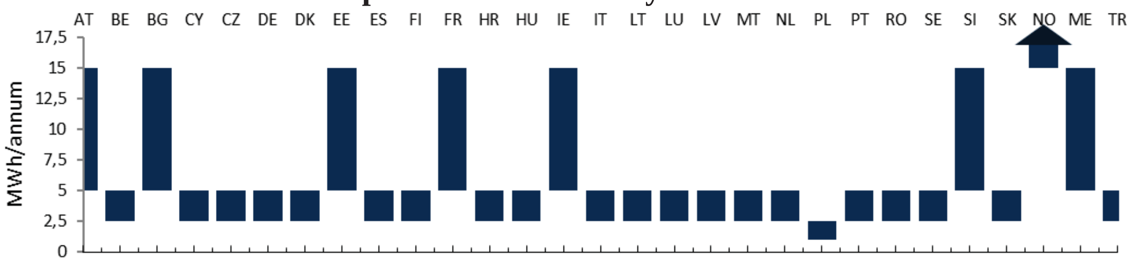
Methodology

In order to understand the price codes used for the graphs in the country sheets, please refer to the table below. Each code corresponds to a specific product (electricity or natural gas), which is related to the household or industry sectors and to a level of annual consumption.

Code	Product	Type	Annual consumption	Description
DC	Electricity	Household	2.5 - 5 MWh	median
IB	Electricity	Industry	20-500 MWh	small
ID	Electricity	Industry	2000-20000 MWh	median
IF	Electricity	Industry	70000-150000 MWh	large
D2	Natural Gas	Household	20-200 GJ	median
I3	Natural Gas	Industry	10000-100000 GJ	median
I5	Natural Gas	Industry	1 mil - 4 mil GJ	large

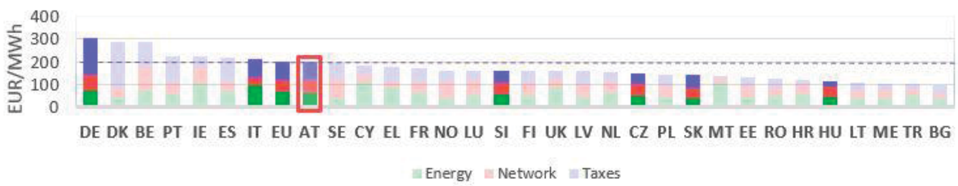
The "Most representative" band for household consumers is defined as the consumption band accounting for the largest share in total household consumption. It is thus the band with the highest volume of electricity irrespectively of the number of consumers in the band. The most representative bands are shown for the Member States that requested so in the context of the data collection of prices undertaken by the EC for the purposes of this report. For the others only the 'DC band' is shown.

Most representative bands by Member State



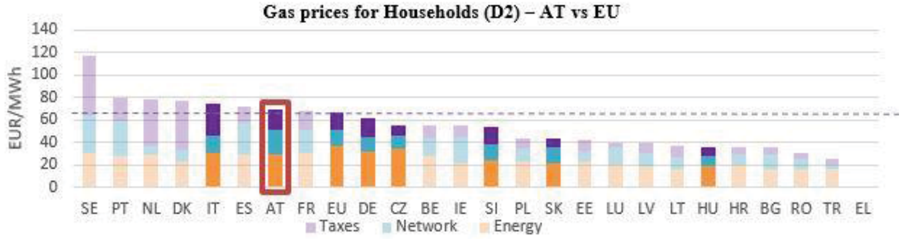
Austria

Electricity prices for Households (DC) – AT vs EU

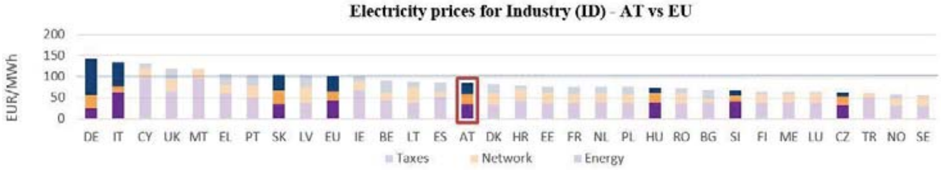


See footnote [1]

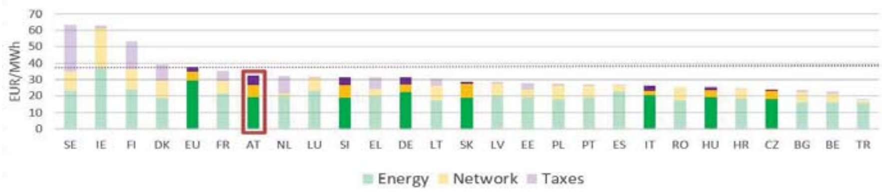
Gas prices for Households (D2) – AT vs EU



Electricity prices for Industry (ID) - AT vs EU



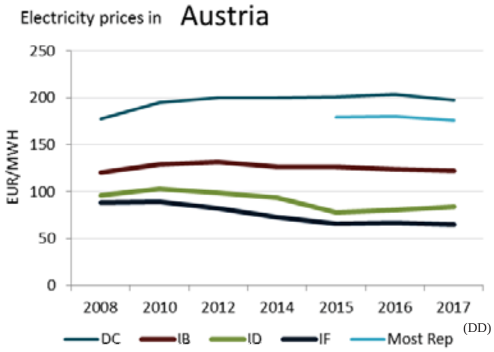
Gas prices for Industry (I3) – AT vs EU

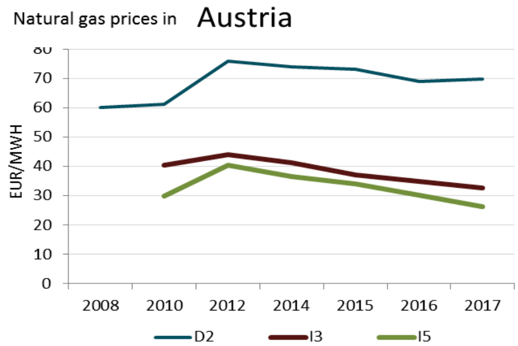


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

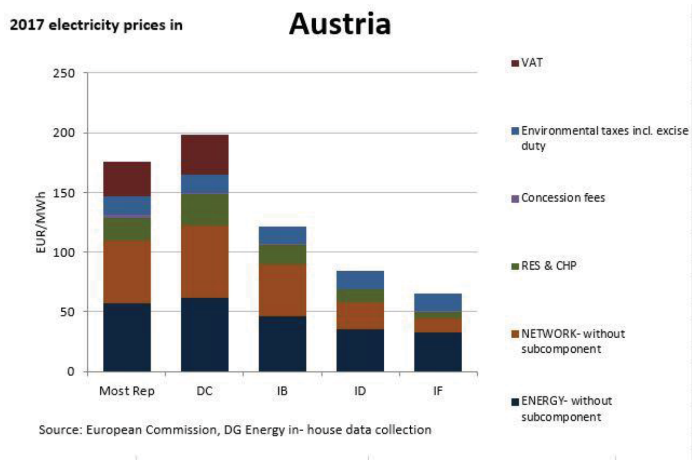
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

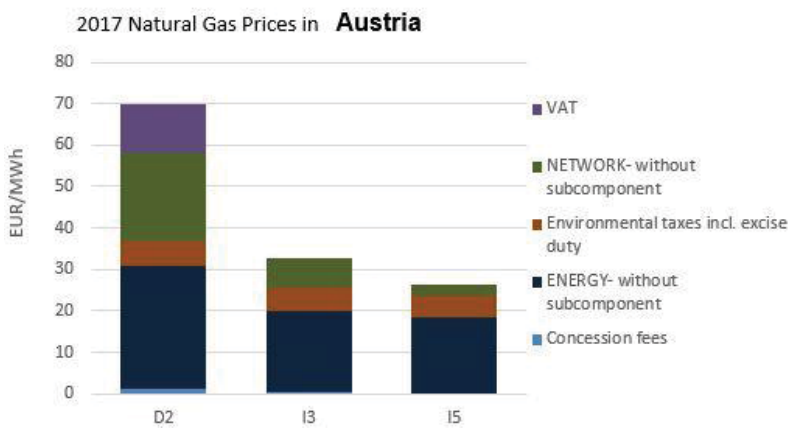
See footnote [2]





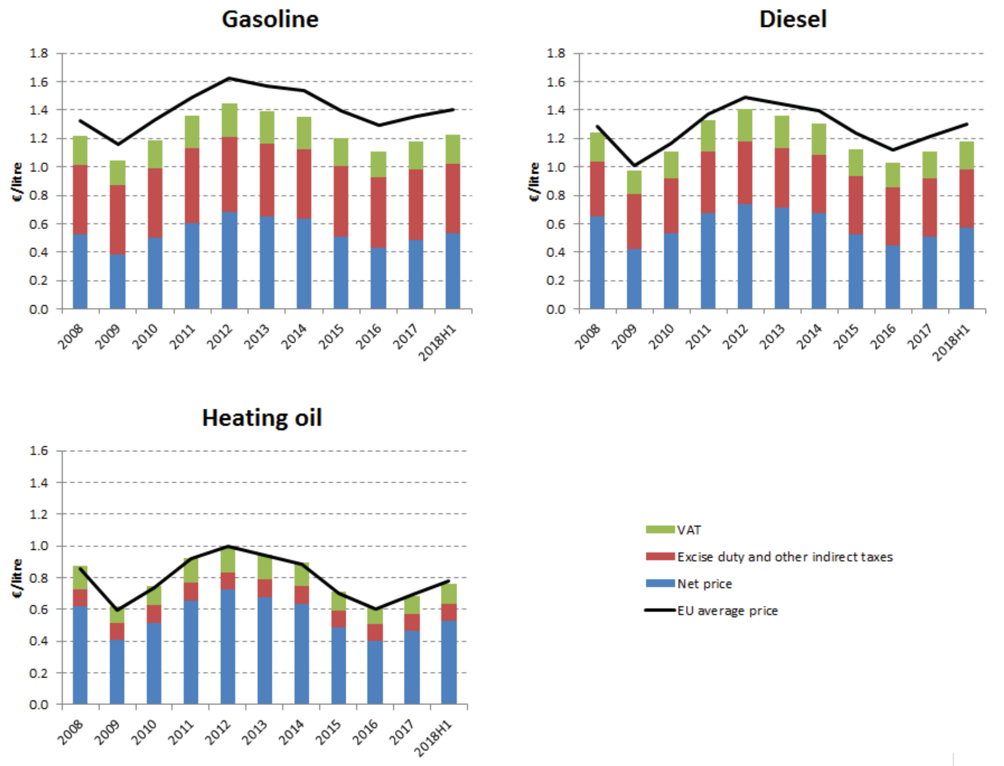
[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.



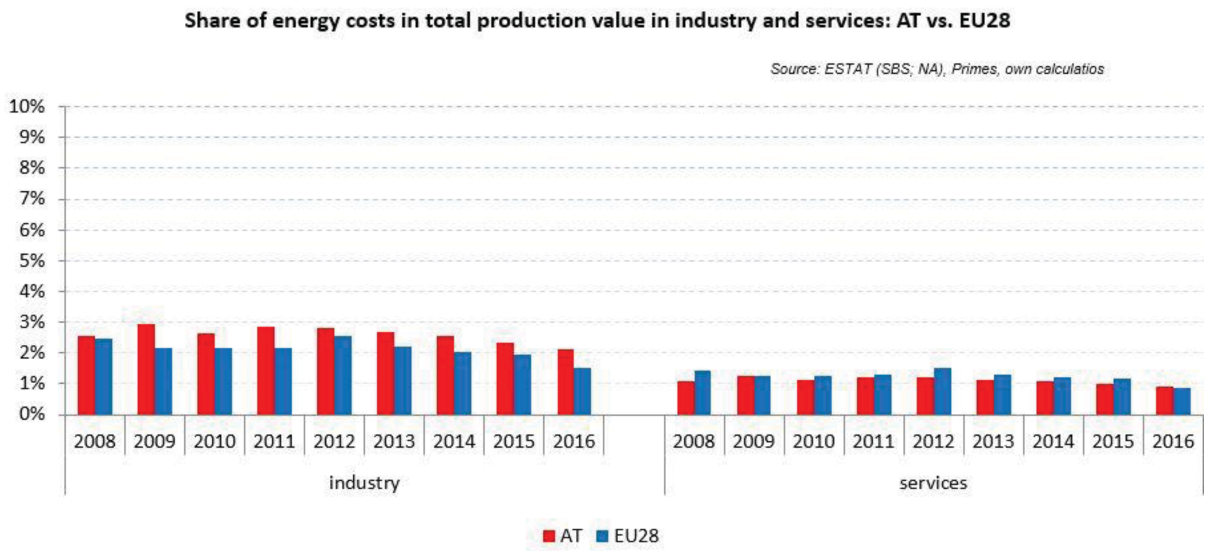


This country liberalised prices before 2008.
No social tariffs identified.

Oil prices

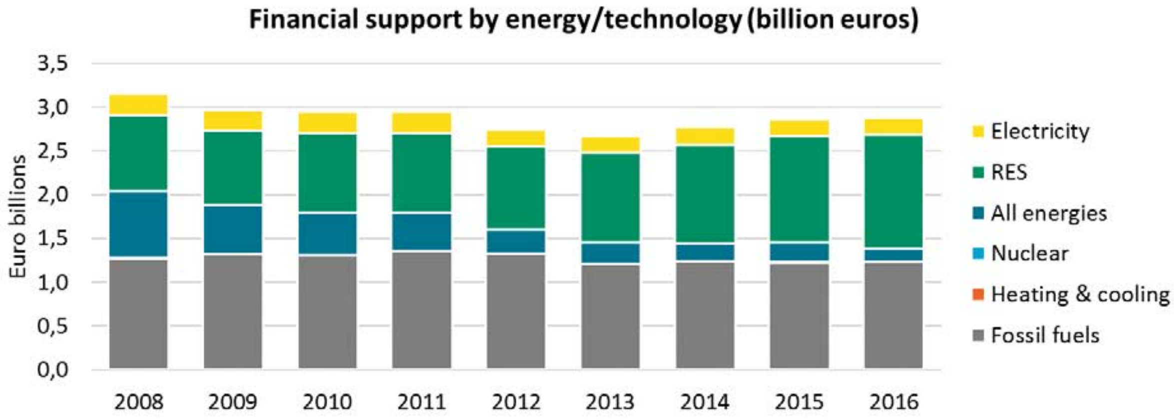


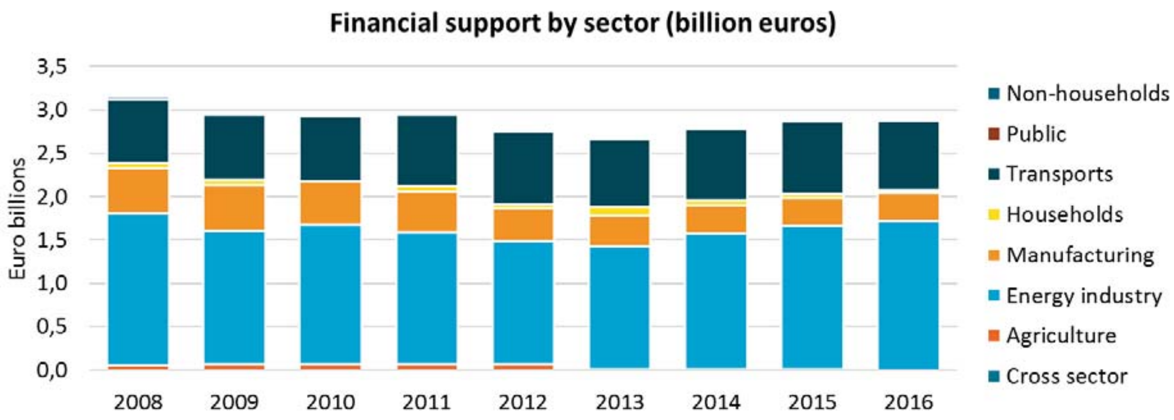
Energy costs shares in total production costs



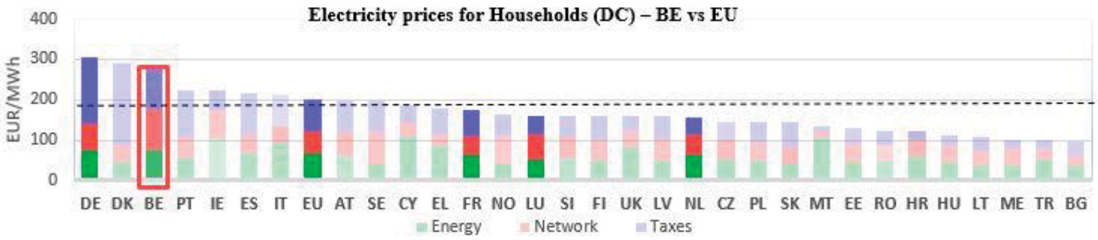
Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Financial support interventions

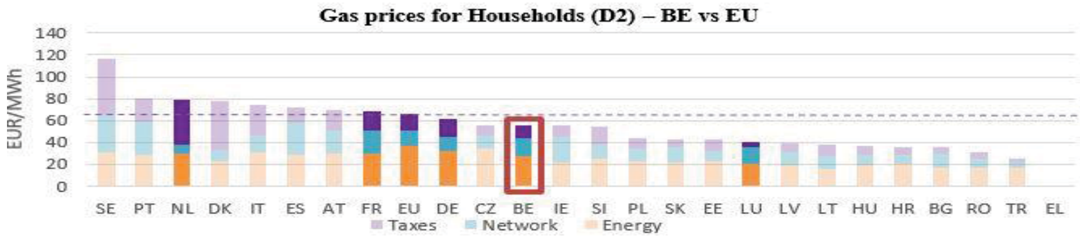


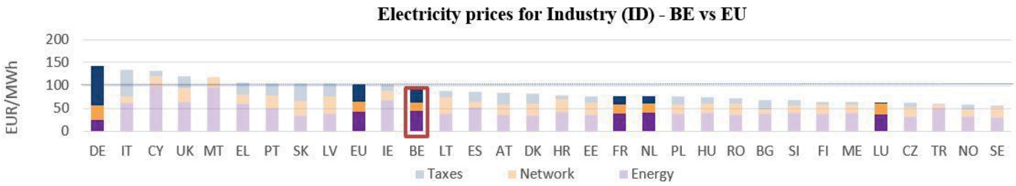


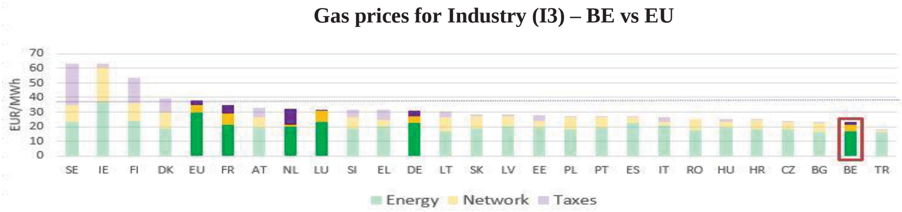
Belgium



See footnote [1]



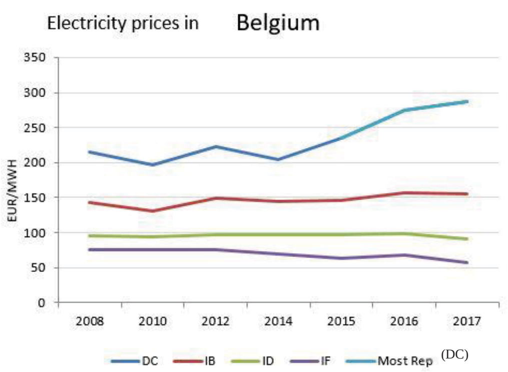


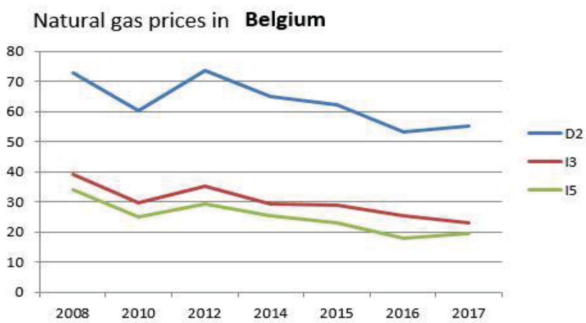


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]





[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017
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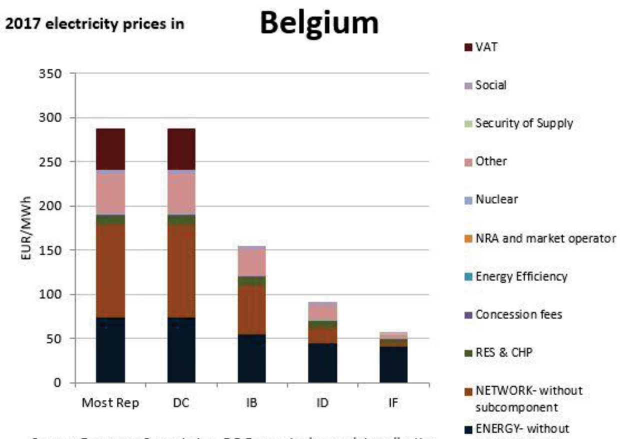
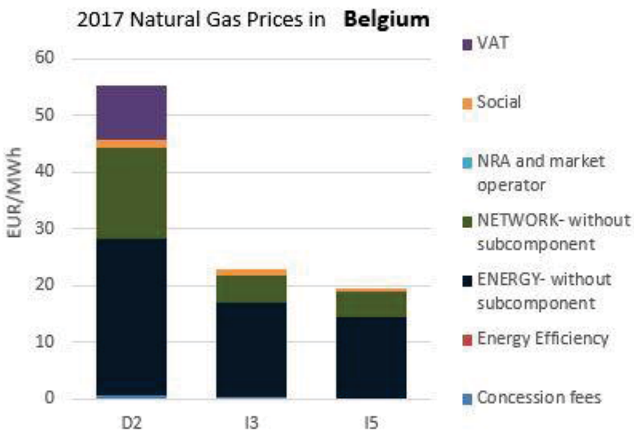
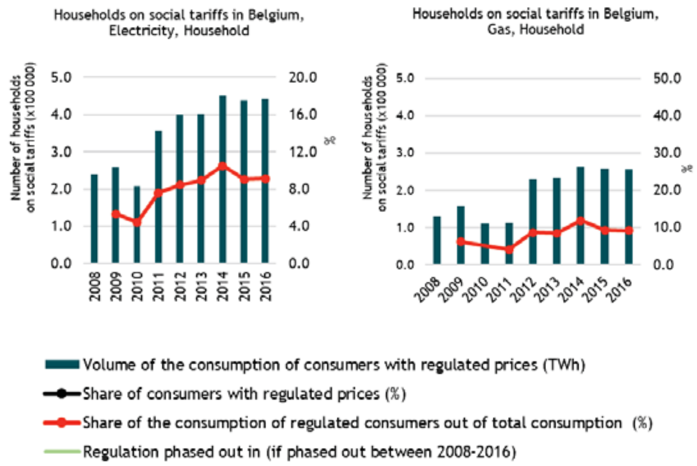


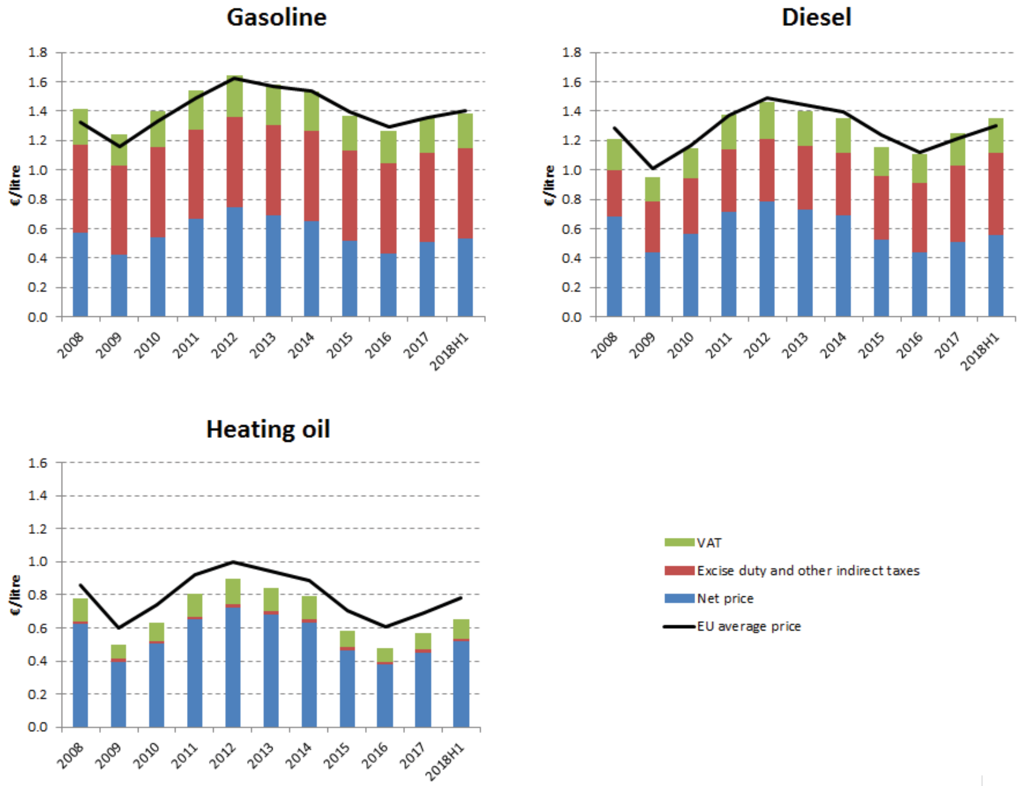
Source: European Commission, DG Energy in- house data collection



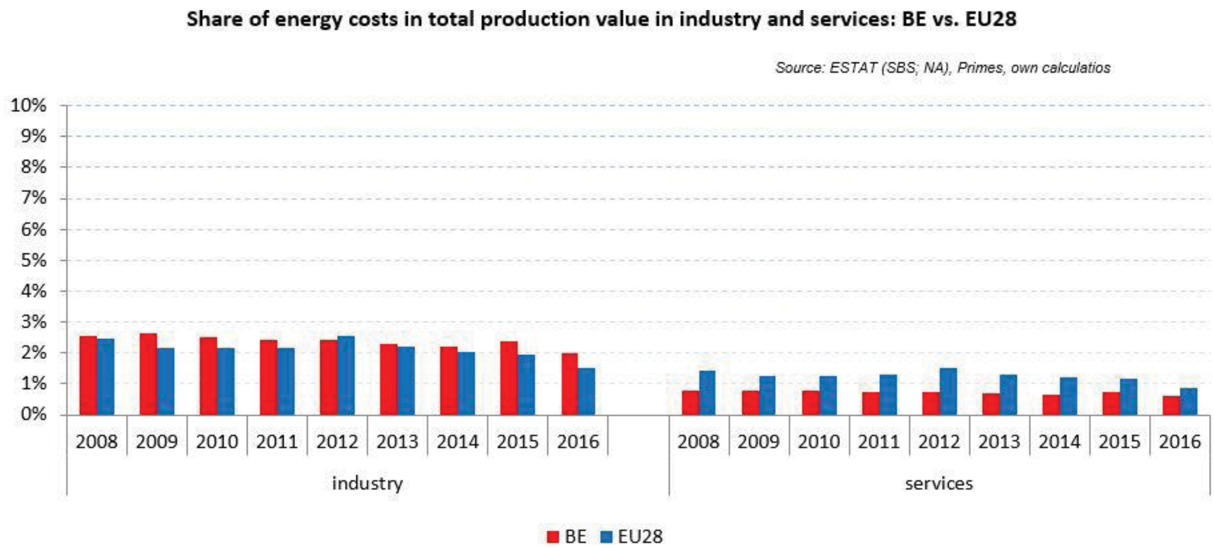
Price regulation



Oil products prices



Energy costs shares in total production costs



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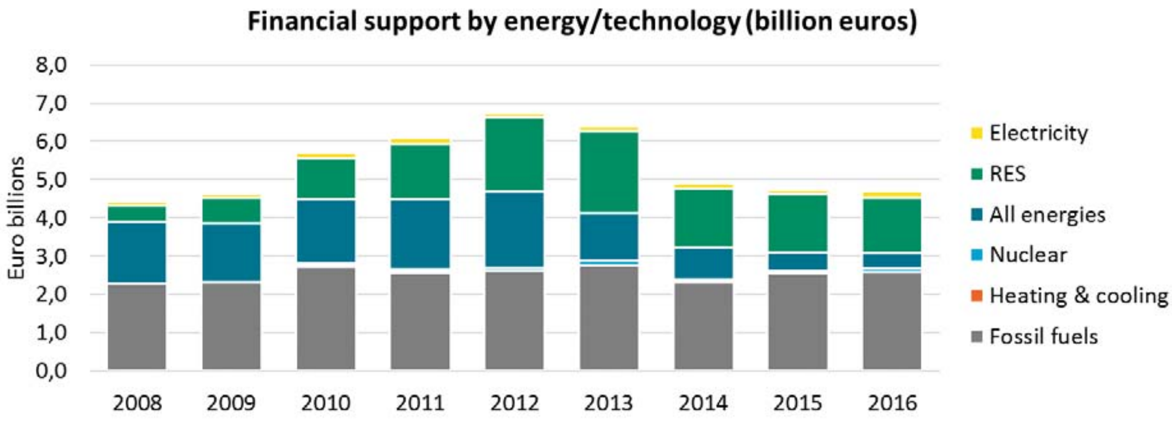
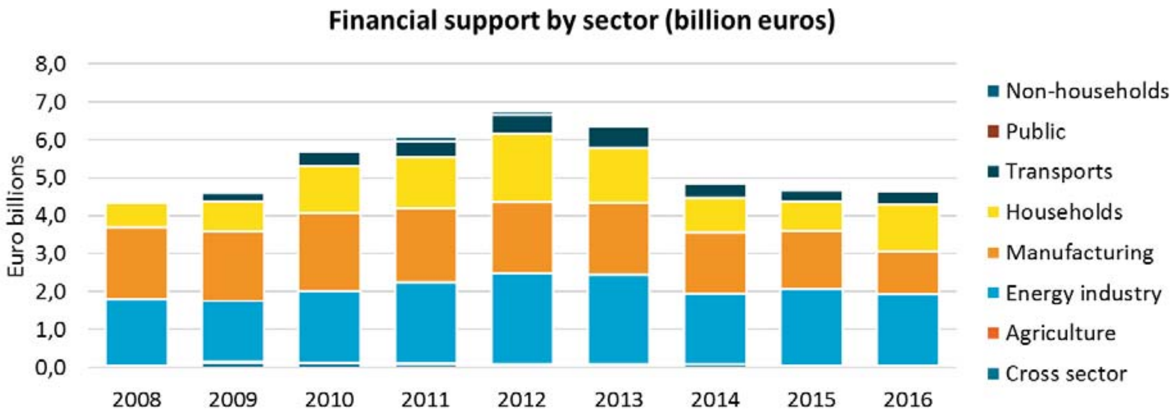
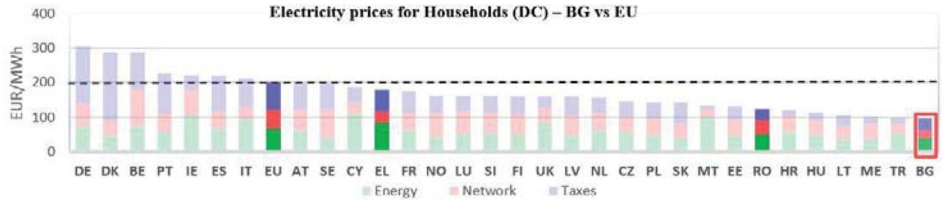
Financial support interventions

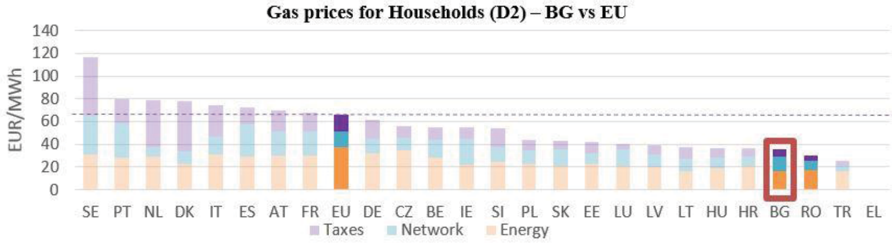


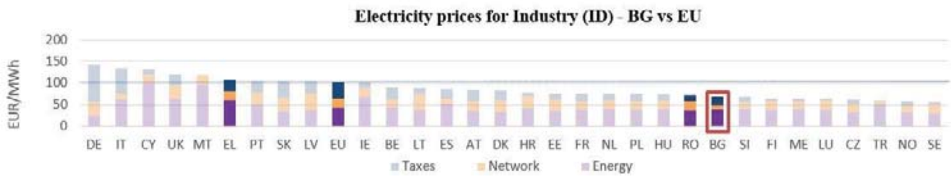


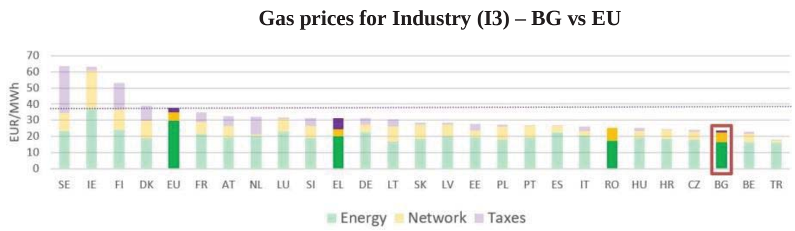
Bulgaria



See footnote [1]



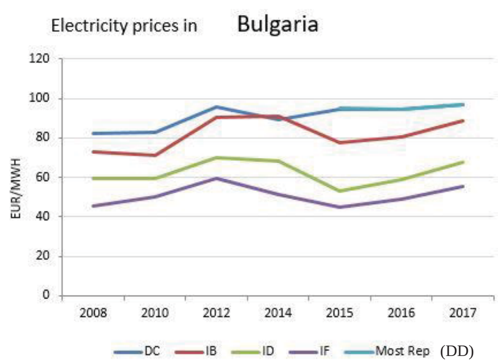


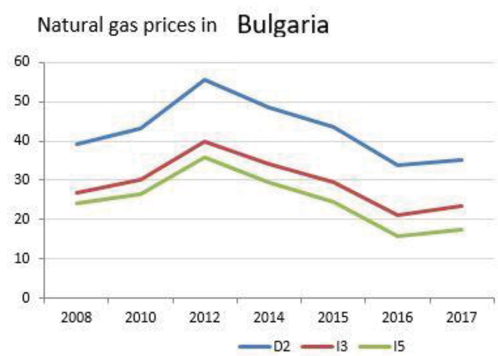


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

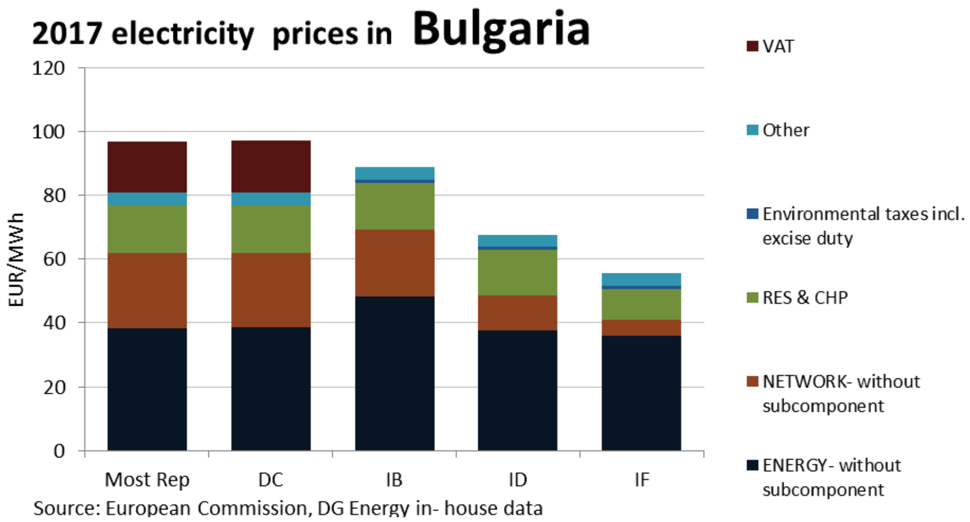
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

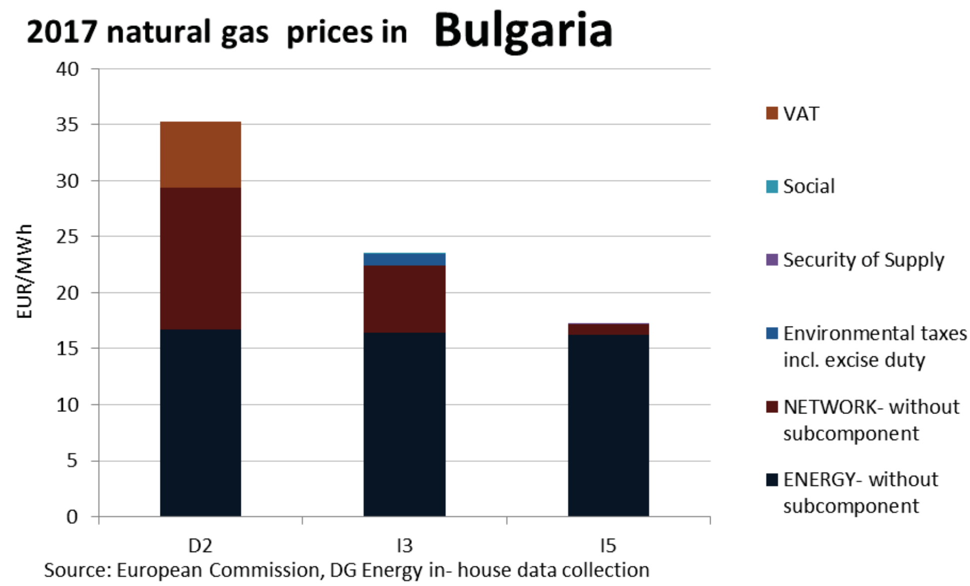
See footnote [2]





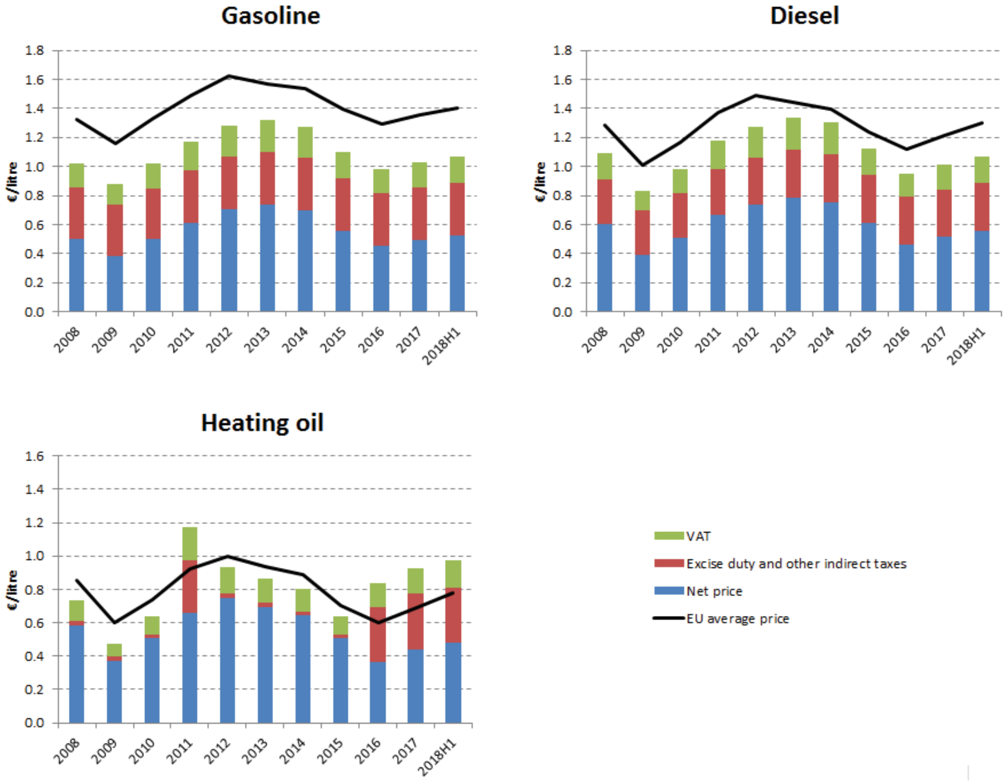
[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.



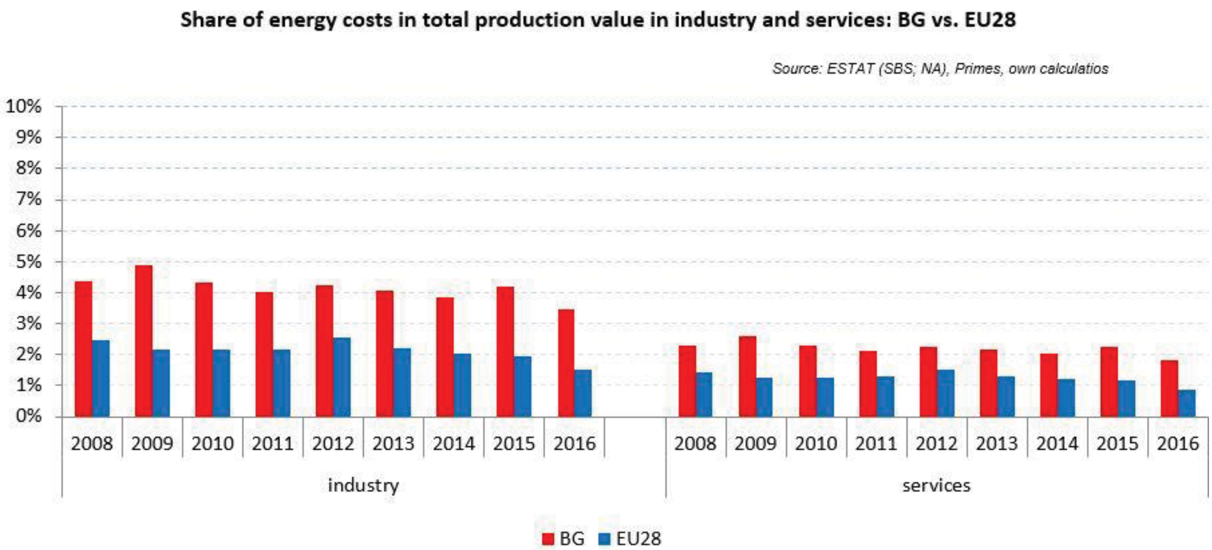


Price regulation was still existent in 2016

Oil products prices

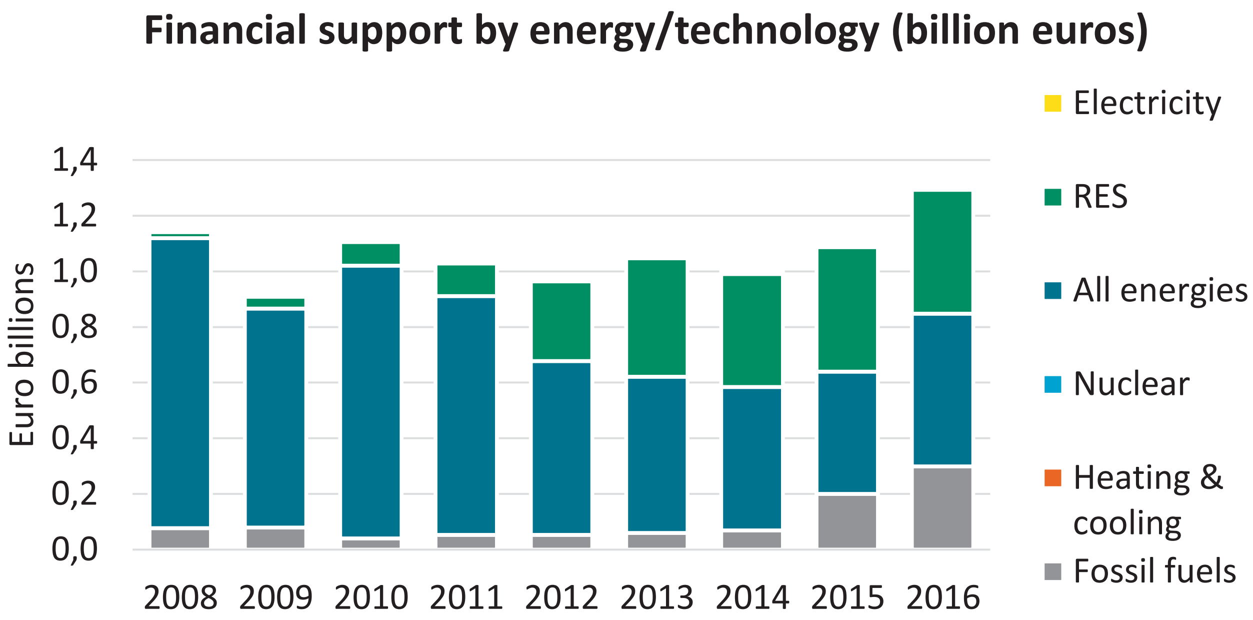


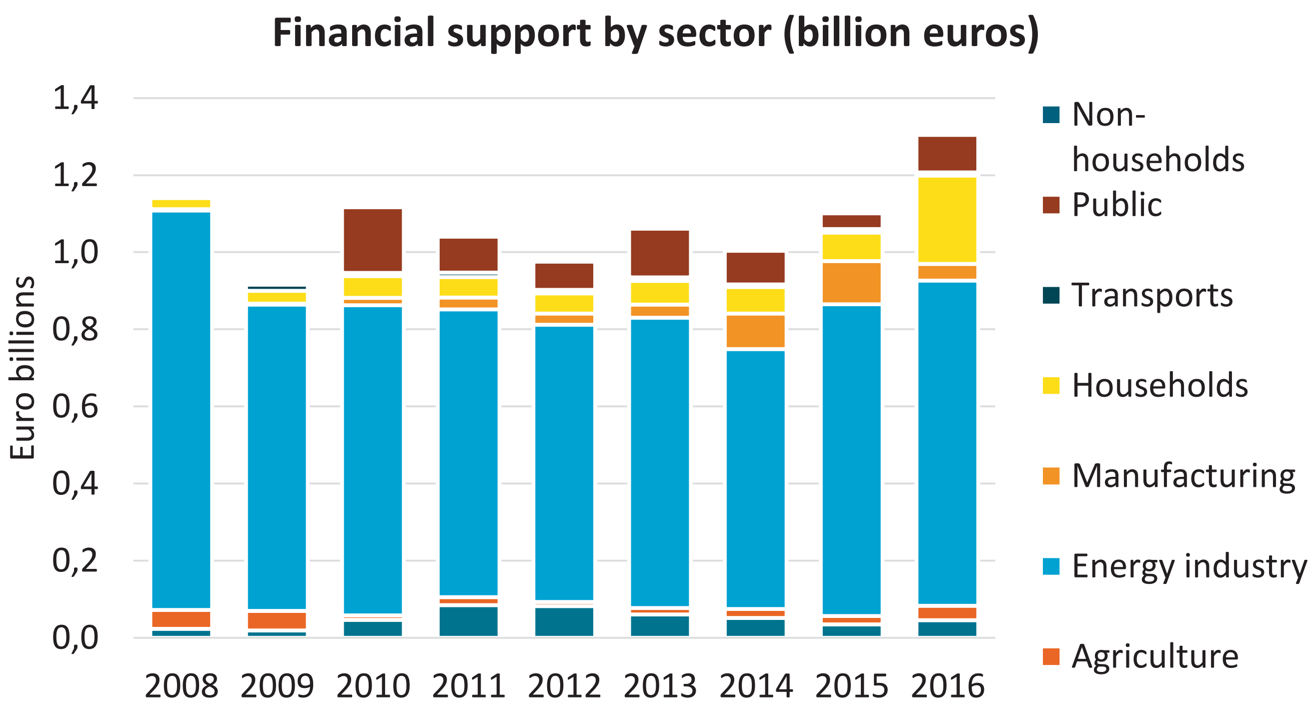
Energy costs shares in total production costs



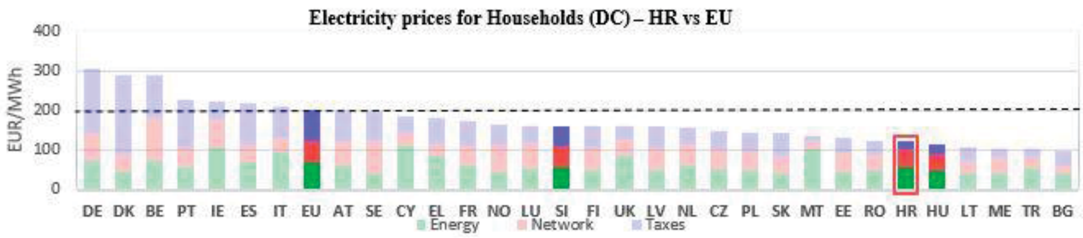
Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Financial support interventions





Croatia



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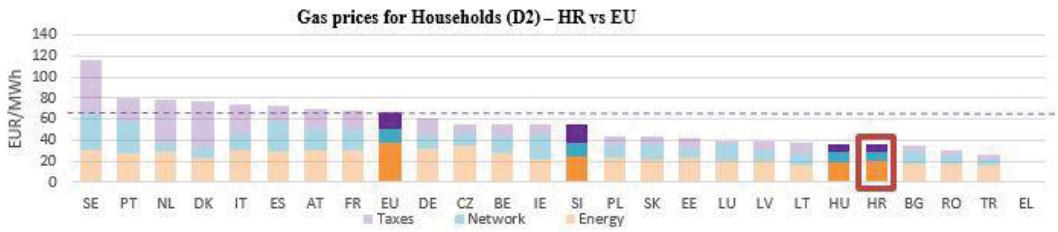
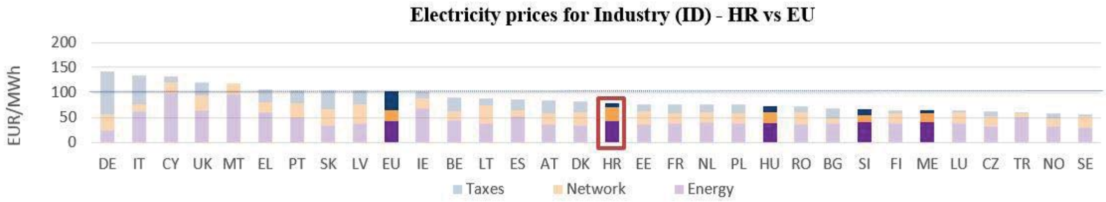
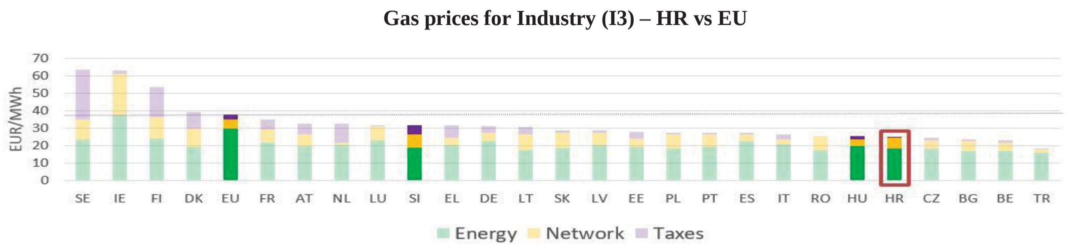


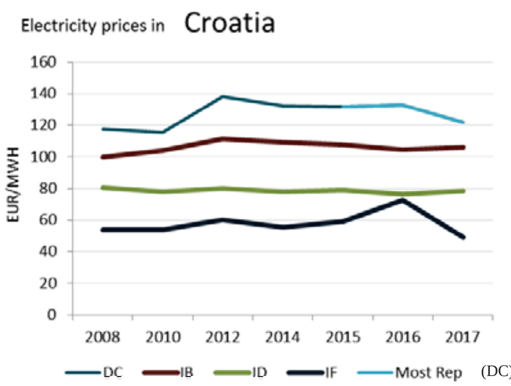


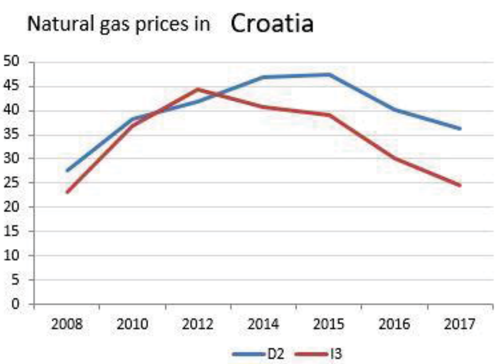


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]





[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
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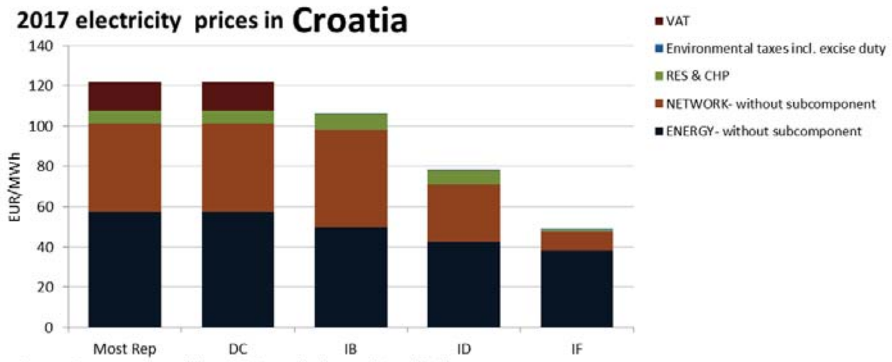
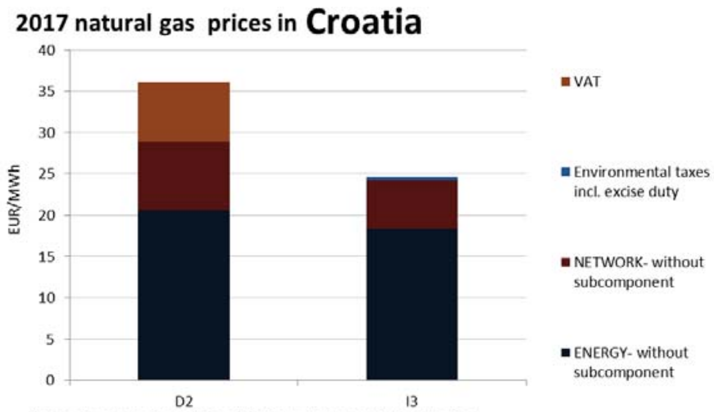
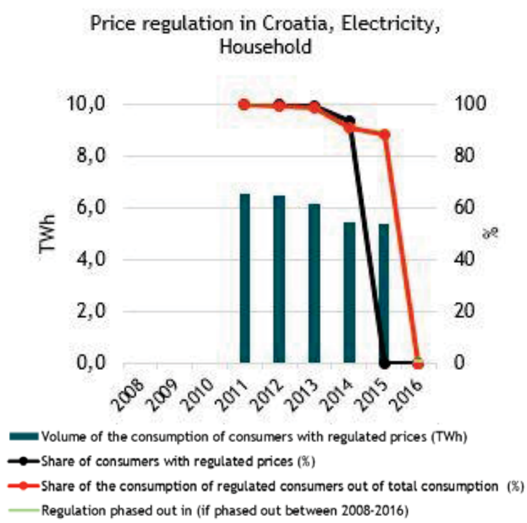


Source: European Commission, DG Energy in- house data collection

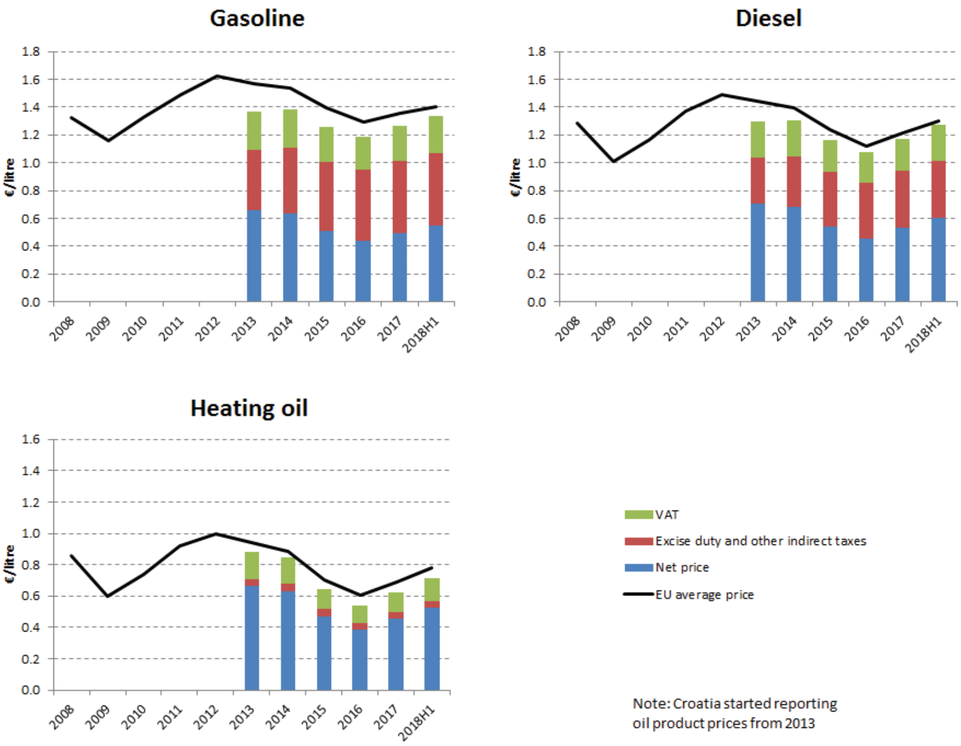


Source: European Commission, DG Energy in- house data collection

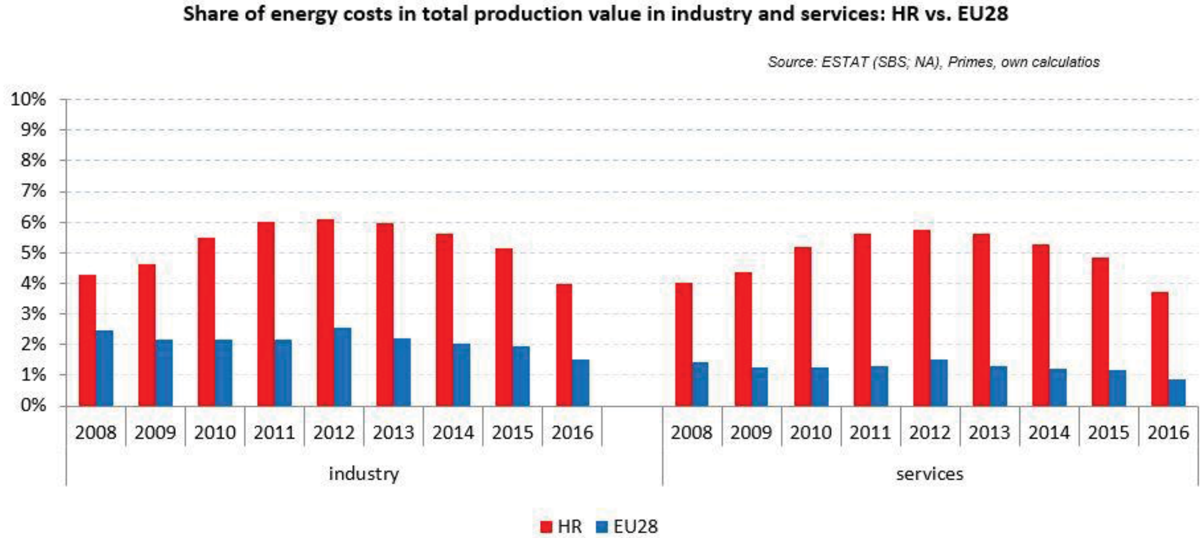
Price regulation



Oil product prices



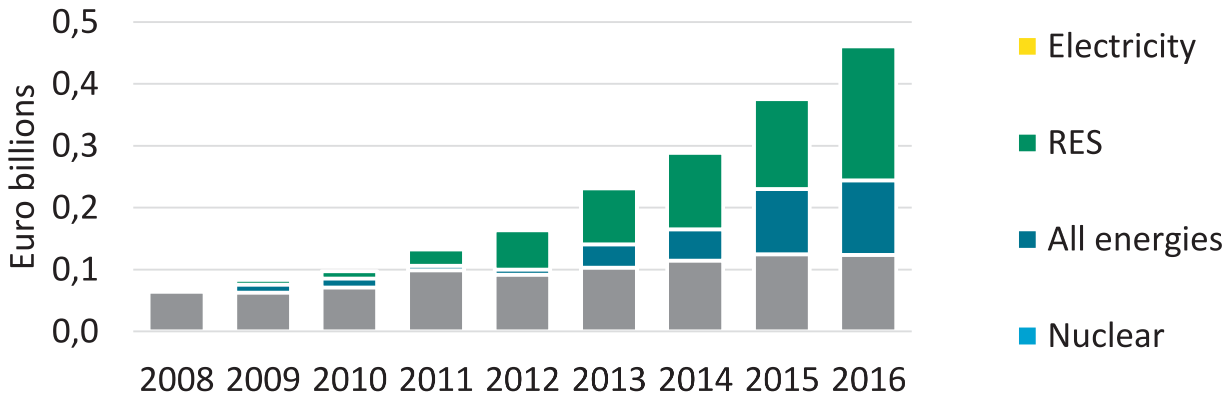
Energy costs shares in total production costs



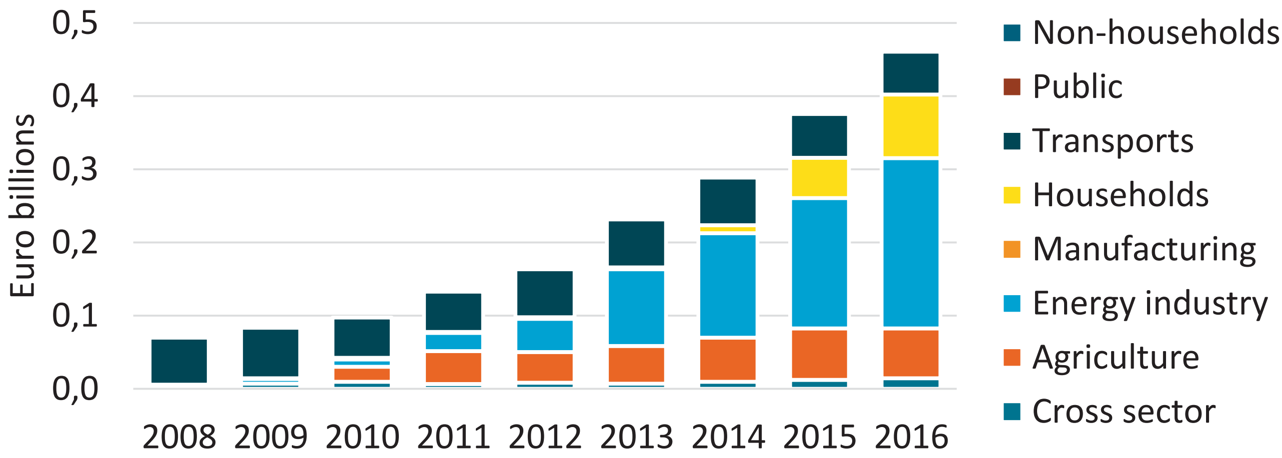
Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Financial support interventions

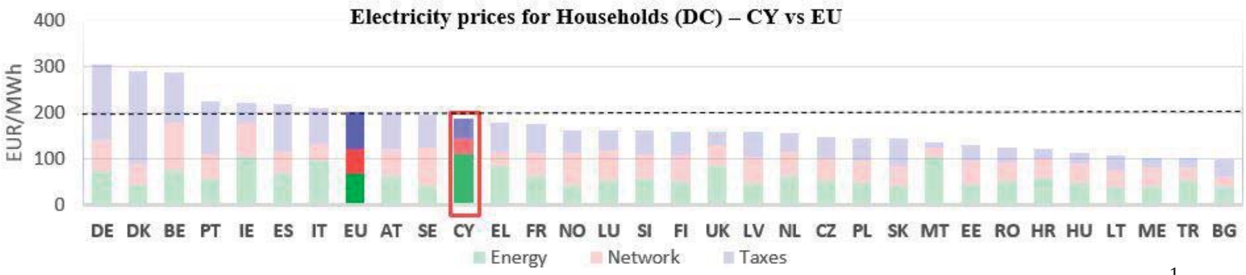
Financial support by energy/technology (billion euros)



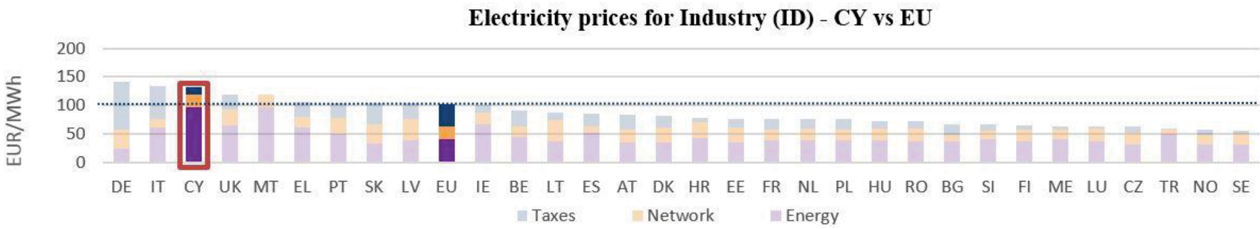
Financial support by sector (billion euros)



Cyprus



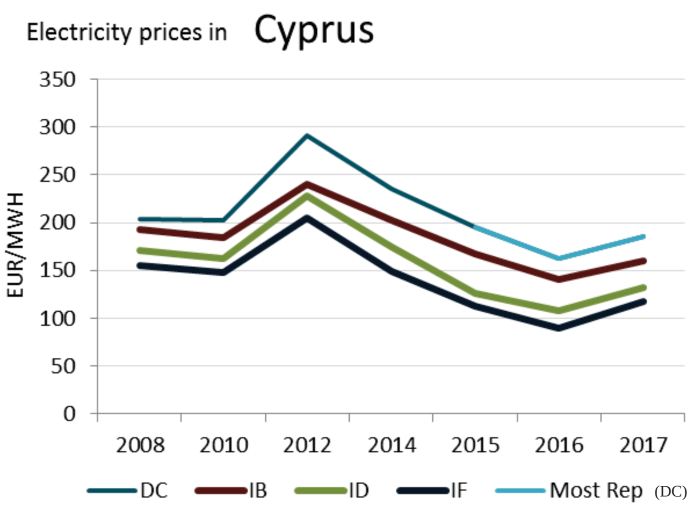
See footnote [1]



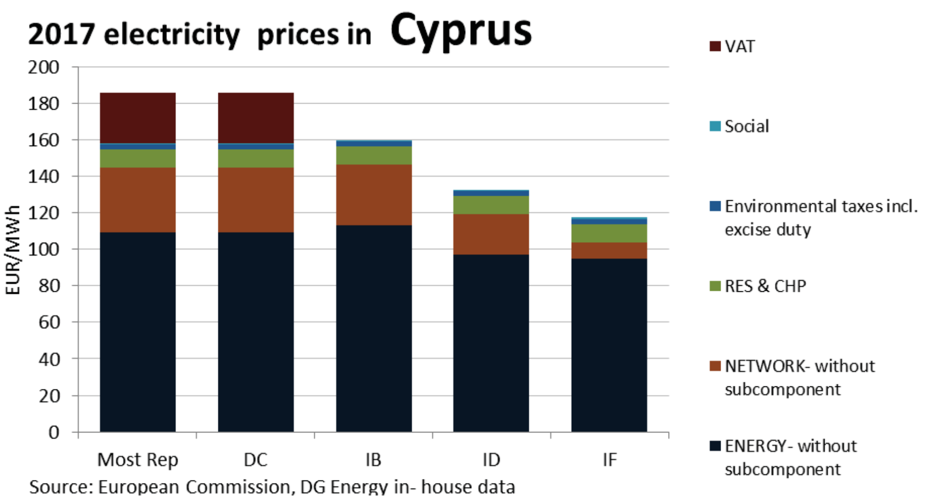
Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

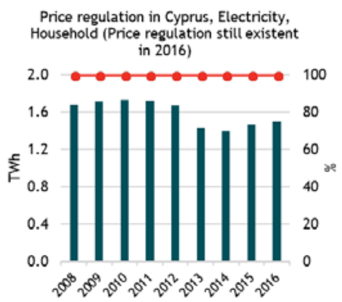
See footnote [2]

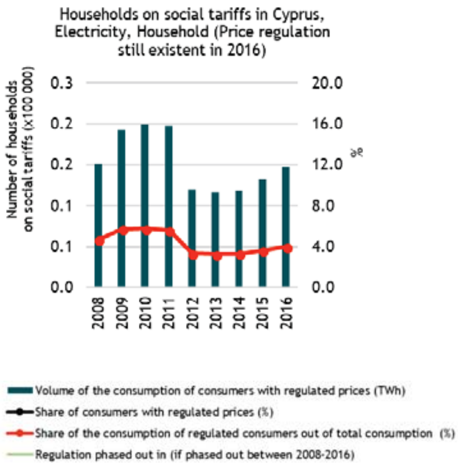


[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.

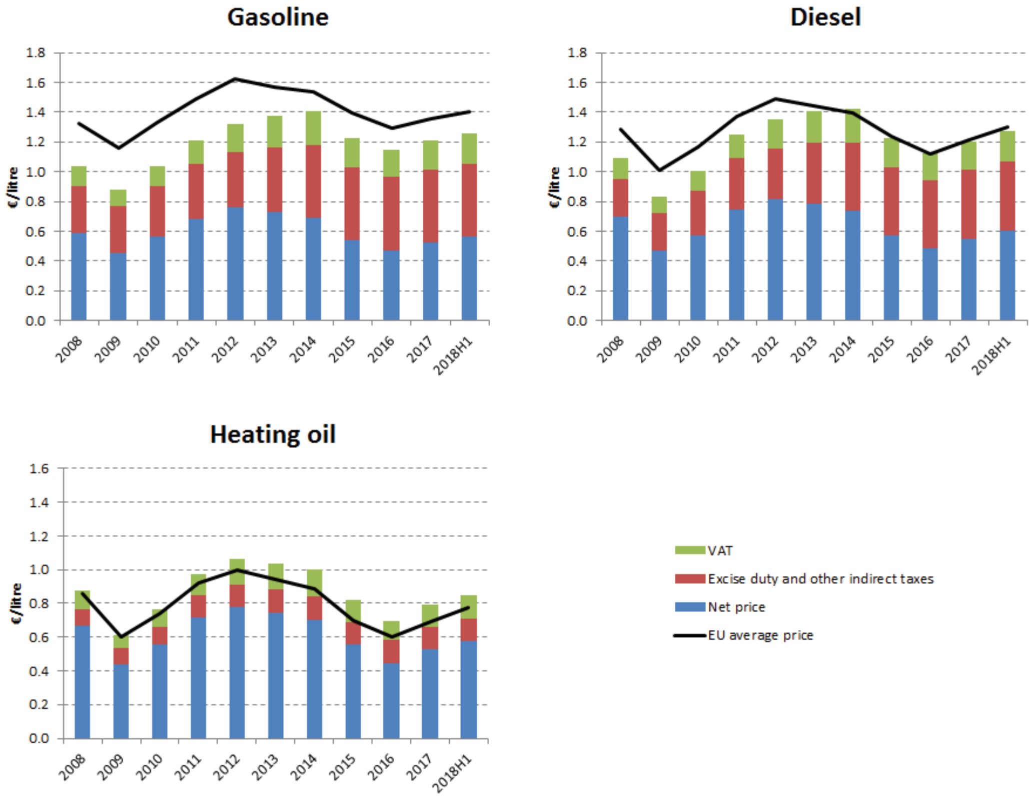


Price regulation

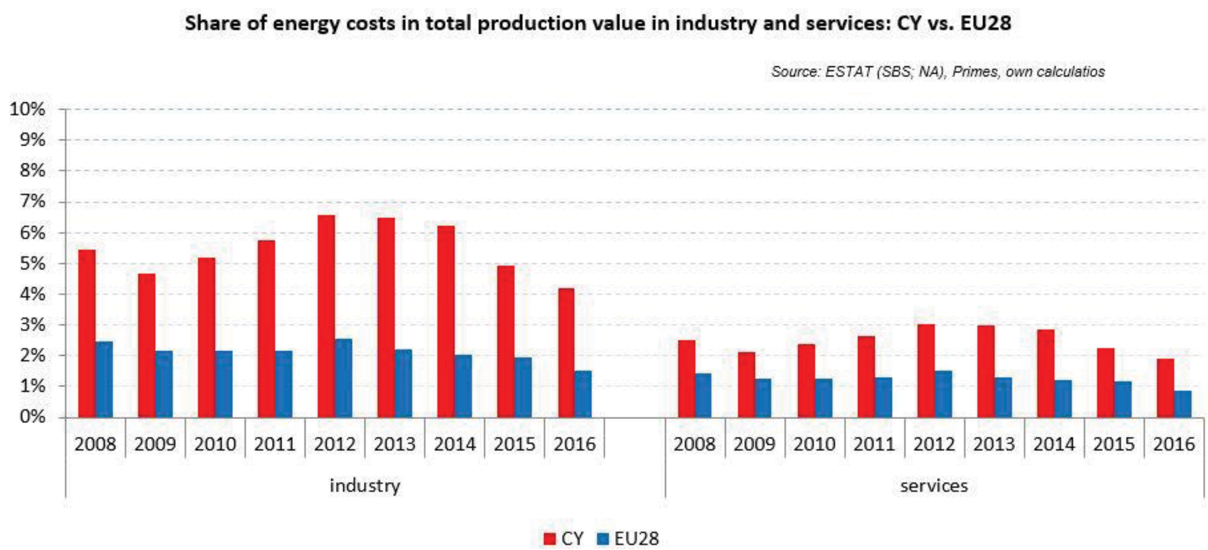




Oil products prices



Energy costs shares in total production costs



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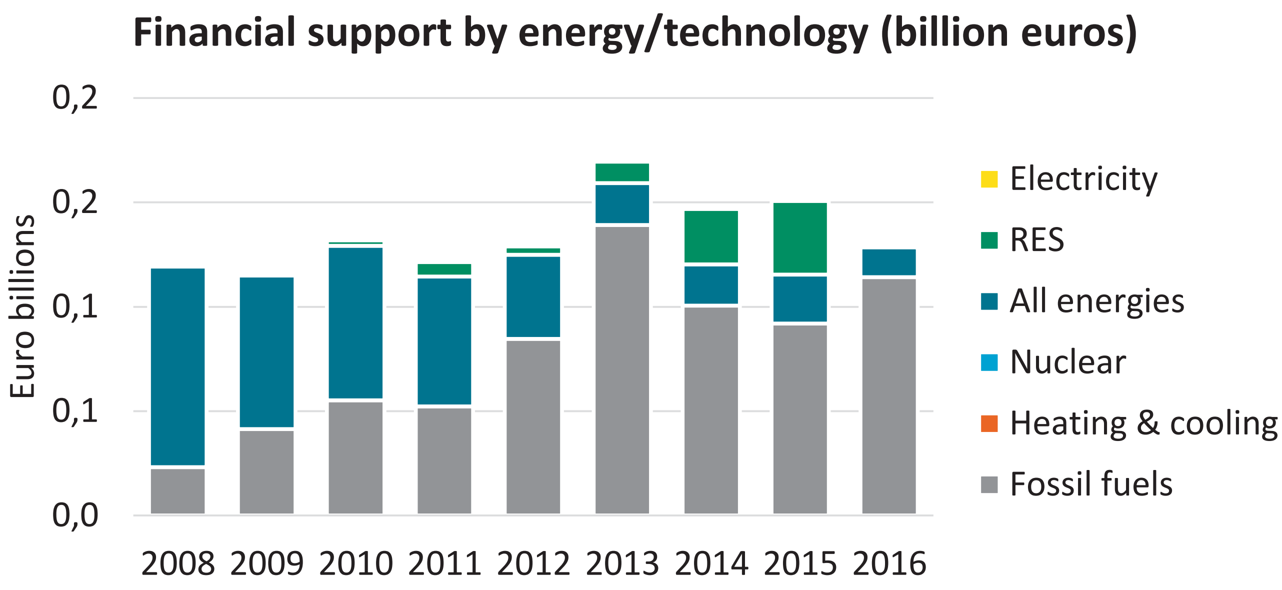
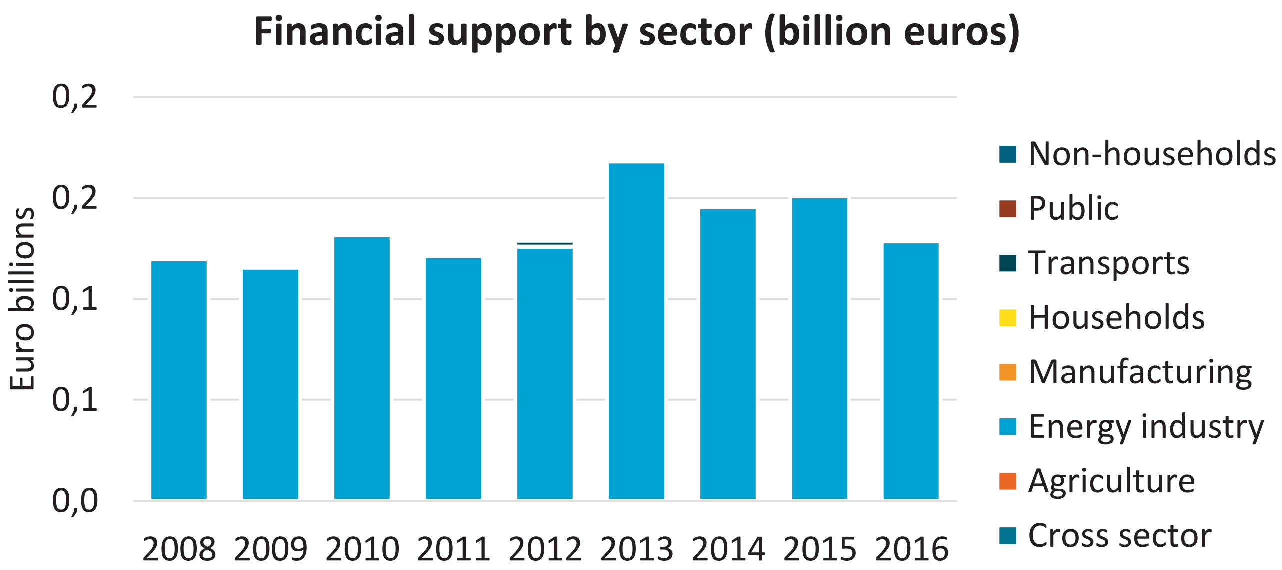
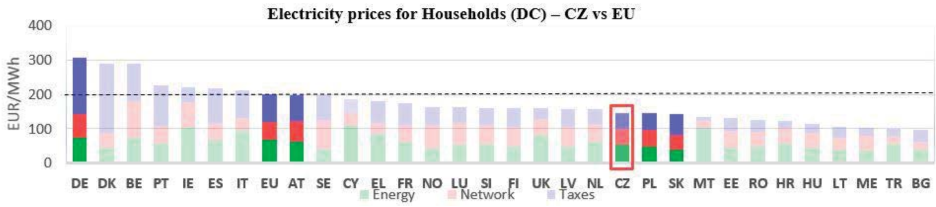
Financial support interventions





Czech Republic



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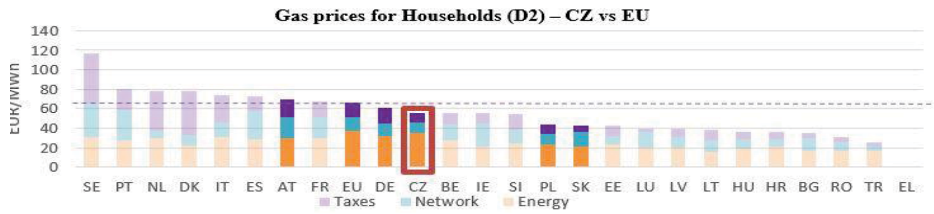
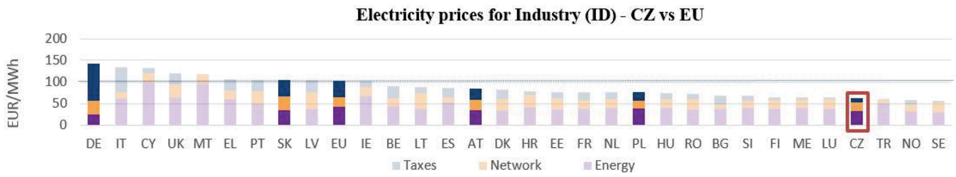
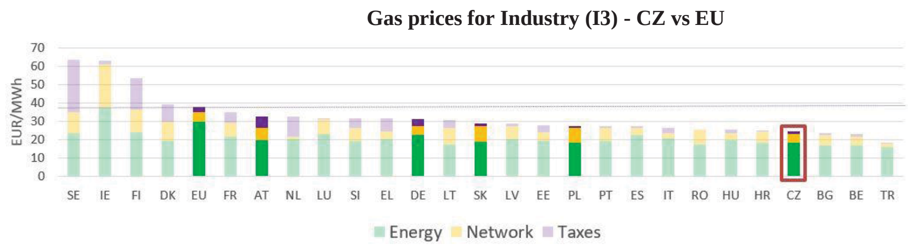


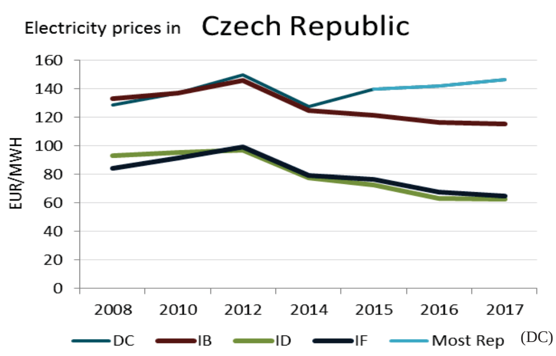


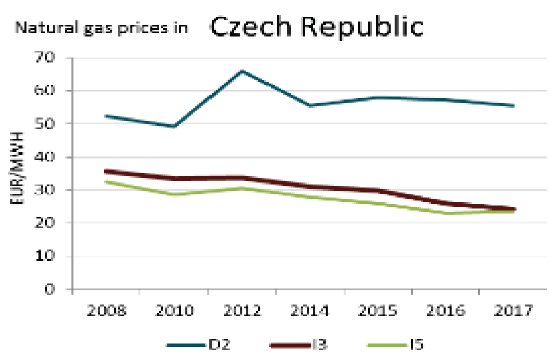


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]





[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.

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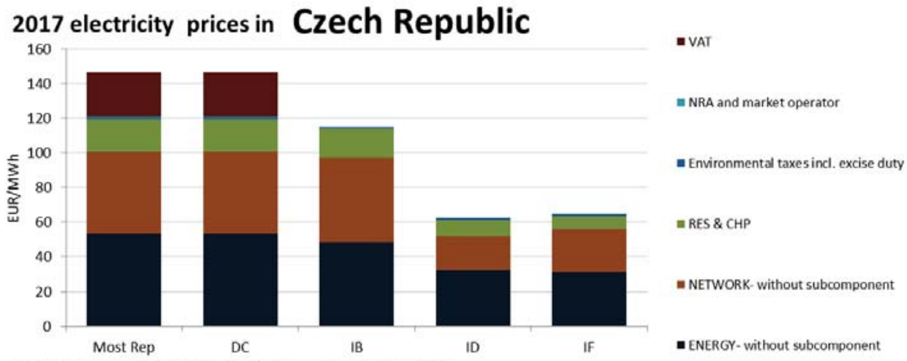
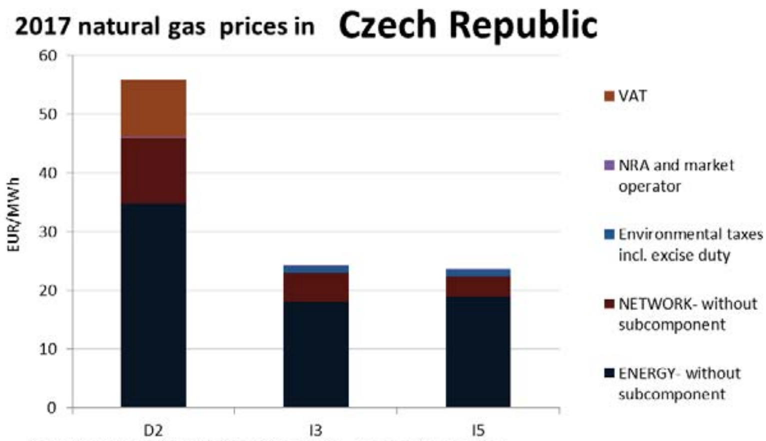


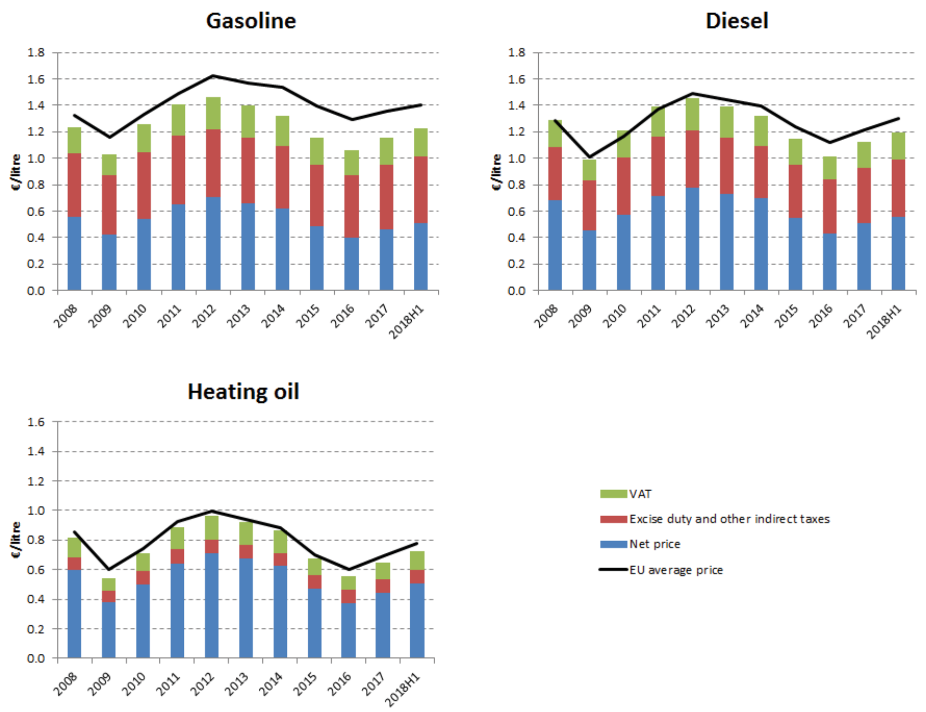
Source: European Commission, DG Energy in- house data collection



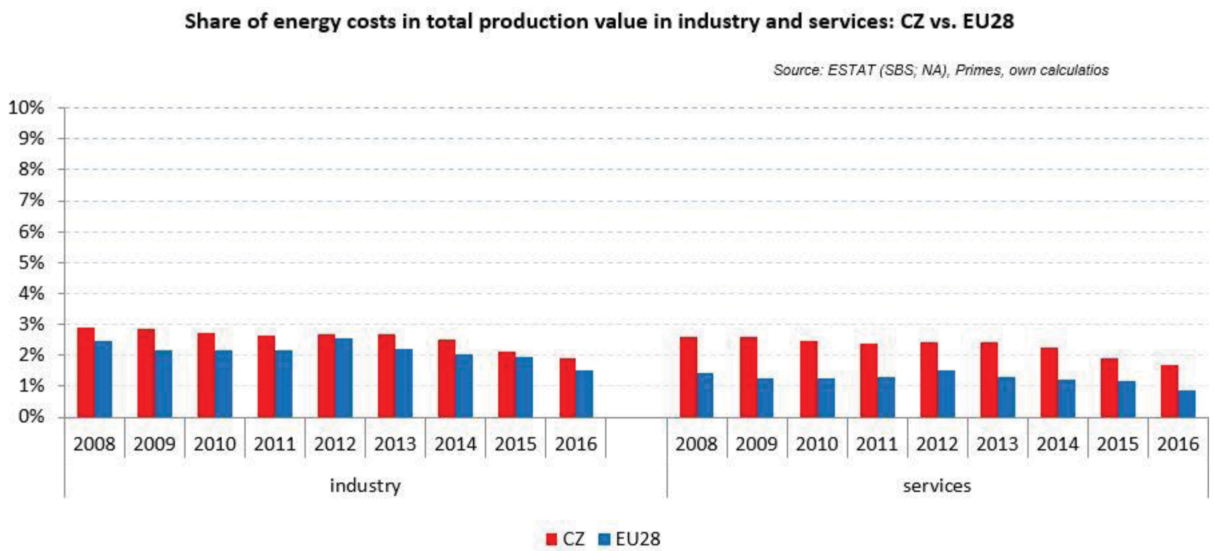
Source: European Commission, DG Energy in- house data collection

This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices



Energy costs shares in total production costs



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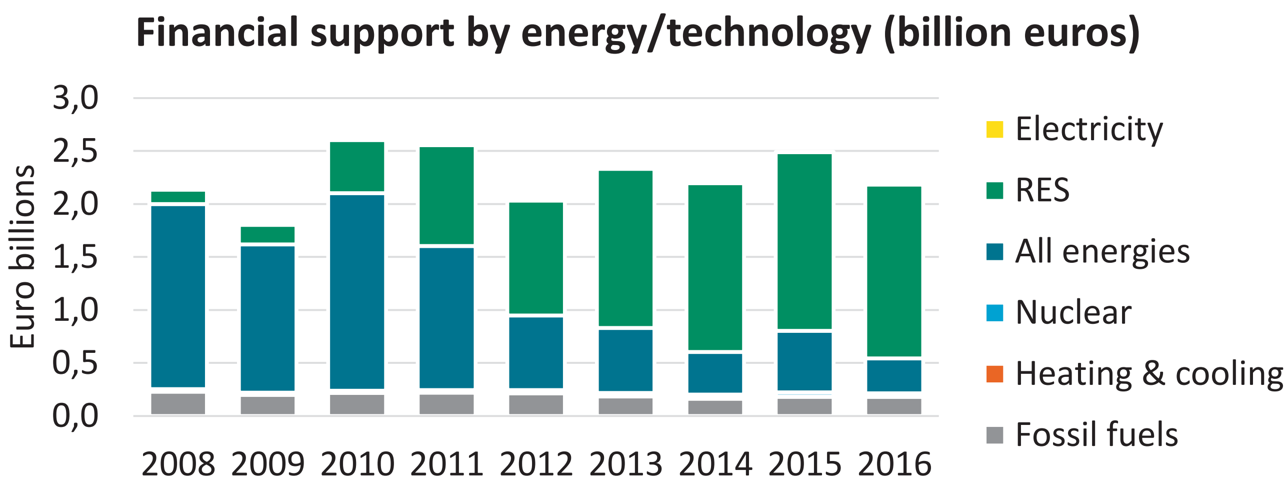
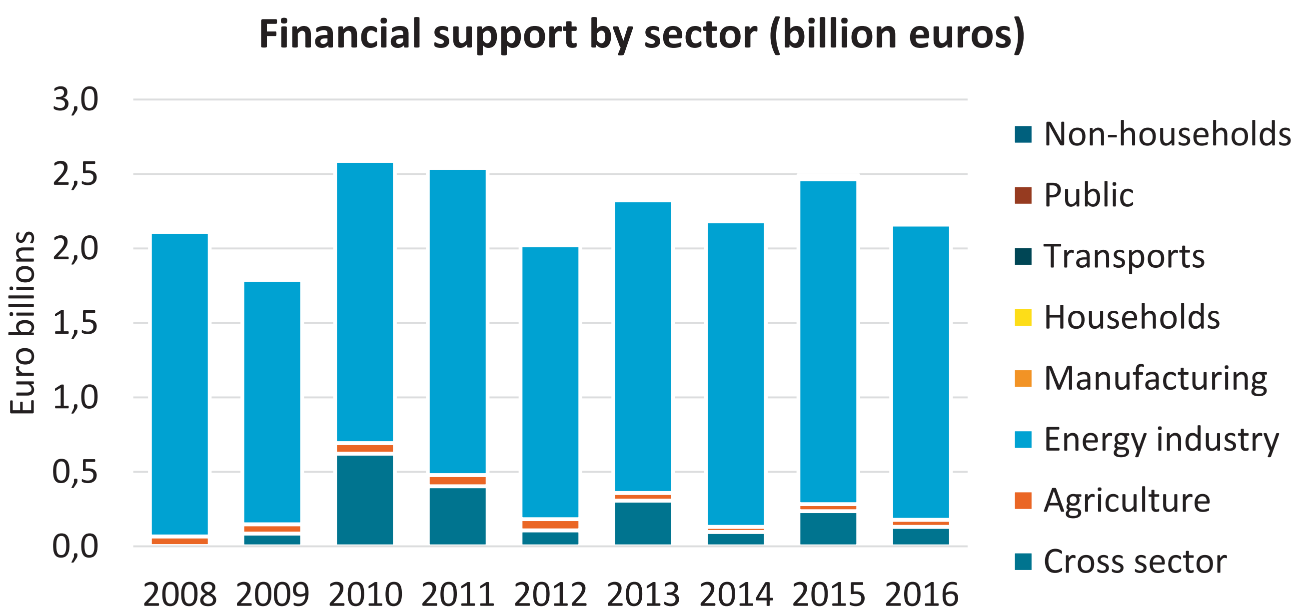
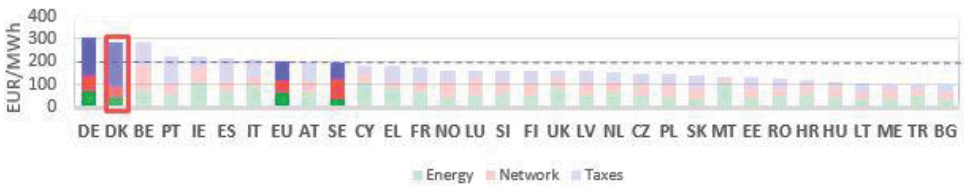
Financial support interventions





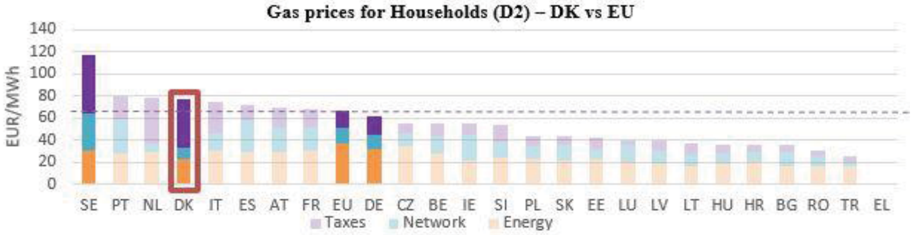
Denmark

Electricity prices for Households (DC) – DK vs EU



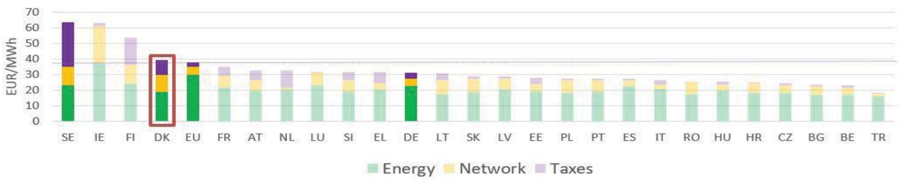
See footnote [1]

Gas prices for Households (D2) – DK vs EU



Electricity prices for Industry (ID) - DK vs EU

Gas prices for Industry (I3) - DK vs EU

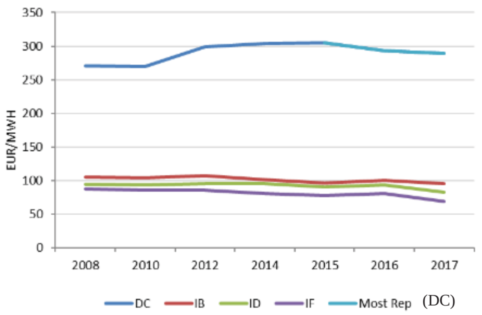


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

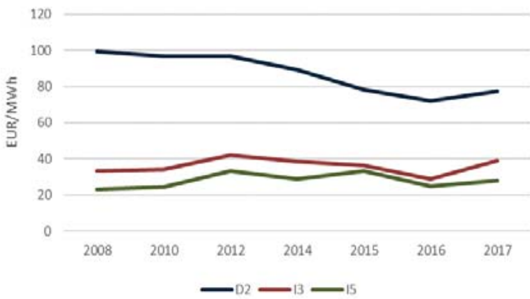
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]

Electricity prices in Denmark



Natural Gas Prices in Denmark



[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.

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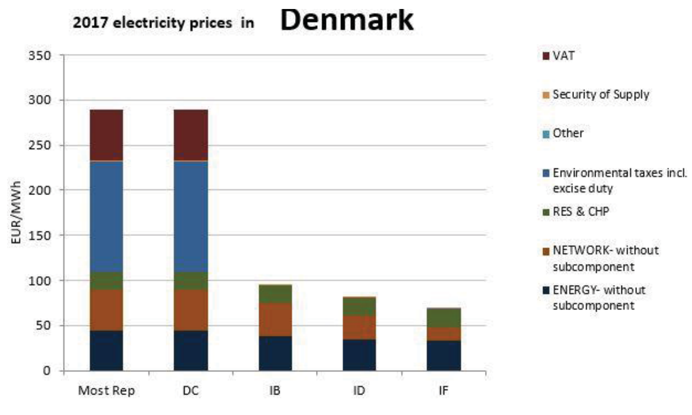
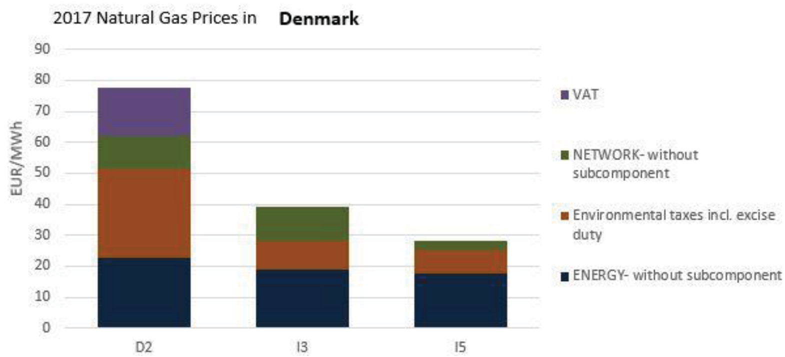
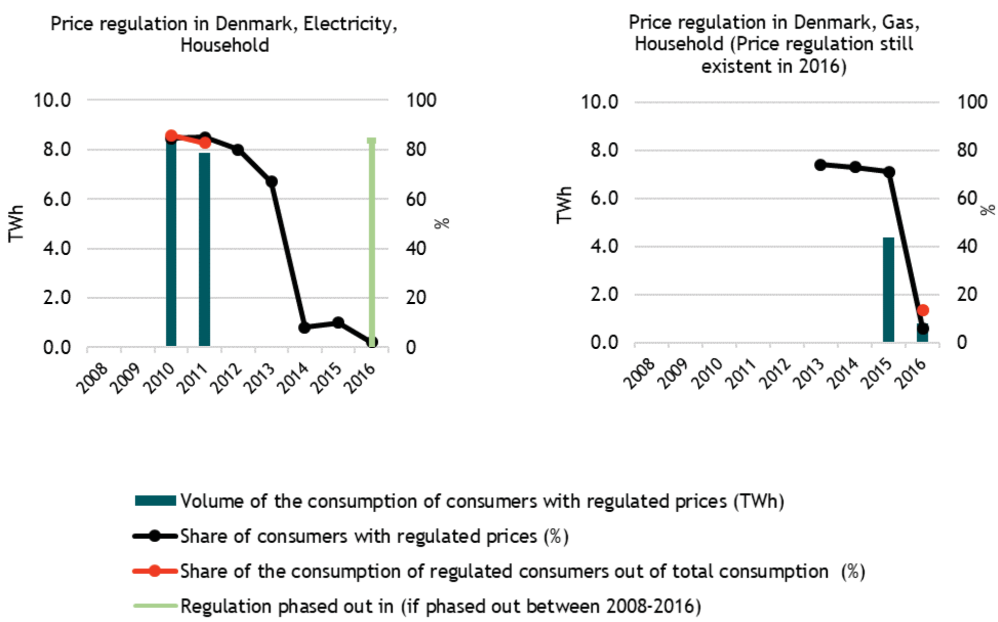


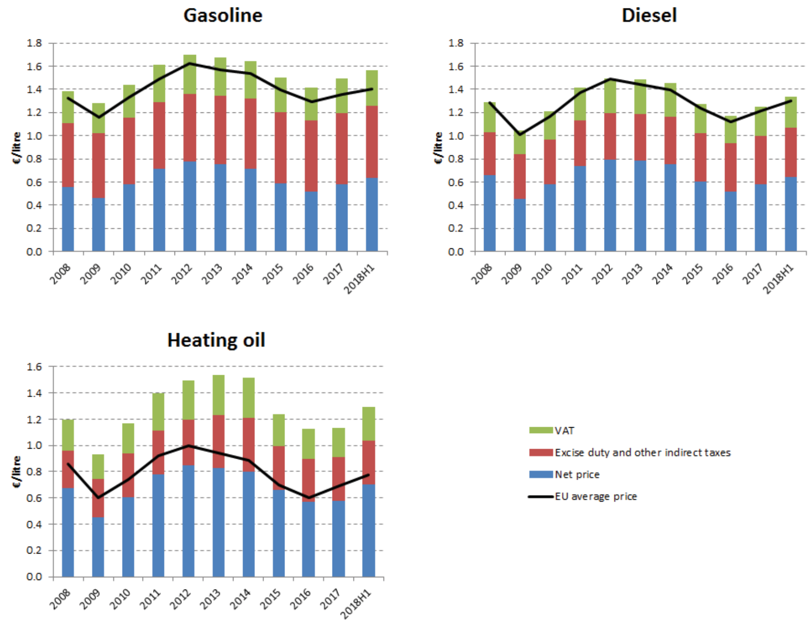
Source: European Commission, DG Energy in- house data collection



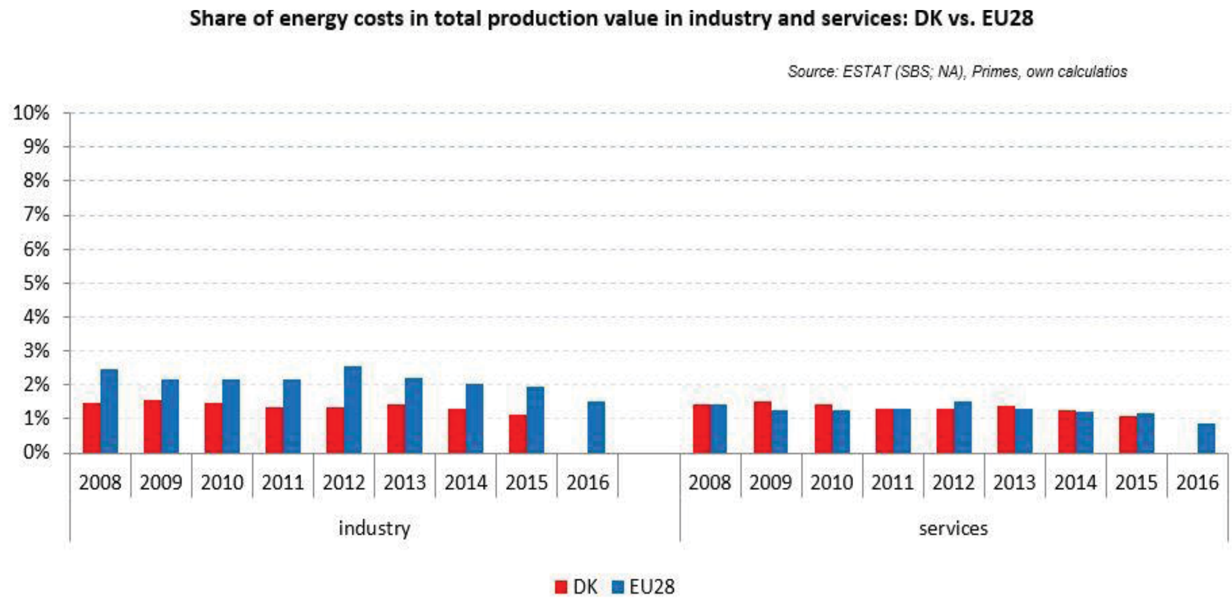
Price regulation



Oil products prices



Energy costs shares in total production costs



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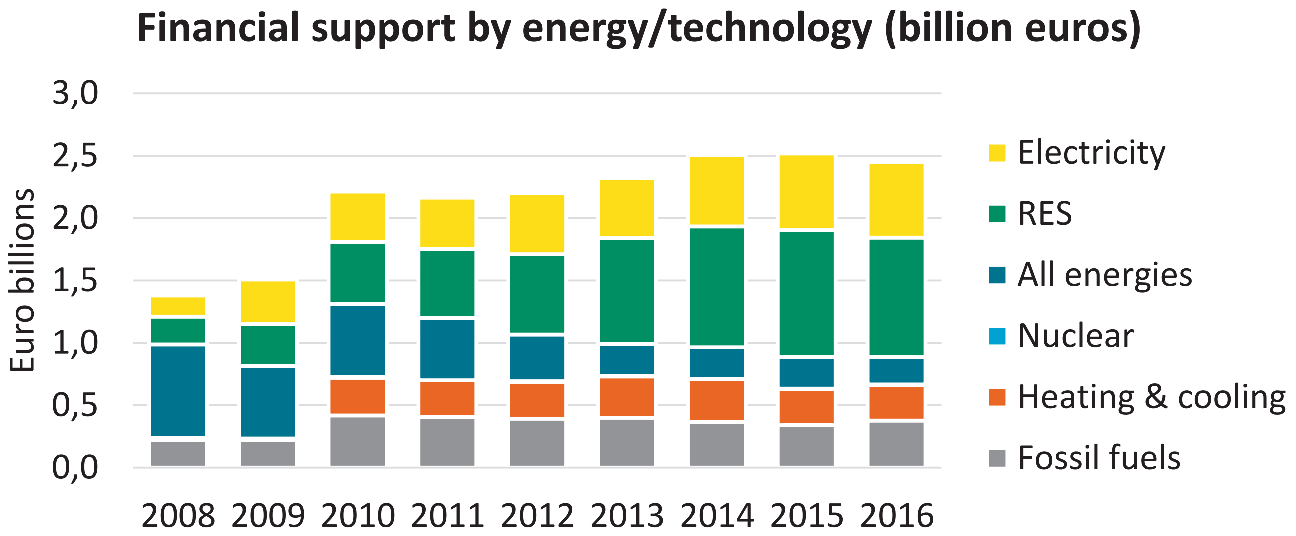
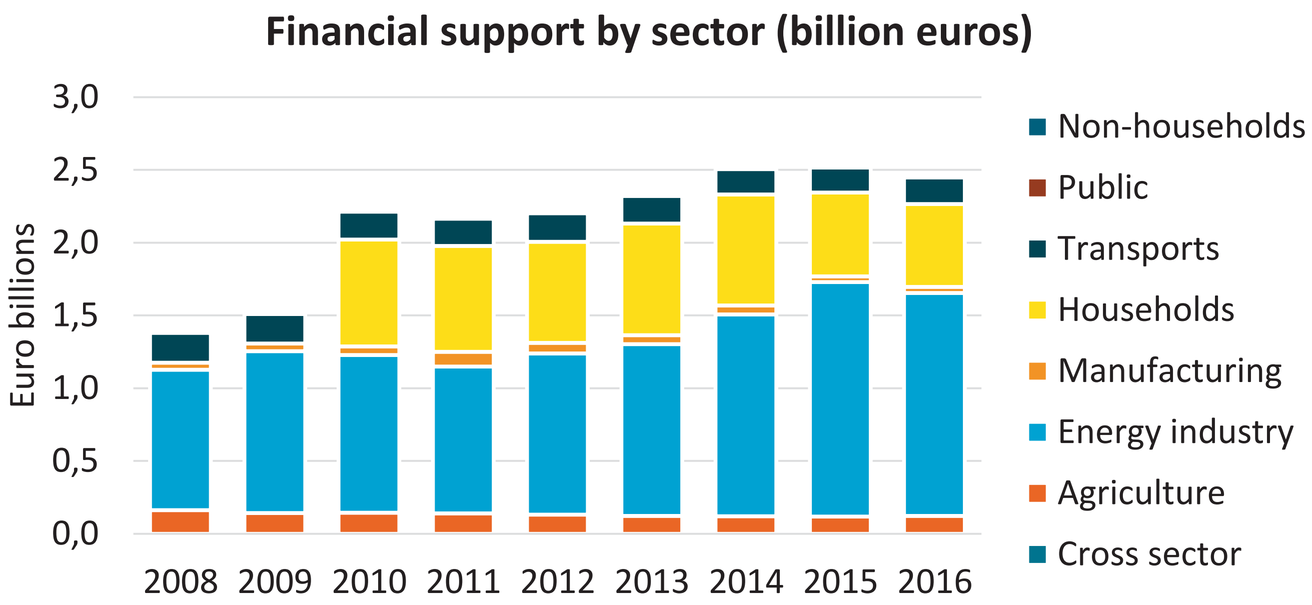
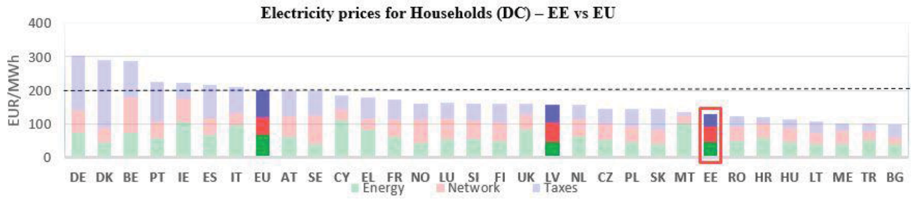
Financial support interventions





Estonia



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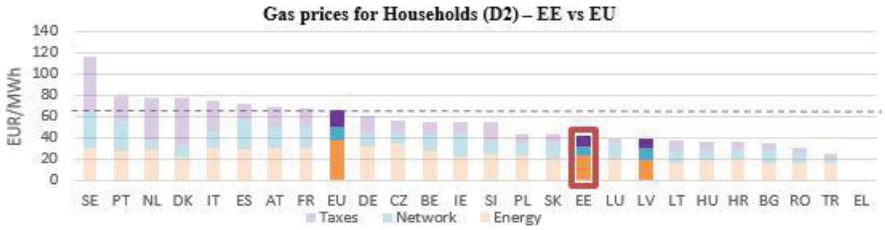
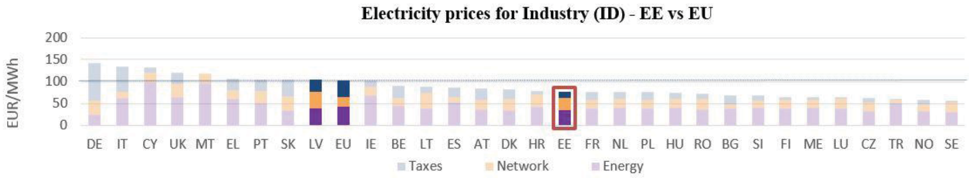
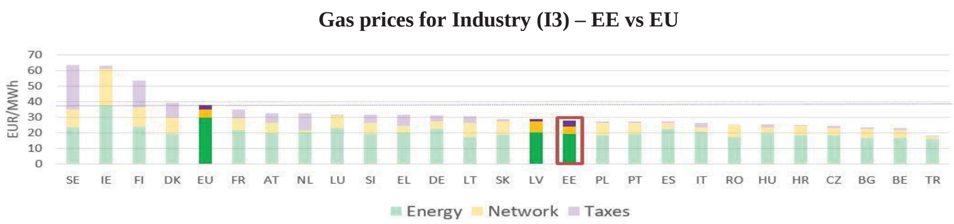


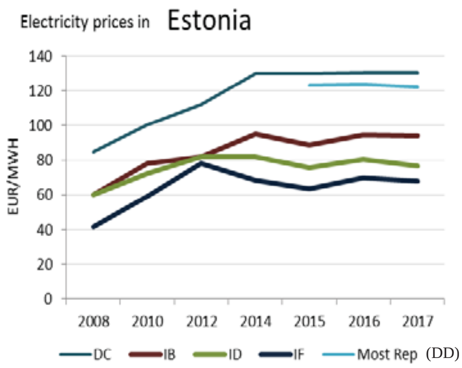


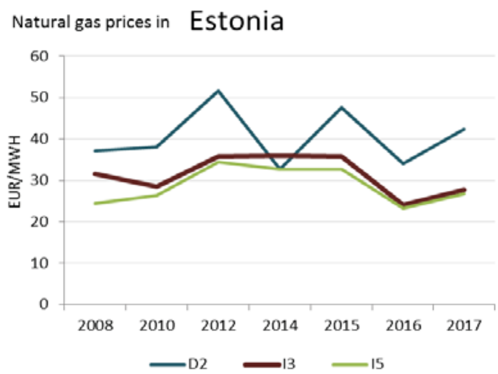


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

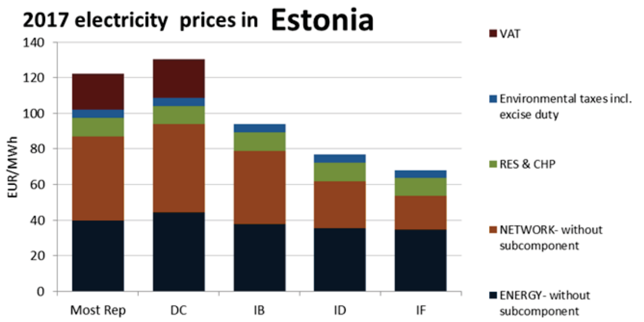
See footnote [2]



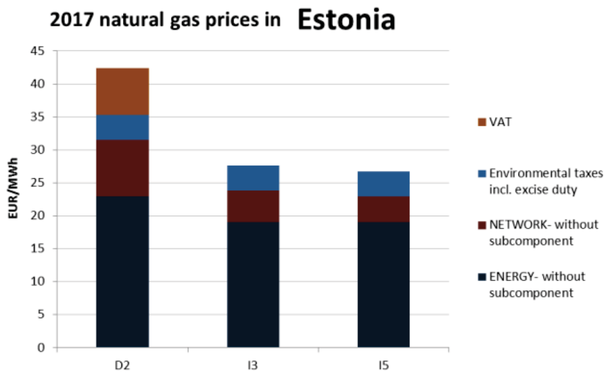


[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.

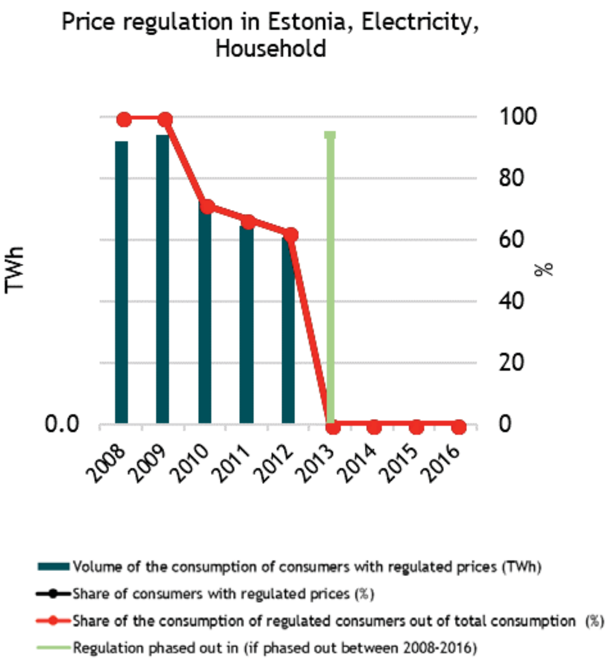
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.



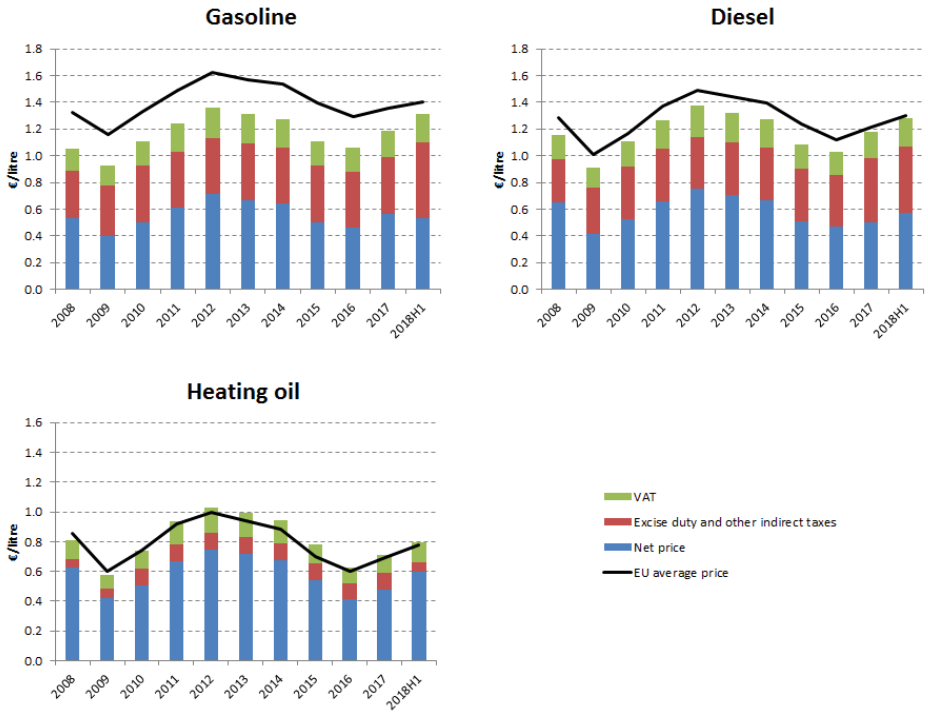
Source: European Commission, DG Energy in- house data



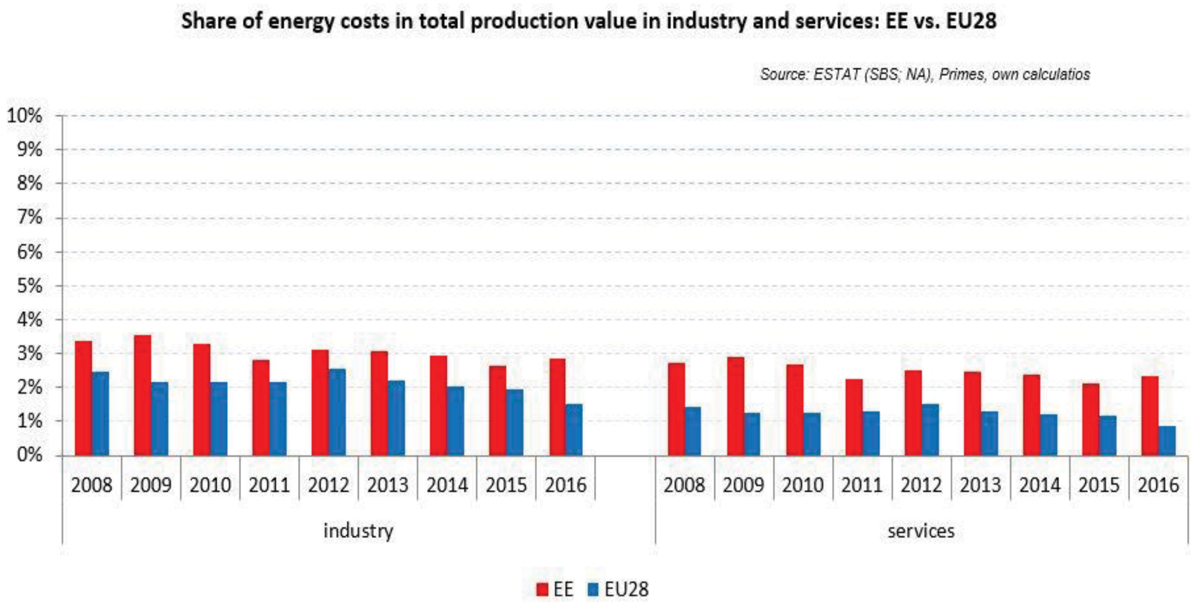
Price regulation



Oil prices

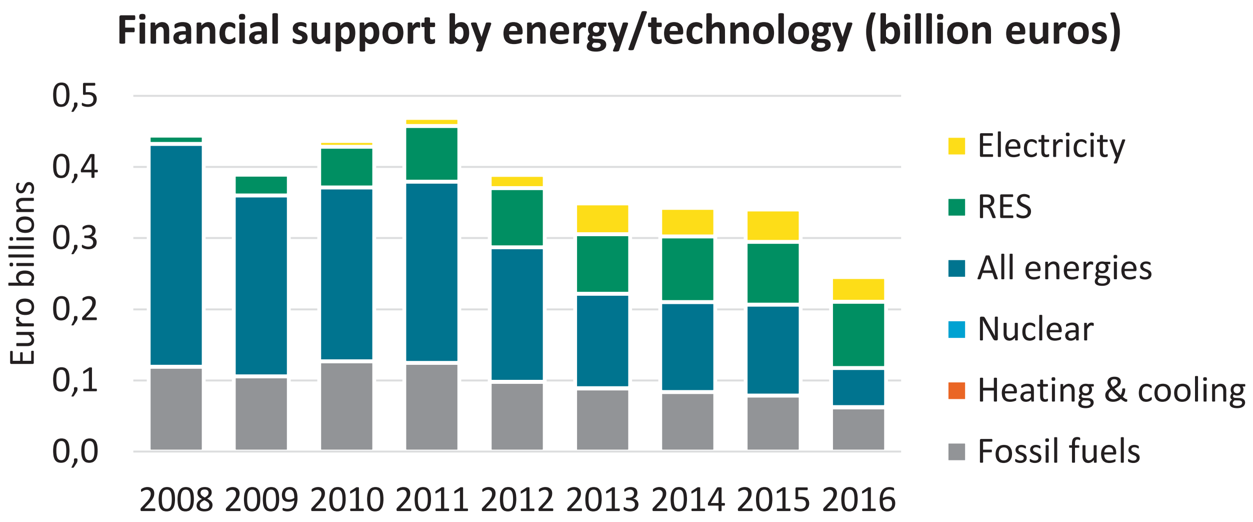


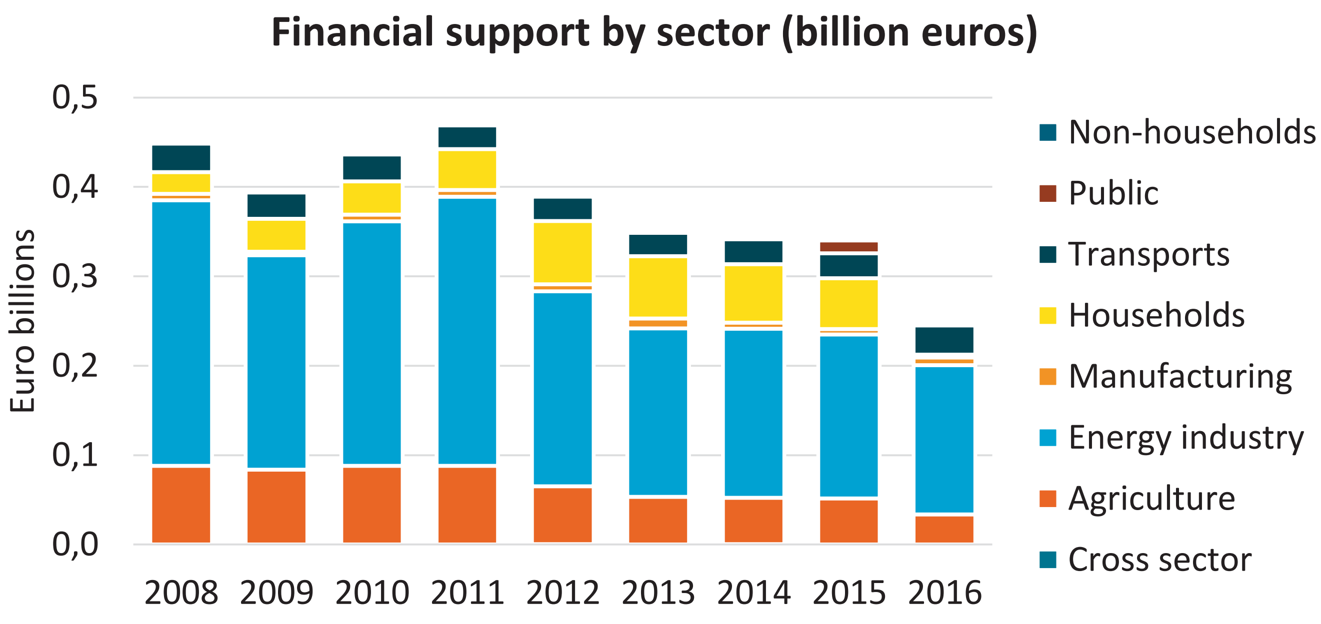
Energy costs shares in total production costs



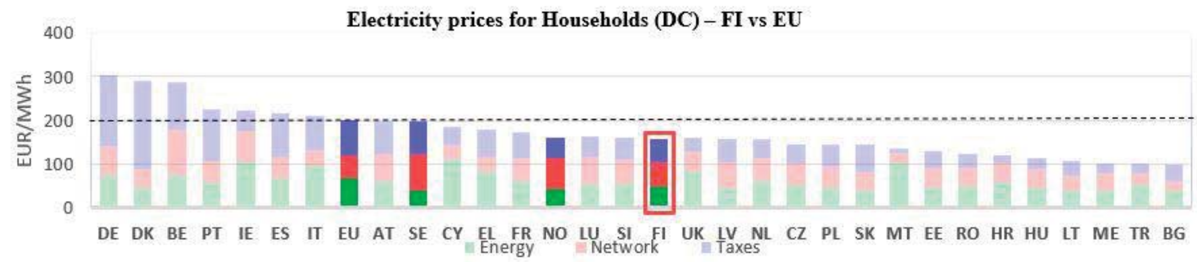
Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Financial support interventions





Finland



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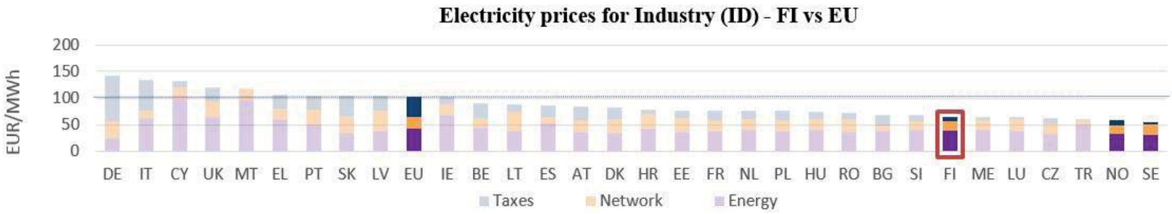
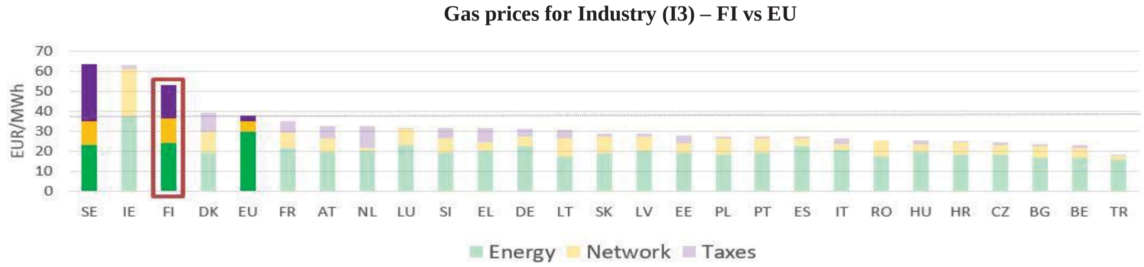
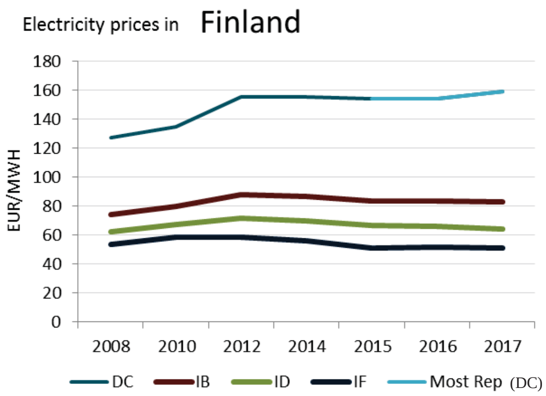


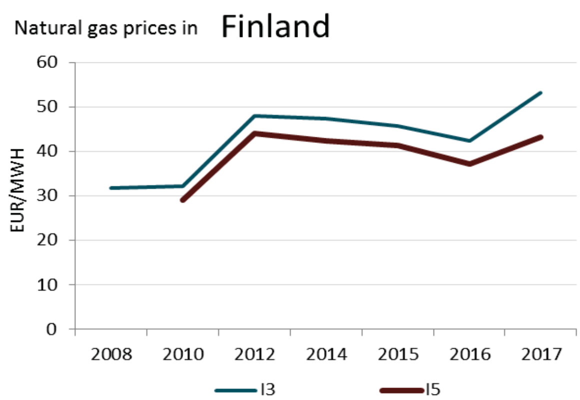


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]





[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
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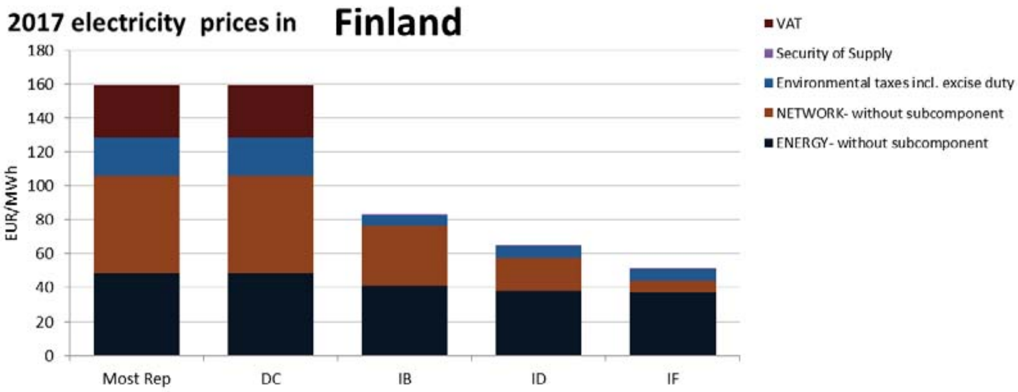
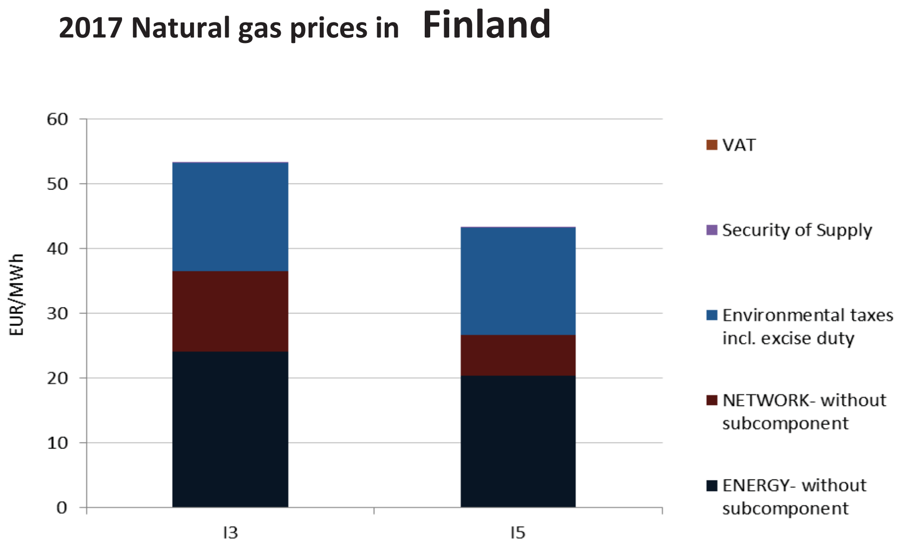


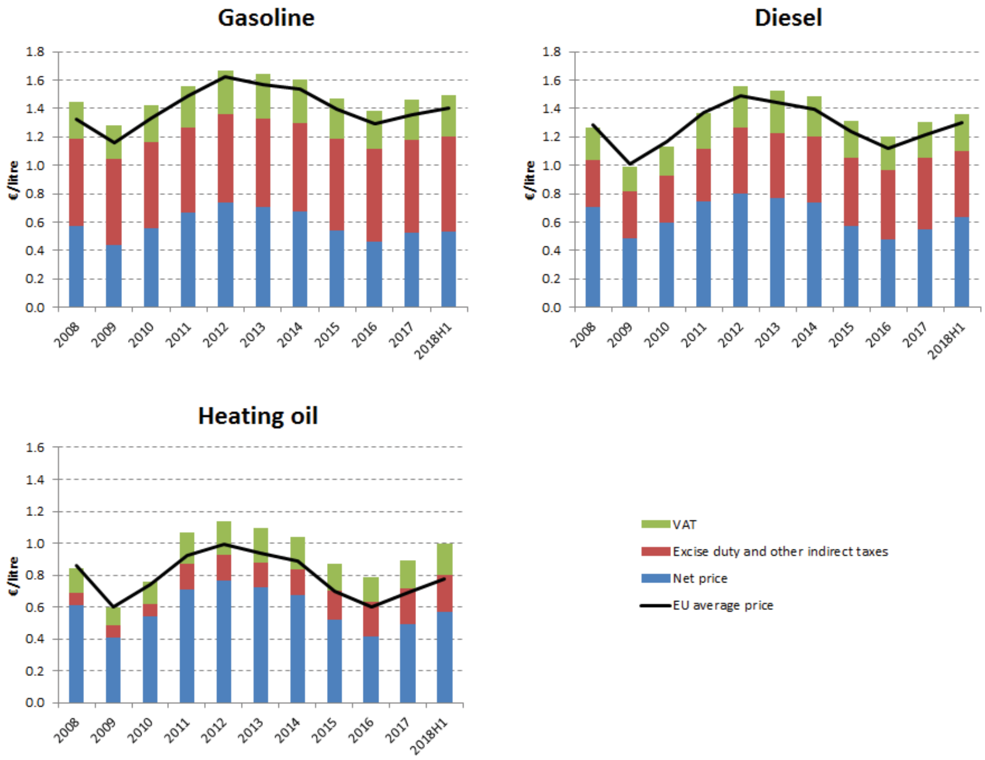
Source: European Commission, DG Energy in- house data collection



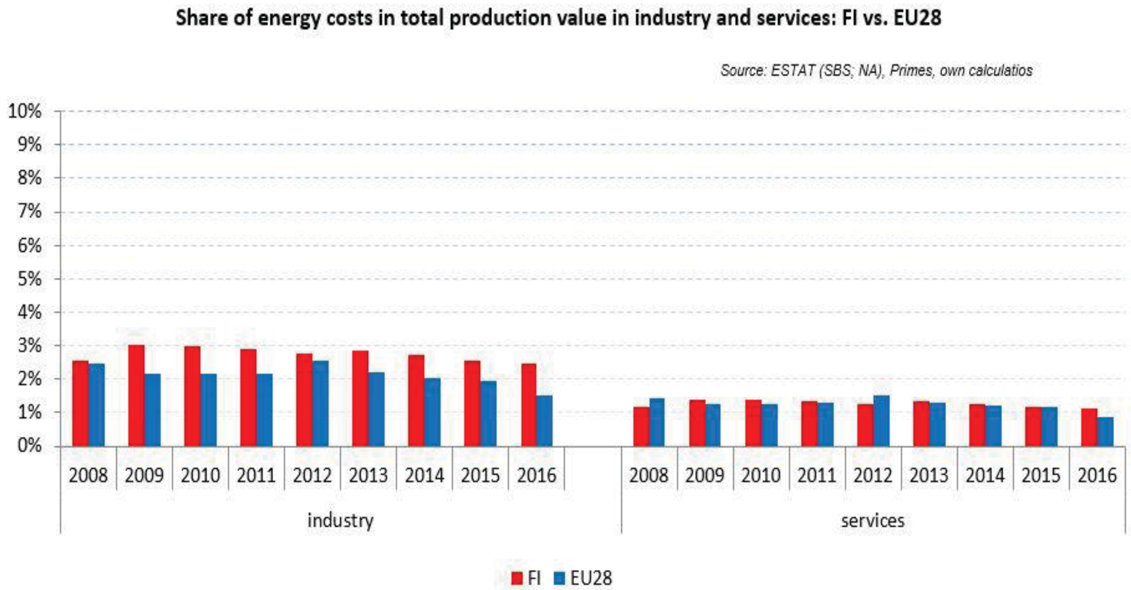
Source: European Commission, DG Energy in- house data collection

This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices



Energy costs shares in total production costs



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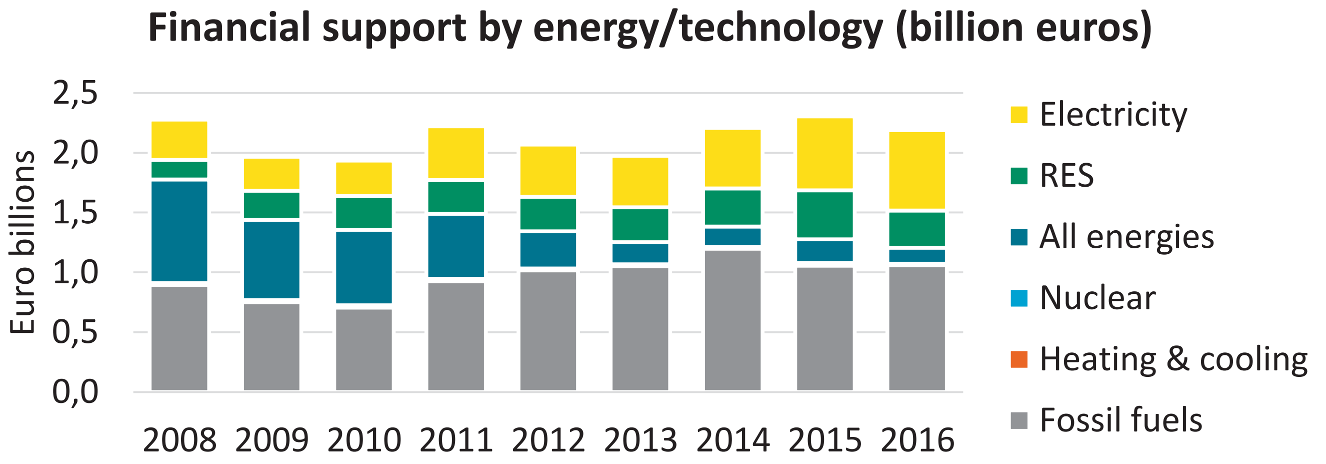
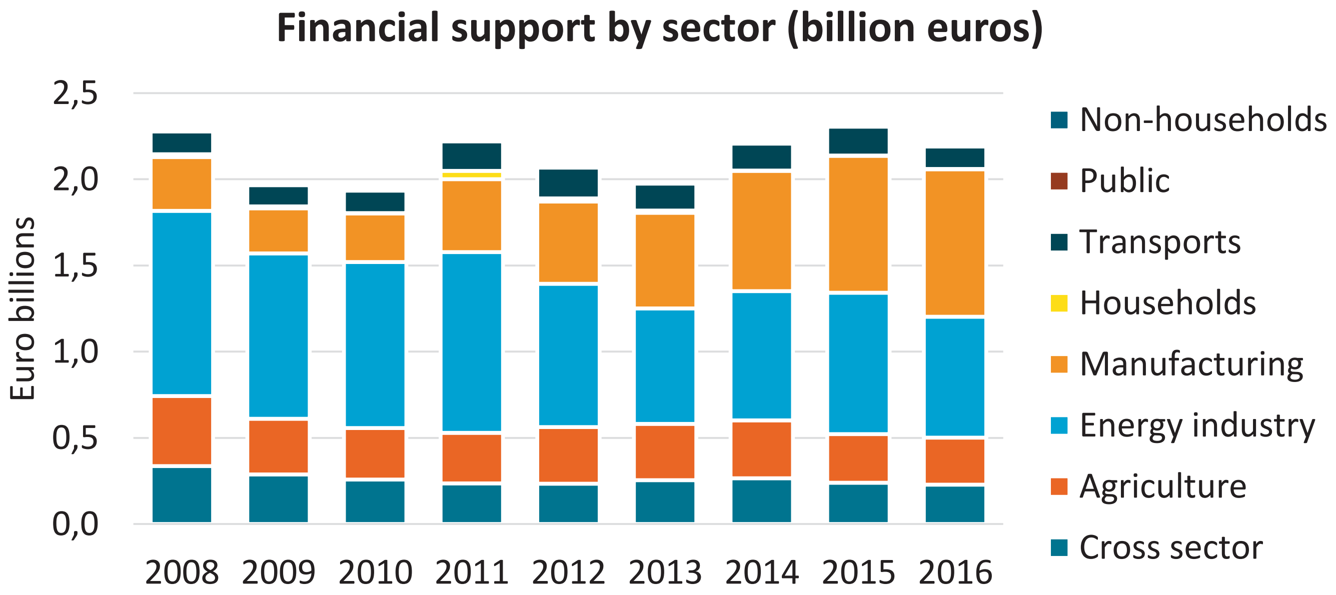
Financial support interventions





EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 9/11

COMMISSION STAFF WORKING DOCUMENT
Accompanying the document

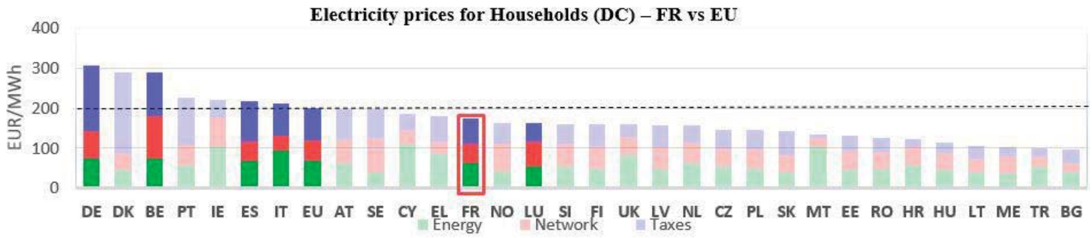
REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Energy prices and costs in Europe

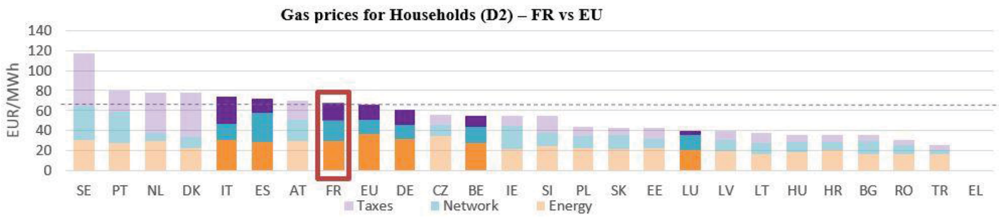
{COM(2019) 1 final}

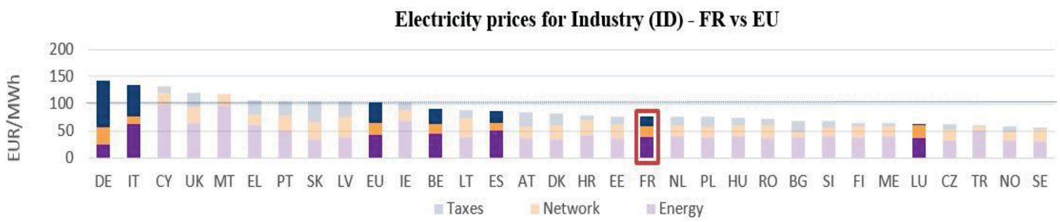
EN EN

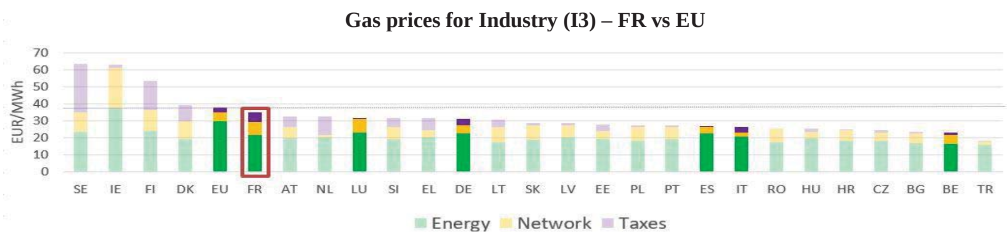
France



See footnote [1]



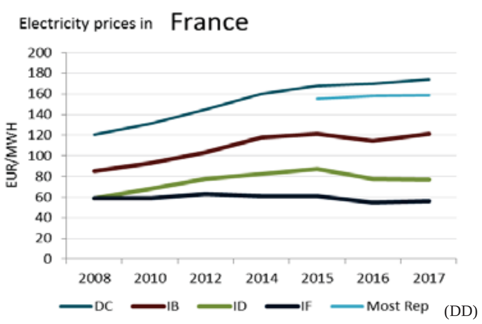


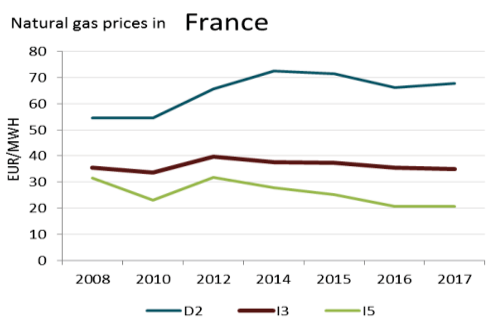


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]





[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.

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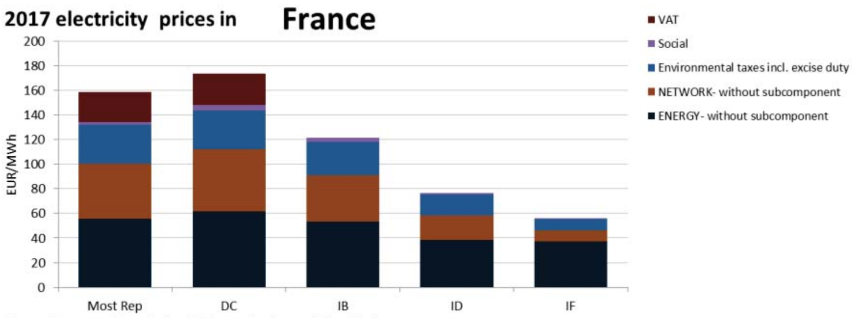
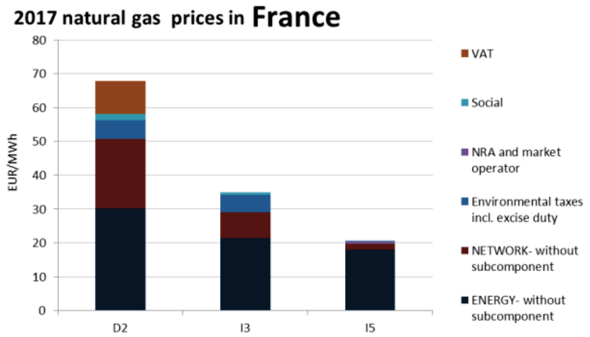
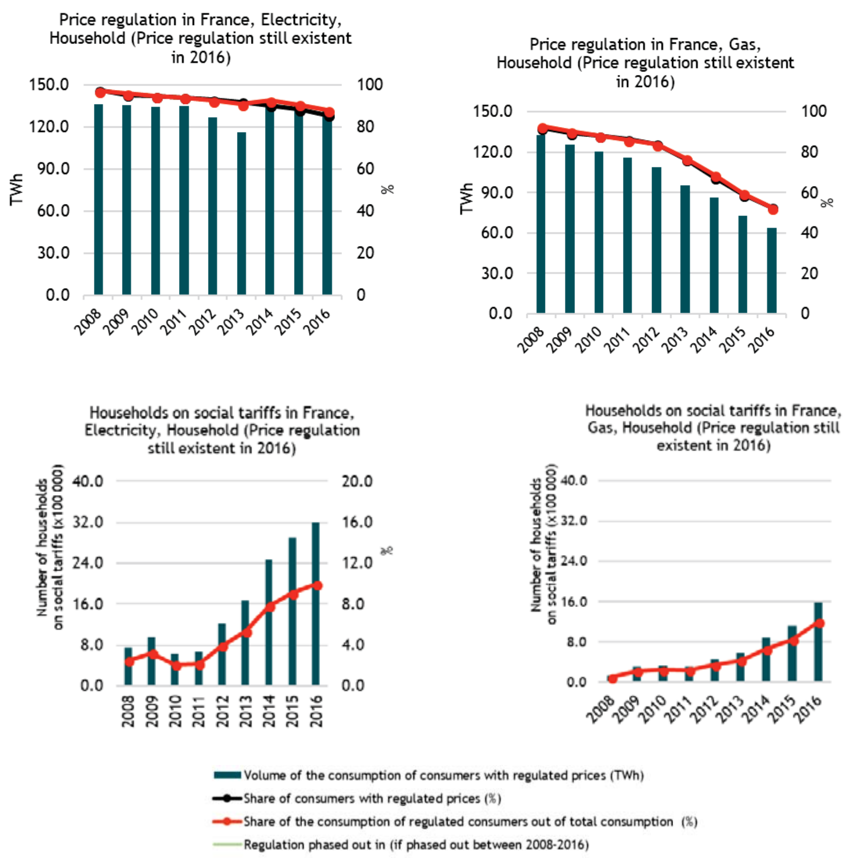


Source: European Commission, DG Energy in- house data collection

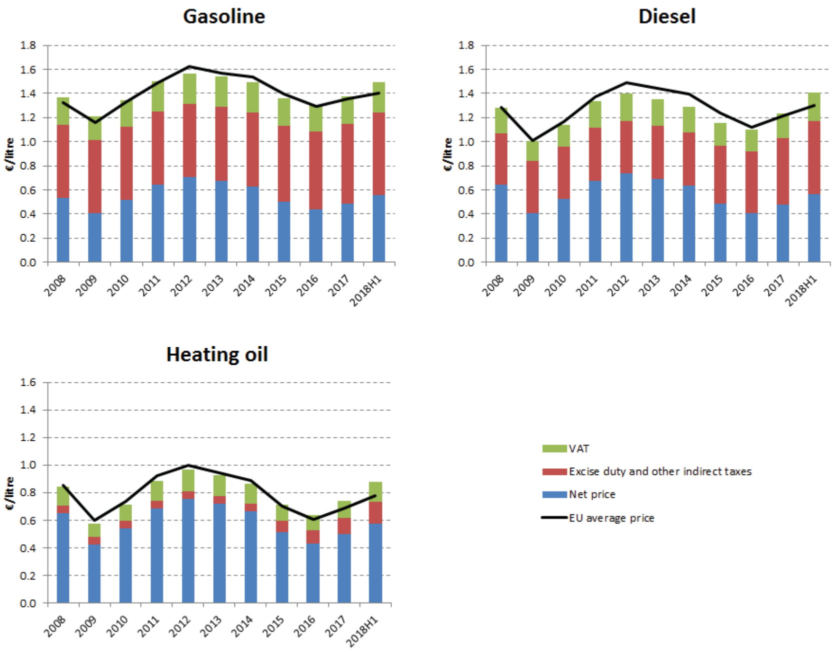


Source: European Commission, DG Energy in- house data collection

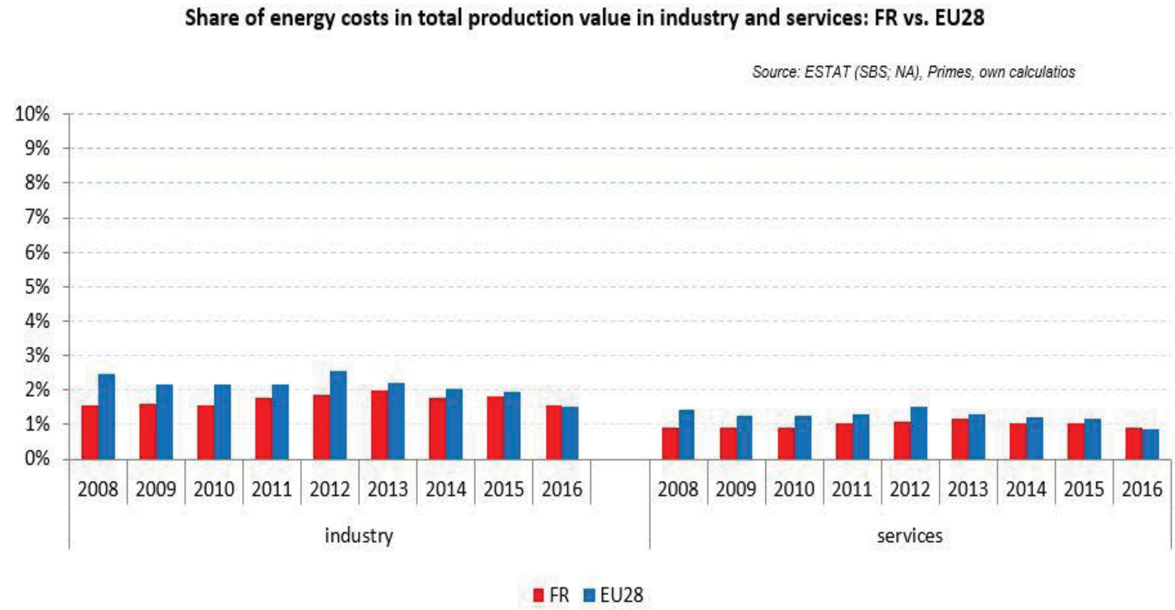
Price regulation



Oil product prices

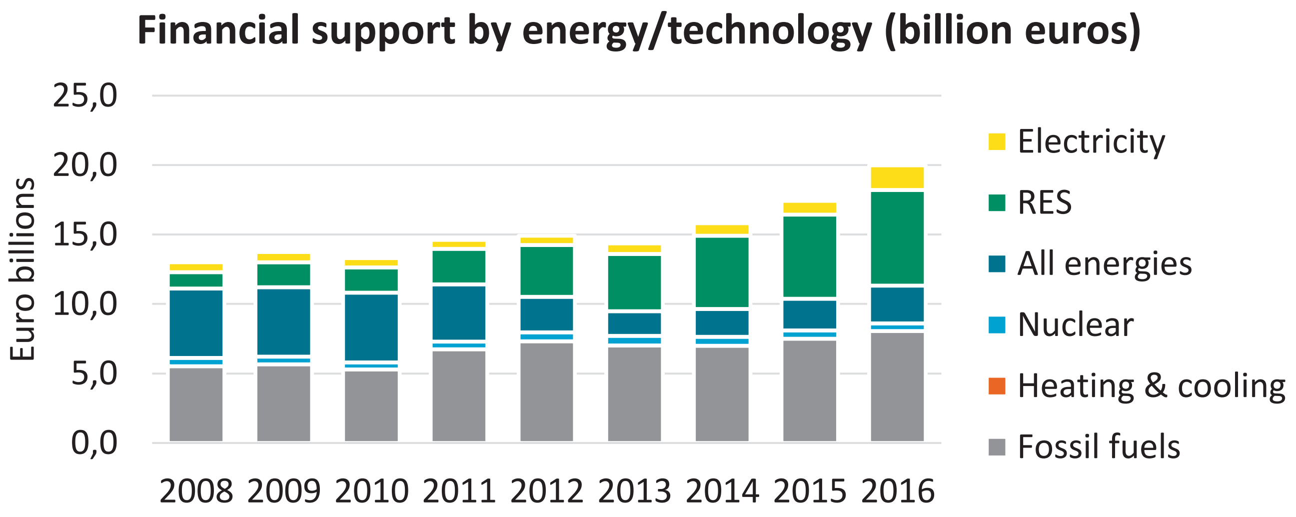


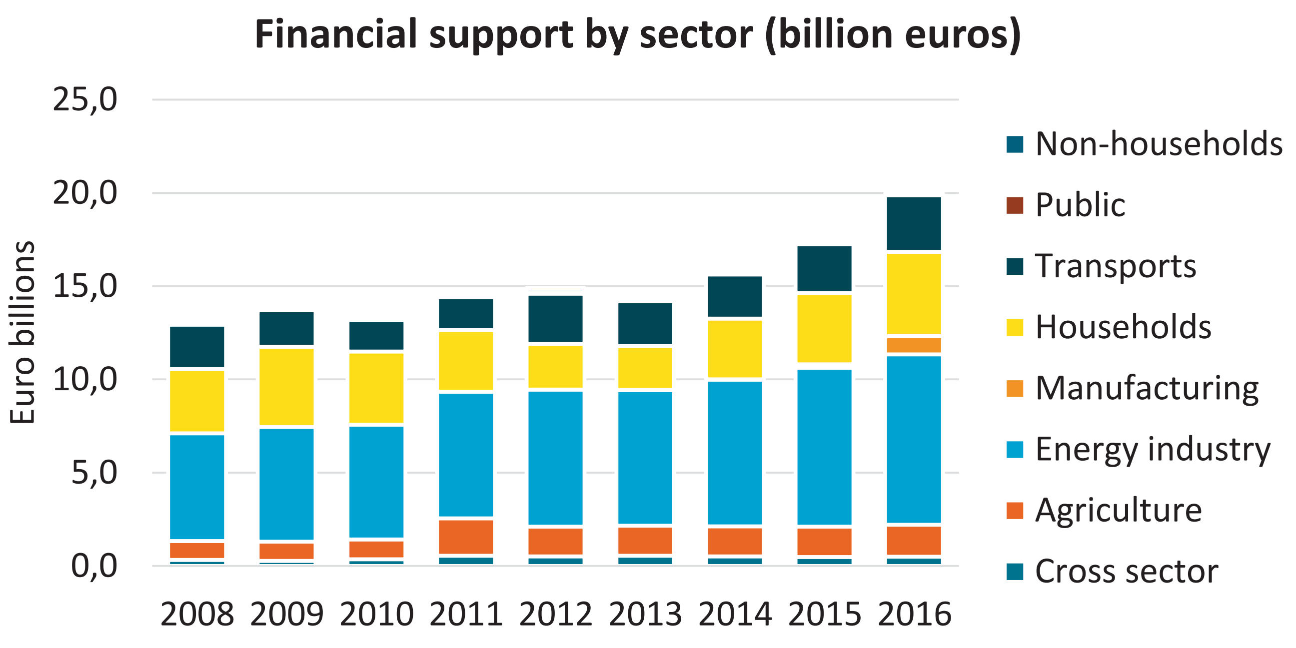
Energy costs shares in total production costs



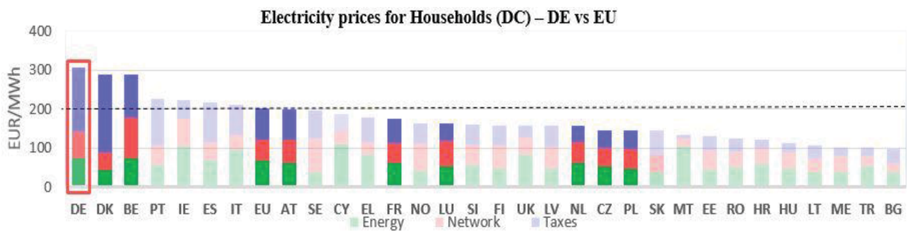
Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Financial support interventions

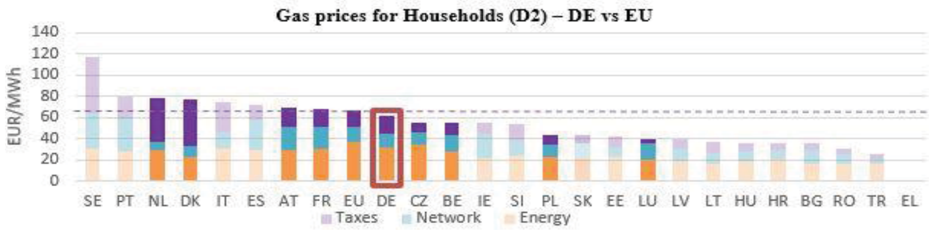


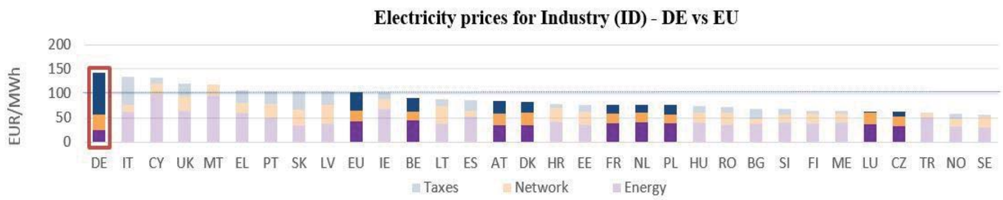


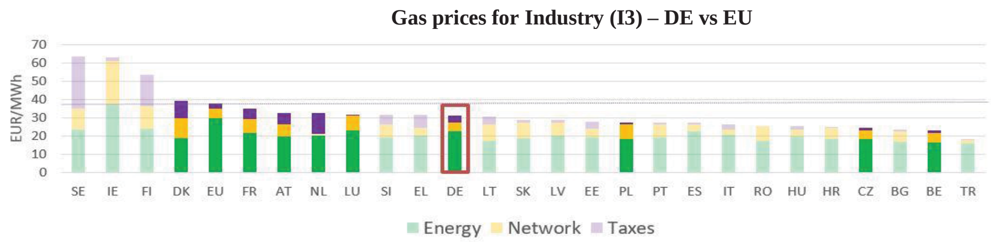
Germany



see footnote[1]



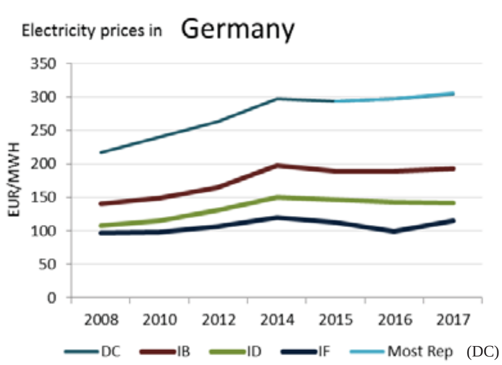


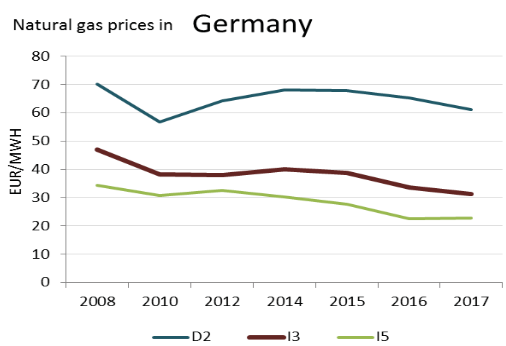


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

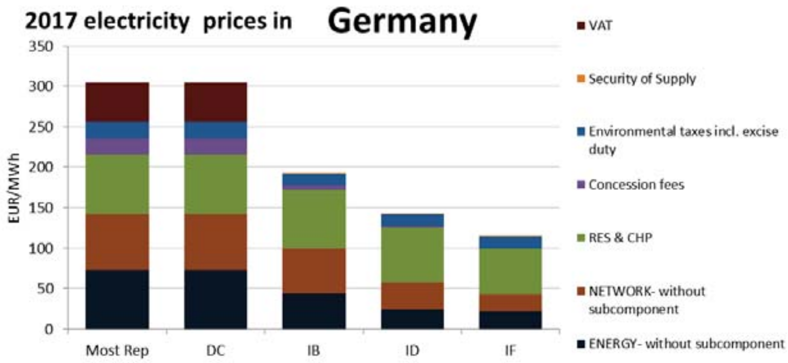
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]

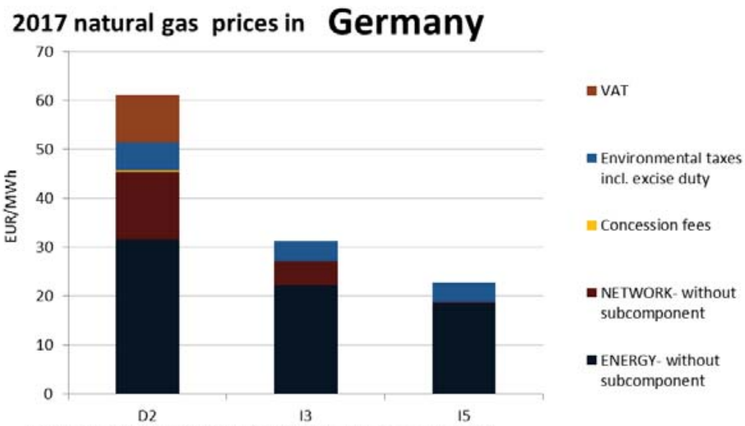




[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.



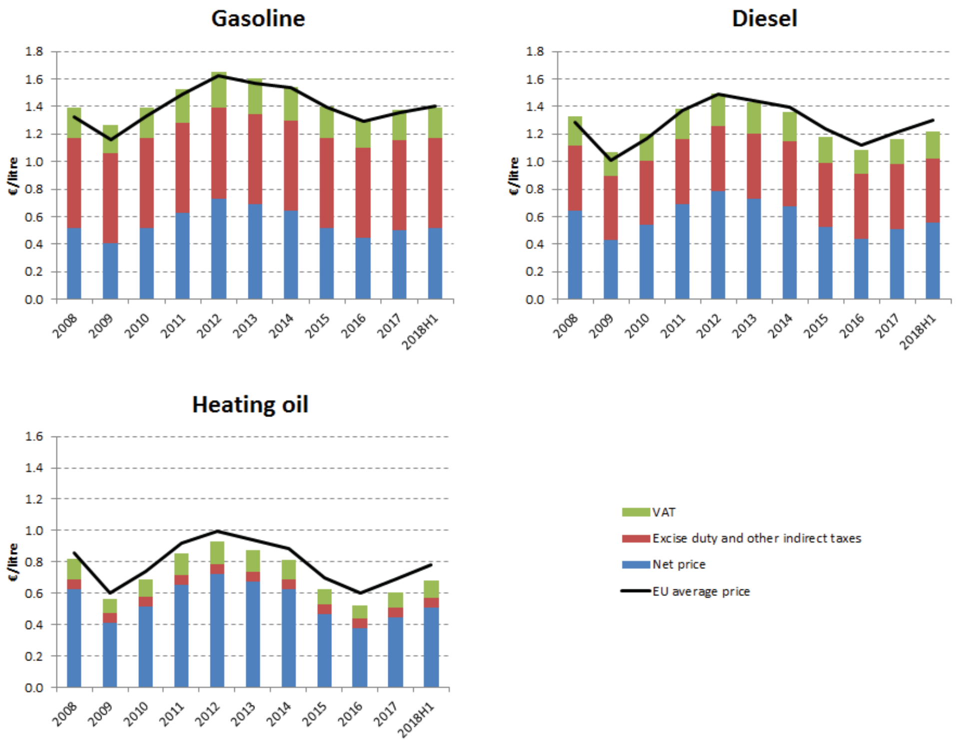
Source: European Commission, DG Energy in- house data collection



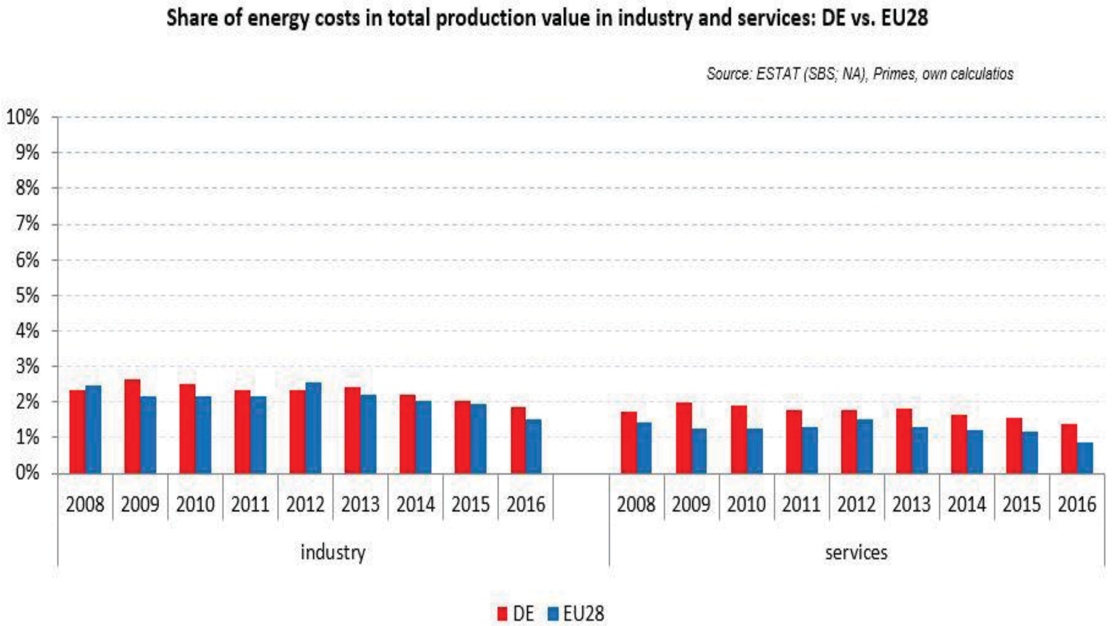
Source: European Commission, DG Energy in- house data collection

This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices



Energy costs shares in total production costs



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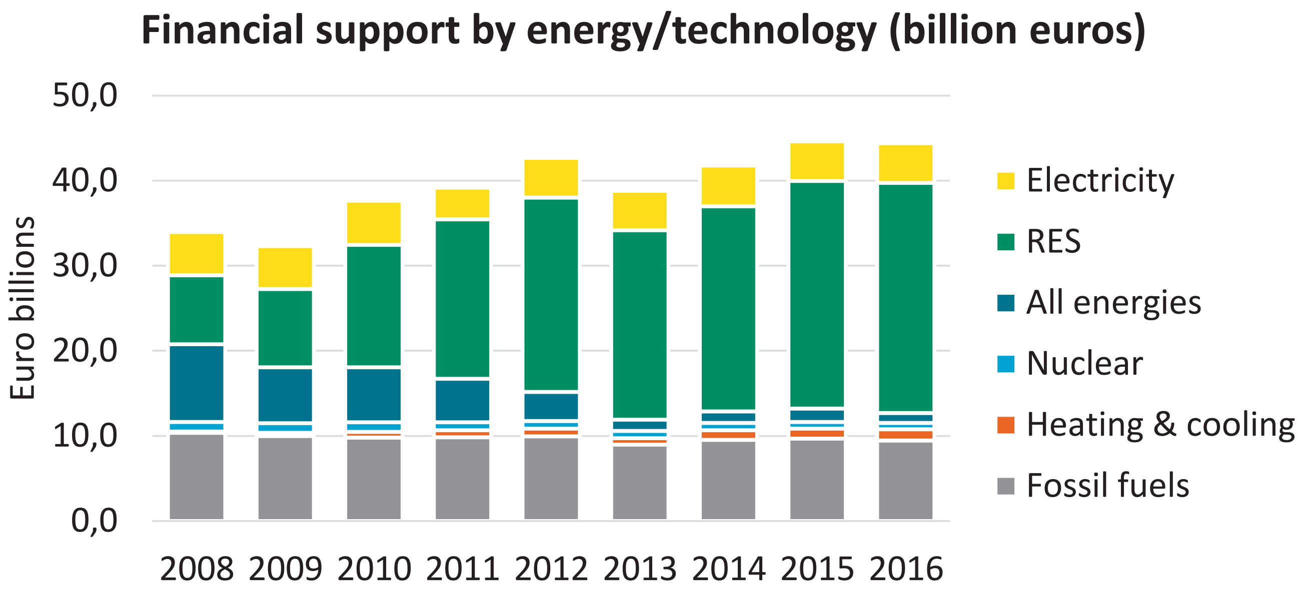
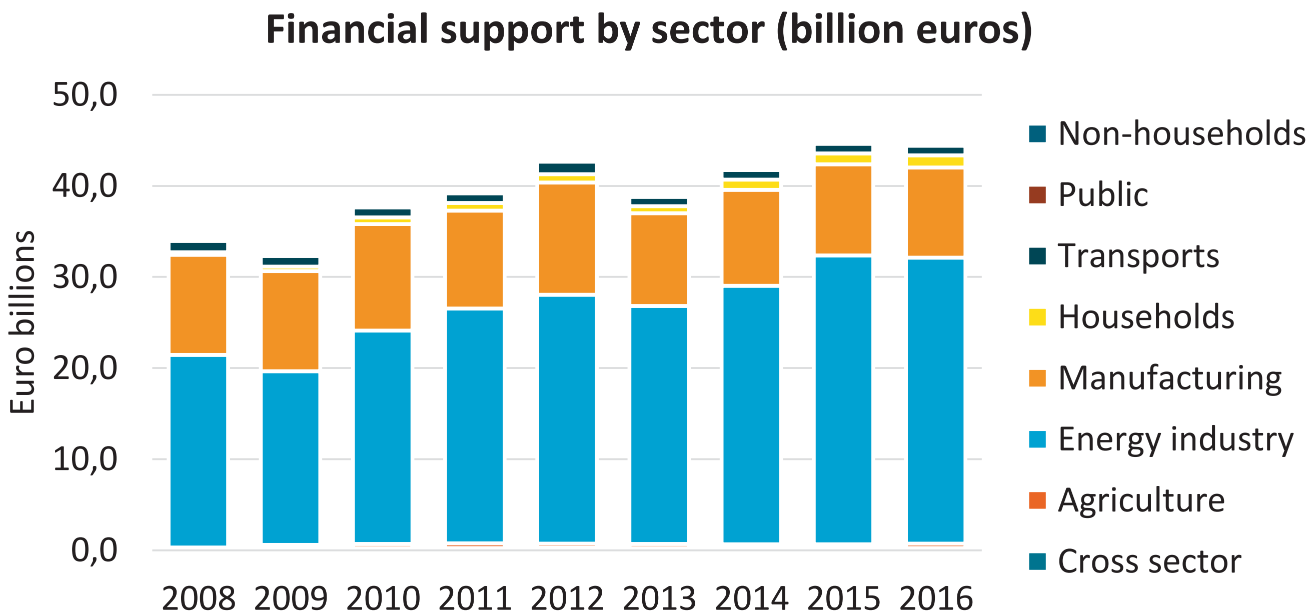
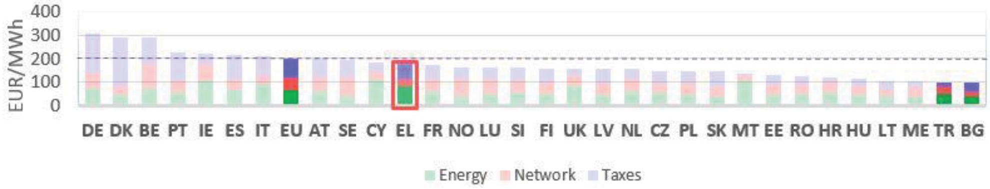
Financial support interventions





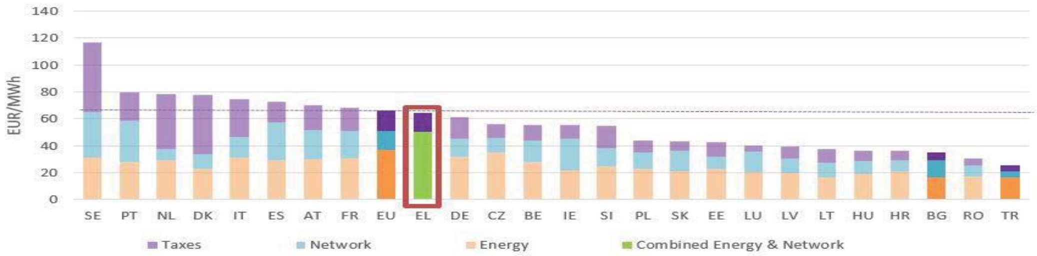
Greece

Electricity prices for Households (DC) – EL vs EU

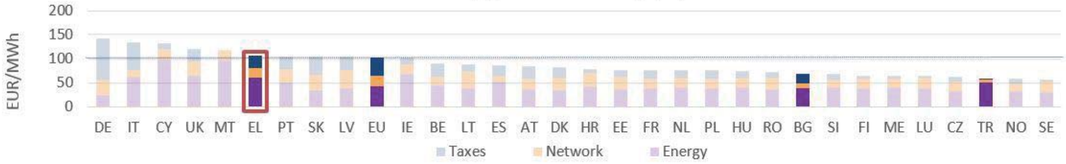


See footnote[1]

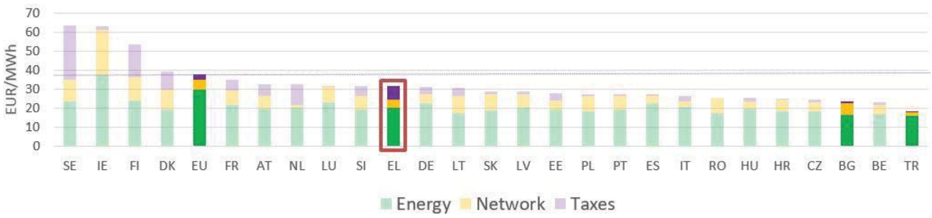
Gas prices for Households (ID) – EL vs EU



Electricity prices for Industry (ID) - EL vs EU



Gas prices for Industry (I3) – EL vs EU

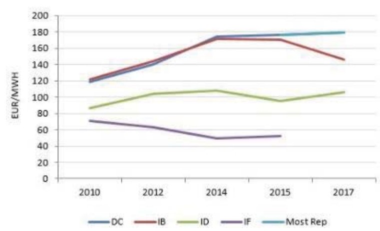


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

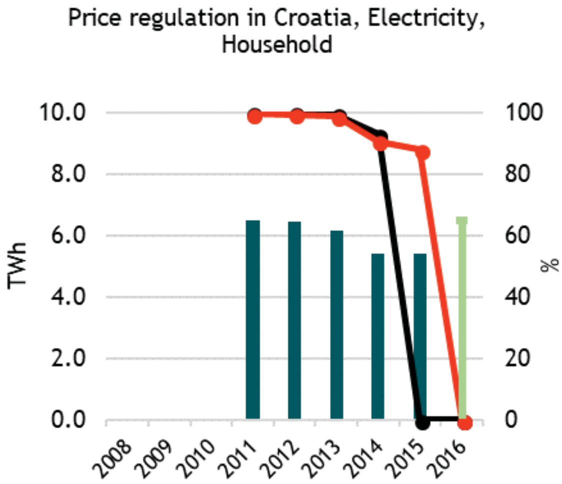
See footnote[2]

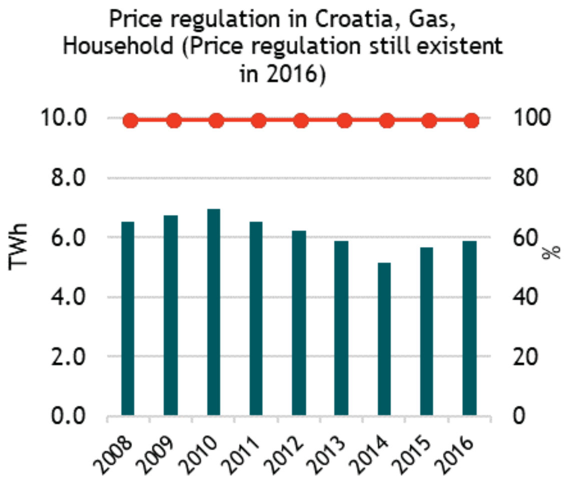
Electricity prices in Greece



[1] Neighbour countries and EU 28. Please note that gas household prices available for Greece refer to 2015 (2017 not available).
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.

Price regulation

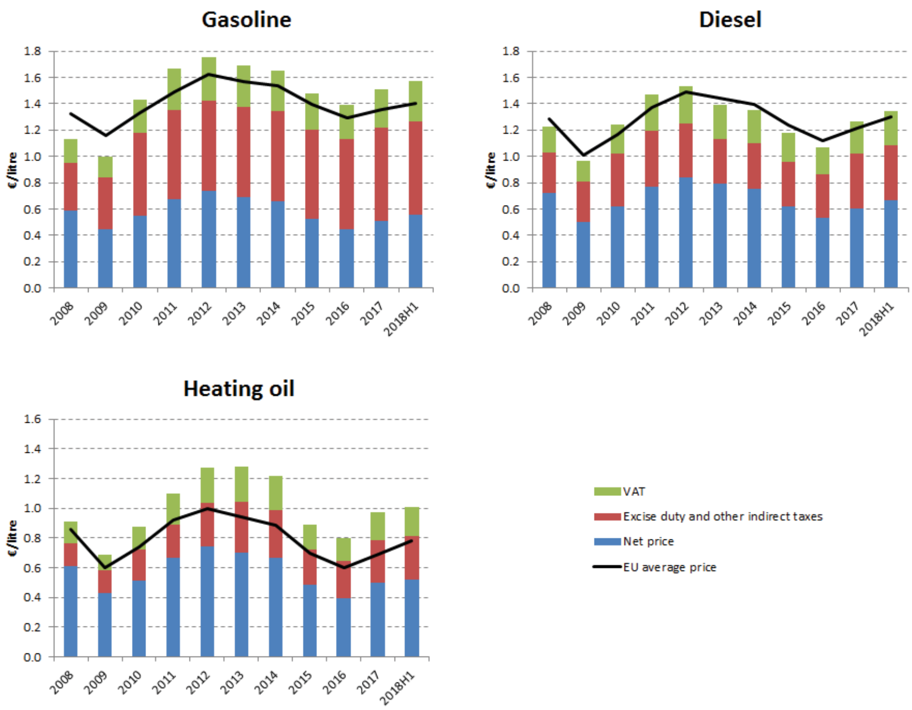




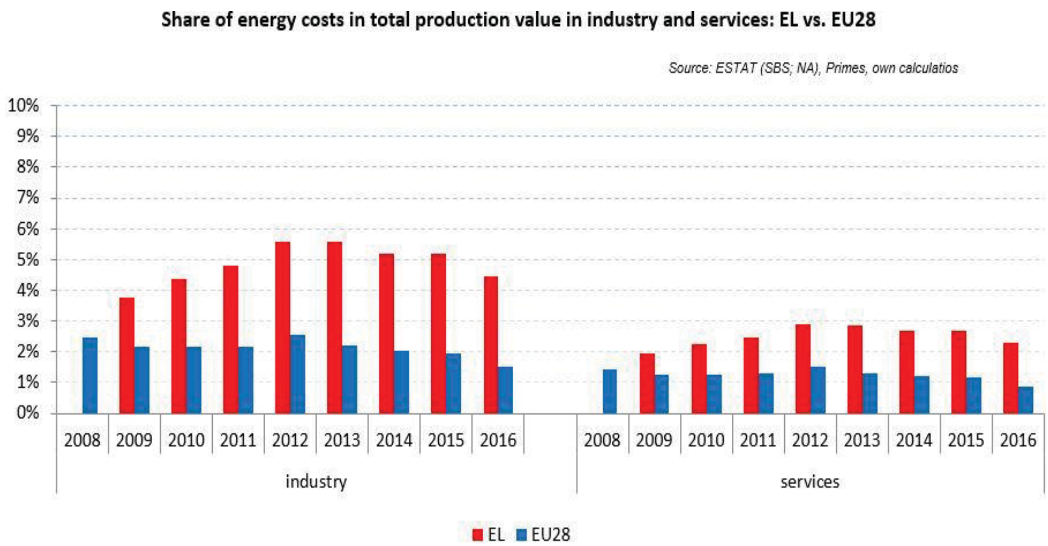
Volume of the consumption of consumers with regulated prices (TWh)
Share of consumers with regulated prices (%)
Share of the consumption of regulated consumers out of total consumption (%)
Regulation phased out in (if phased out between 2008-2016)

No data available for 2017 electricity and natural gas prices

Oil products prices



Energy costs shares in total production costs



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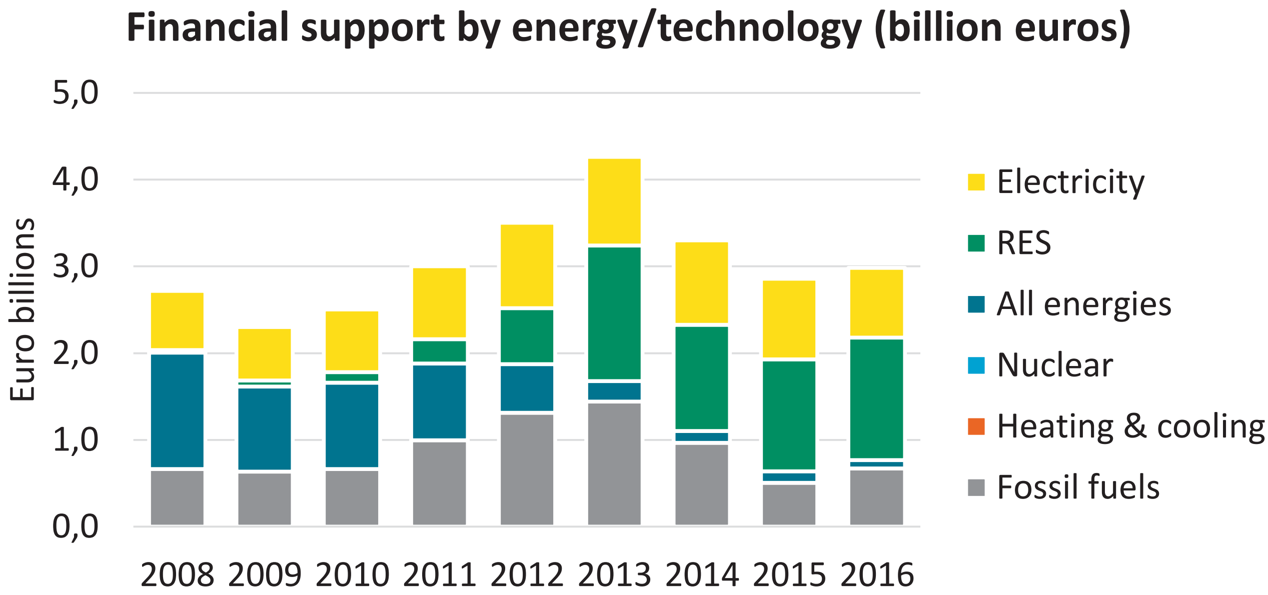
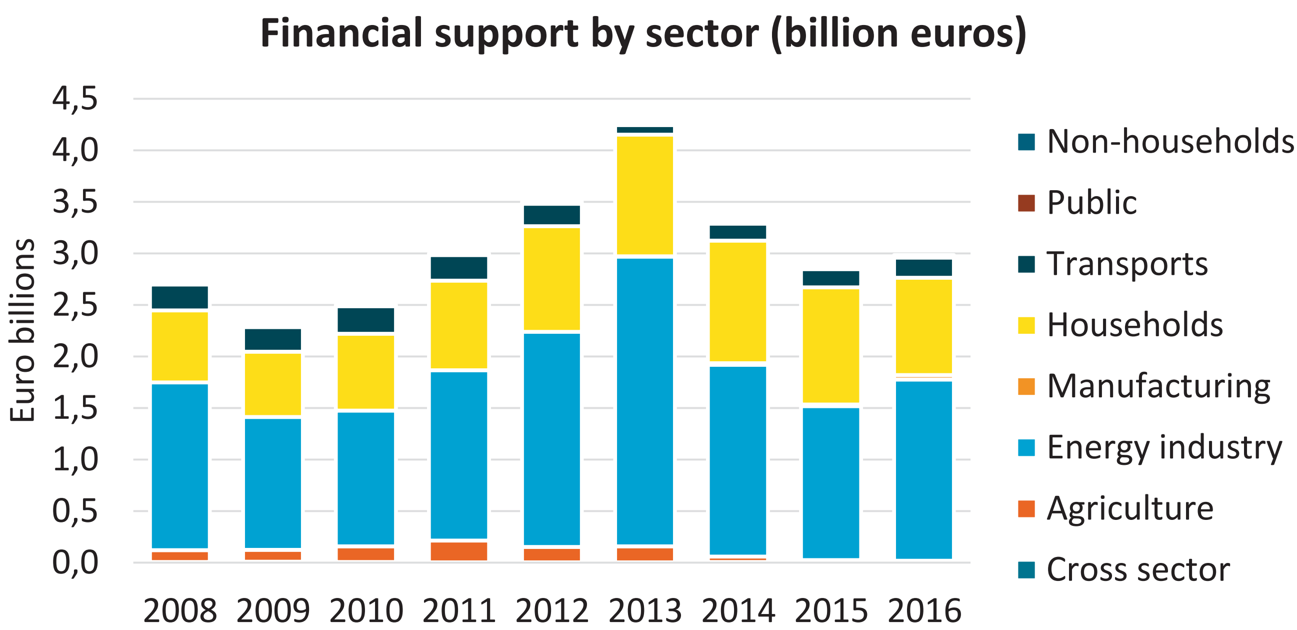
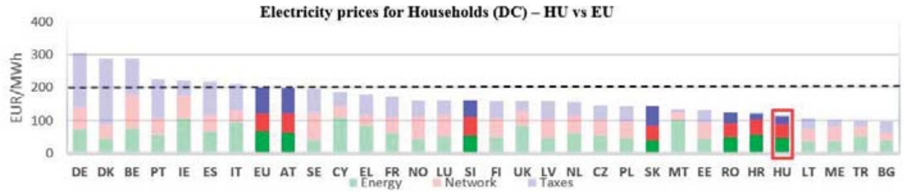
Financial support interventions





Hungary



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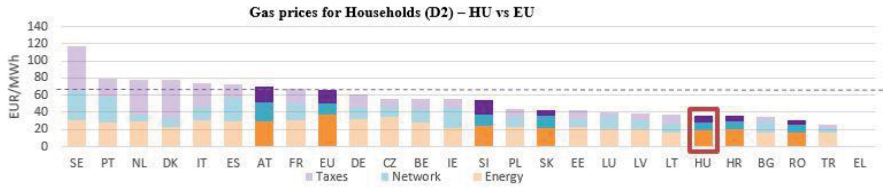
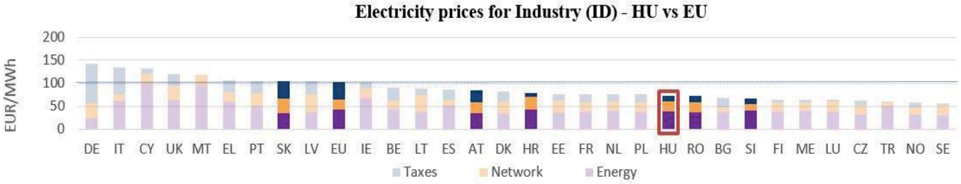
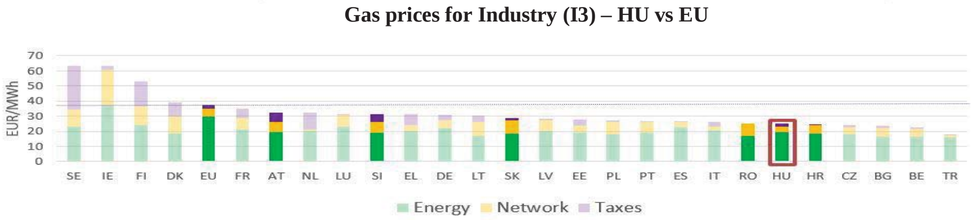


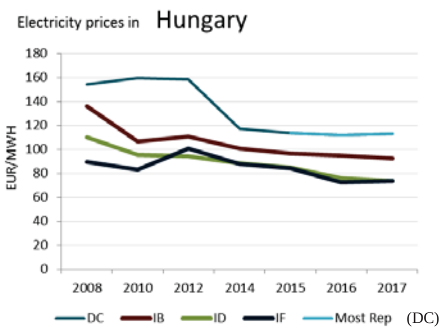


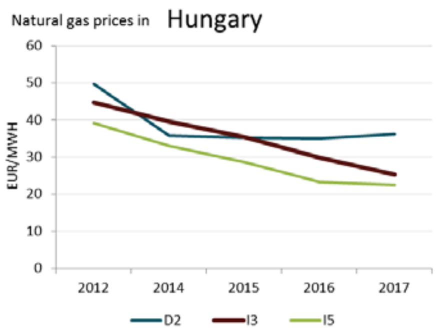


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

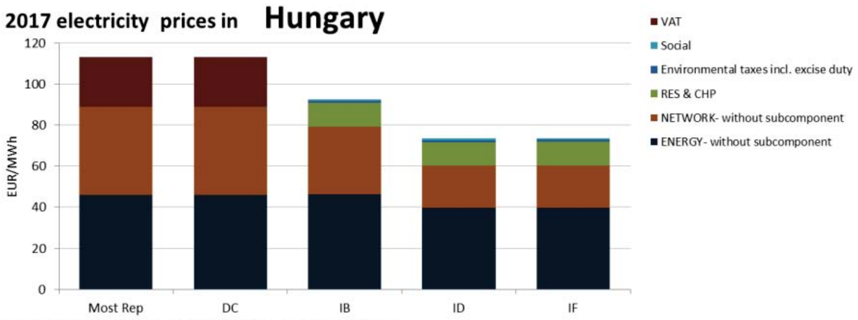
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]

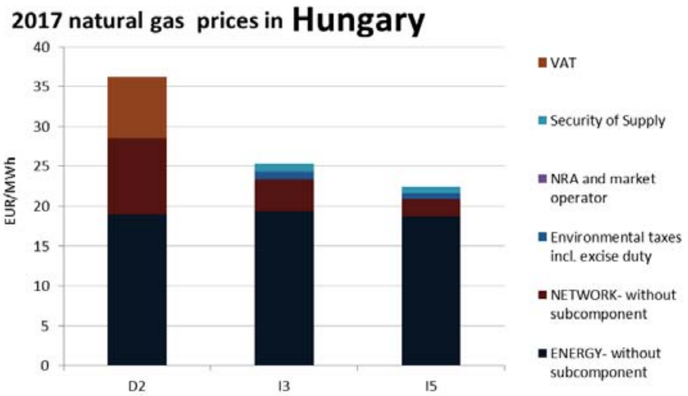




[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.

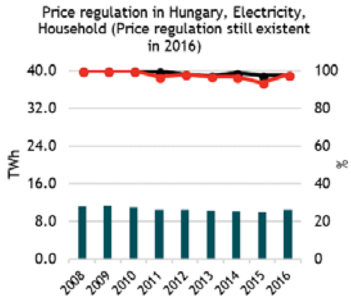


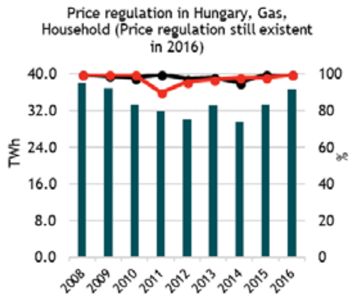
Source: European Commission, DG Energy in- house data collection

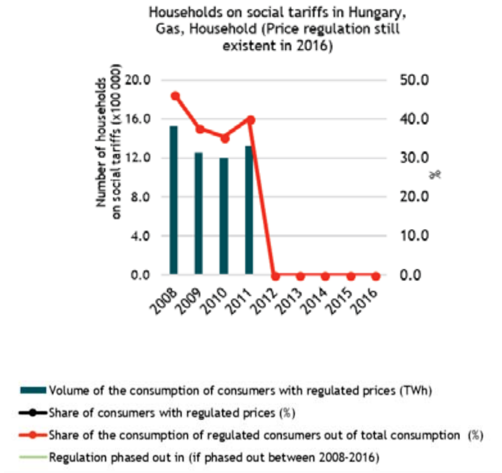


Source: European Commission, DG Energy in- house data collection

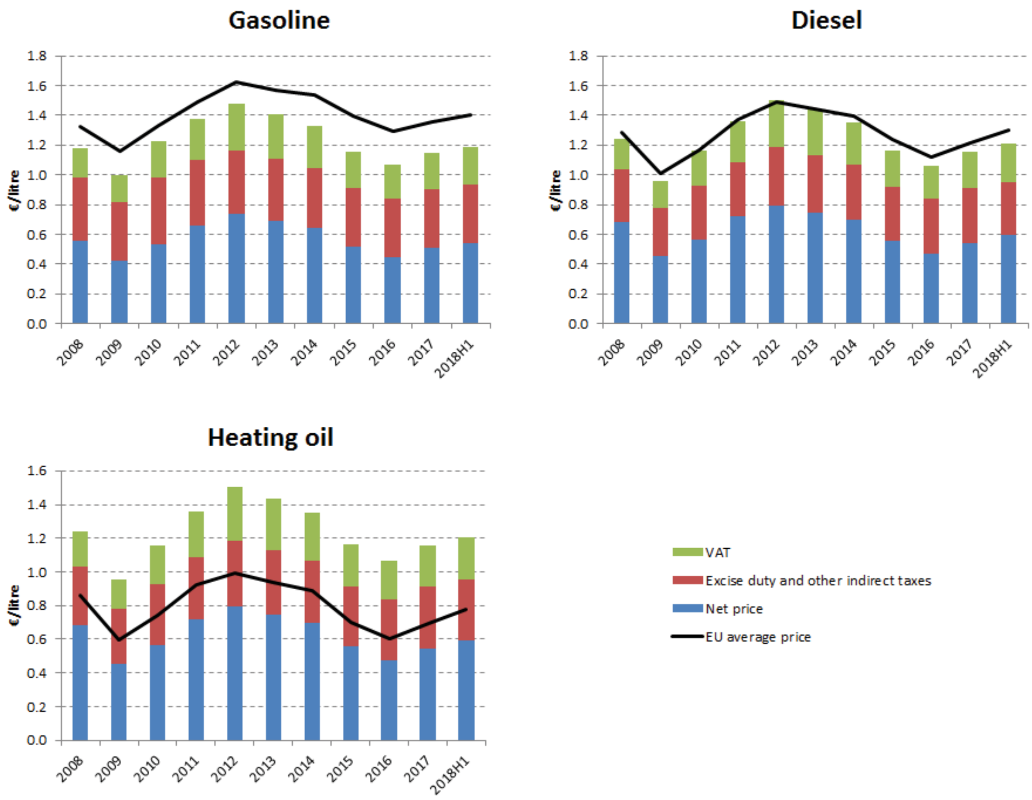
Price regulation



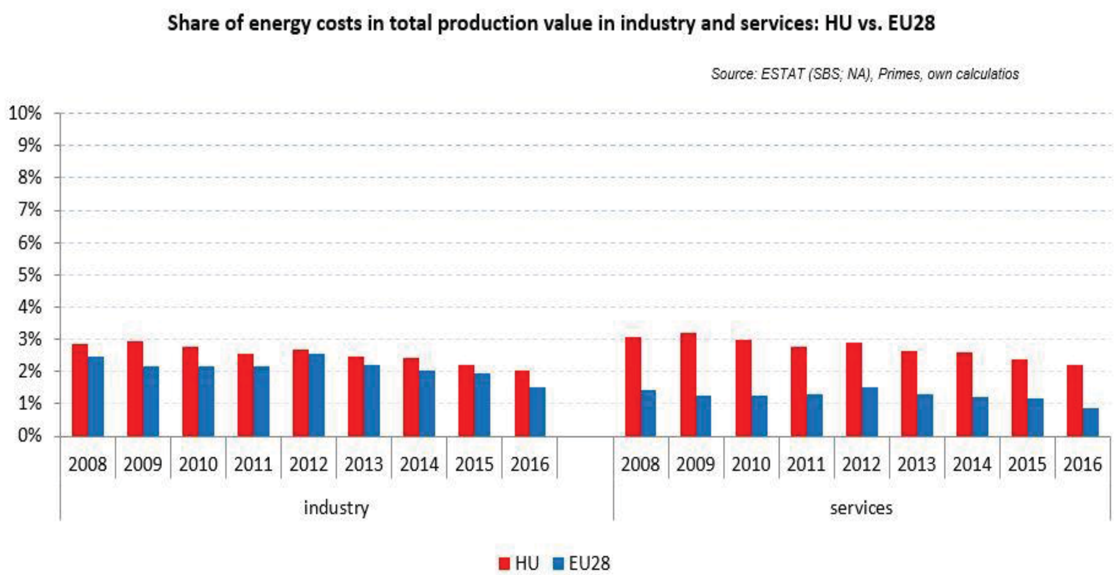




Oil product prices

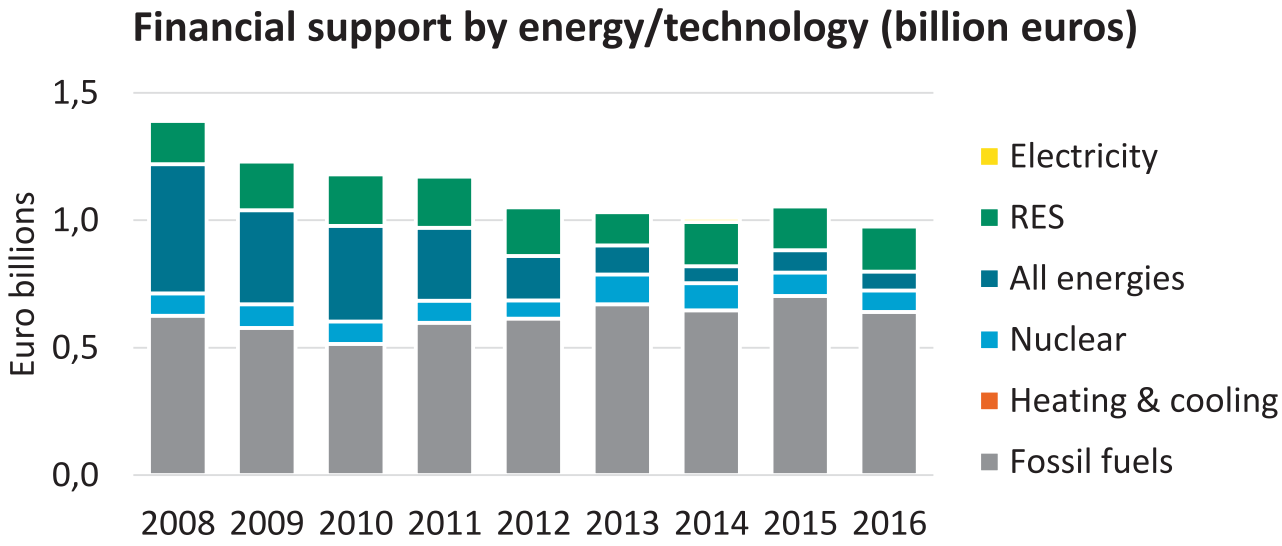


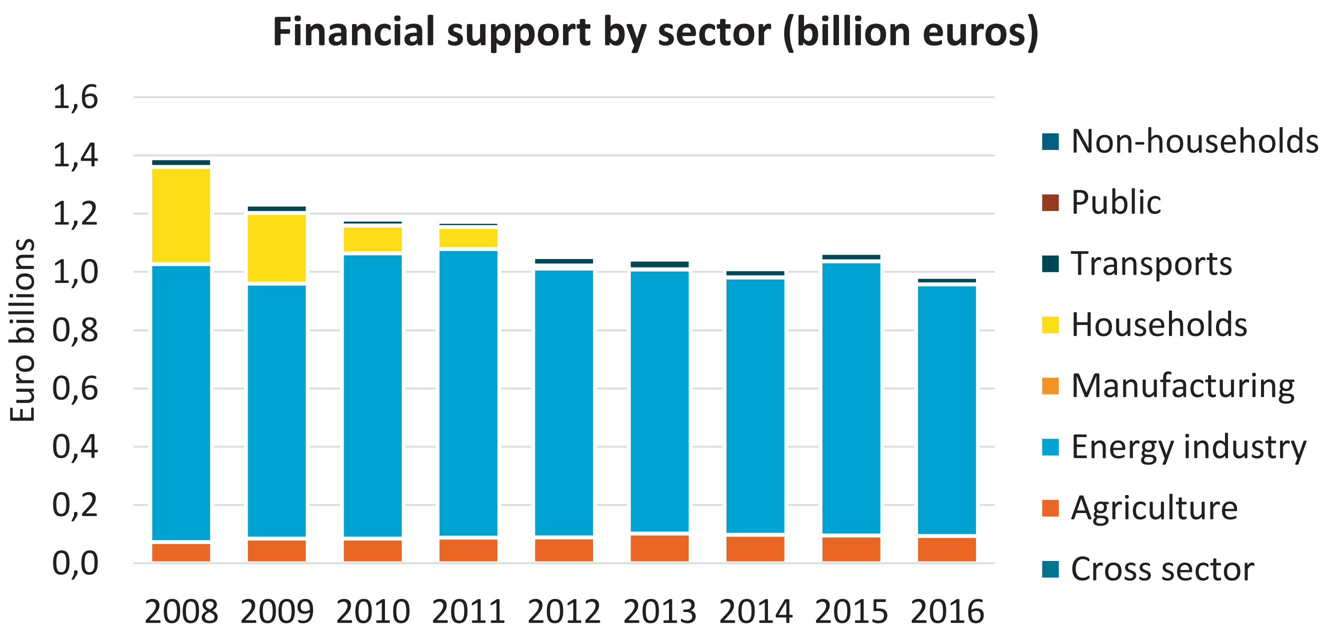
Energy costs shares in total production costs



Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

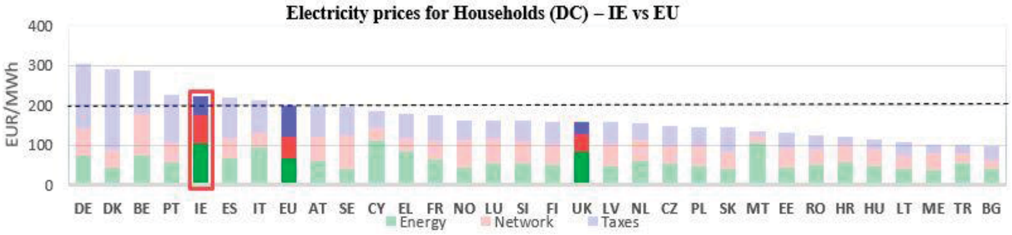
Financial support interventions

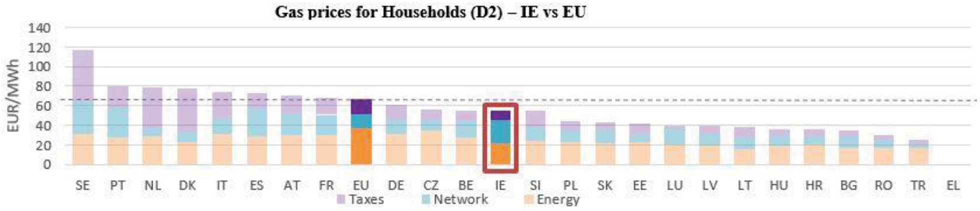


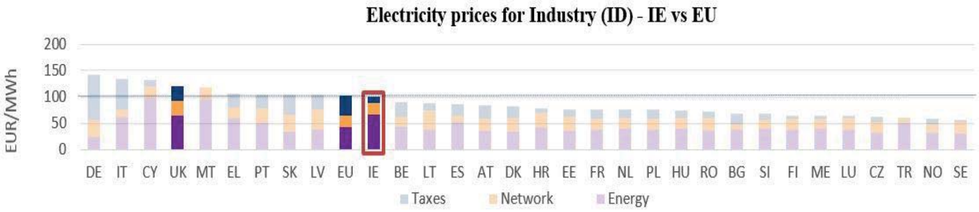


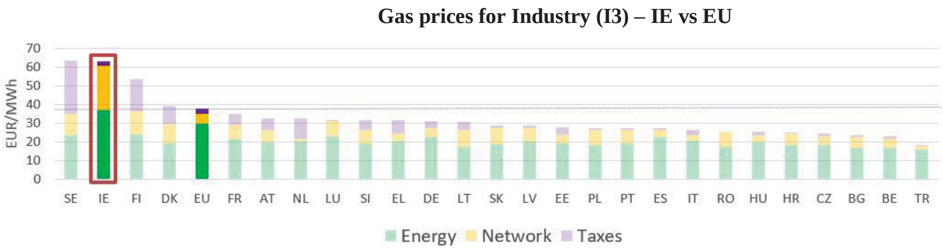
Ireland

see footnote[1]





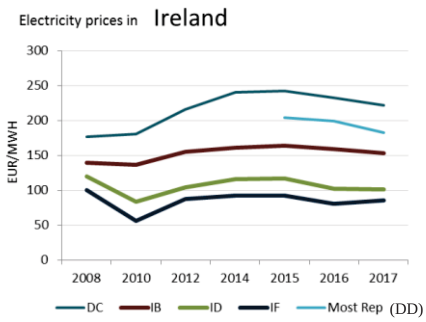




Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

See footnote[2]



[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
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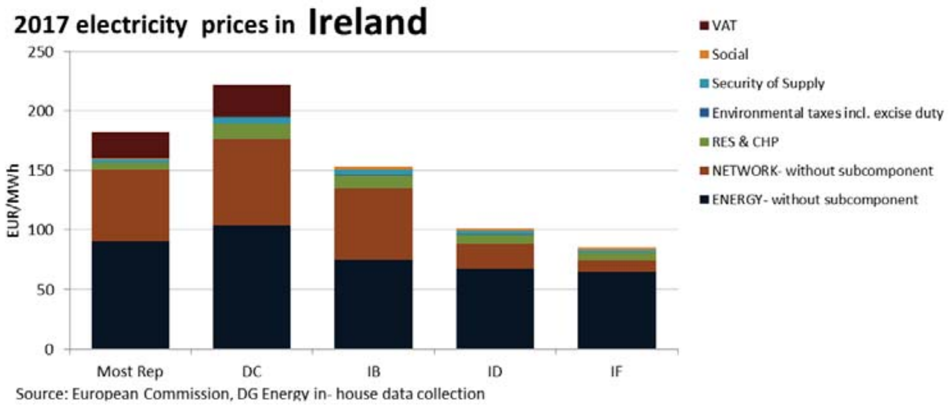
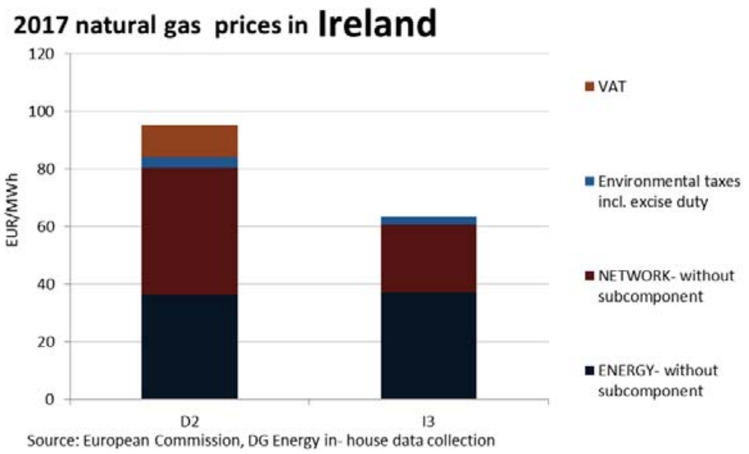
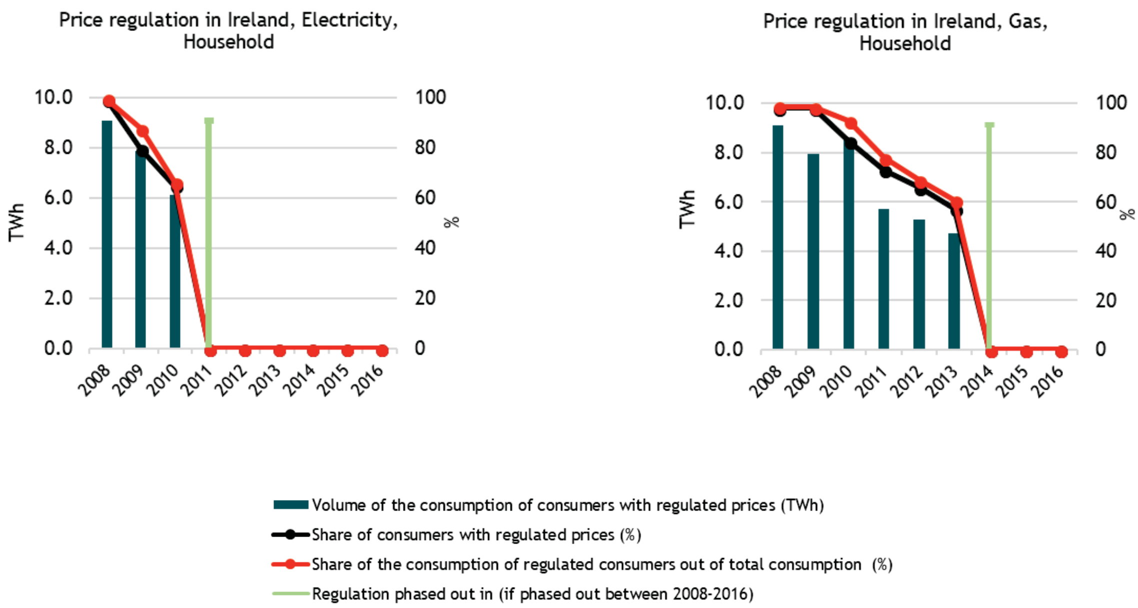
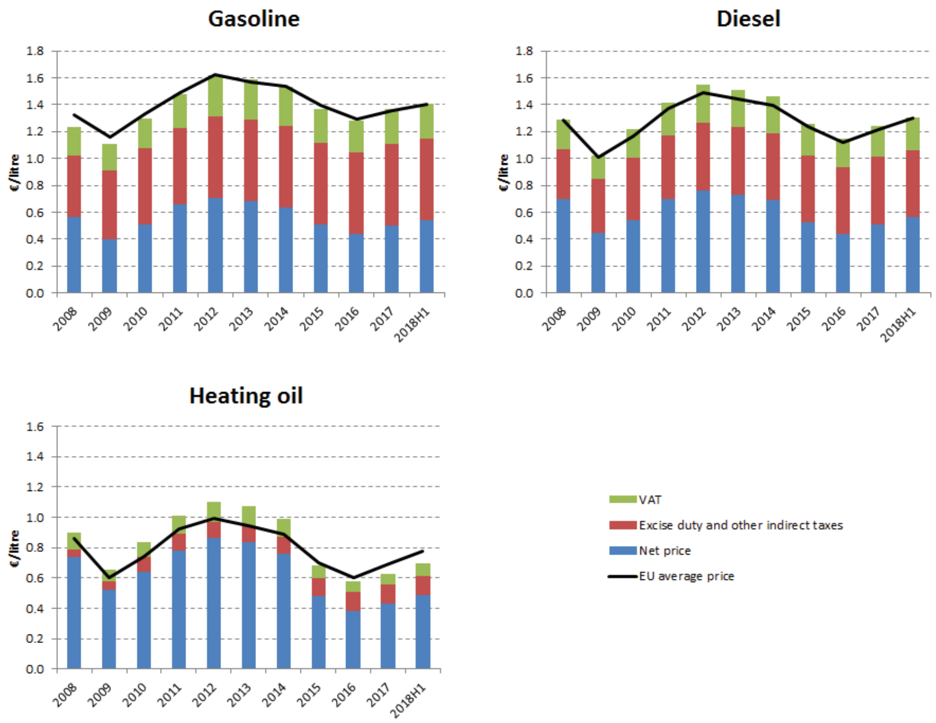




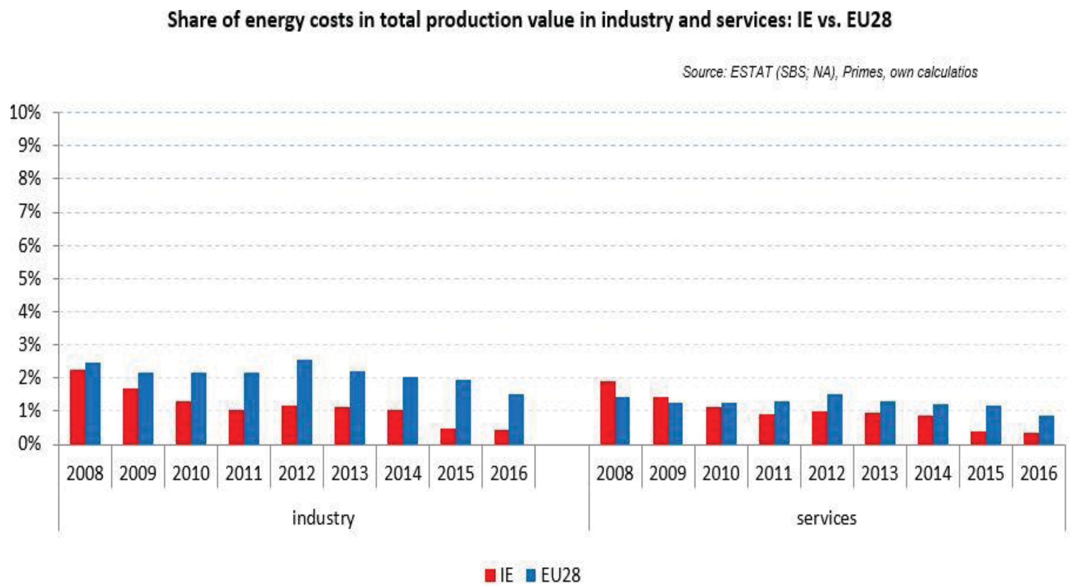
Price regulation



Oil products prices

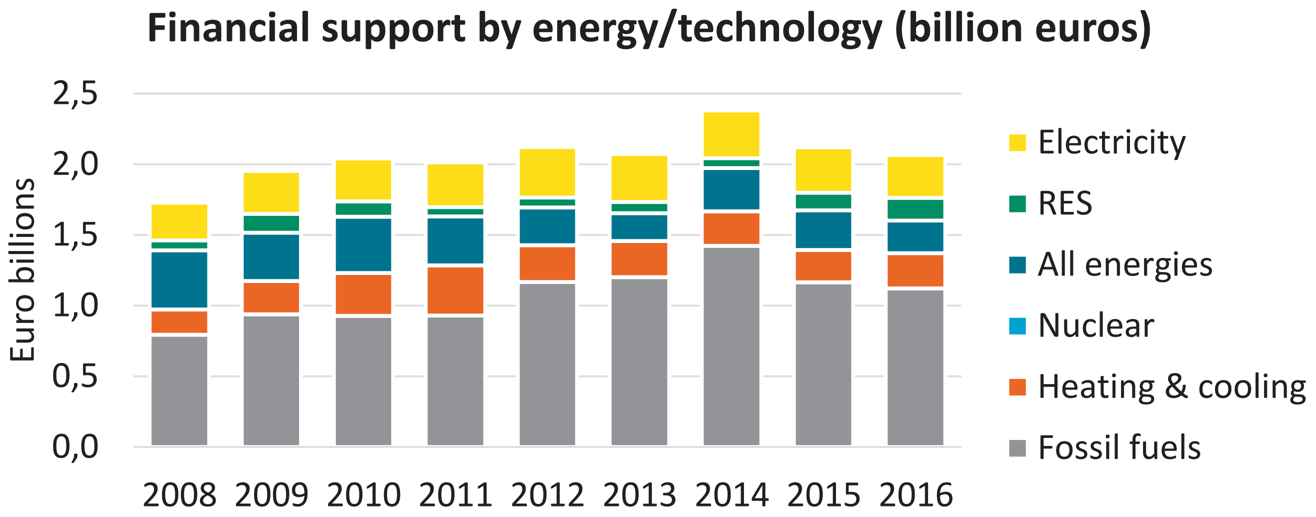


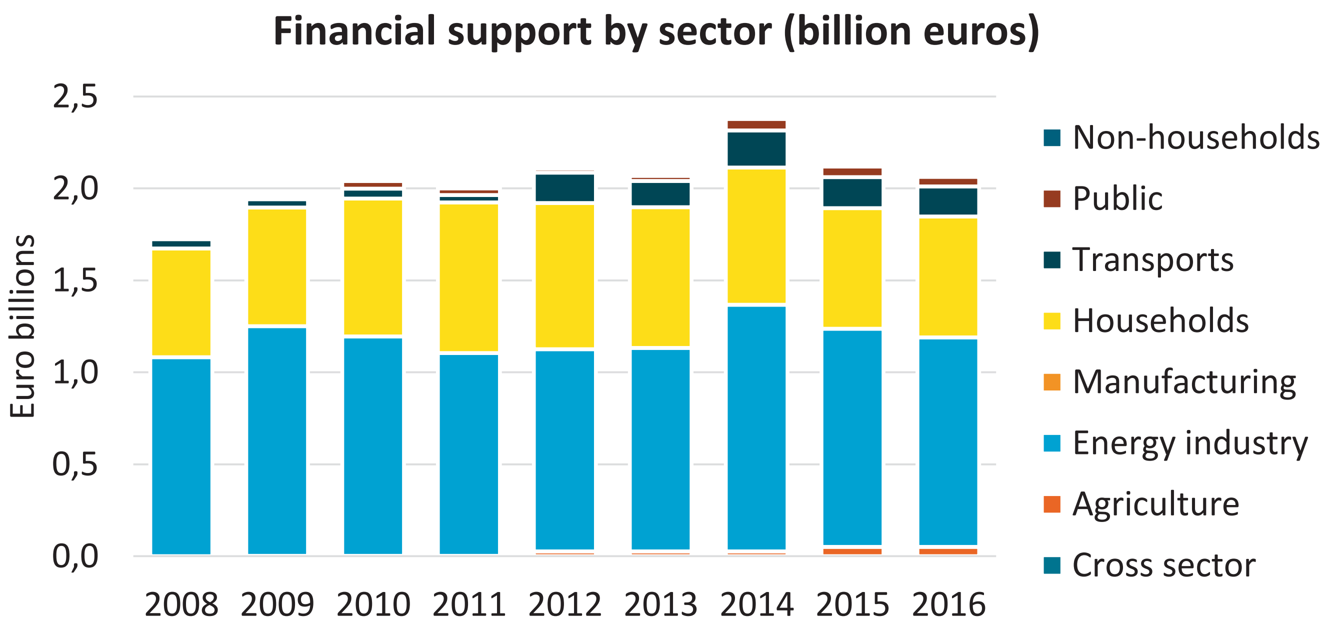
Energy costs shares in total production costs



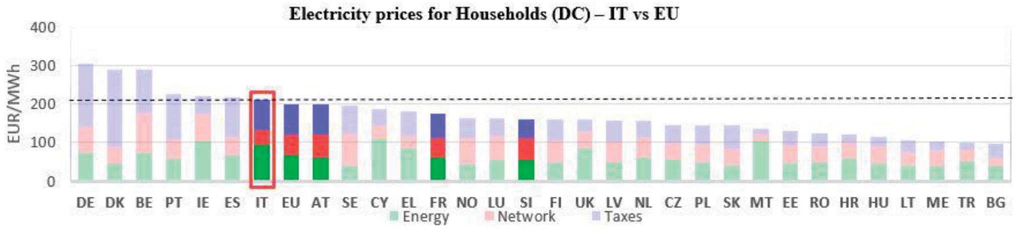
Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmerk, Sweden and the United Kingdom for 2016 was missing by the time of extraction

Financial support interventions

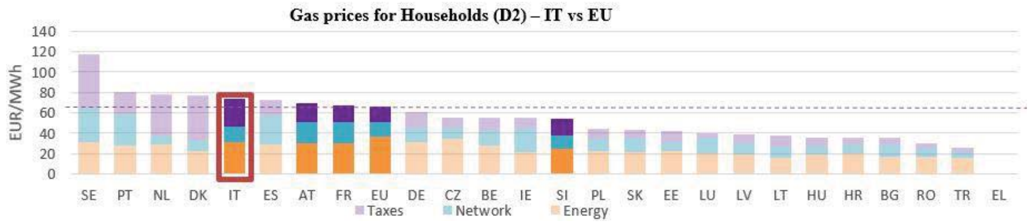


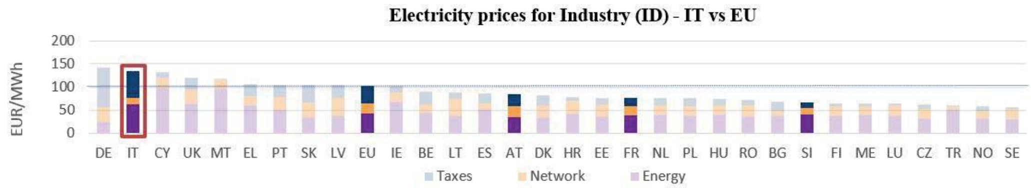


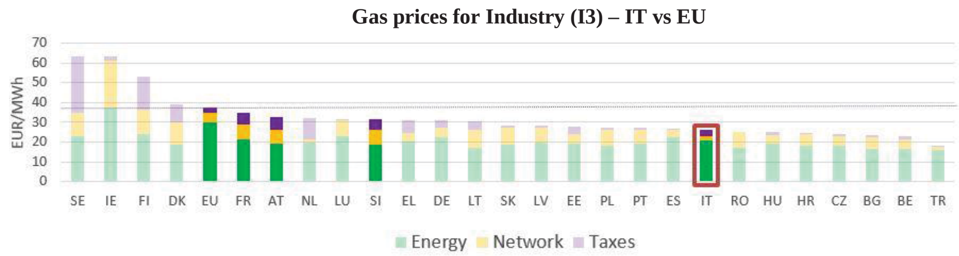
Italy



see footnote[1]



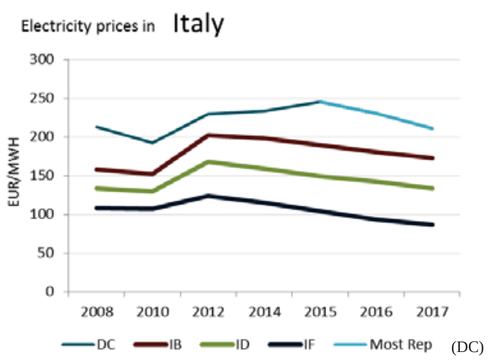


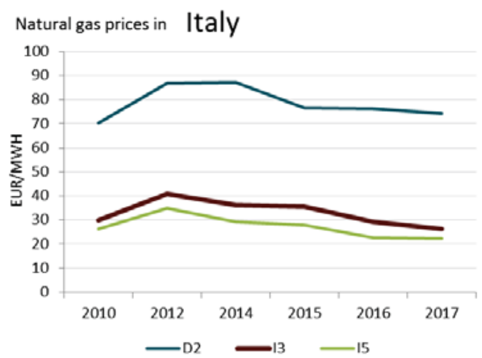


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]

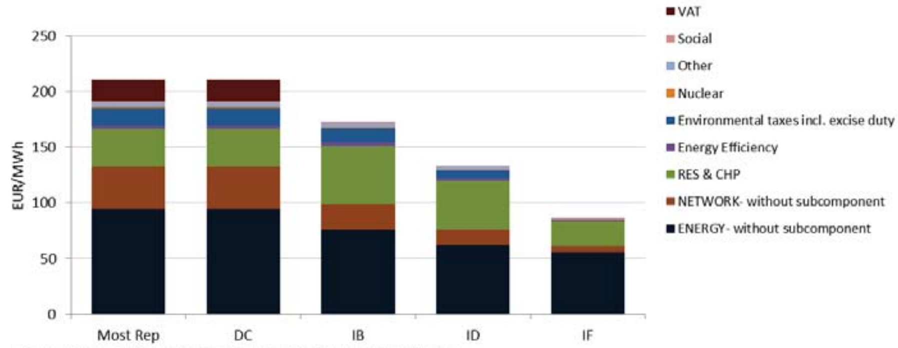




[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.

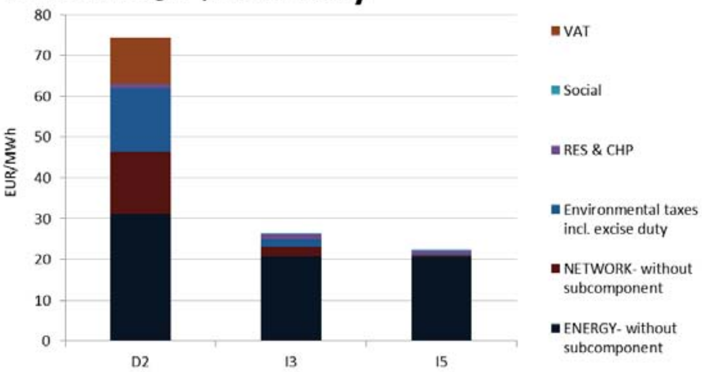
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.

2017 electricity prices in Italy



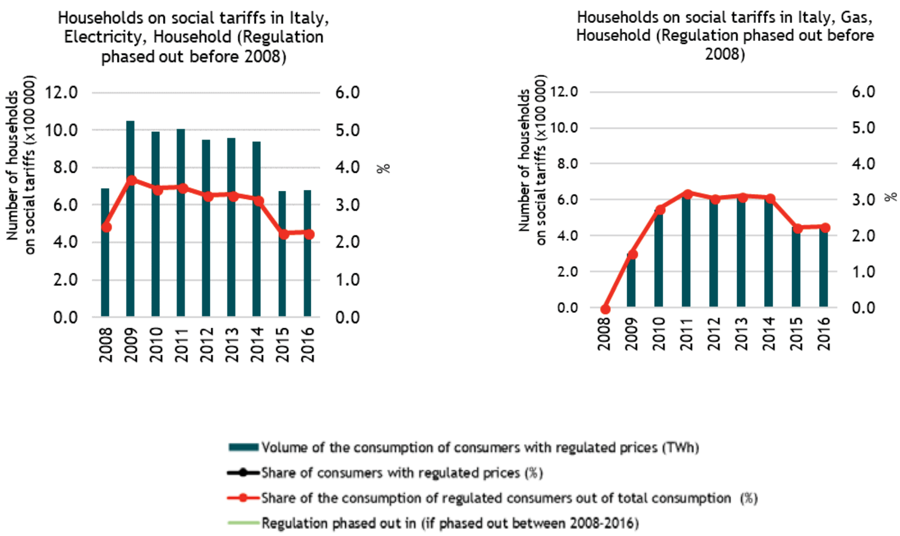
Source: European Commission, DG Energy in- house data collection

2017 natural gas prices in Italy

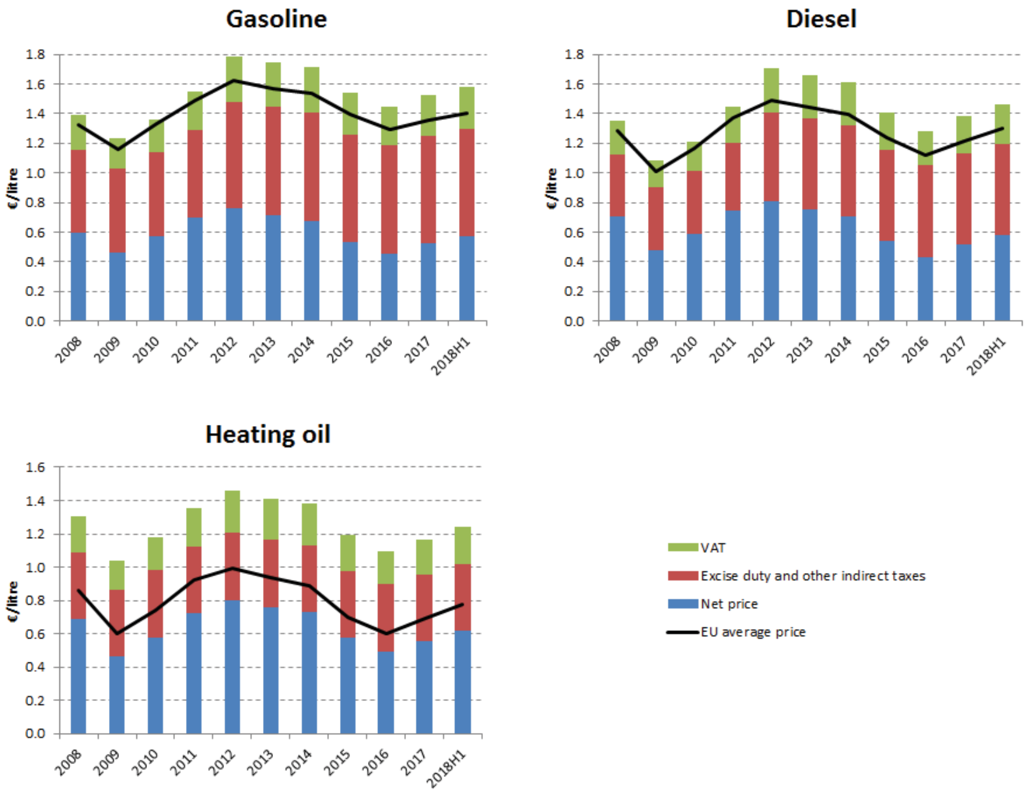


Source: European Commission, DG Energy in- house data collection

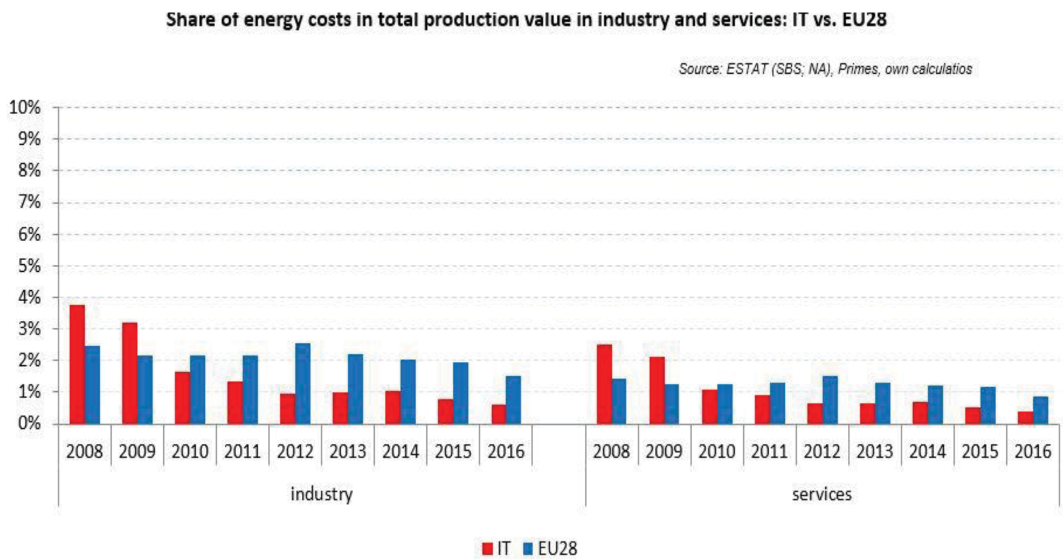
Price regulation



Oil products prices

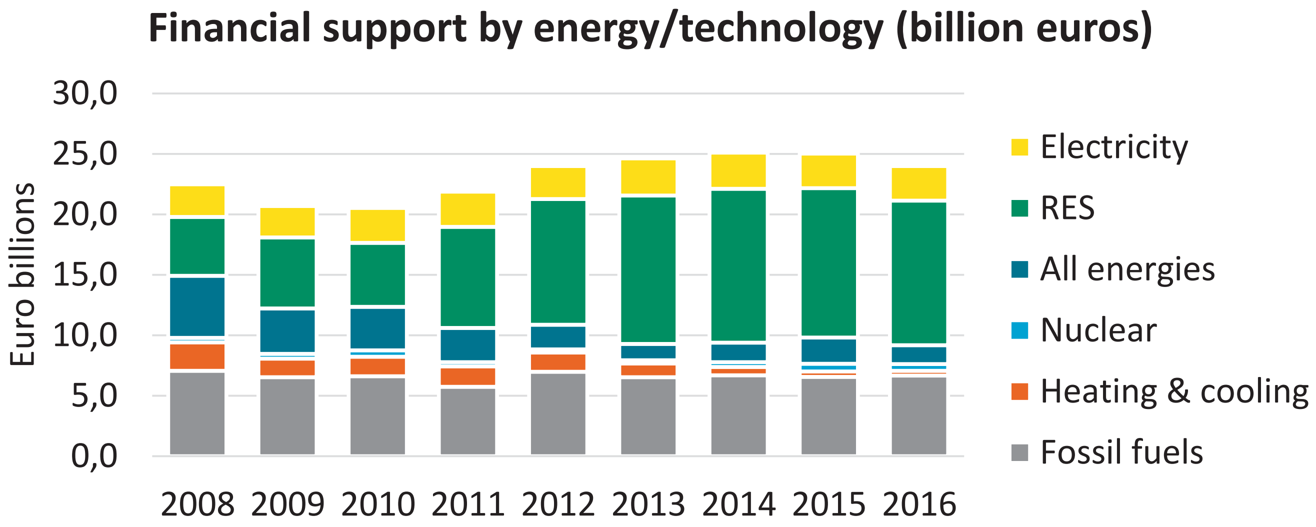


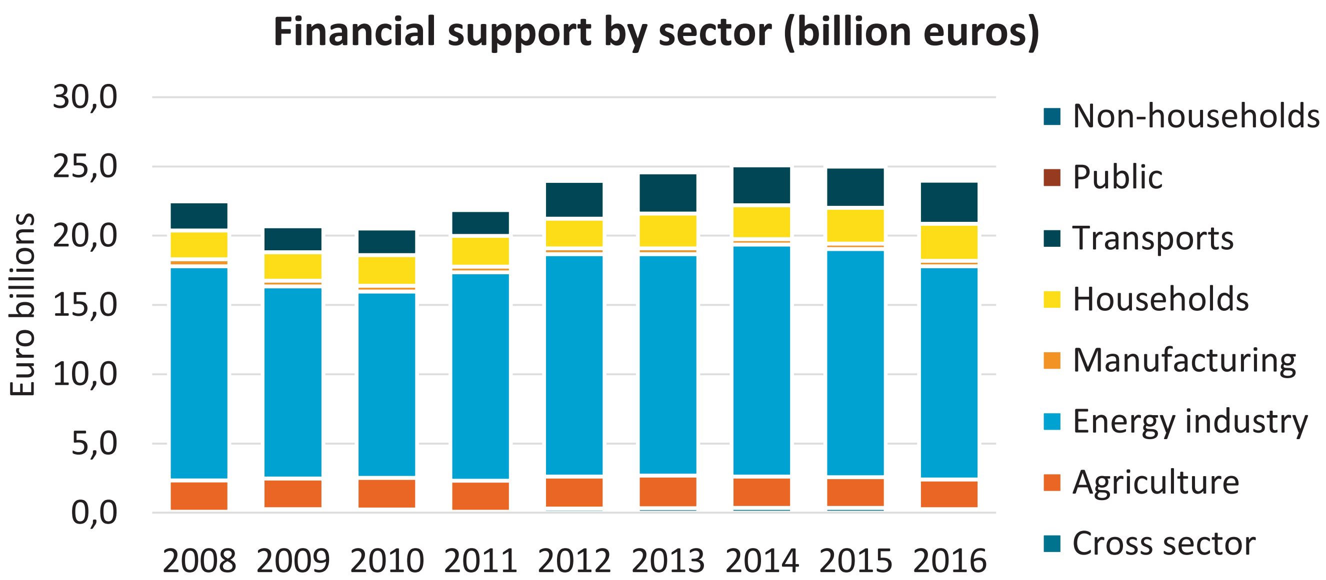
Energy costs shares in total production costs



Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

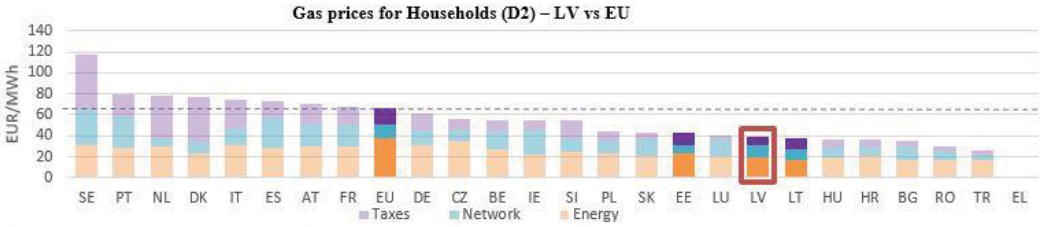
Financial support interventions

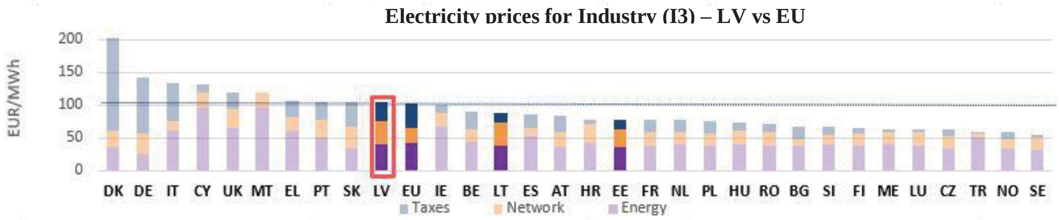


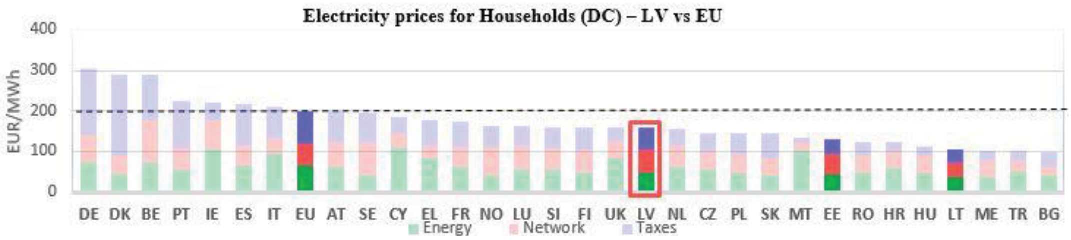


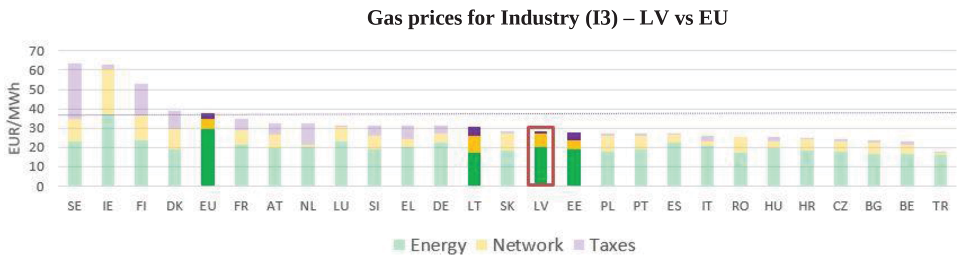
Latvia

See footnote[1]





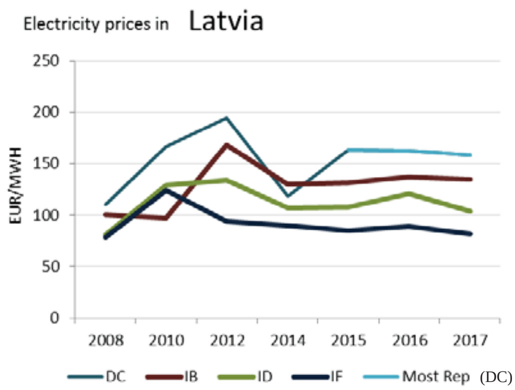




Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]



[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
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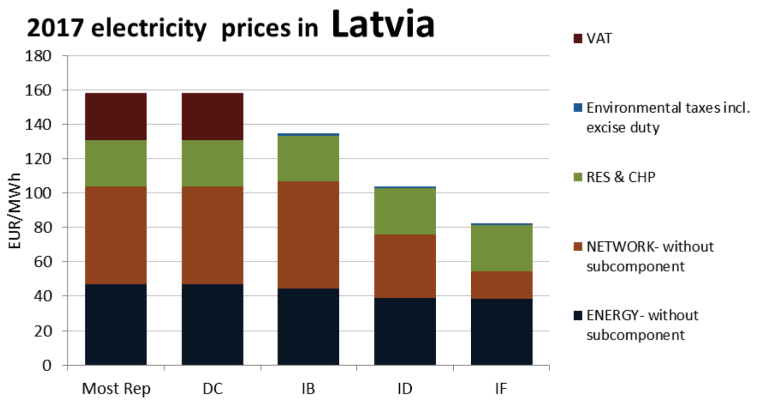
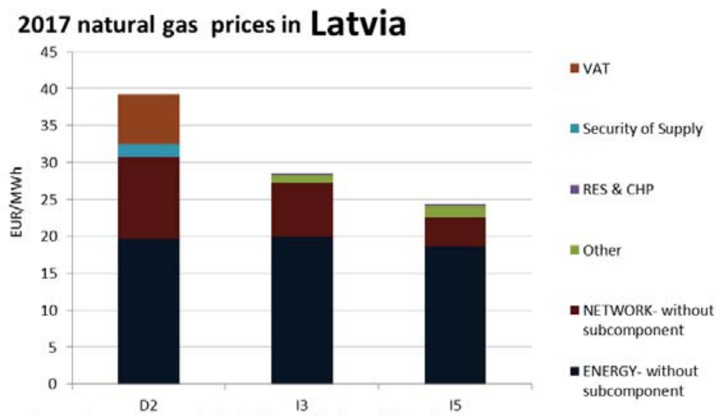
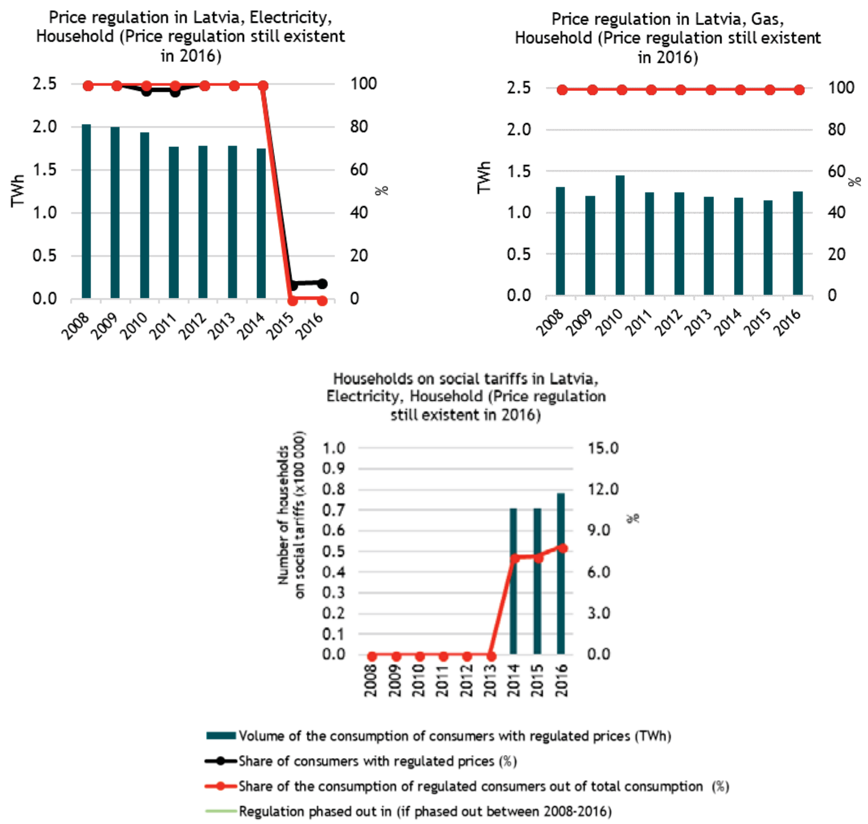


Source: European Commission, DG Energy in- house data

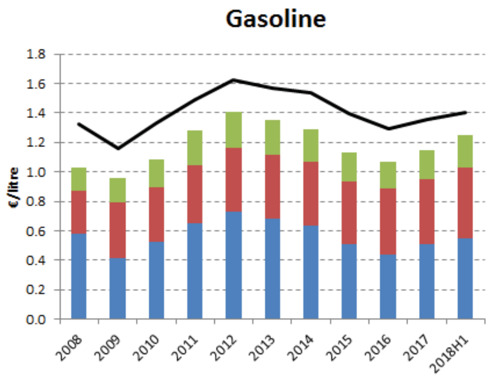


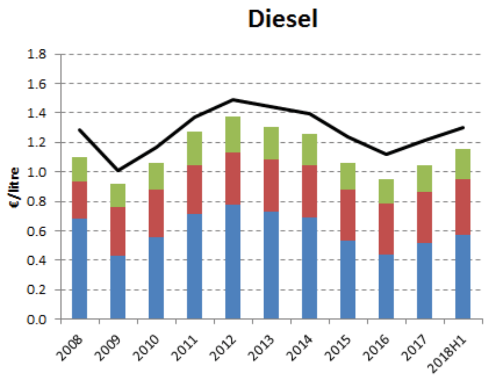
Source: European Commission, DG Energy in- house data collection

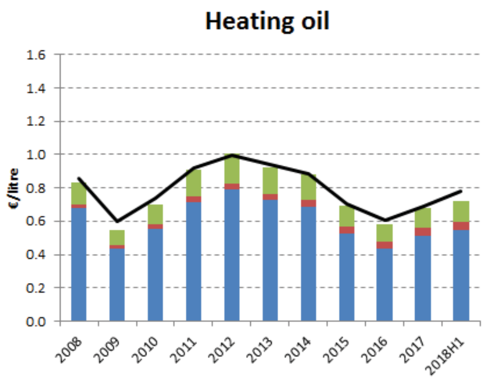
Price regulation



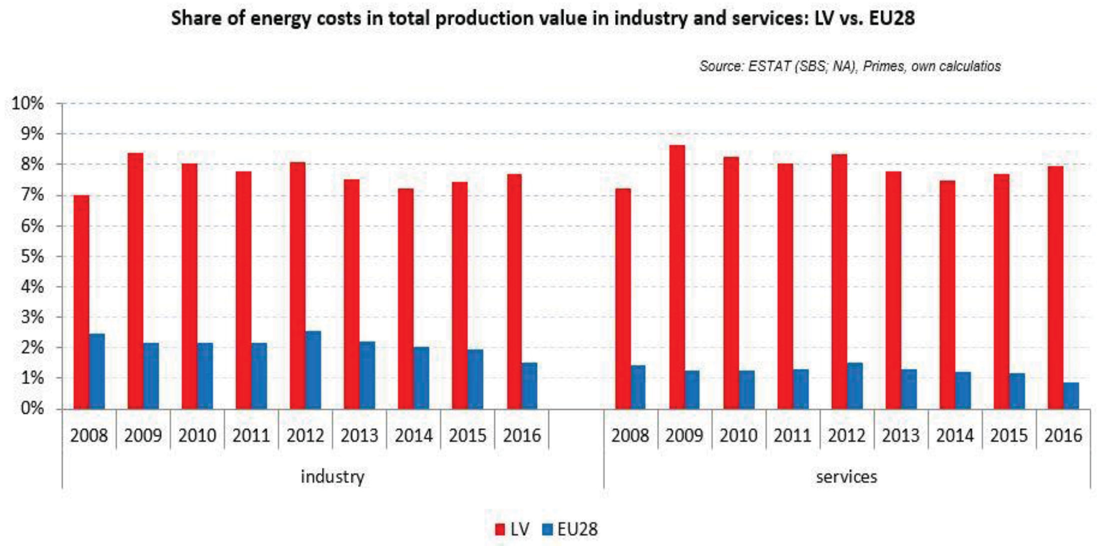
Oil products prices







Energy costs shares in total production costs



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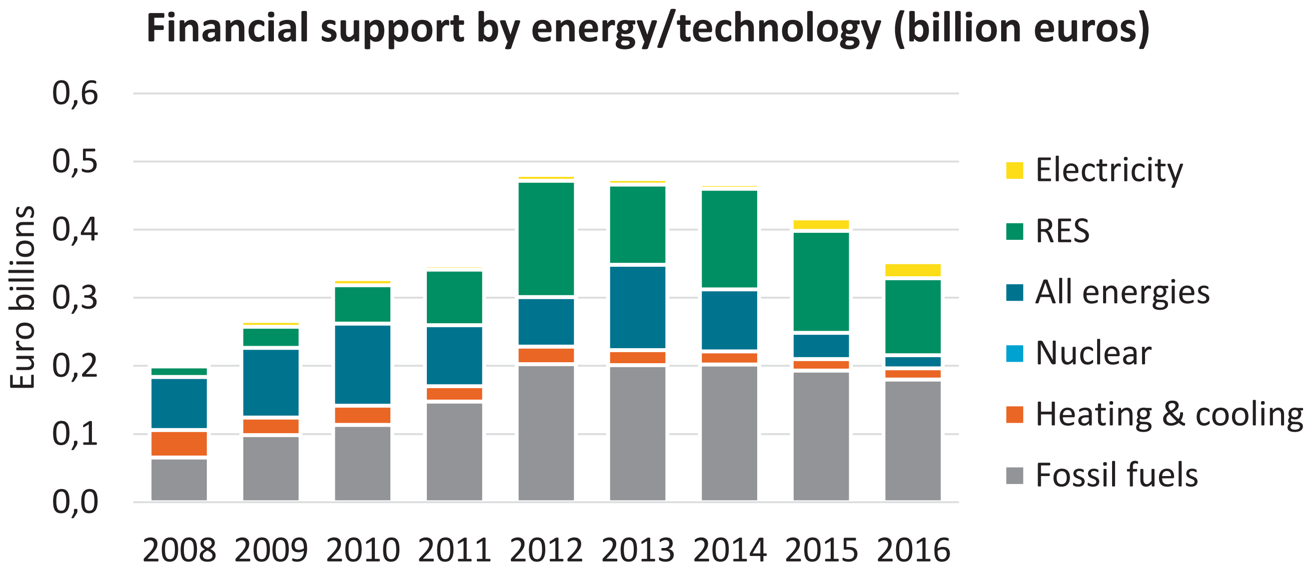
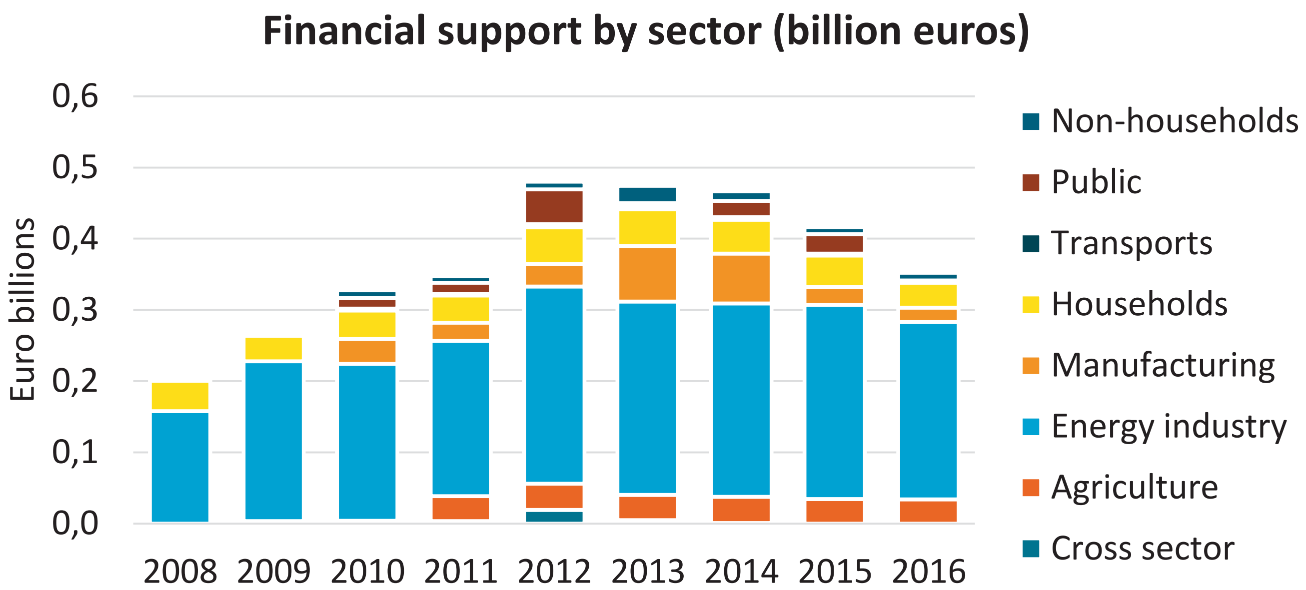
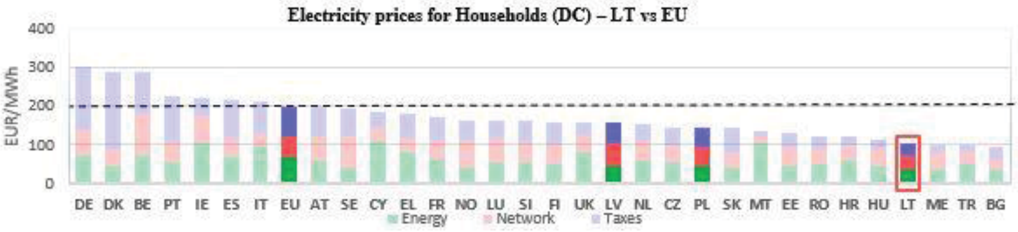
Financial support interventions

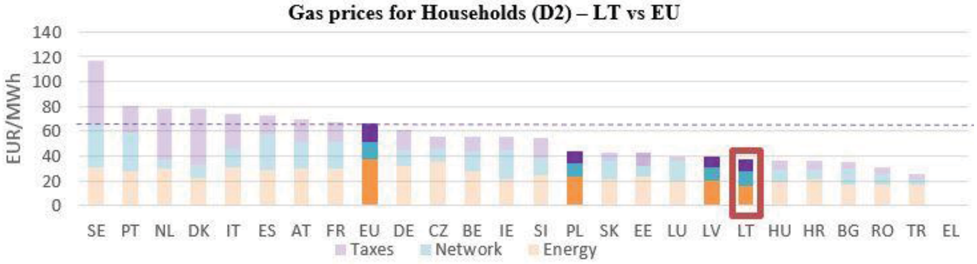


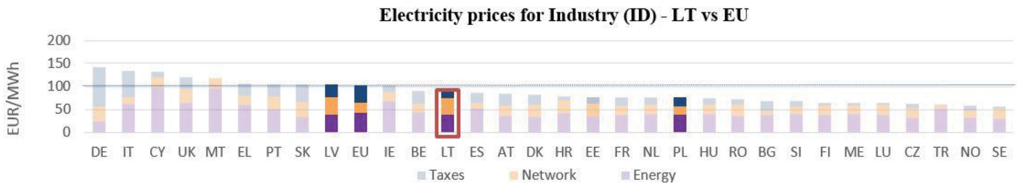


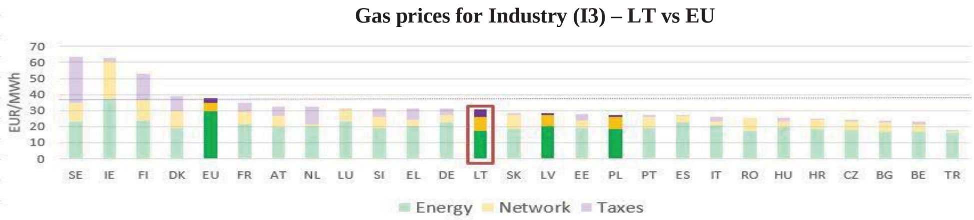
Lithuania



see footnote[1]



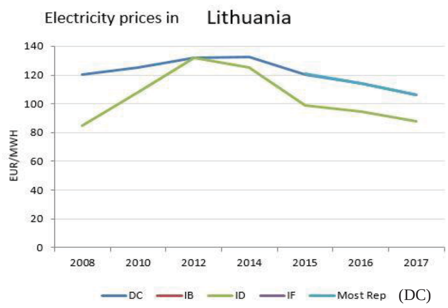


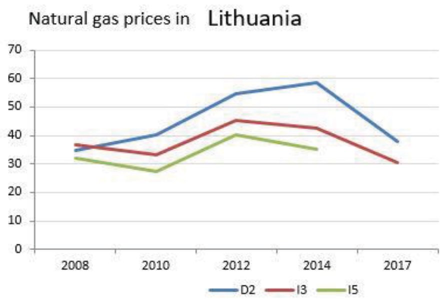


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]





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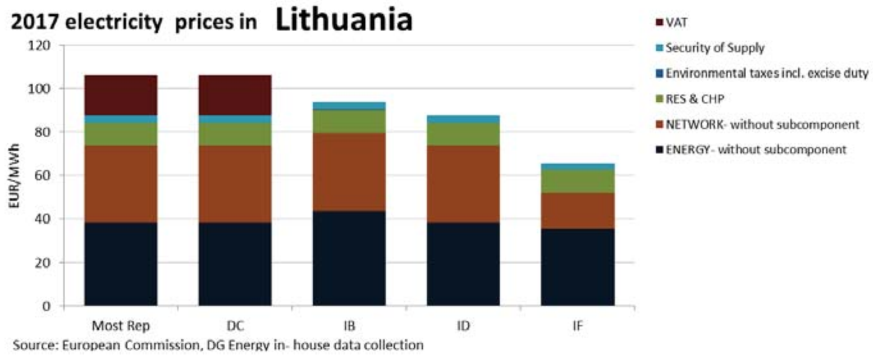
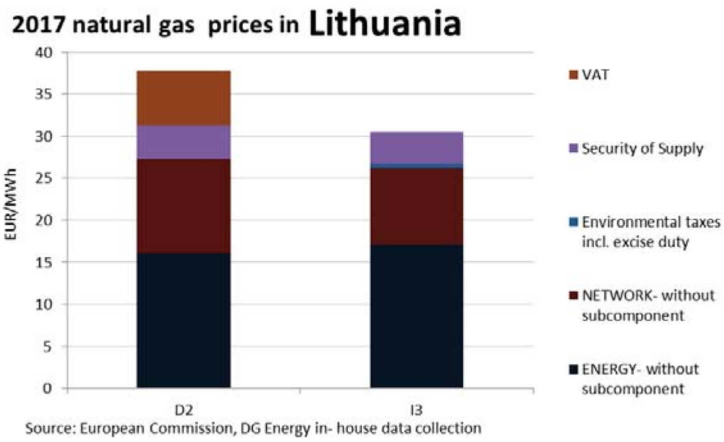
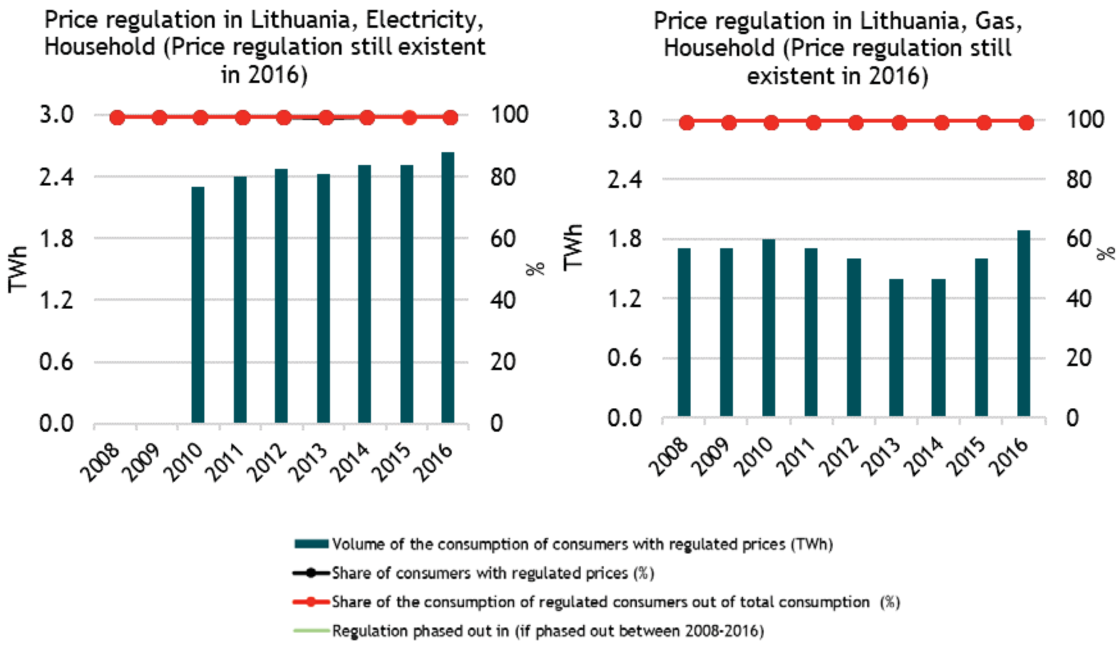
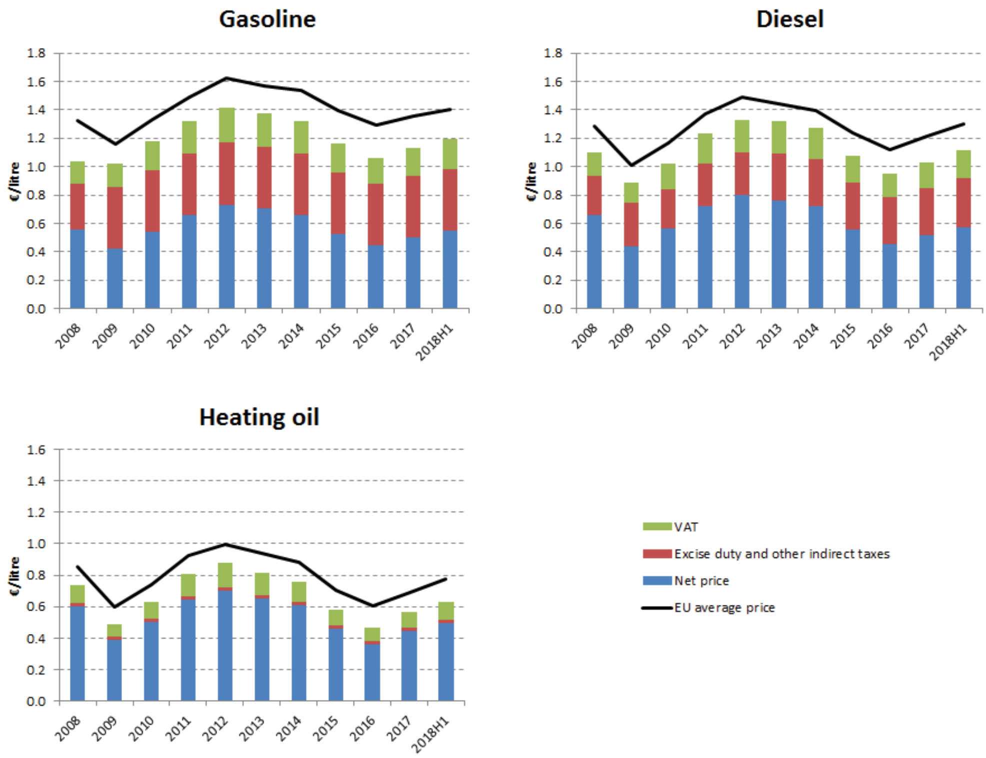




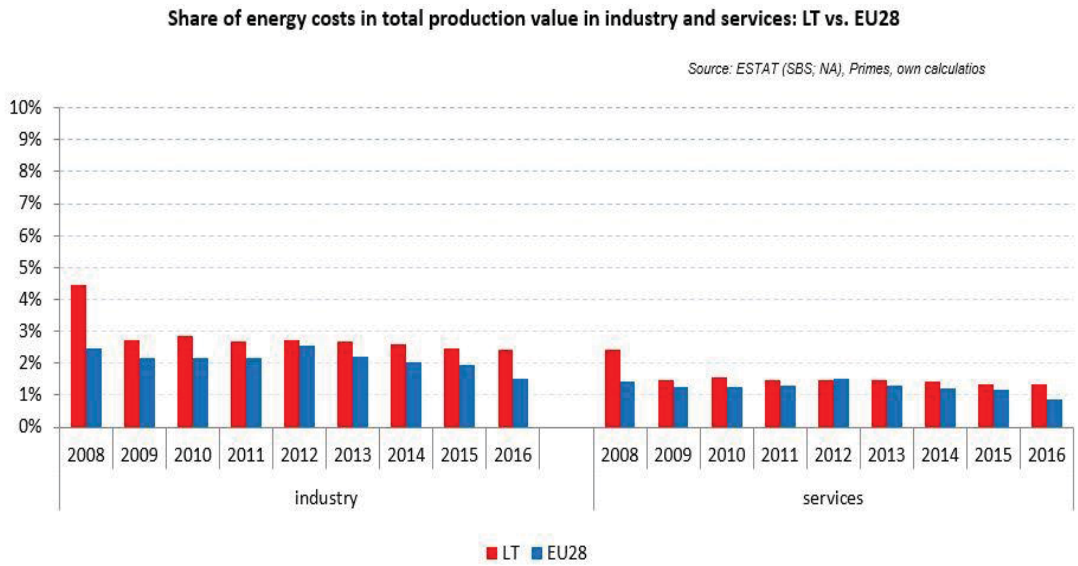
Price regulation



Oil products prices



Energy costs shares in total production costs



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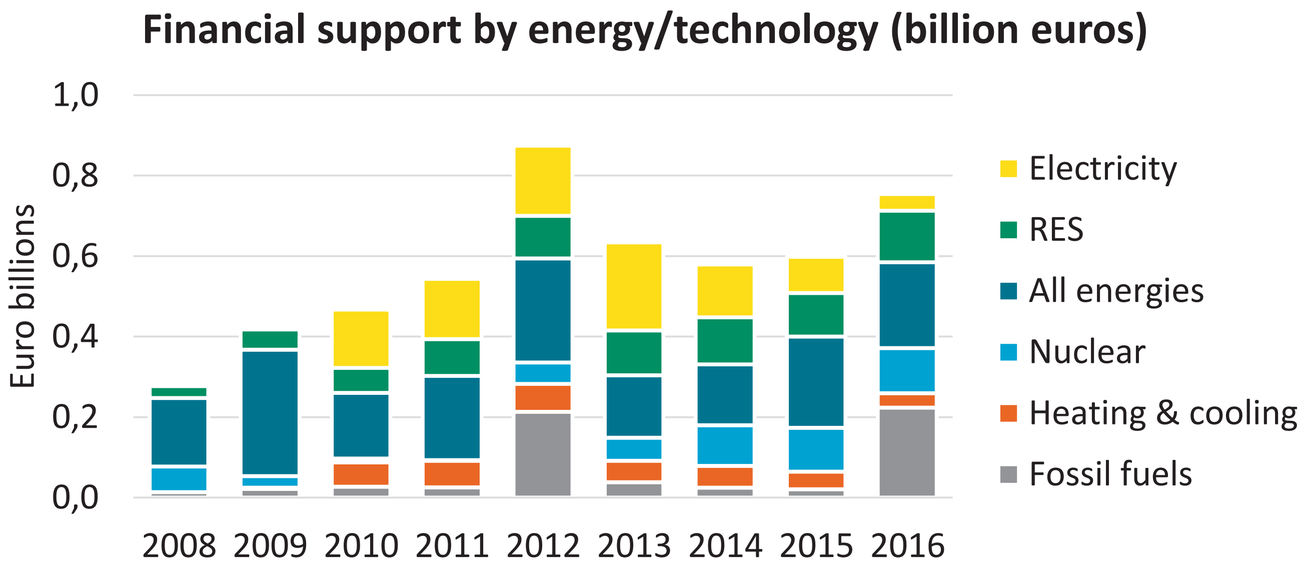
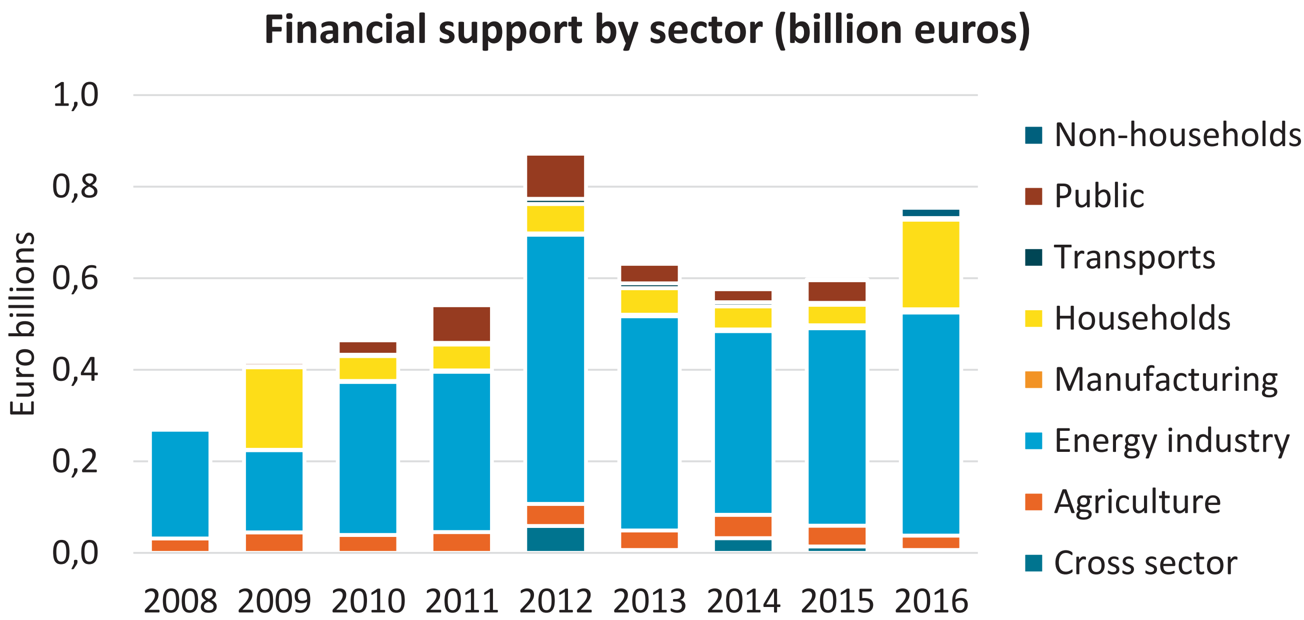
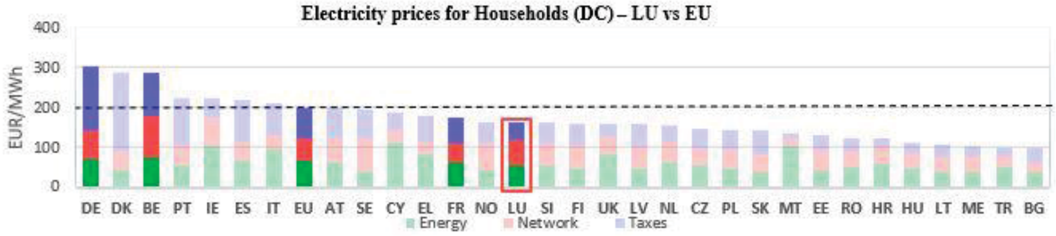
Financial support interventions

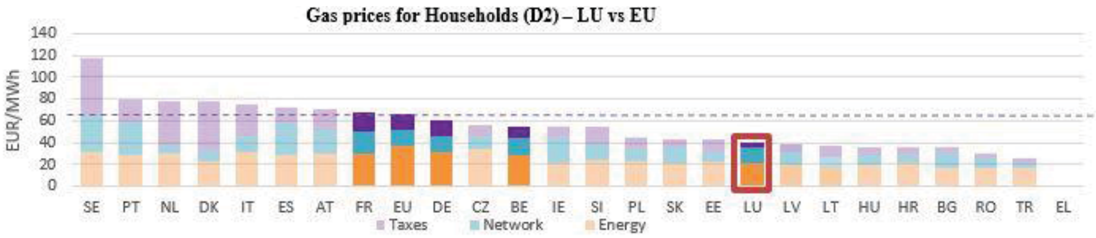


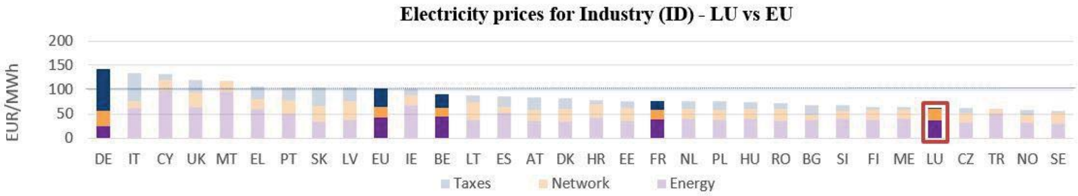


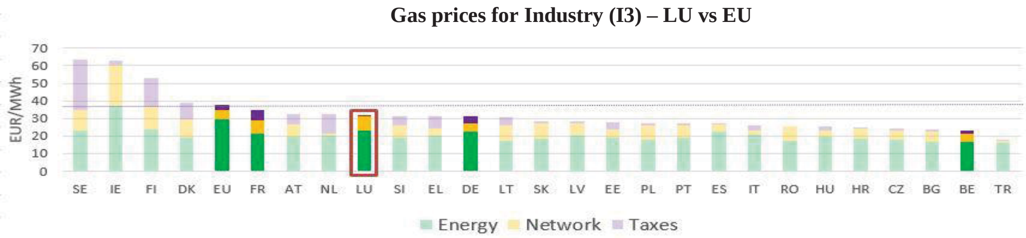
Luxembourg



see footnote[1]



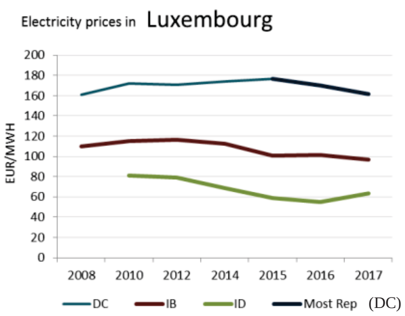


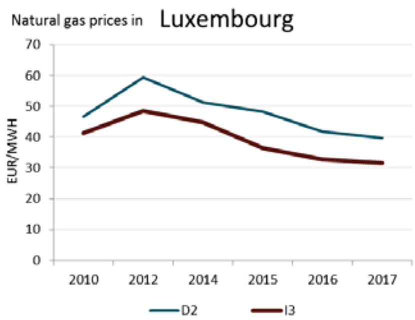


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]





[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
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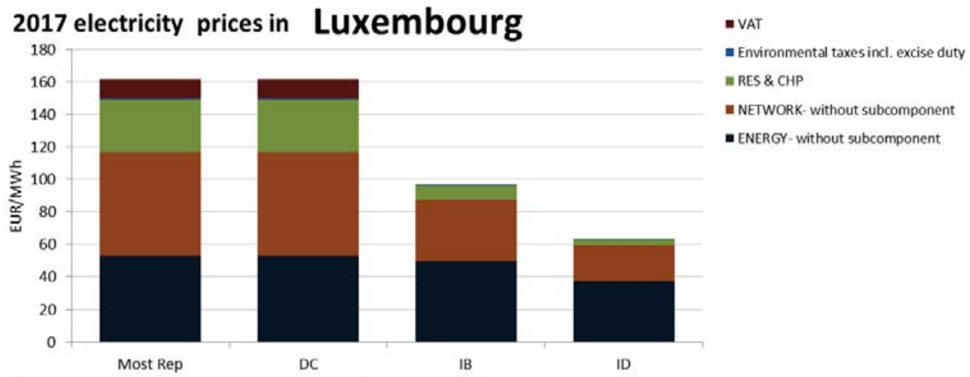
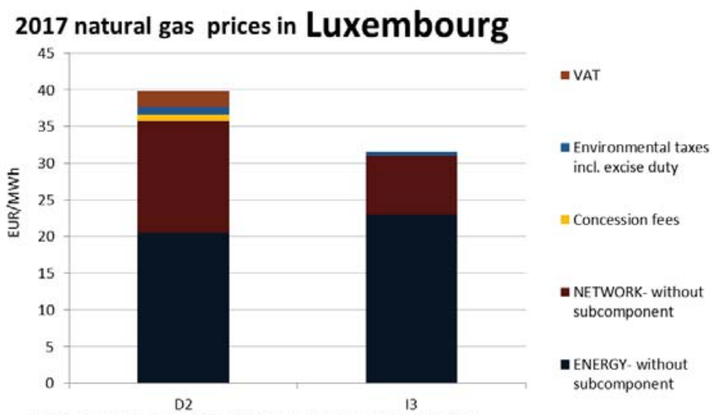


Source: European Commission, DG Energy in- house data collection



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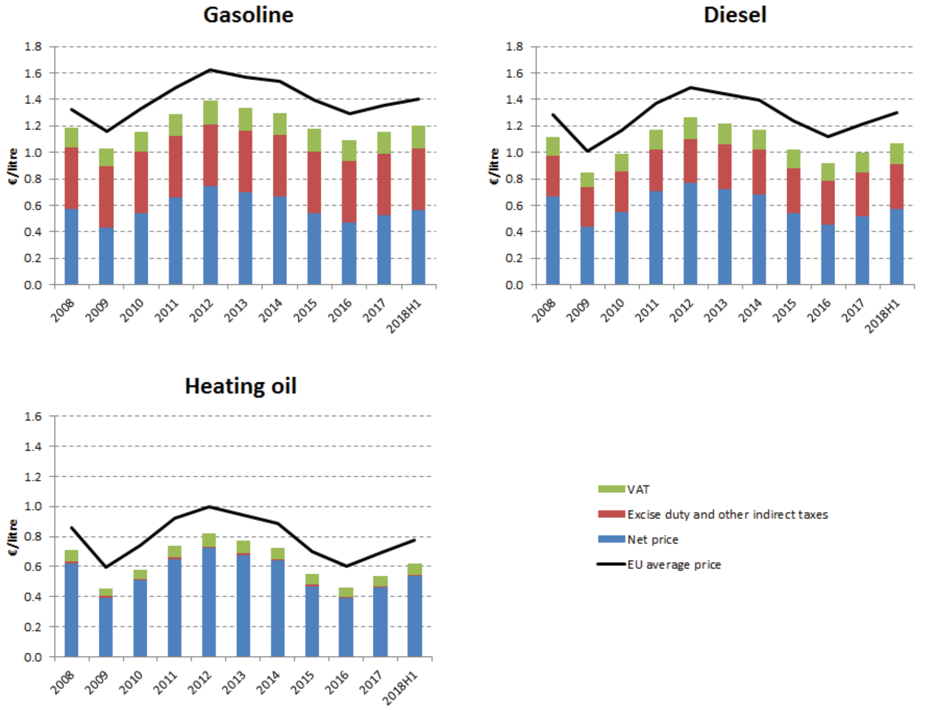
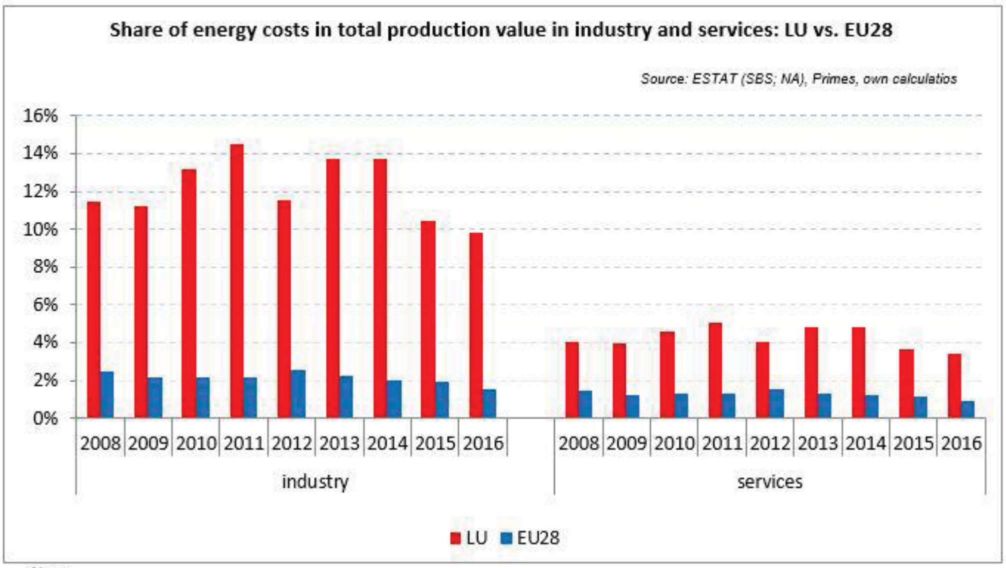
This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices



Energy costs shares in total production costs



Notes
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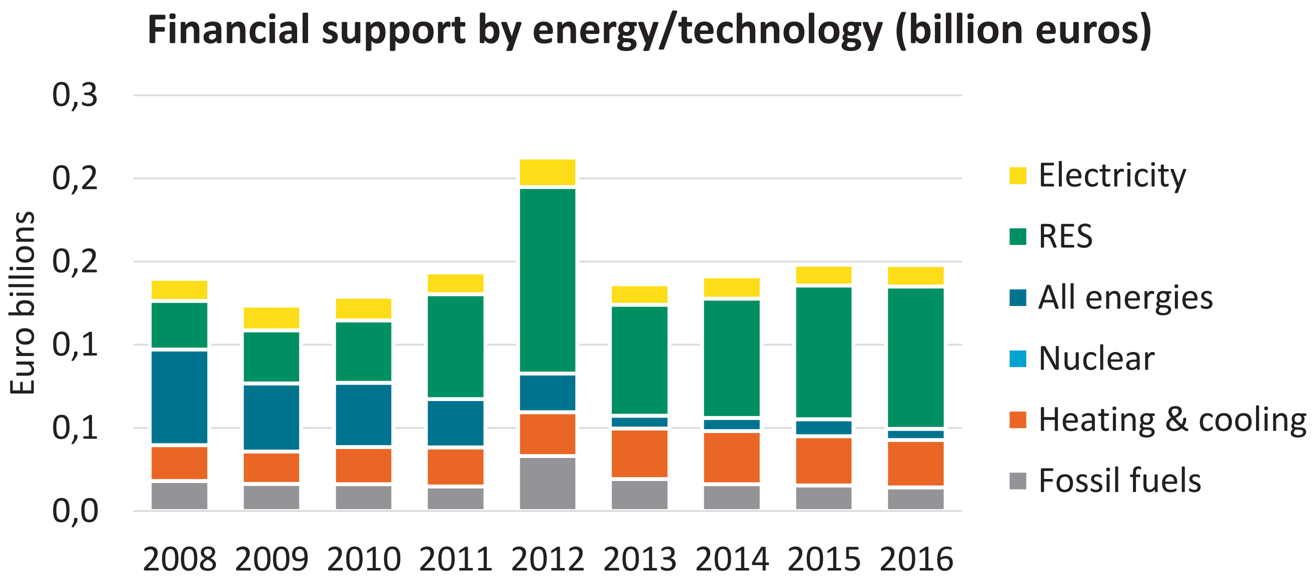
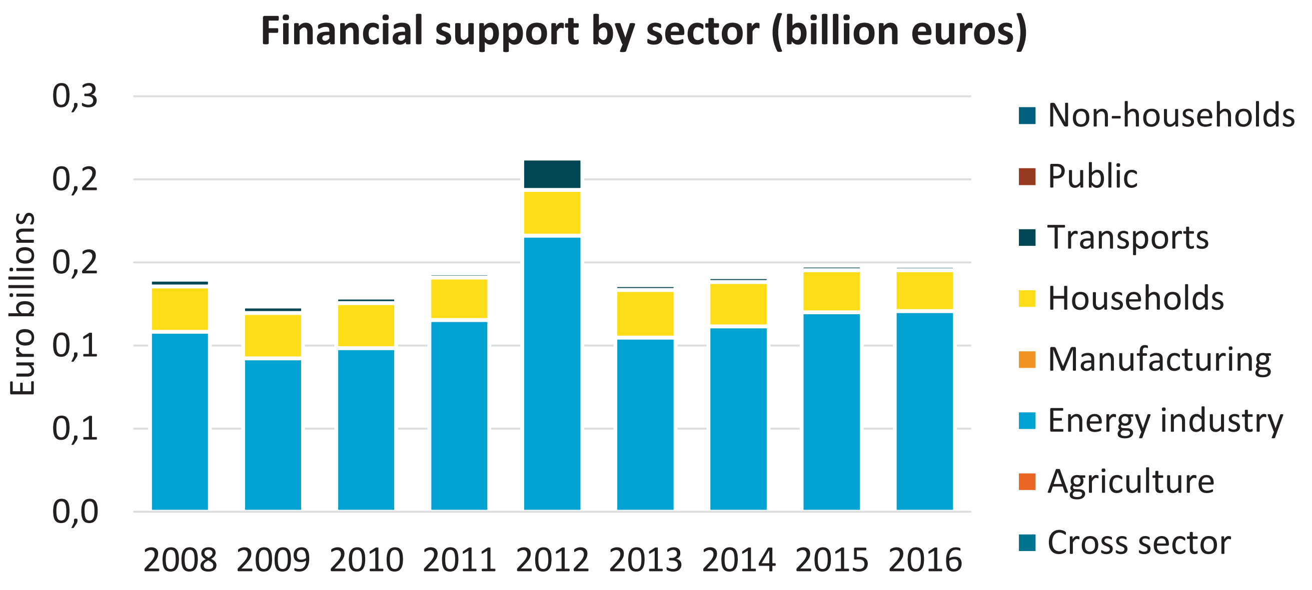




EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 10/11

COMMISSION STAFF WORKING DOCUMENT
Accompanying the document

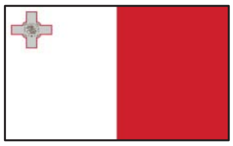
REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

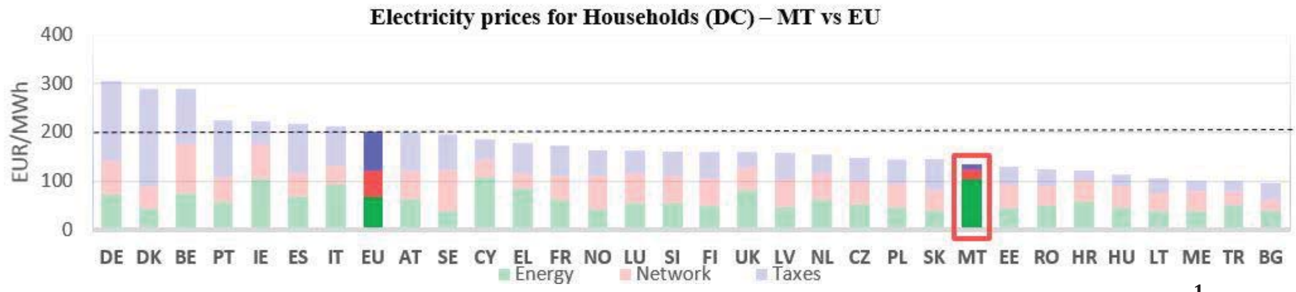
Energy prices and costs in Europe

{COM(2019) 1 final}

EN EN

Malta





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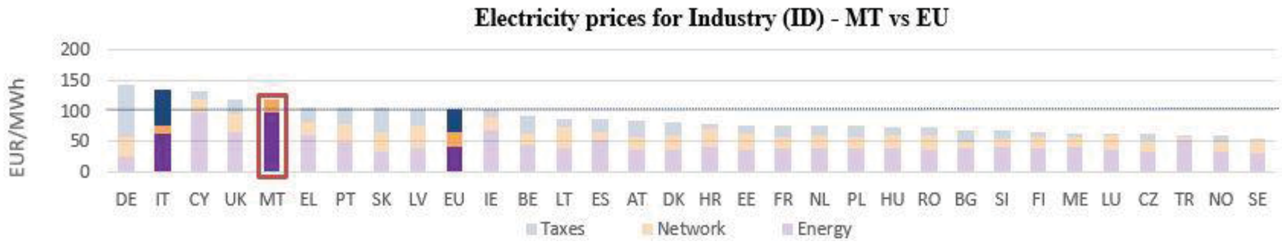
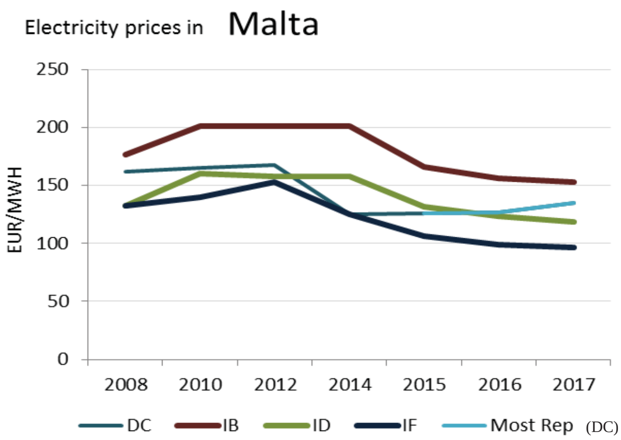


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]



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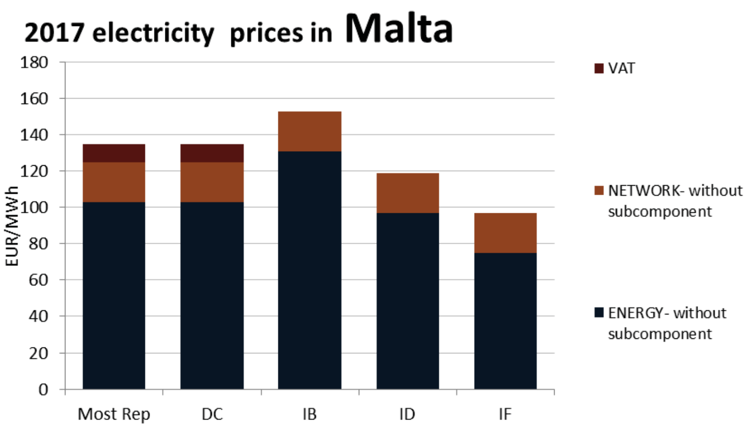
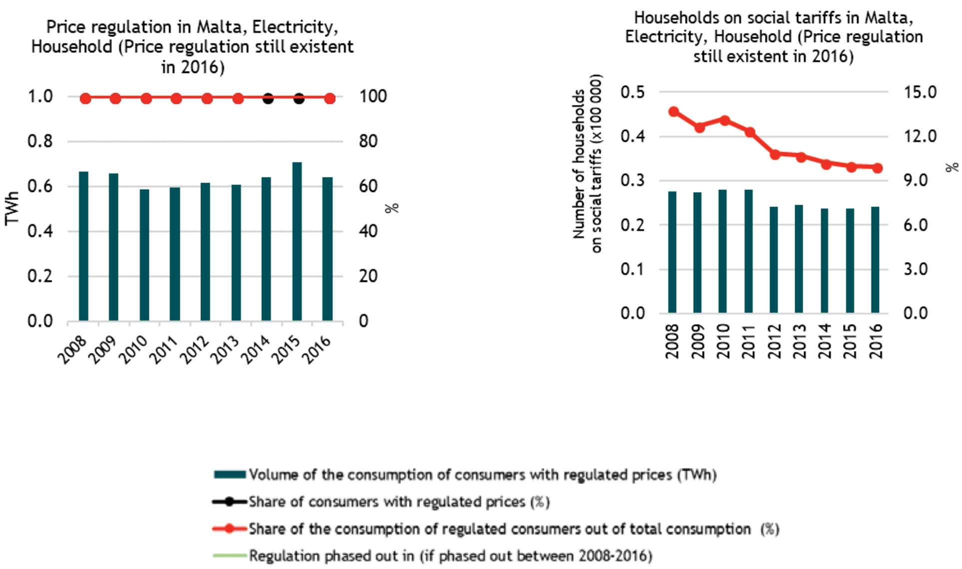
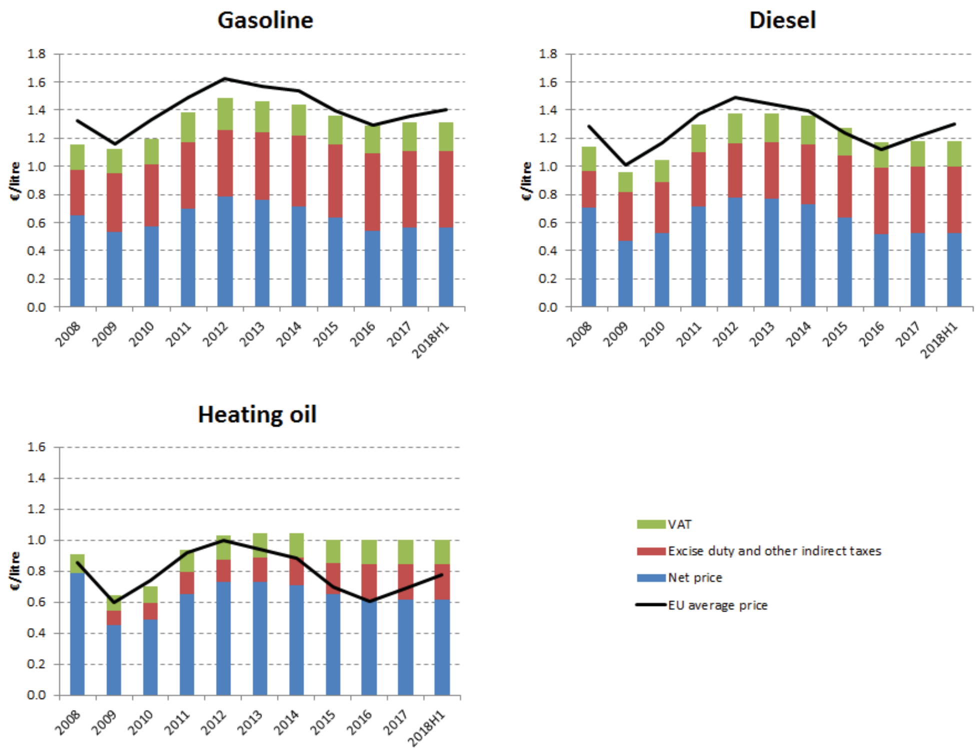


Source: European Commission, DG Energy in- house data

Price regulation

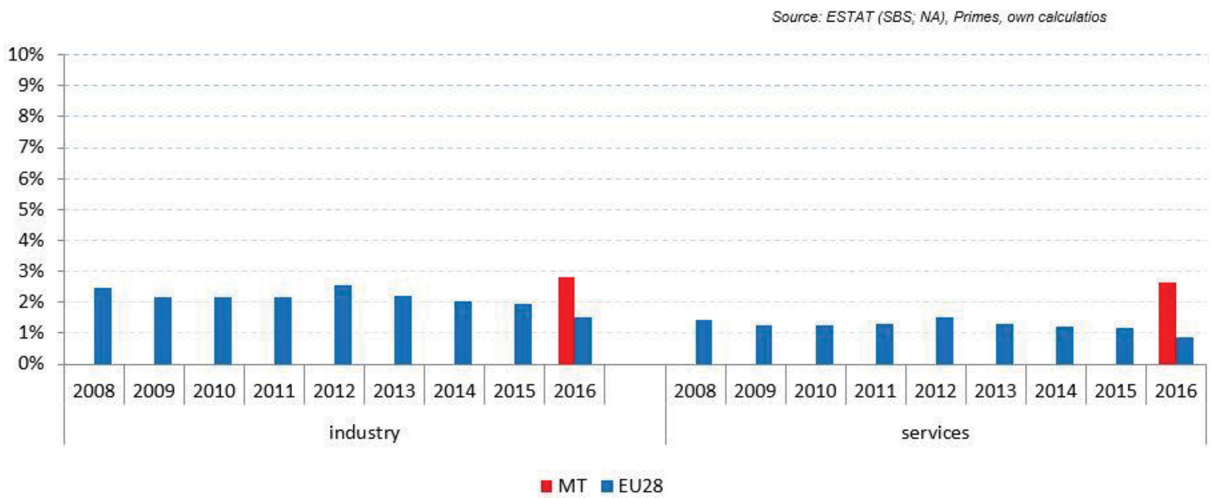


Oil products prices



Energy costs shares in total production costs

Share of energy costs in total production value in industry and services: MT vs. EU28



Eurostat SBS data not available due to confidentiality issues

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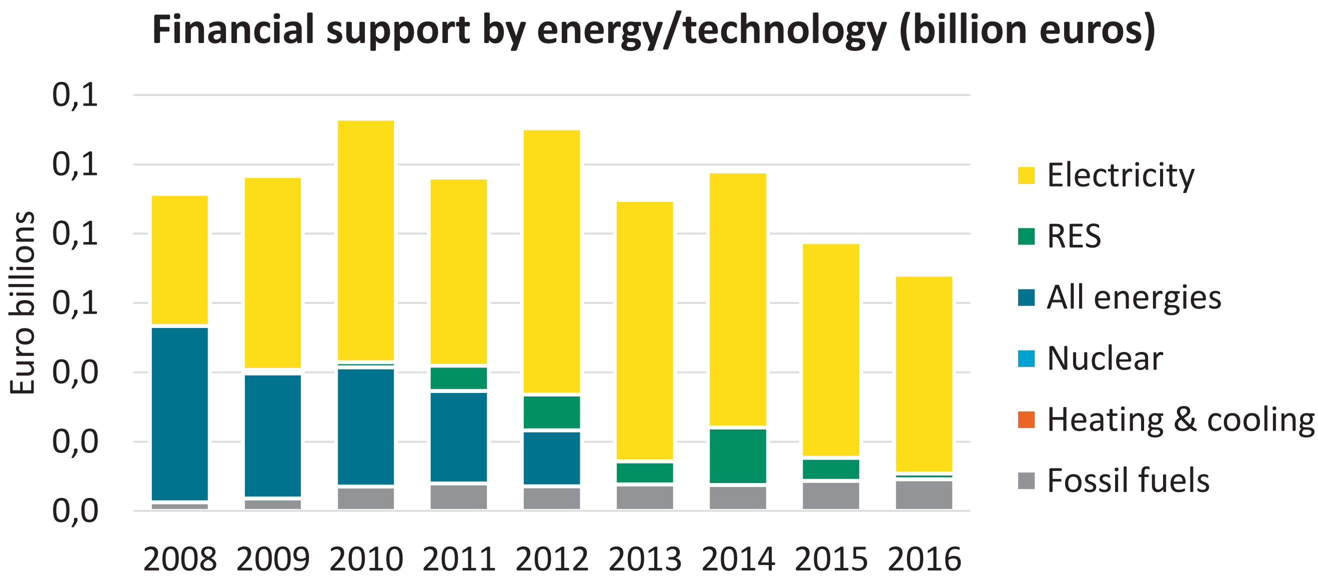
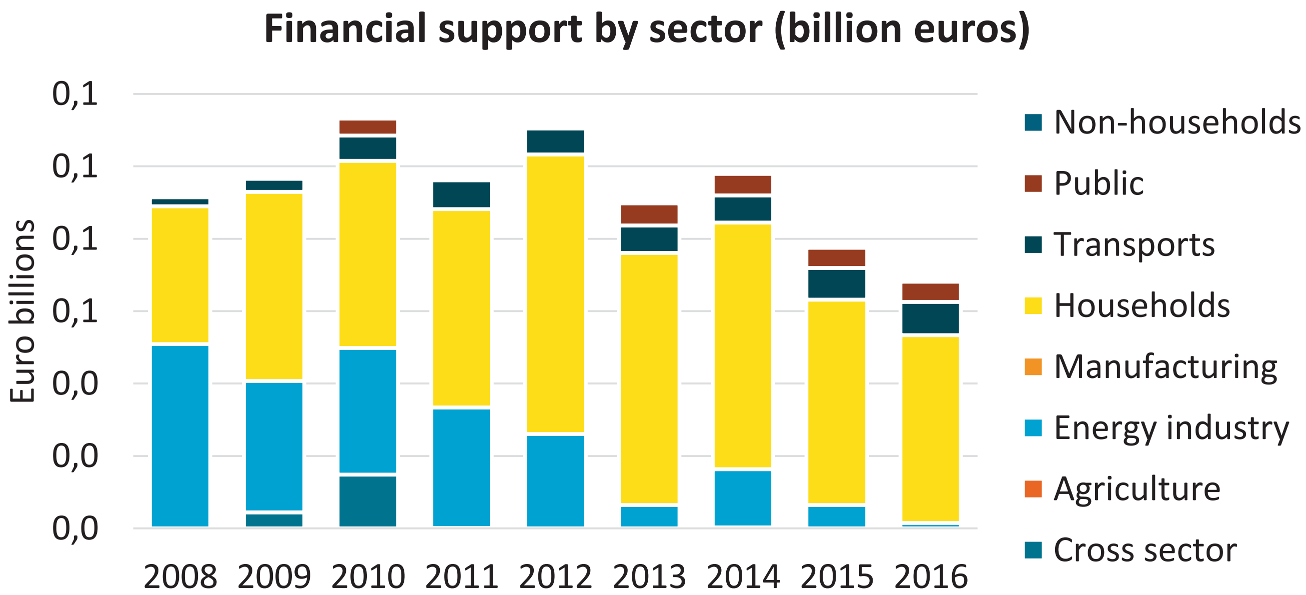
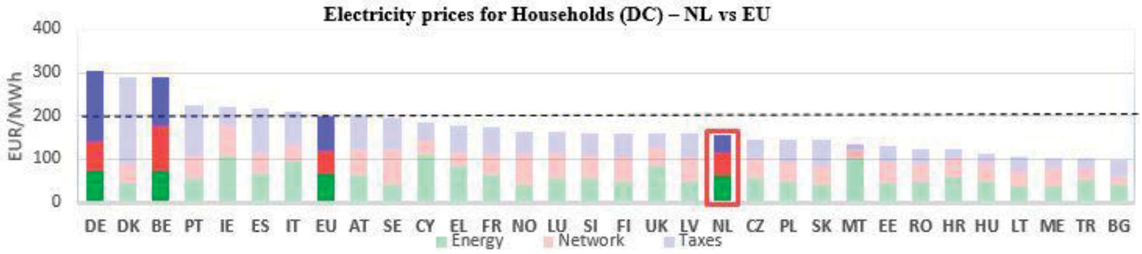
Financial support interventions





Netherlands



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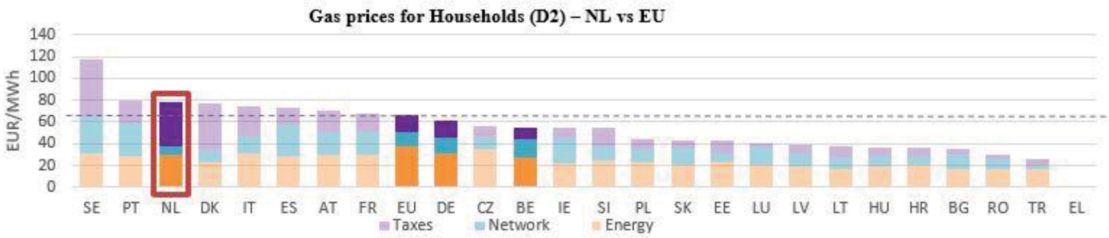
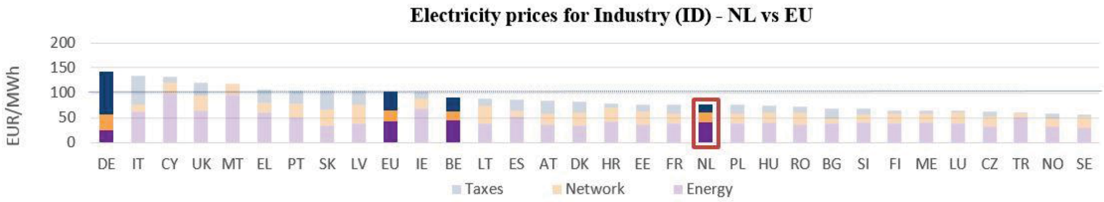
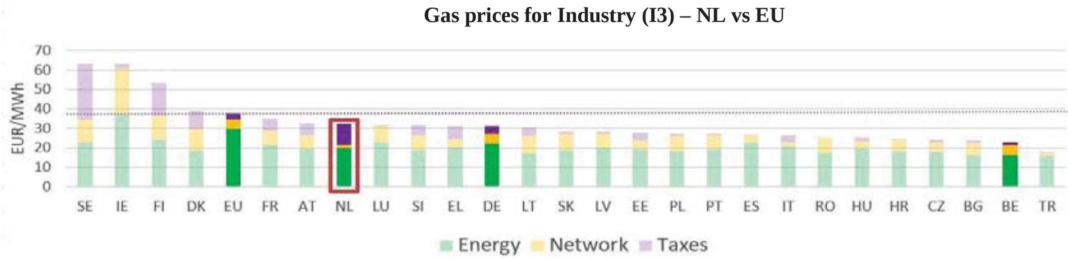


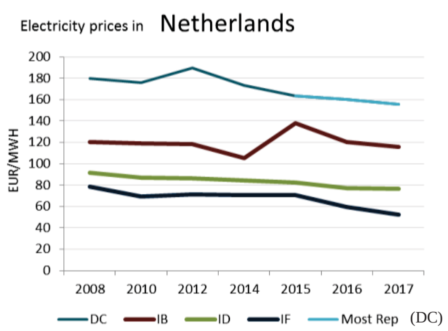


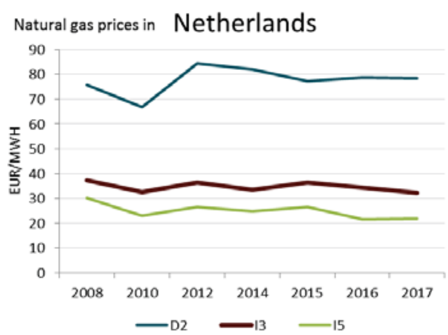


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]





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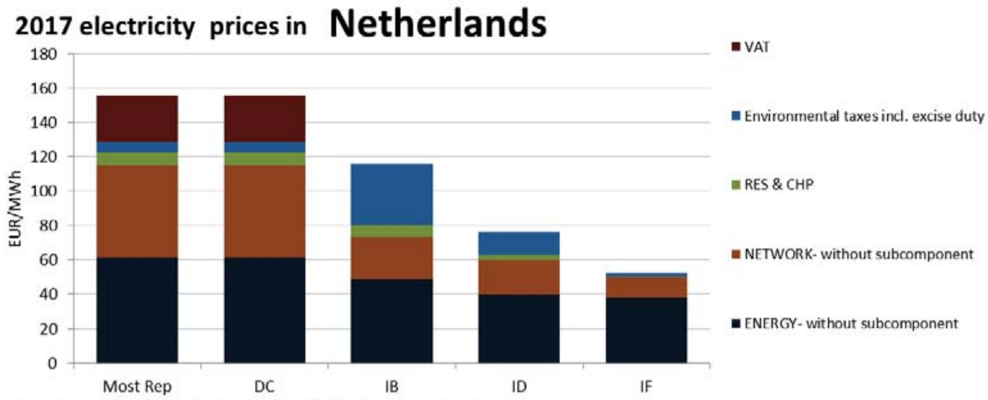
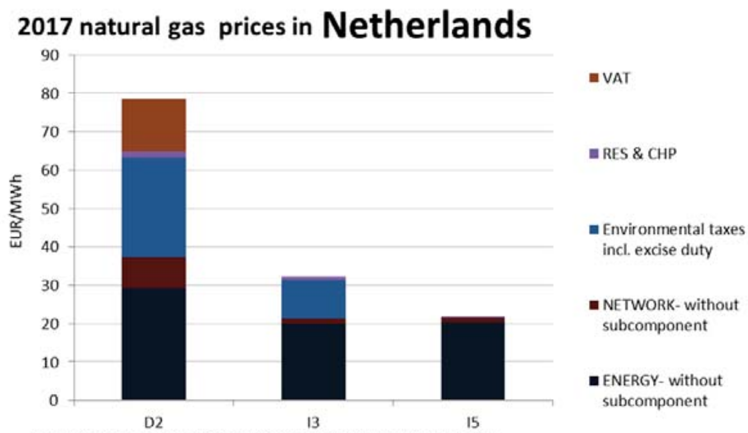


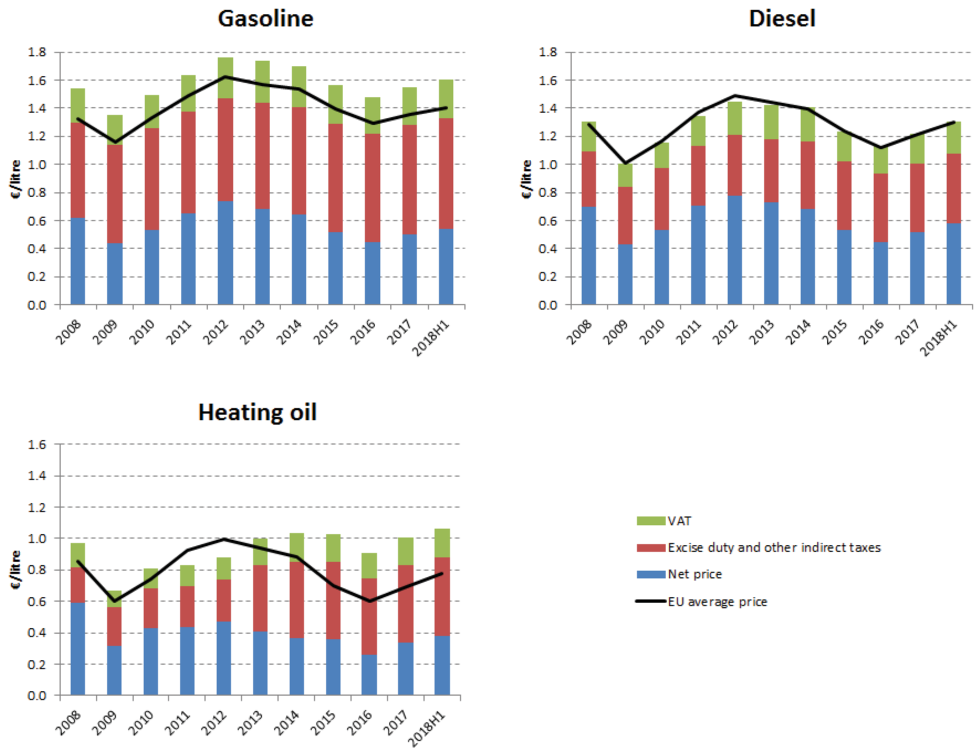
Source: European Commission, DG Energy in- house data collection



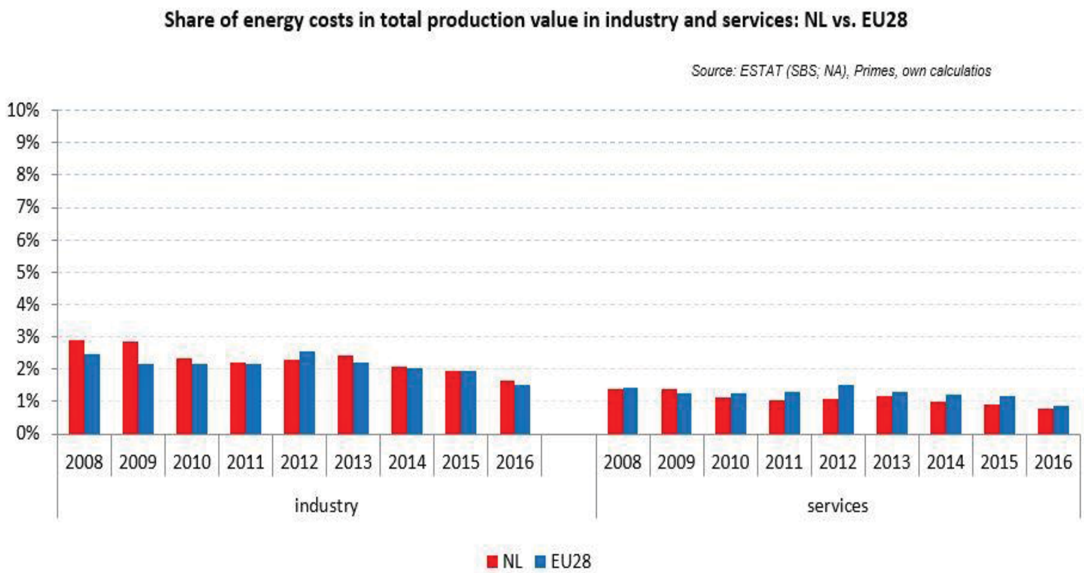
Source: European Commission, DG Energy in- house data collection

This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices



Energy costs shares in total production costs



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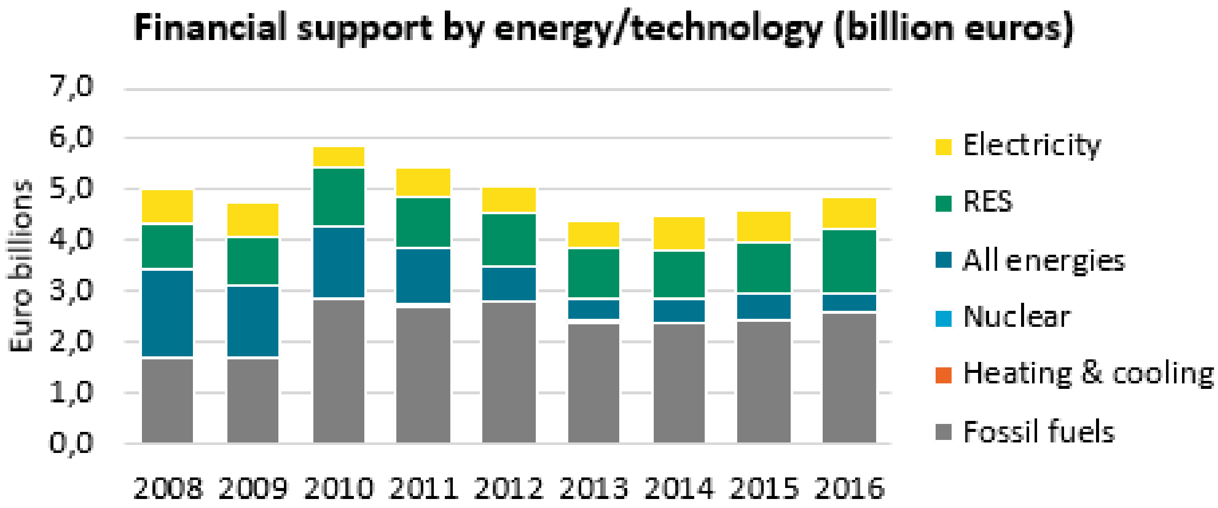
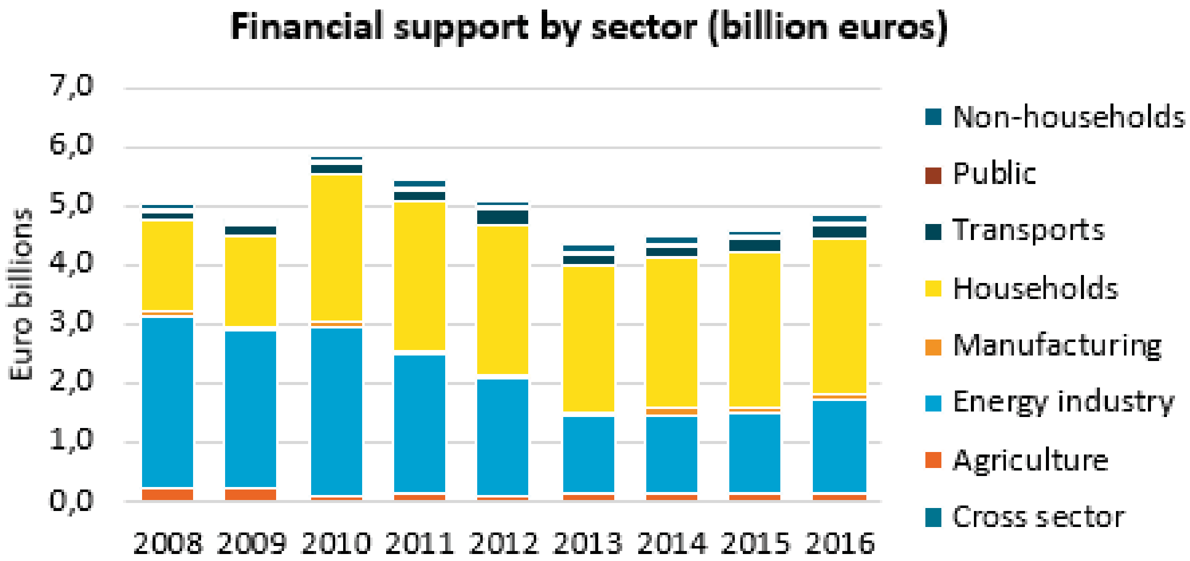
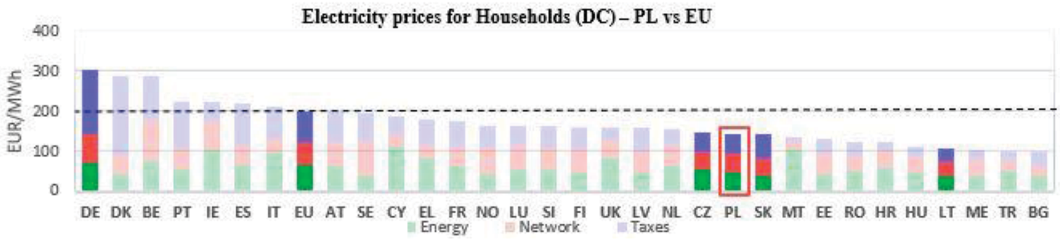
Financial support interventions





Poland



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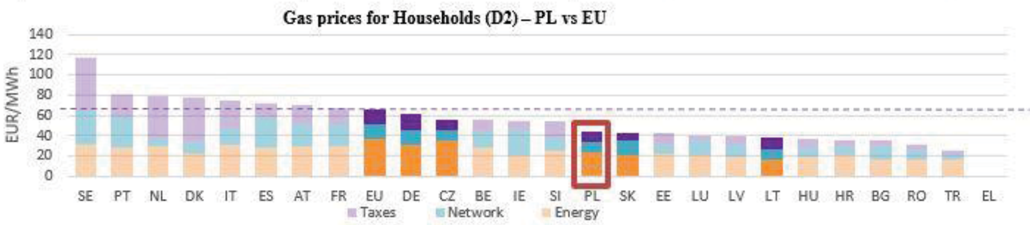

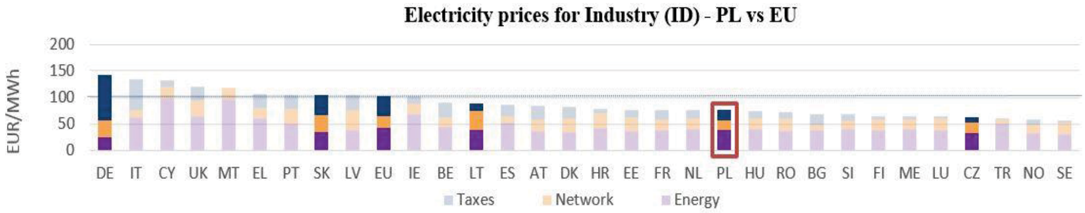

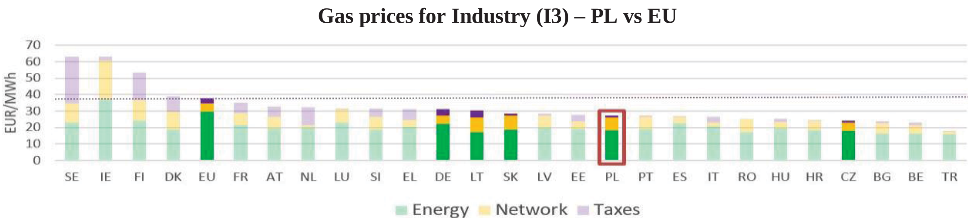

Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
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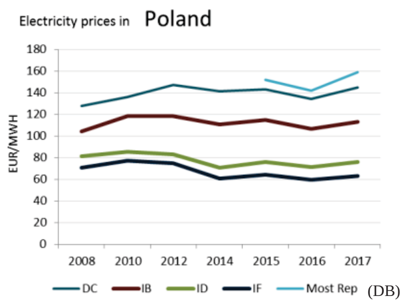
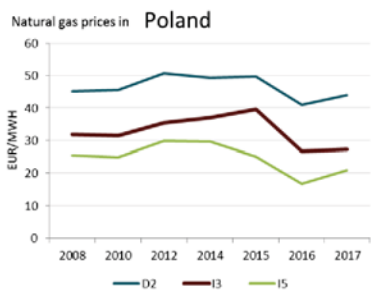
See footnote[2]





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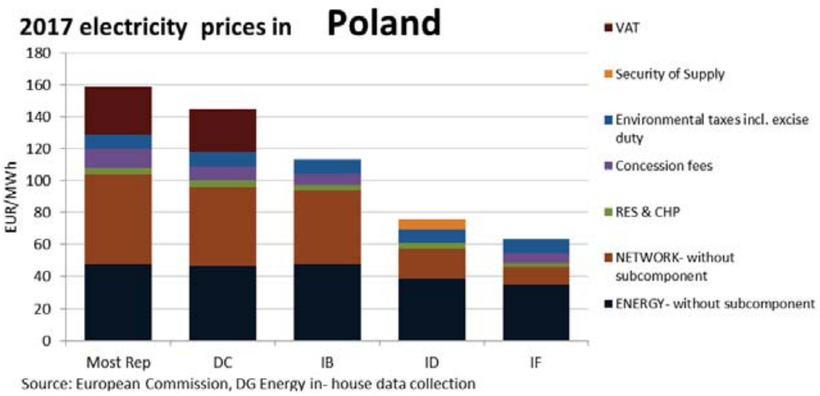
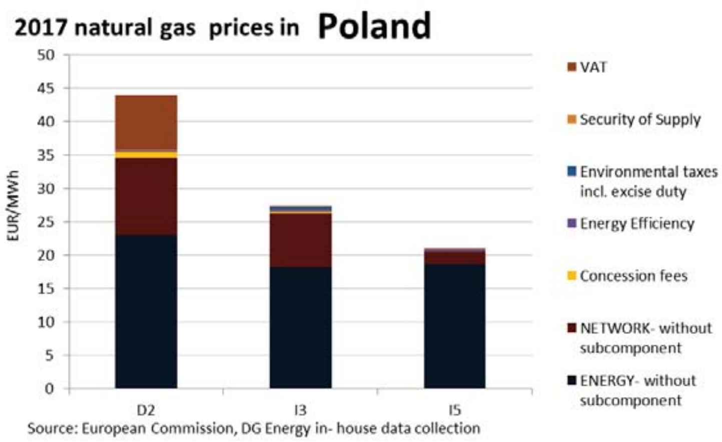
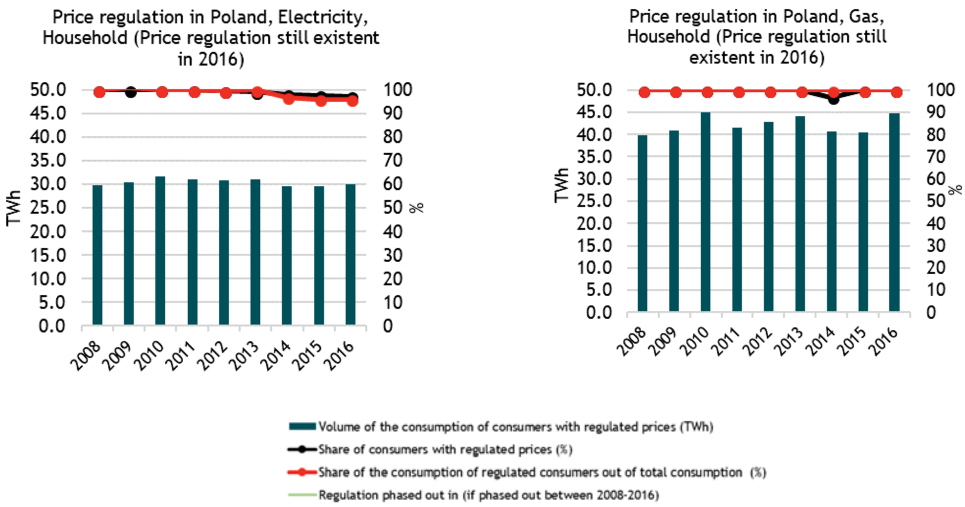
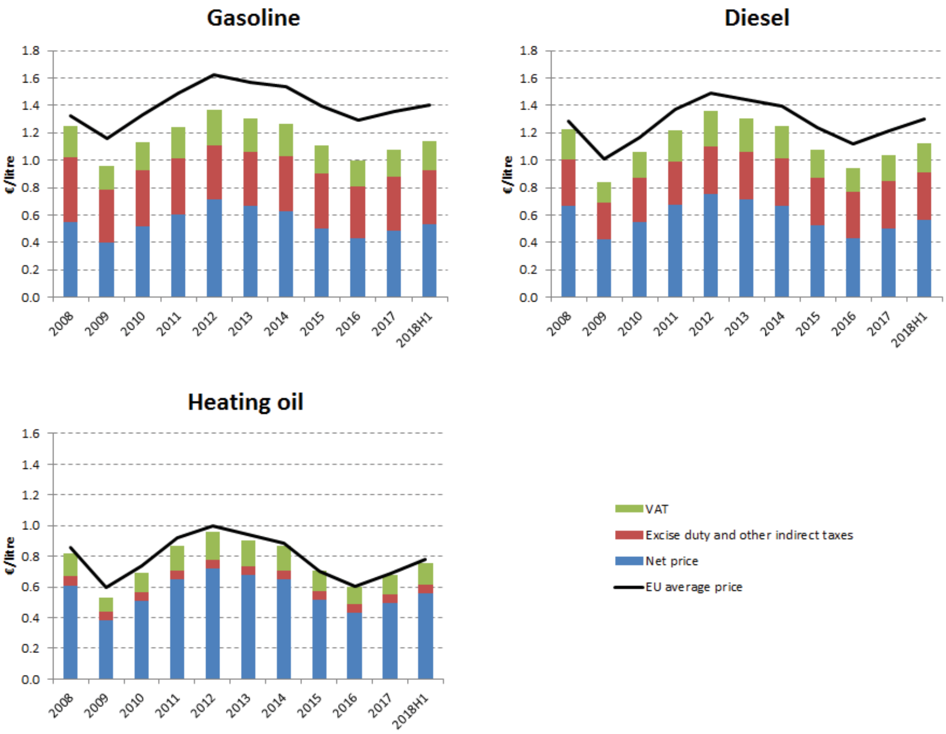




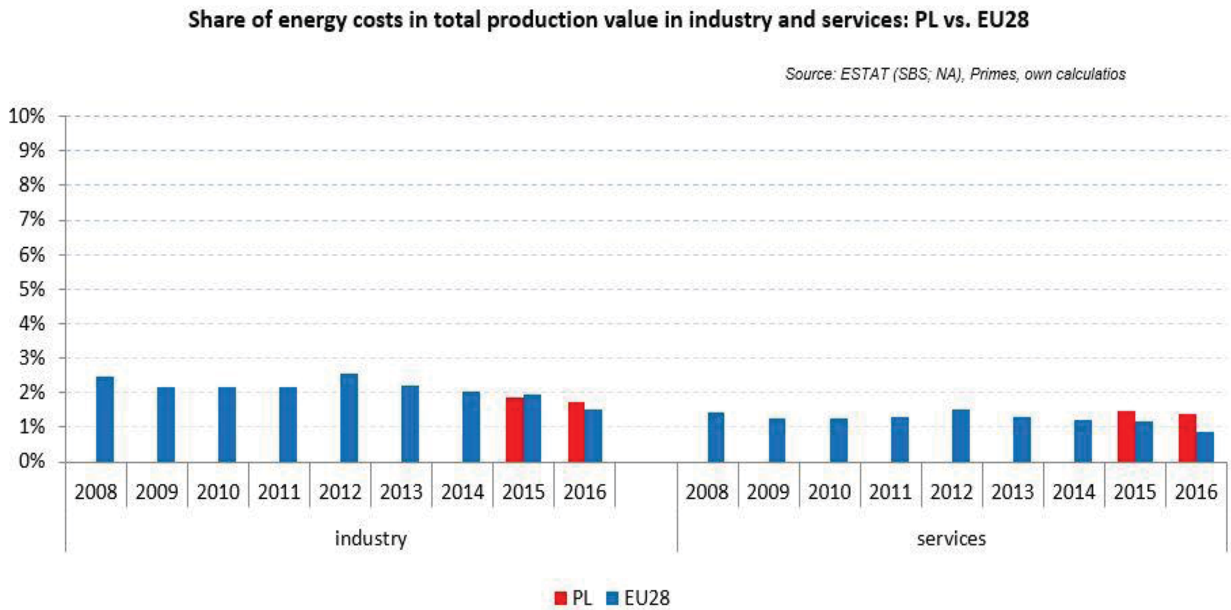
Price regulation



Oil products prices



Energy costs shares in total production costs



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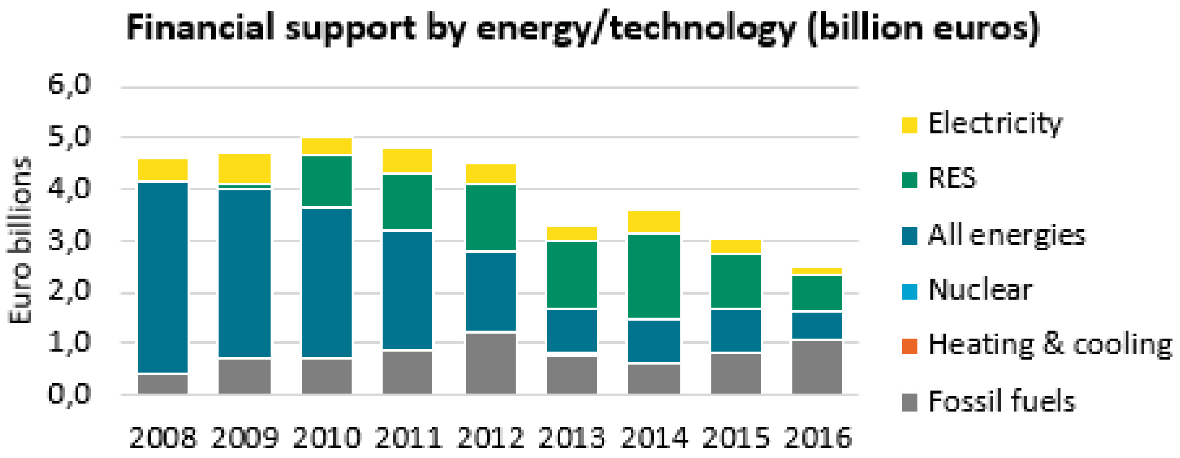
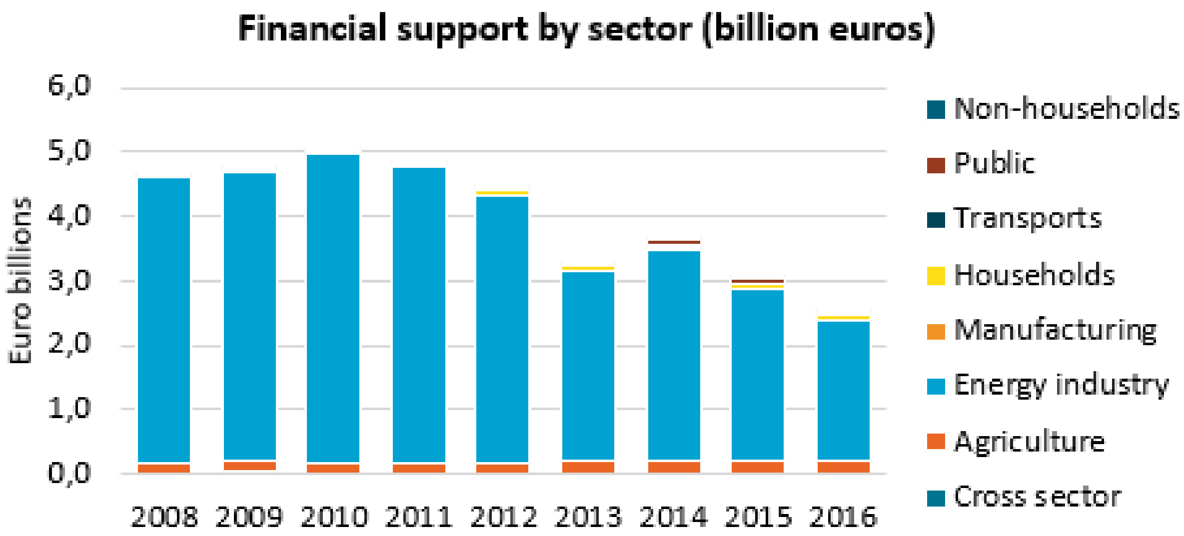
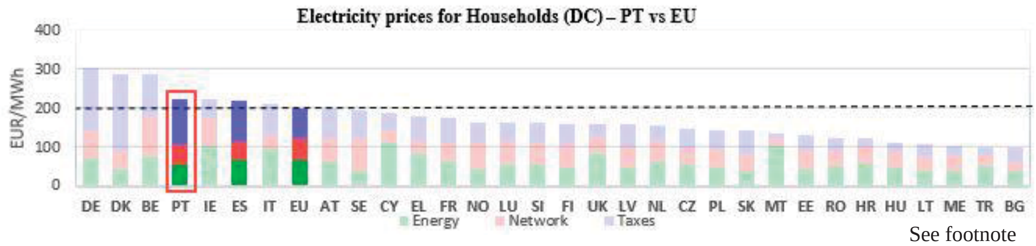
Financial support interventions

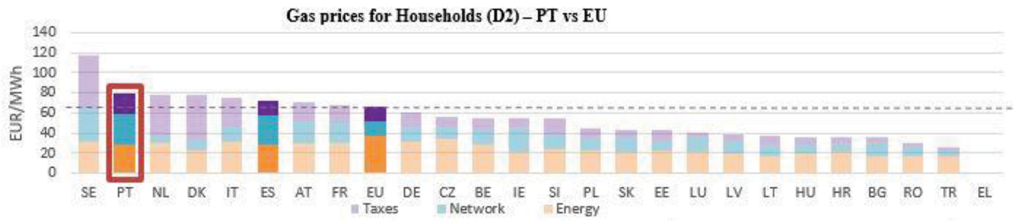


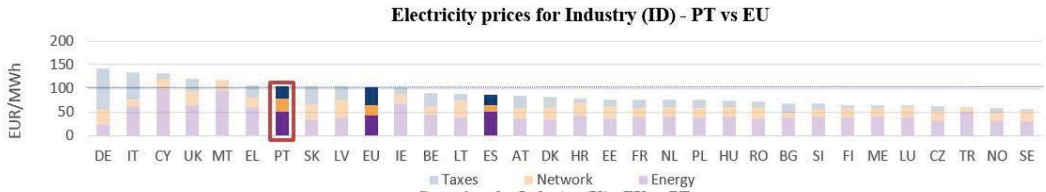


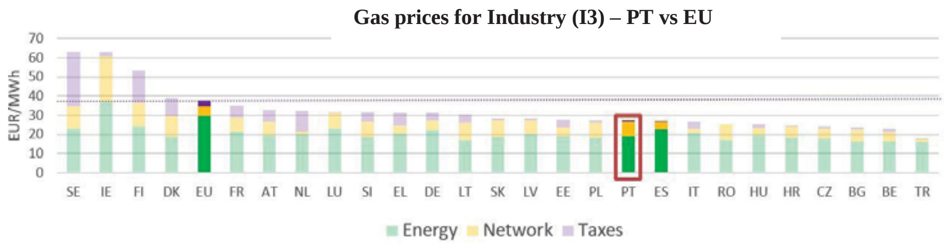
Portugal



1 See footnote



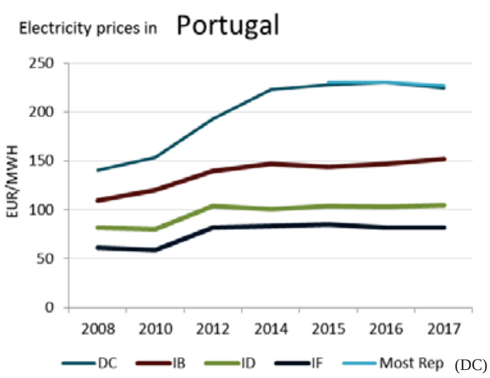


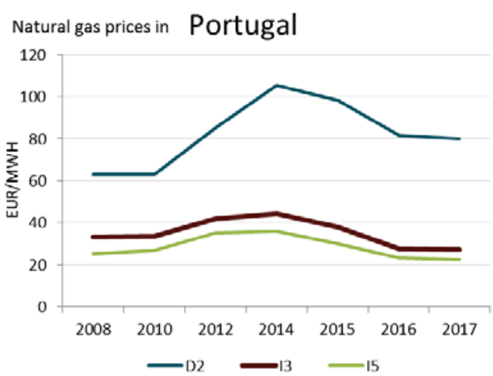


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote 2





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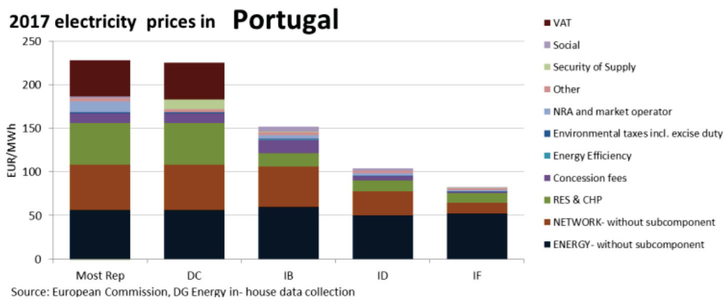
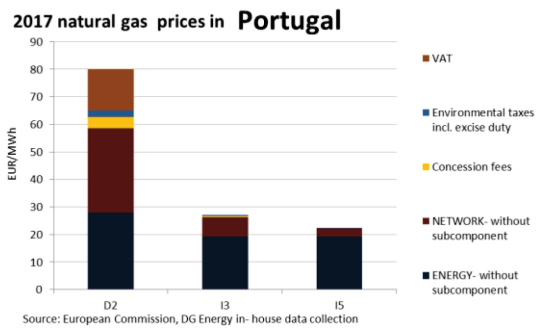
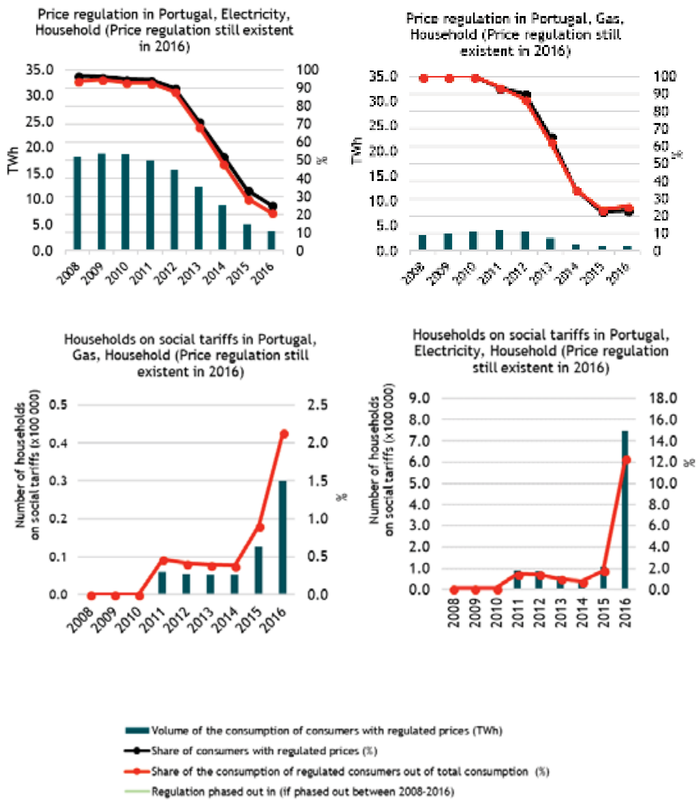
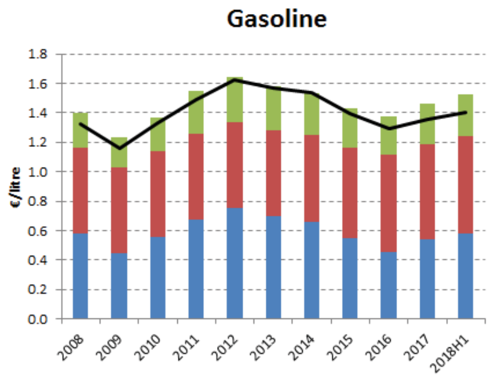


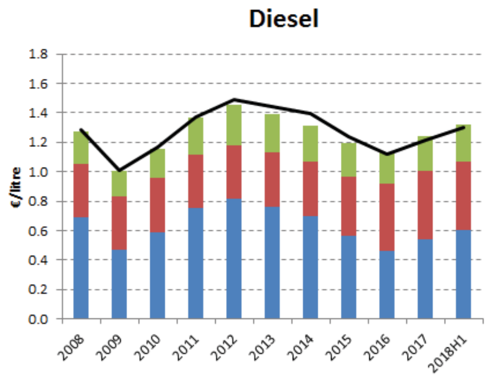


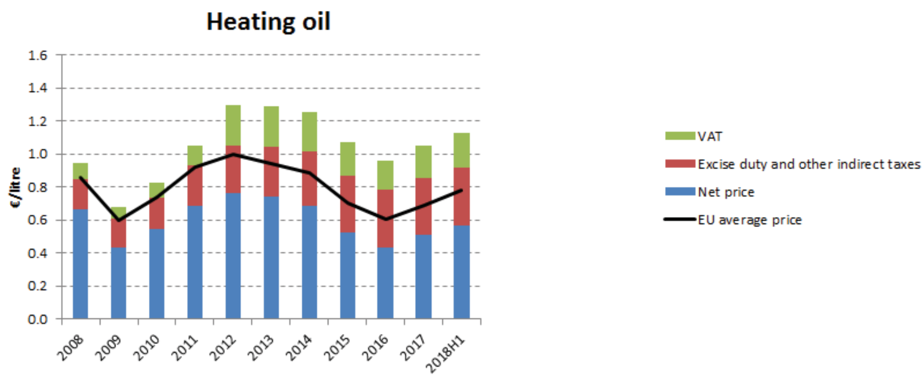
Price regulation



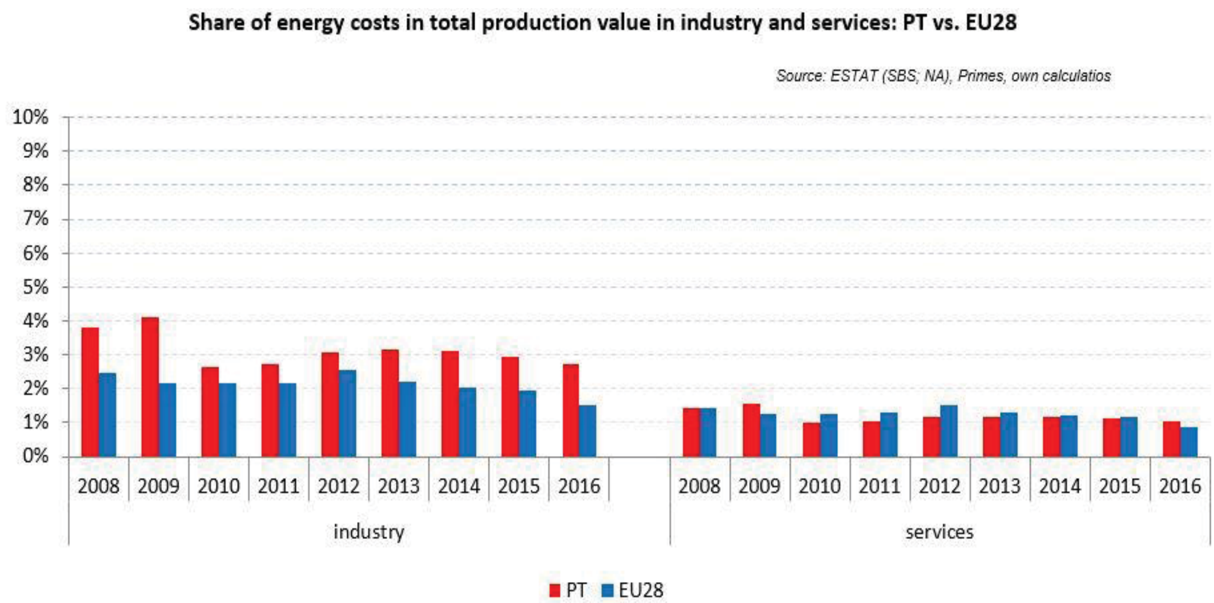
Oil products prices







Energy costs shares in total production costs



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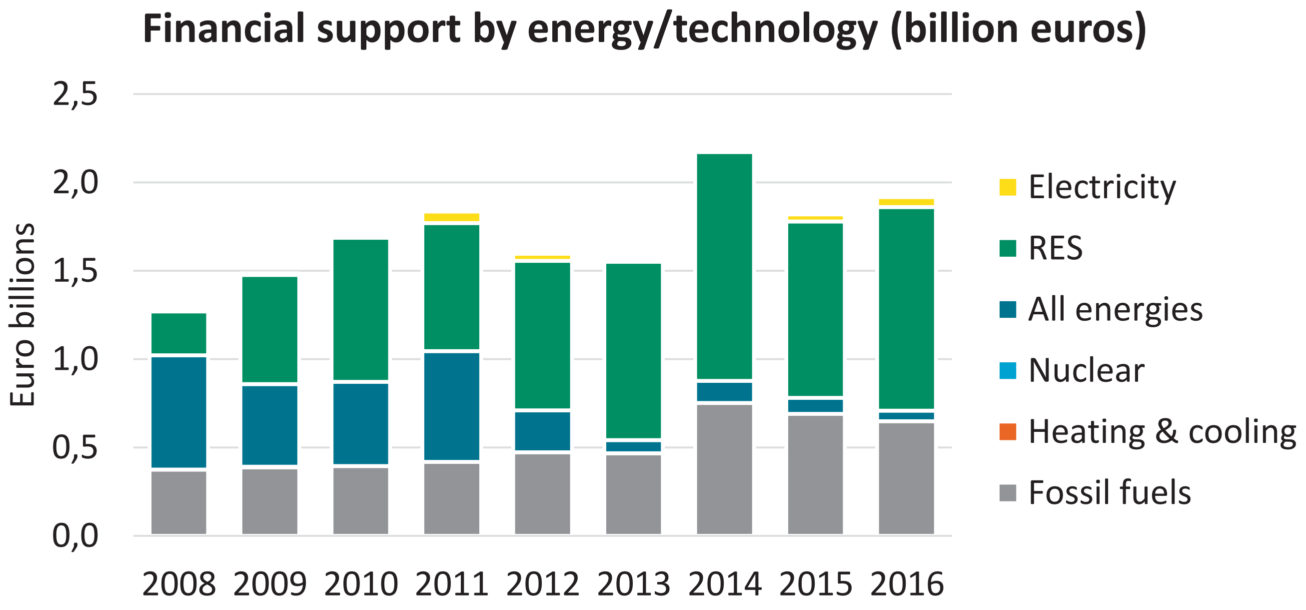
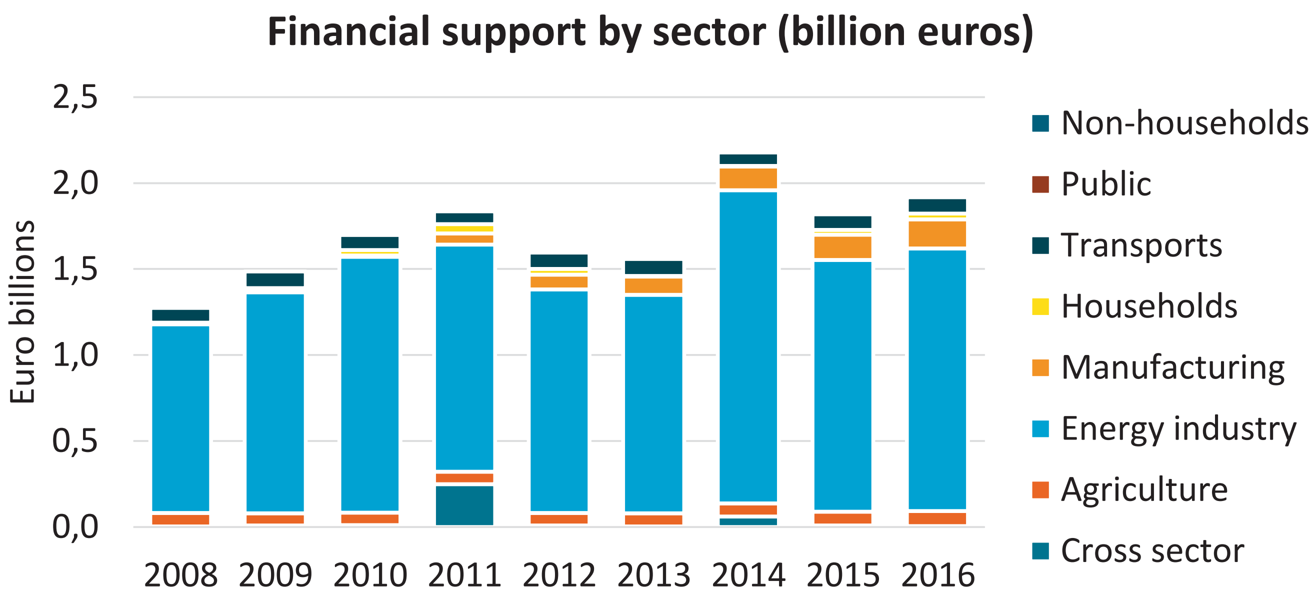
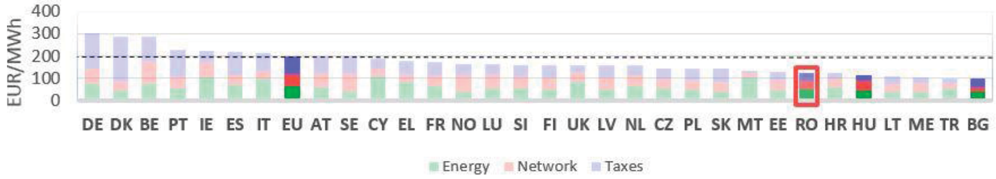




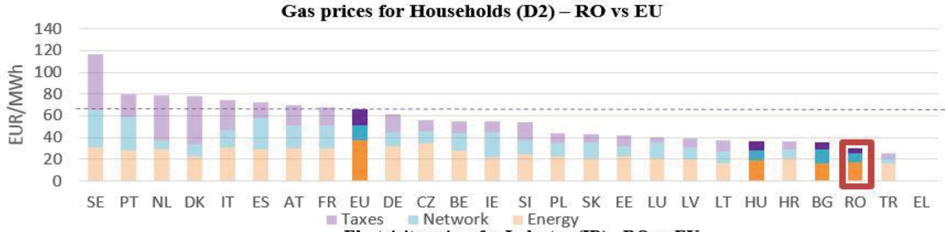
Romania

Electricity prices for Households (DC) – RO vs EU

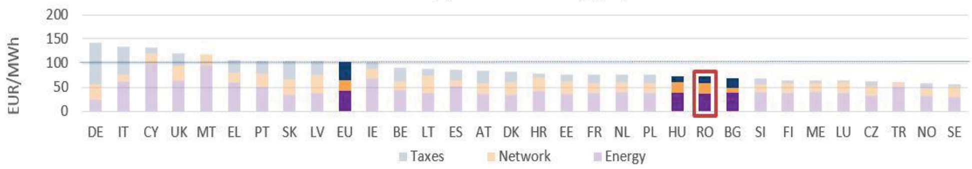


see footnote[1]

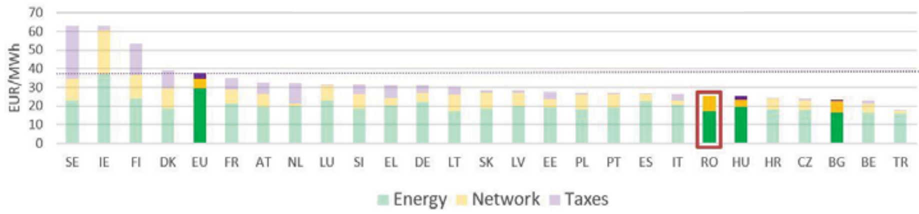
Gas prices for Households (D2) – RO vs EU



Electricity prices for Industry (ID) - RO vs EU



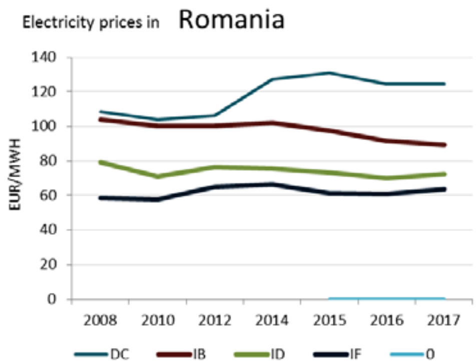
Gas prices for Industry (I3) – RO vs EU

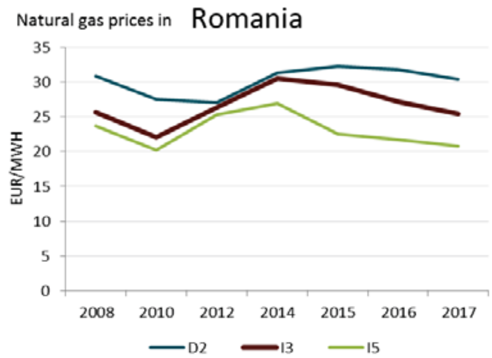


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]





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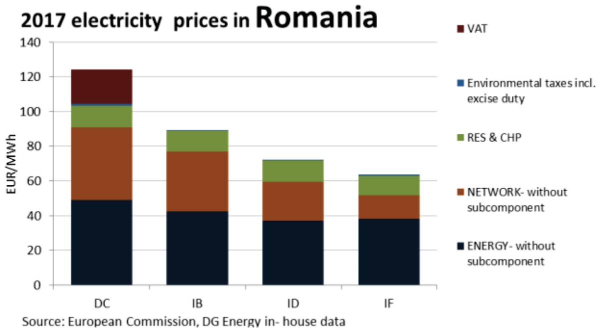
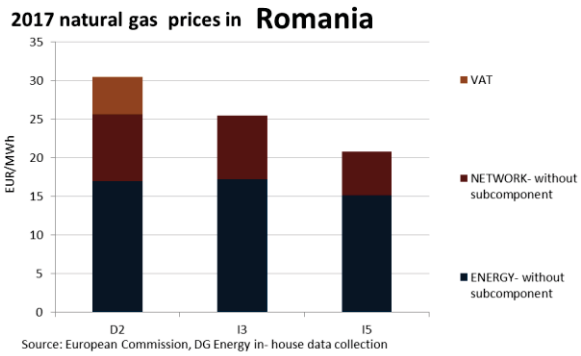
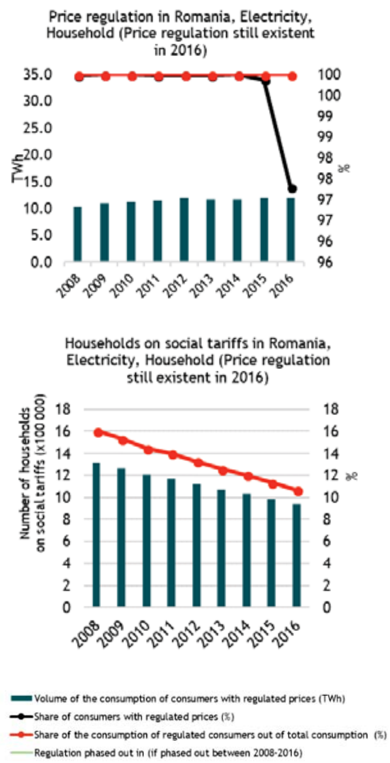
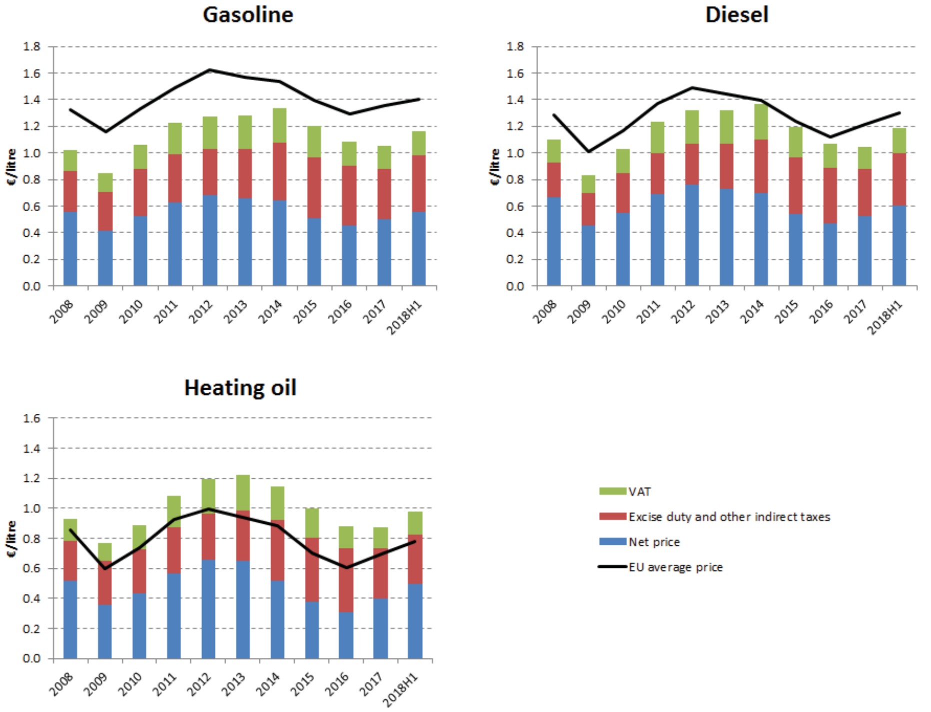




Price regulation

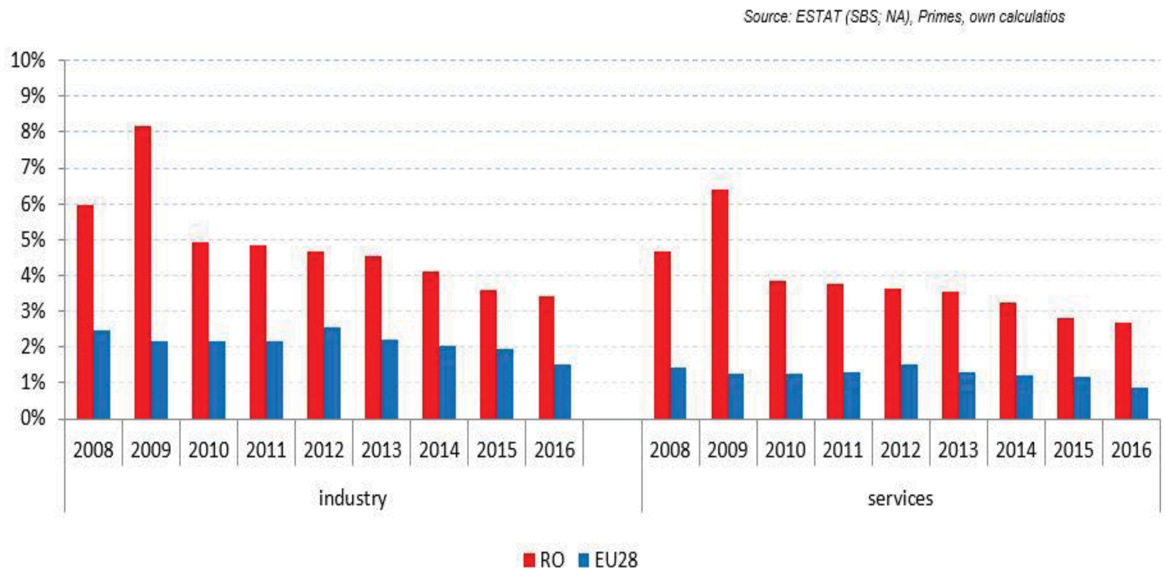


Oil products prices



Energy costs shares in total production costs

Share of energy costs in total production value in industry and services: RO vs. EU28



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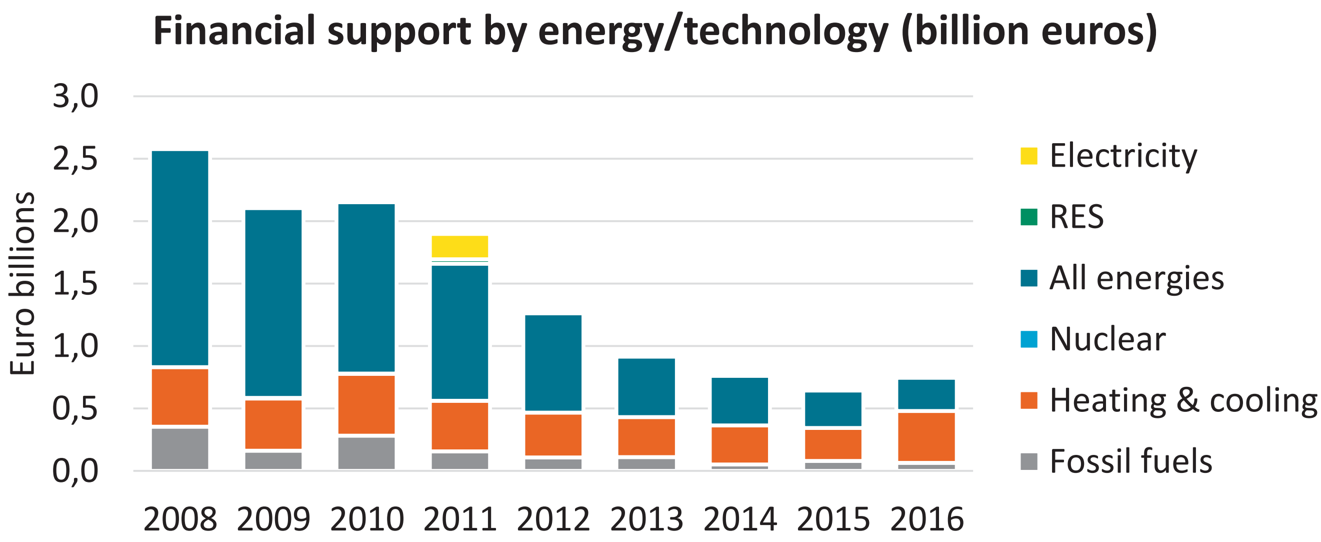
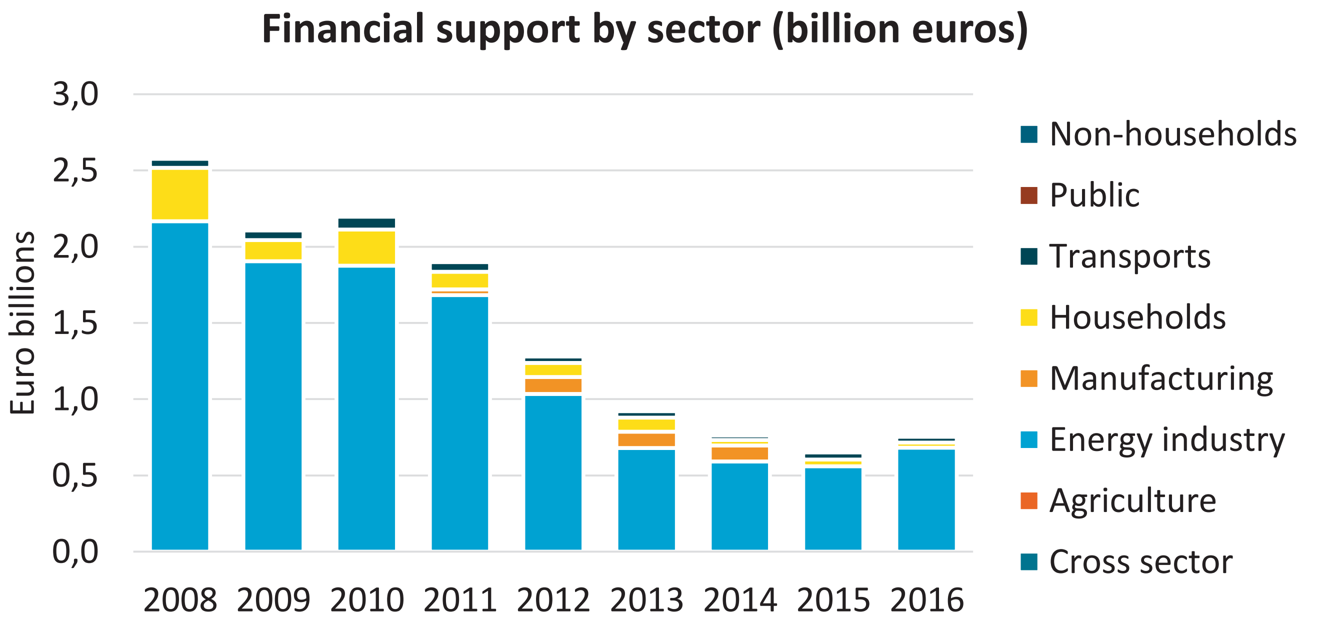
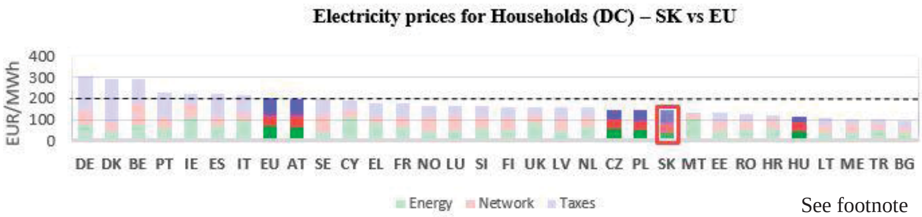
Financial support interventions

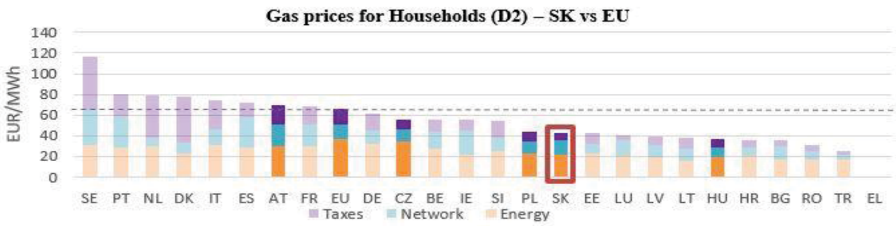


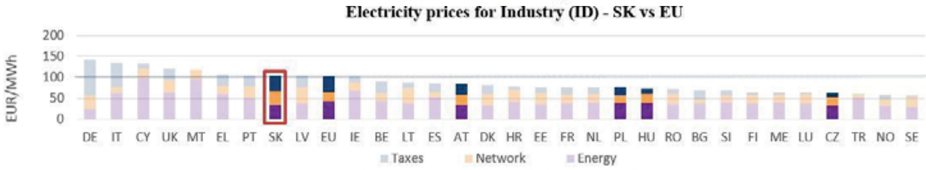


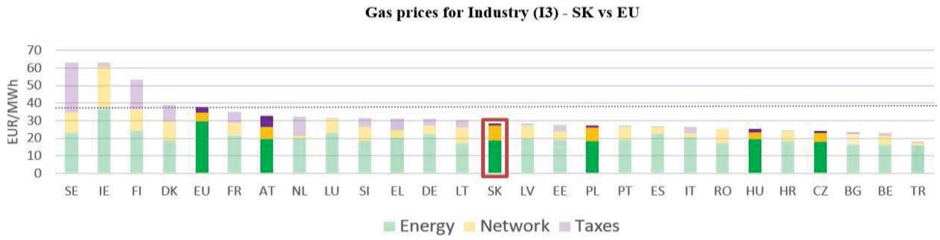
Slovakia



See footnote [1]



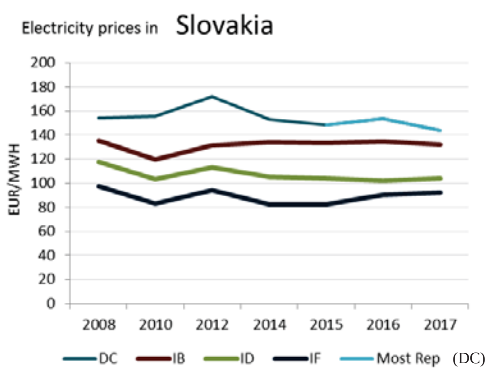


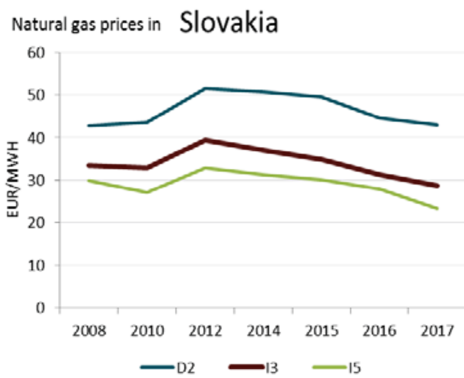


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

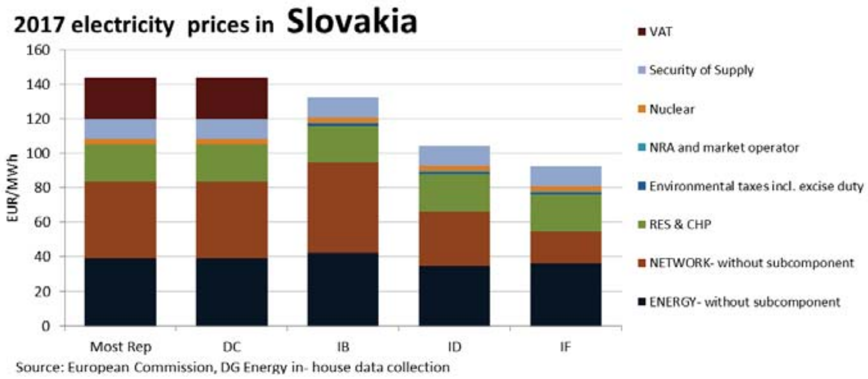
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

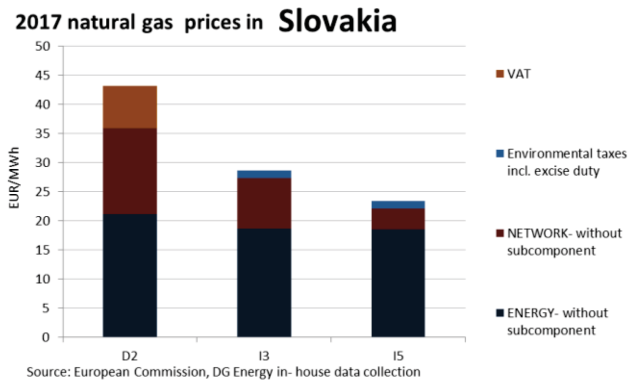
See footnote [2]



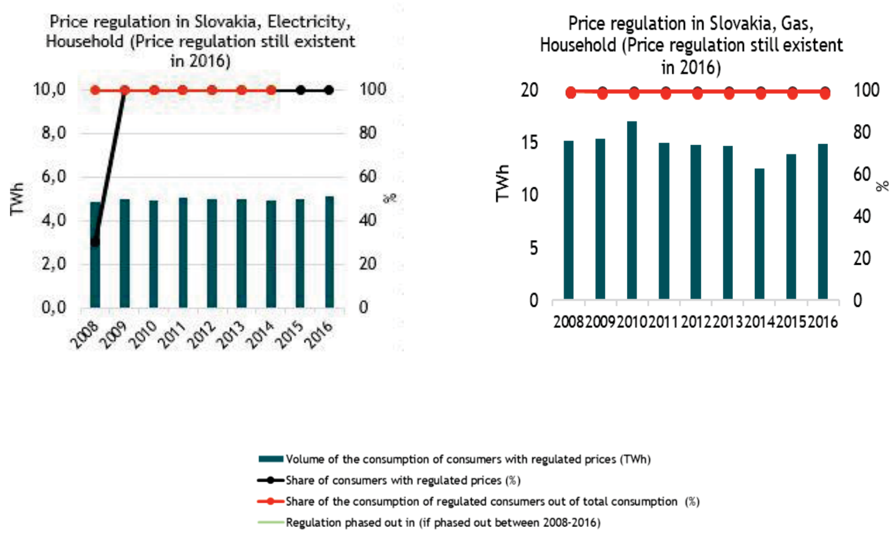


[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.

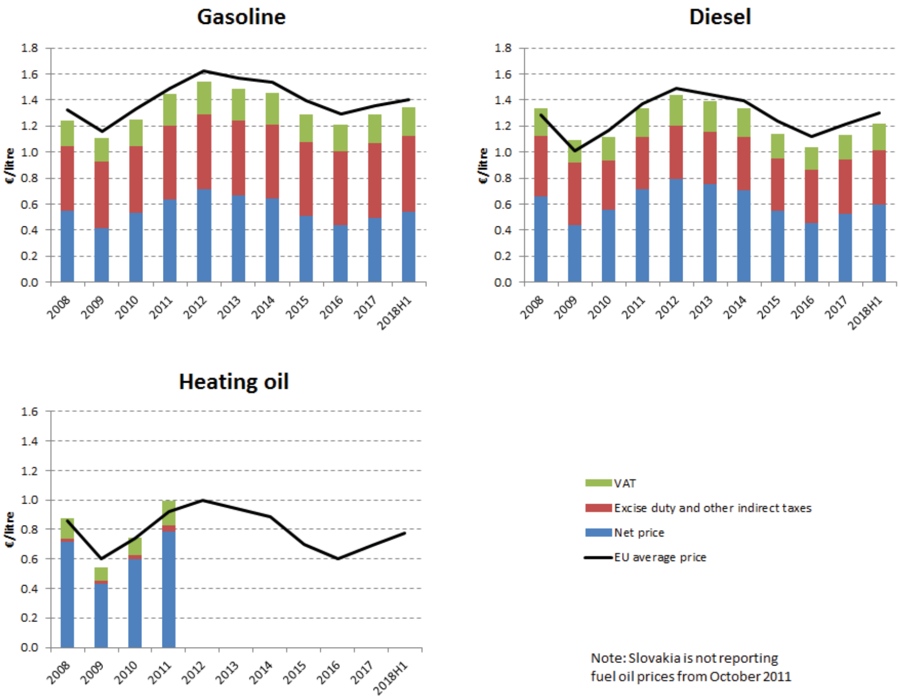




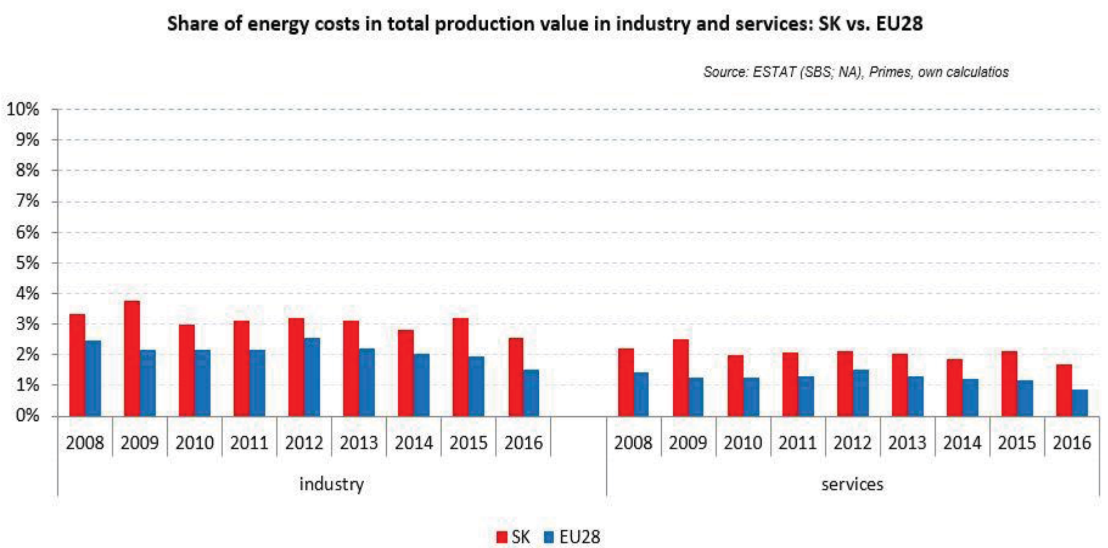
Price regulation



Oil products prices



Energy costs shares in total production costs



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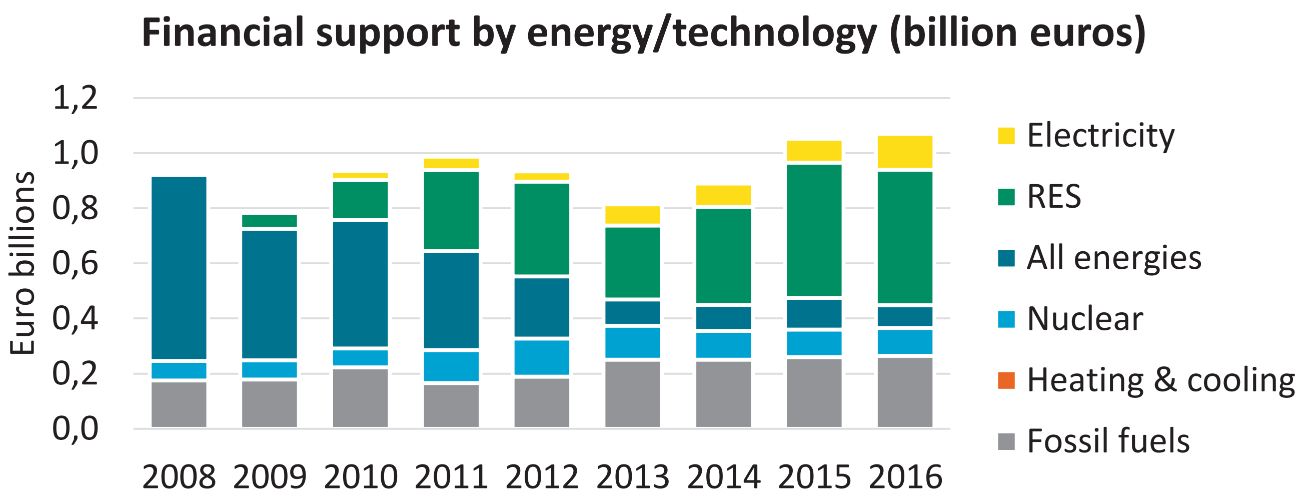
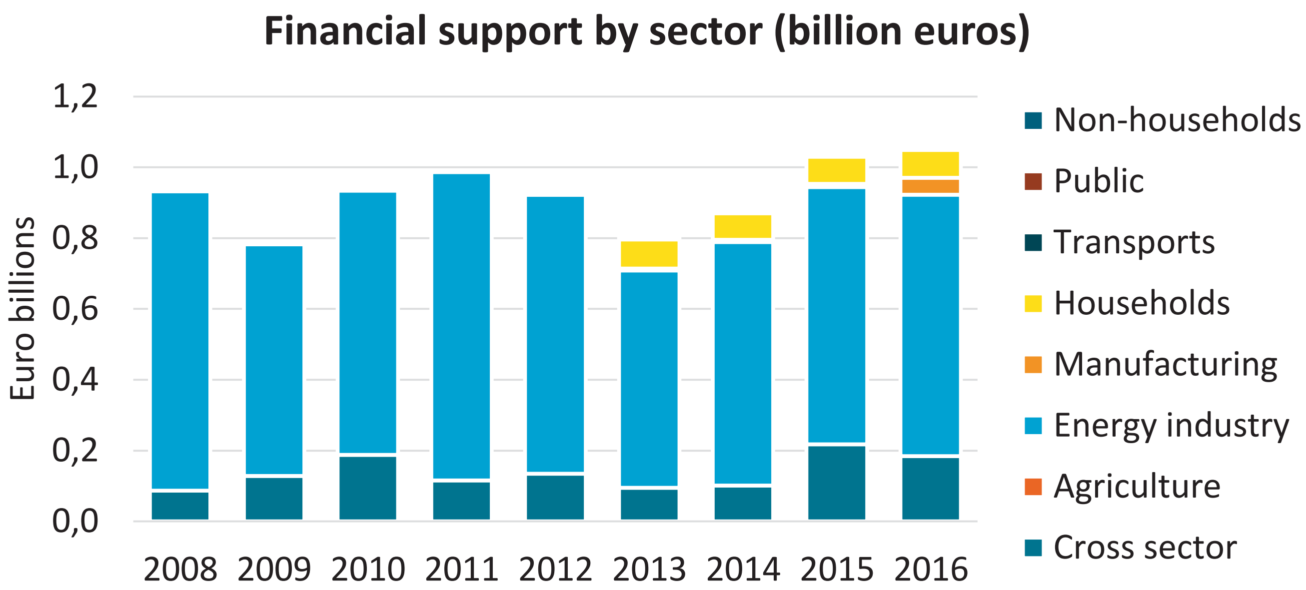
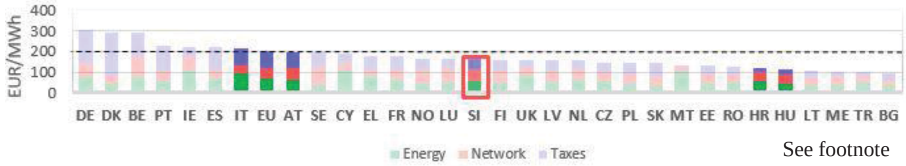
Financial support interventions





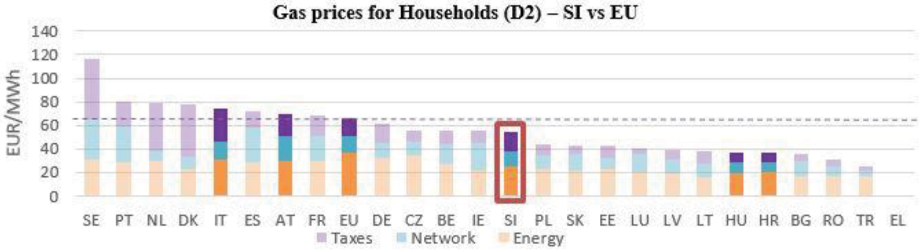
Slovenia

Electricity prices for Households (DC) – SI vs EU

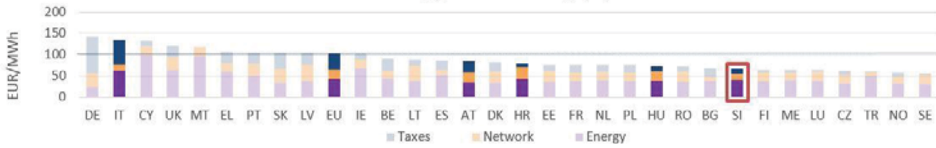


See footnote 1

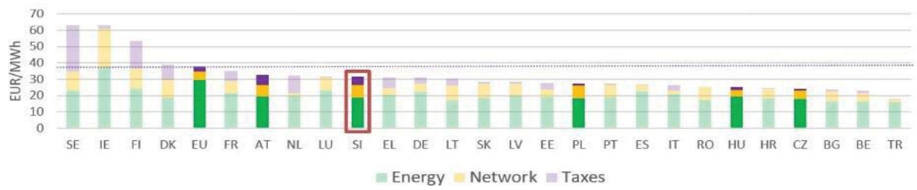
Gas prices for Households (D2) – SI vs EU



Electricity prices for Industry (ID) - SI vs EU



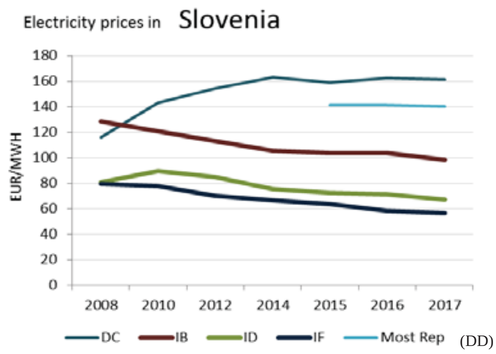
Gas prices for Industry (I3) – SI vs EU



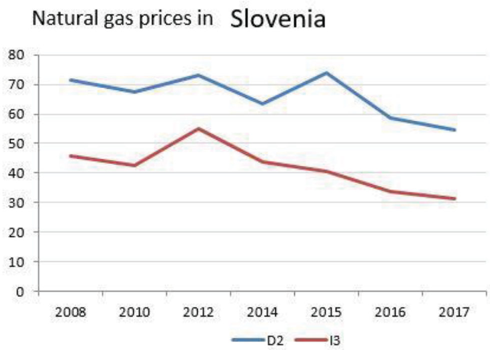
Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote 2

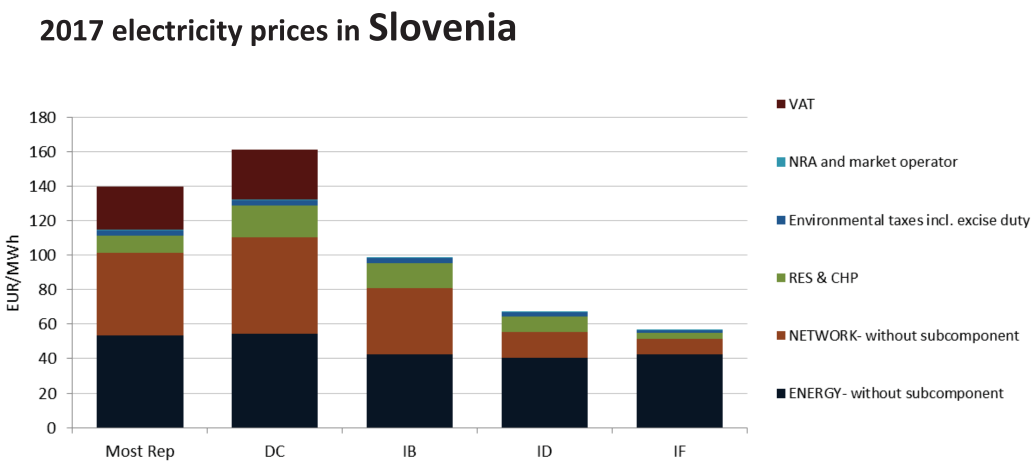


(DD)

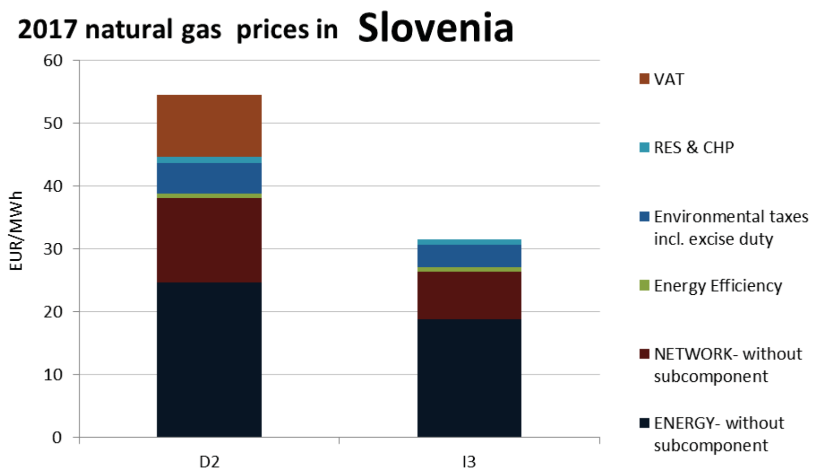


1 Neighbour countries and EU 28. No gas household prices available for Greece for 2017.

2 Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.



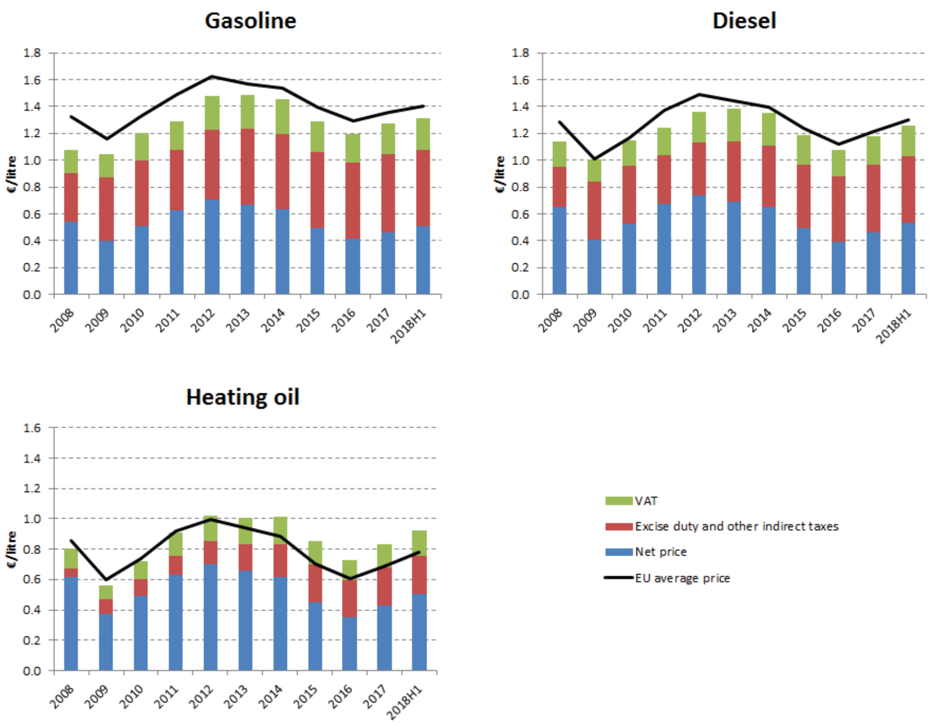
Source: European Commission, DG Energy in- house data collection



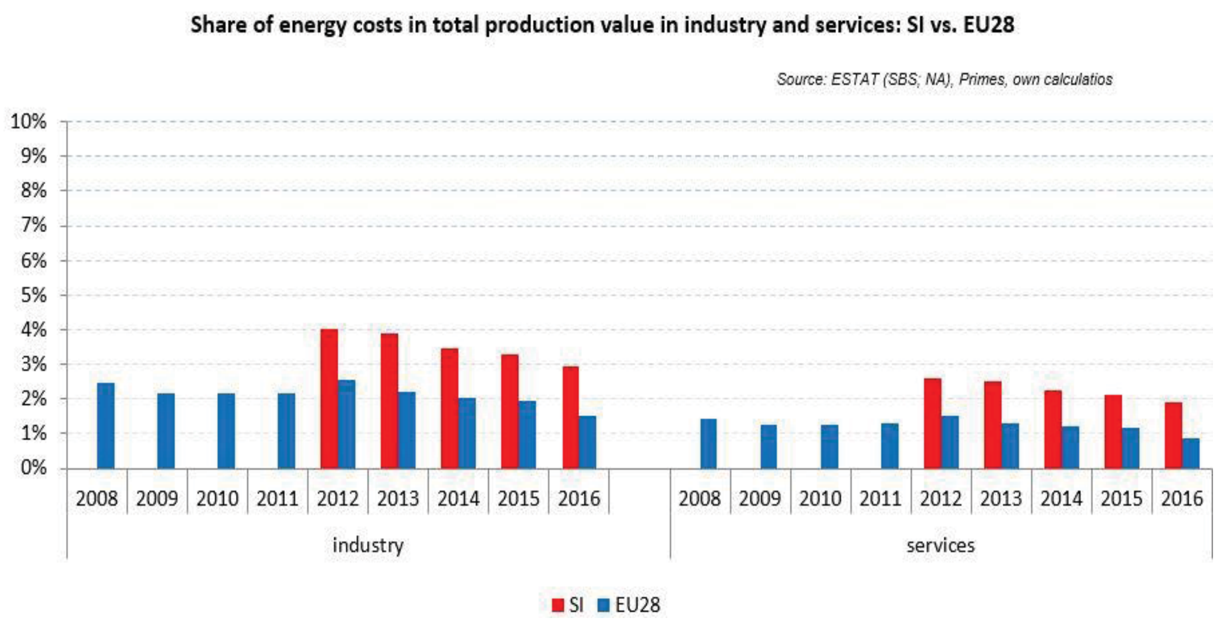
Source: European Commission, DG Energy in- house data collection

This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices



Energy costs shares in total production costs



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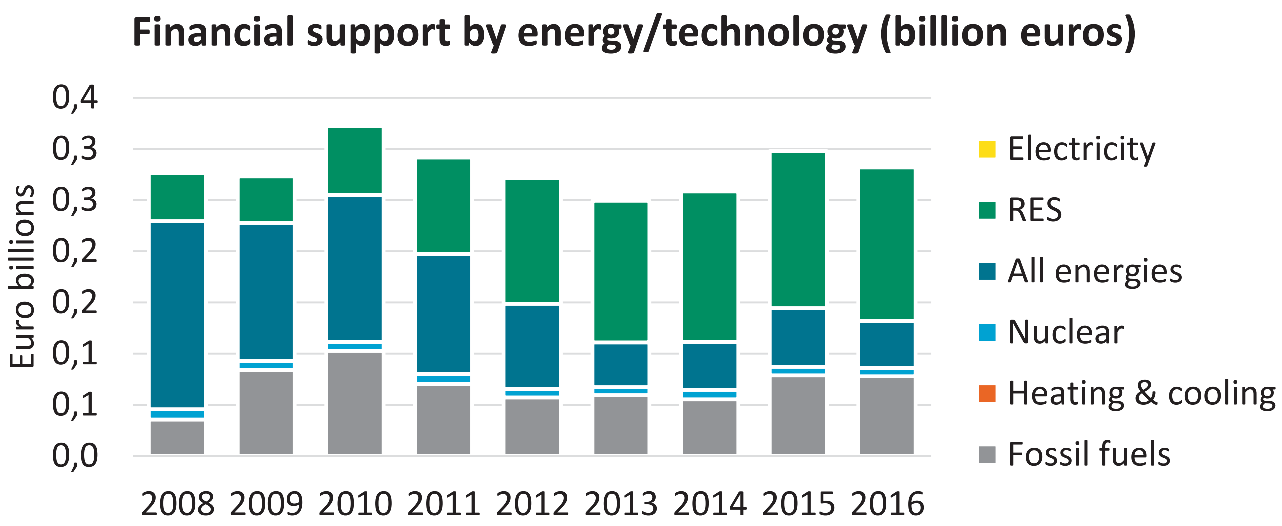
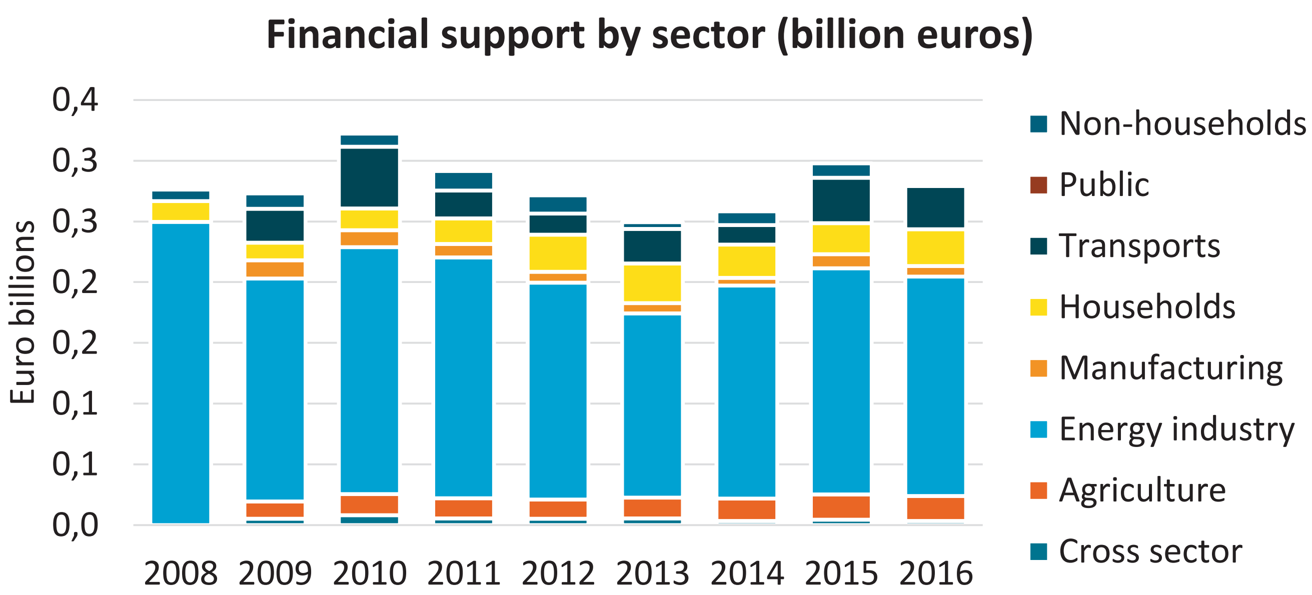
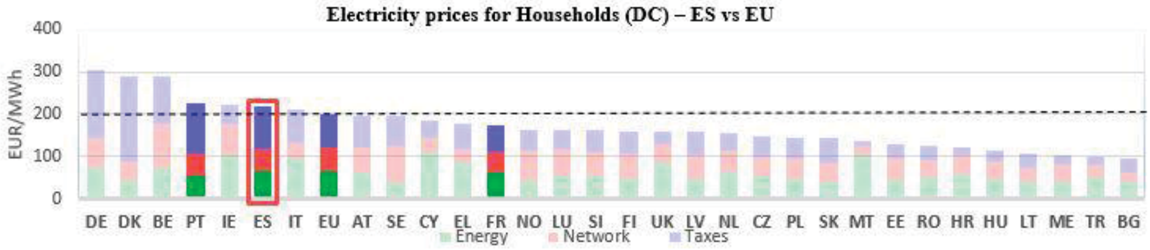
Financial support interventions

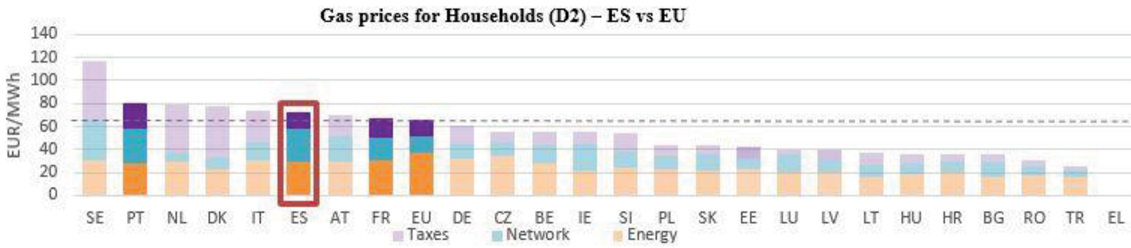


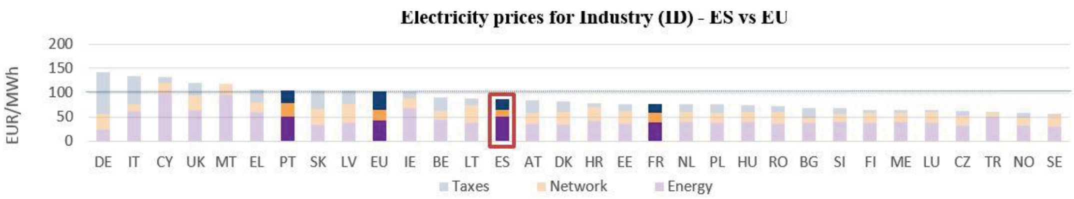


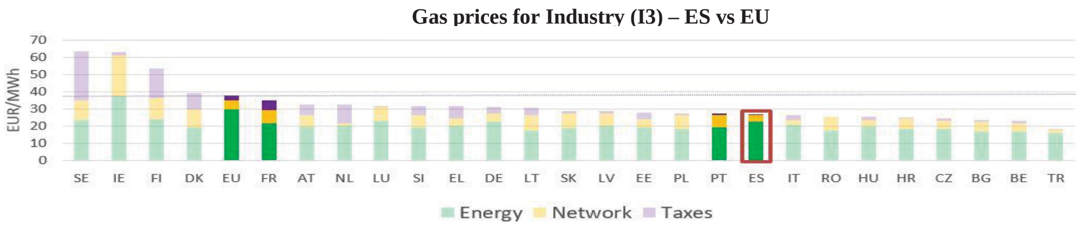
Spain

See footnote [1]





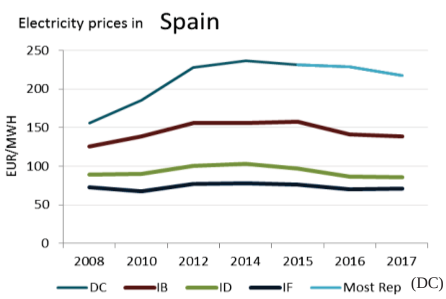


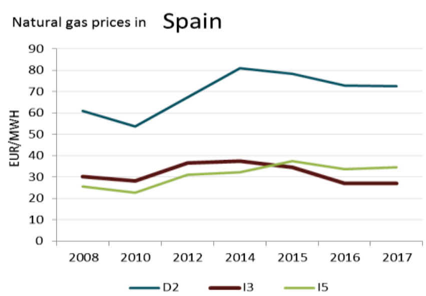


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]





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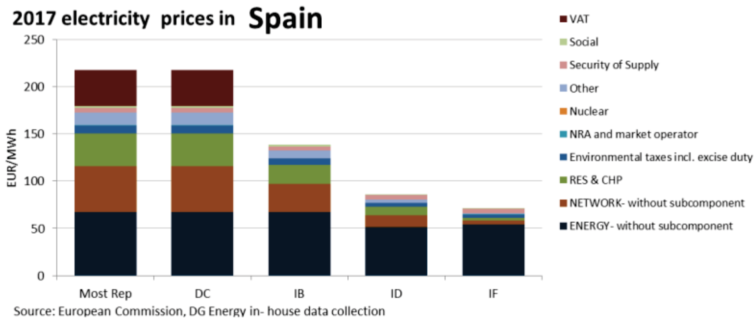
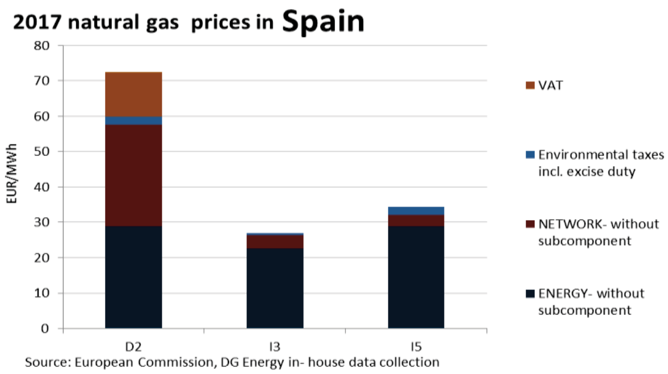
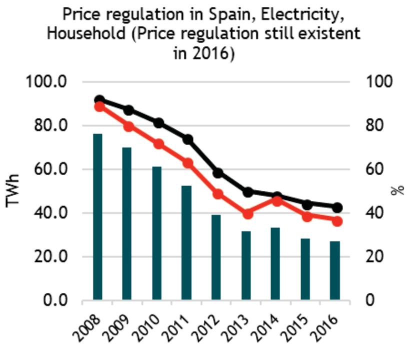
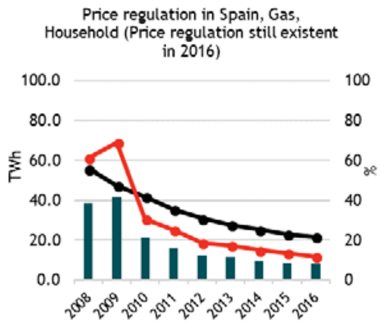
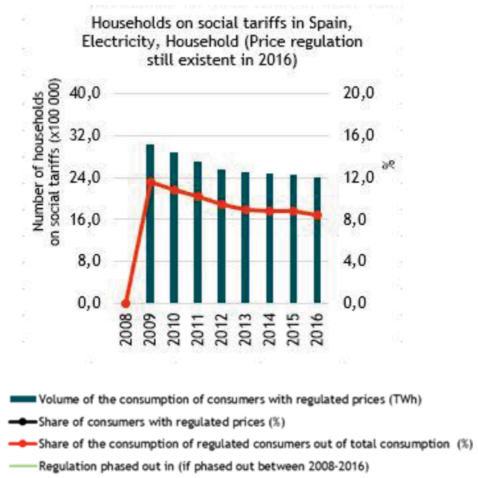




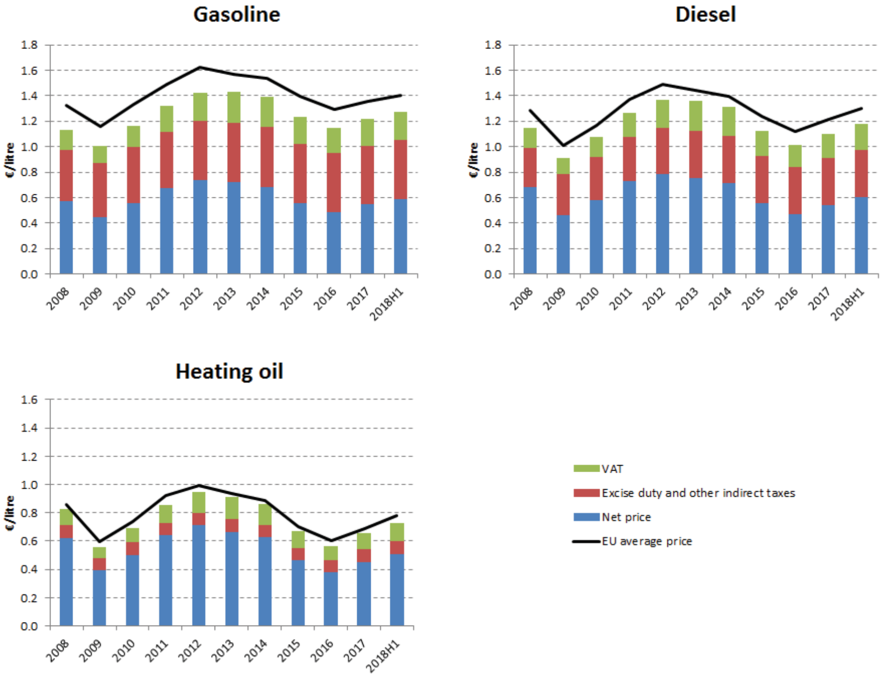
Price regulation



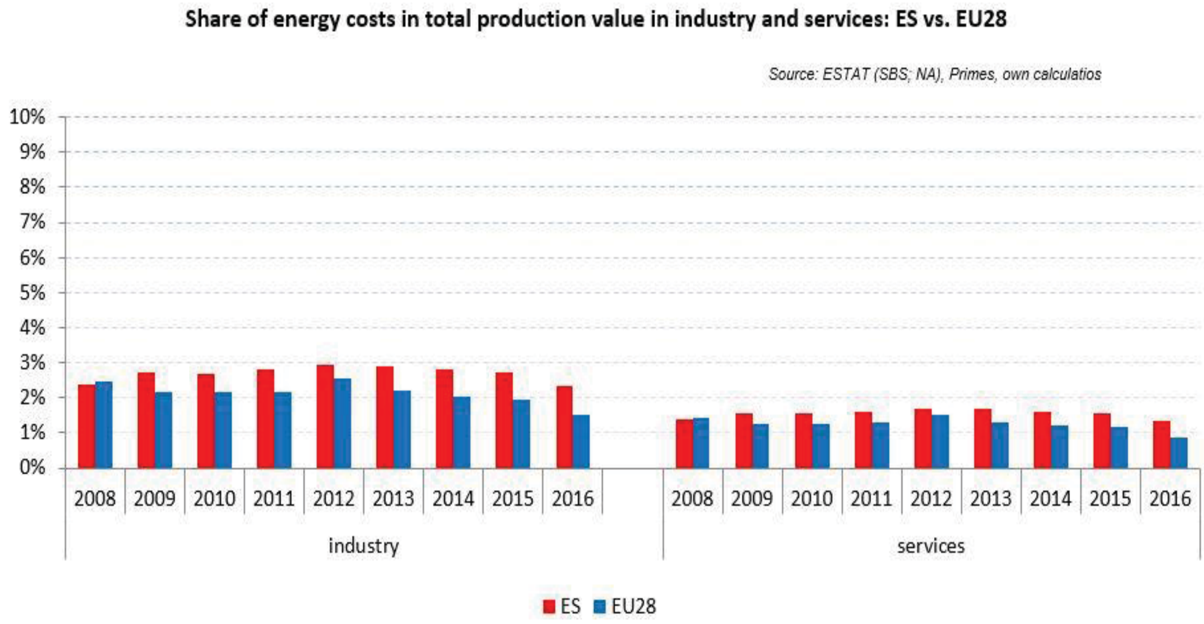




Oil products prices



Energy costs shares in total production costs



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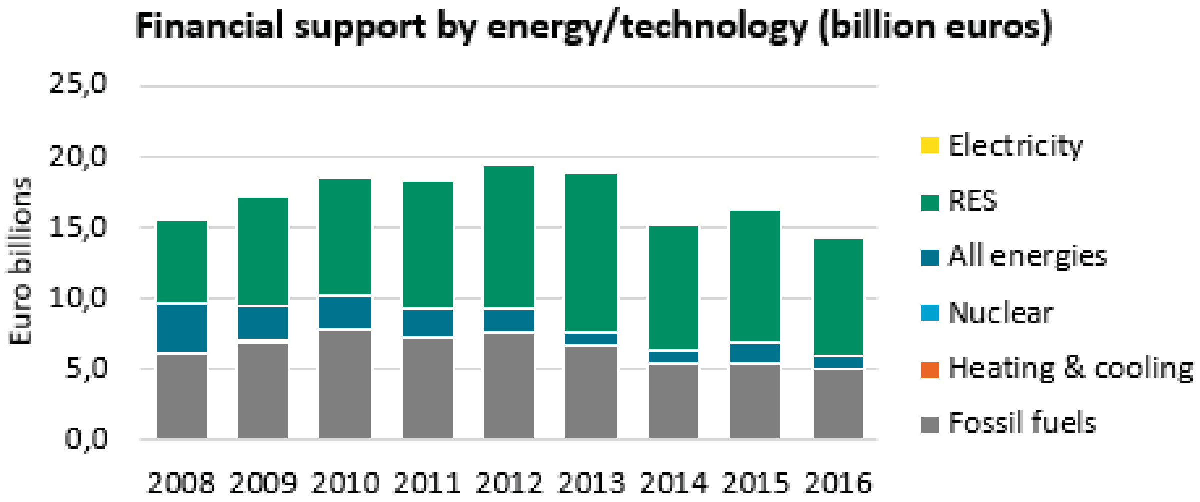
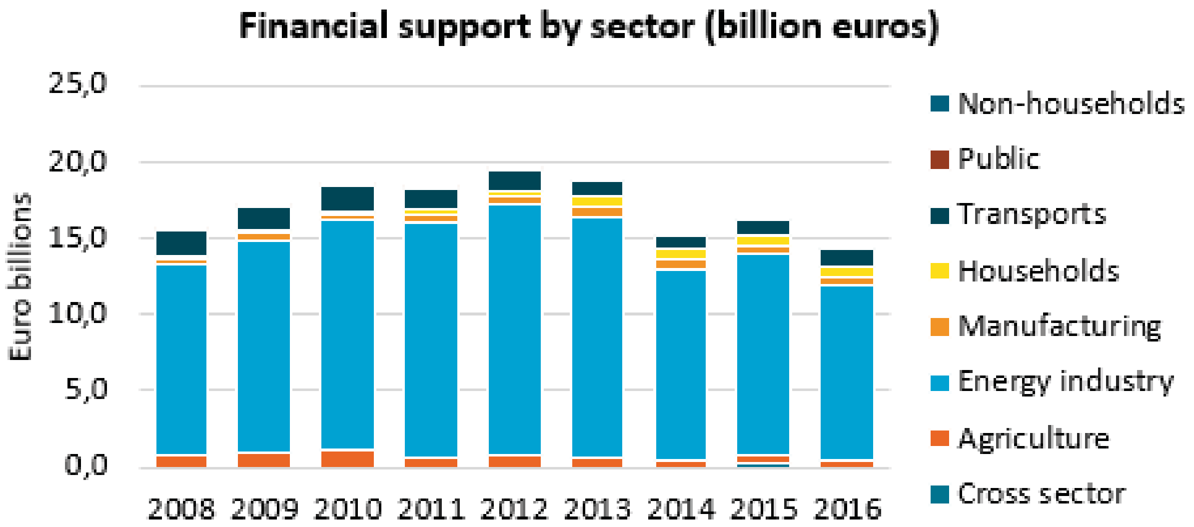
Financial support interventions





EUROPEAN
COMMISSION

Brussels, 9.1.2019
SWD(2019) 1 final

PART 11/11

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(2019) 1 final}

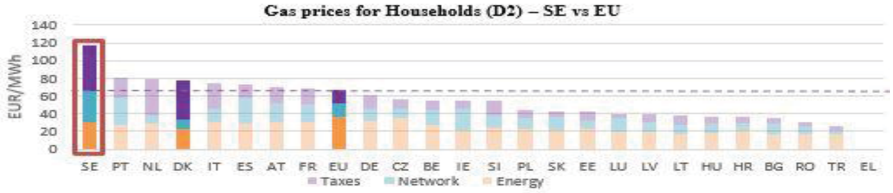
EN EN

Sweden

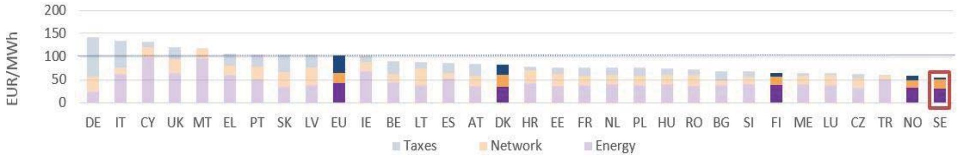
Electricity prices for Households (DC) – SE vs EU

See footnote [1]

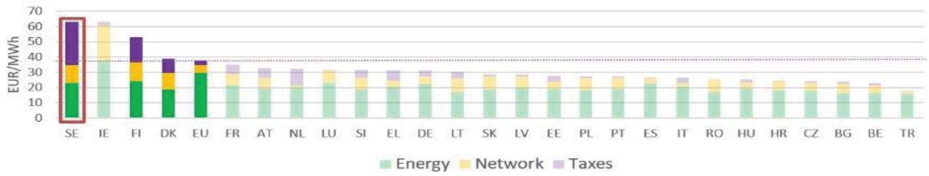
Gas prices for Households (D2) – SE vs EU



Electricity prices for Industry (ID) - SE vs EU



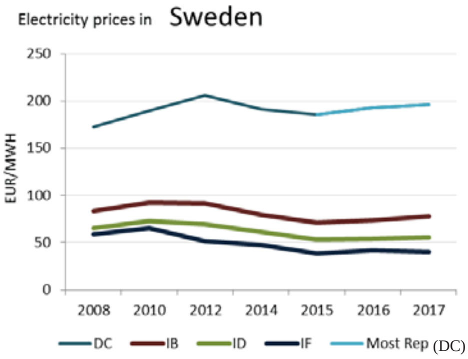
Gas prices for Industry (I3) – SI vs EU

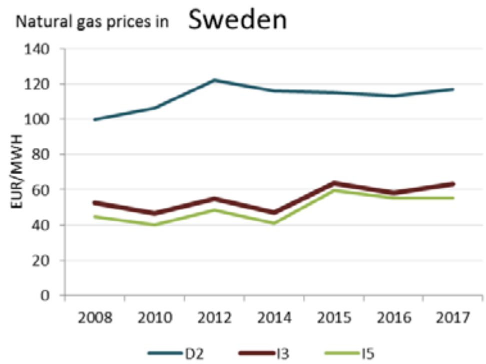


Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]





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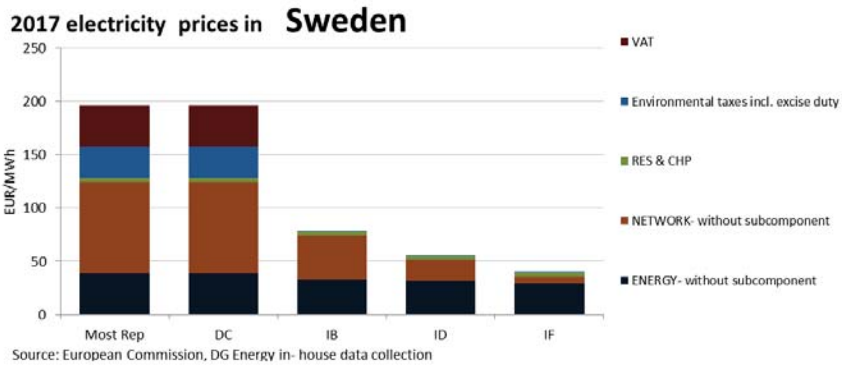
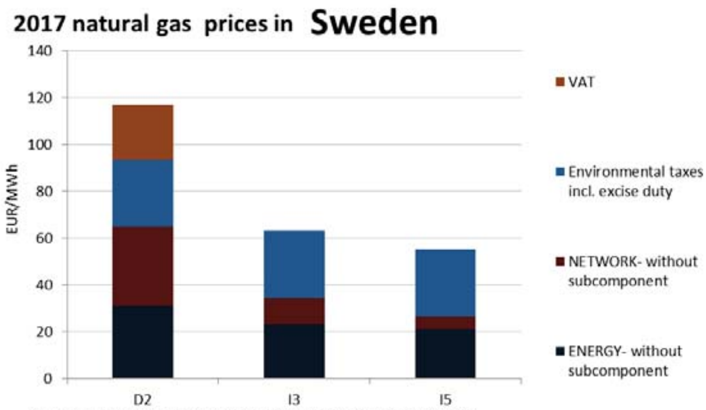


Source: European Commission, DG Energy in- house data collection

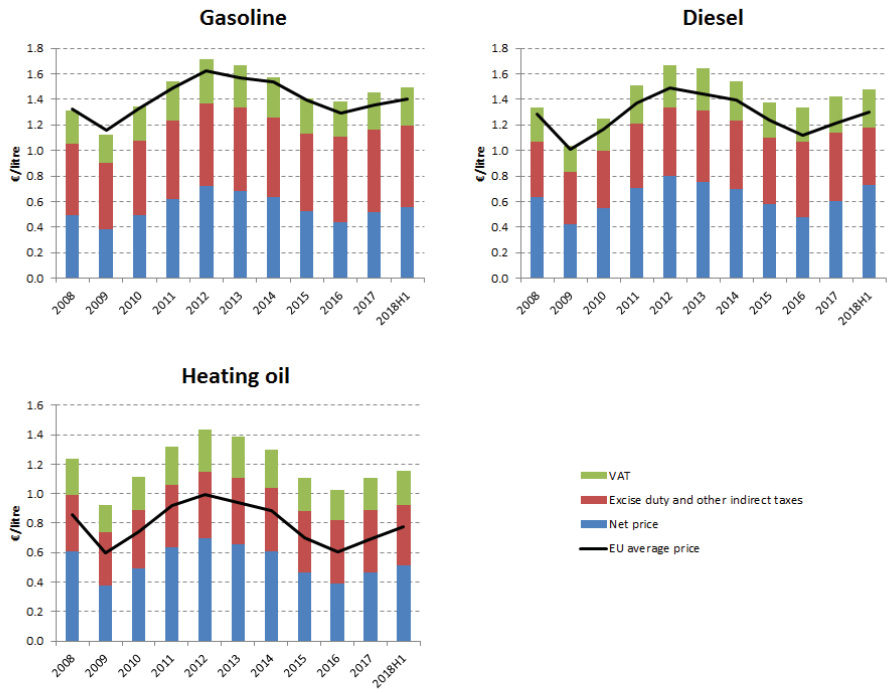


Source: European Commission, DG Energy in- house data collection

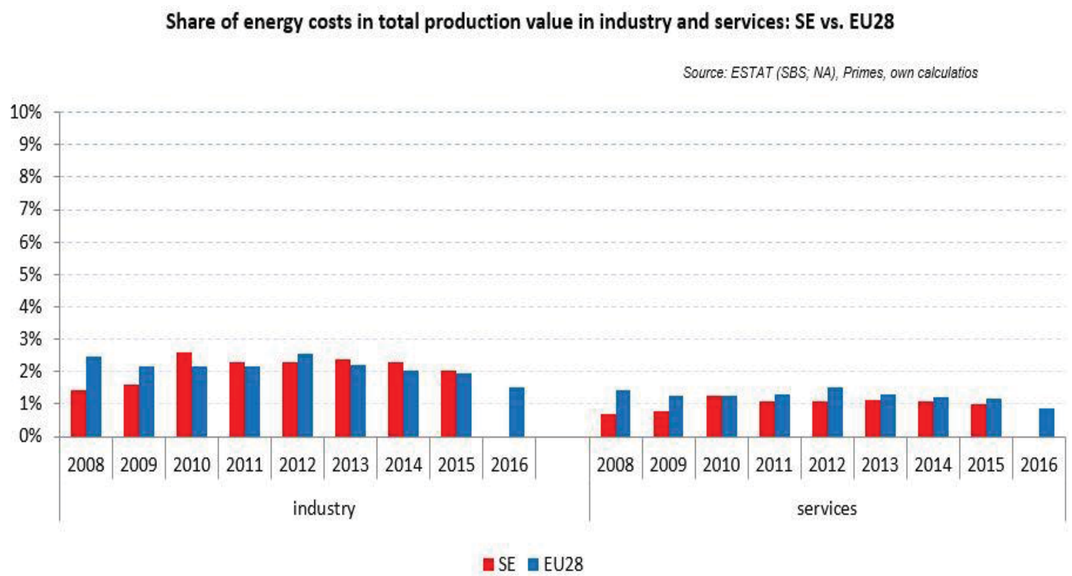
Price regulation

This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices



Energy costs shares in total production costs



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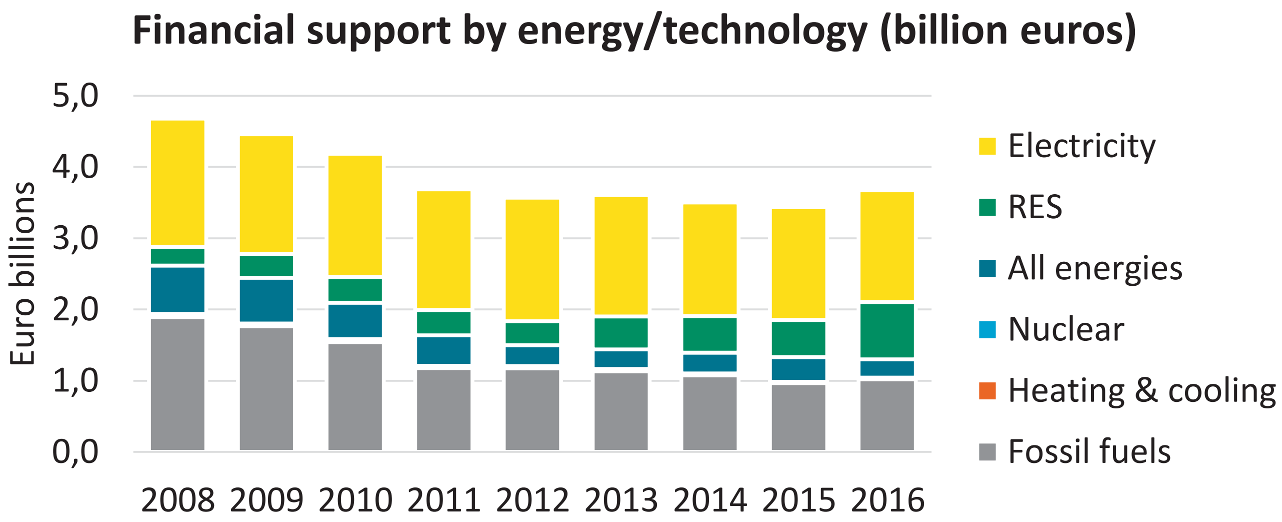
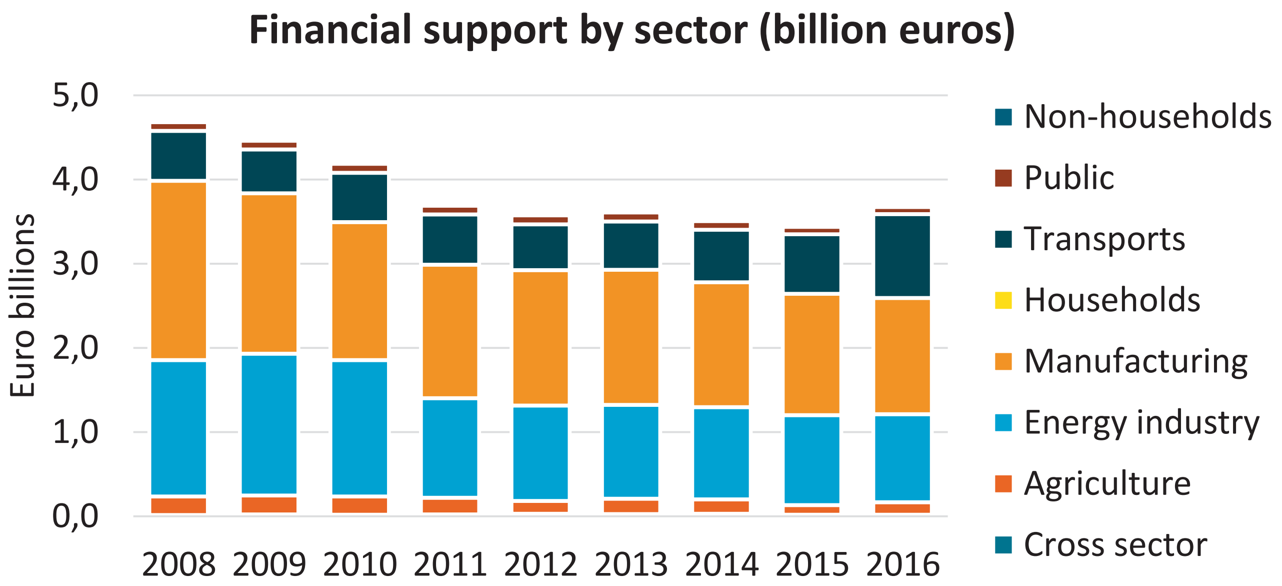
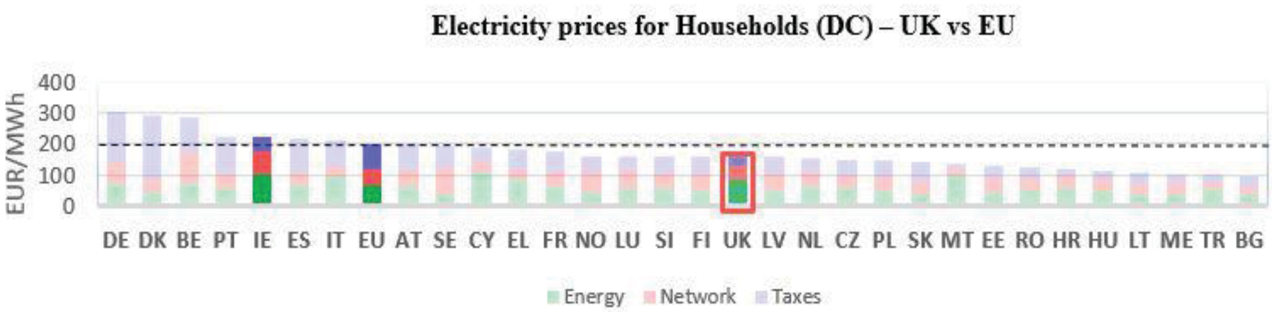
Financial support interventions

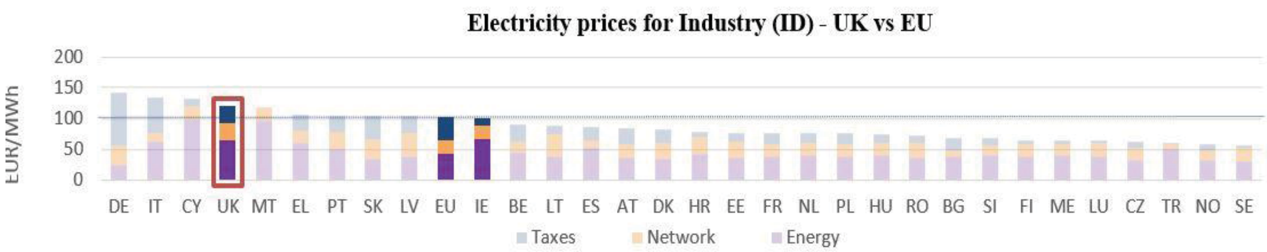




United Kingdom



see footnote[1]



Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

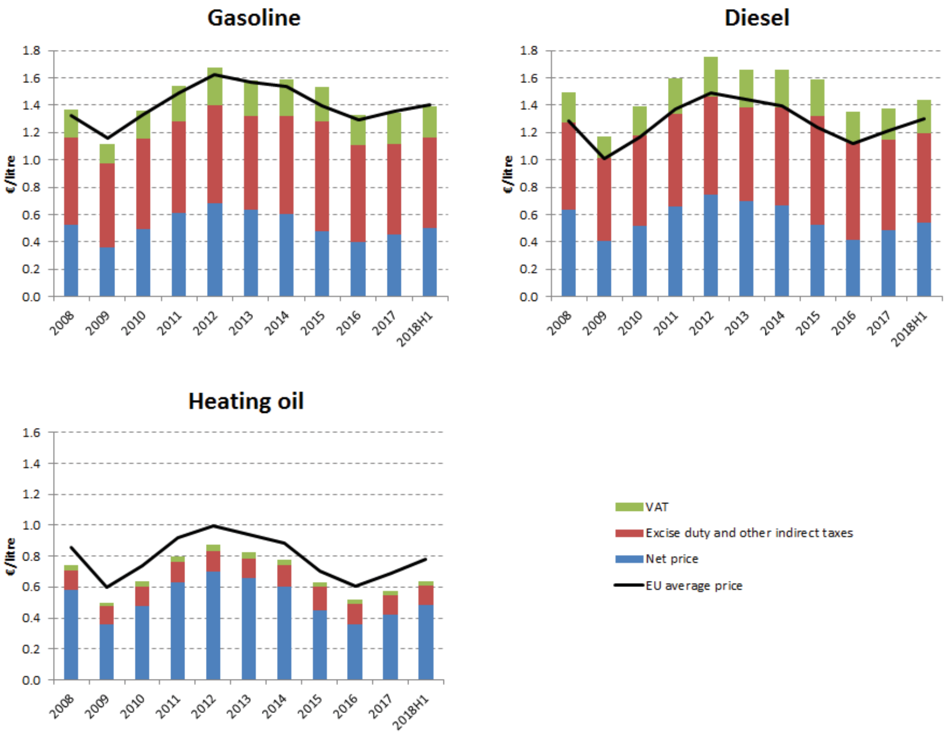
See footnote[2]

No data available for electricity and natural gas prices

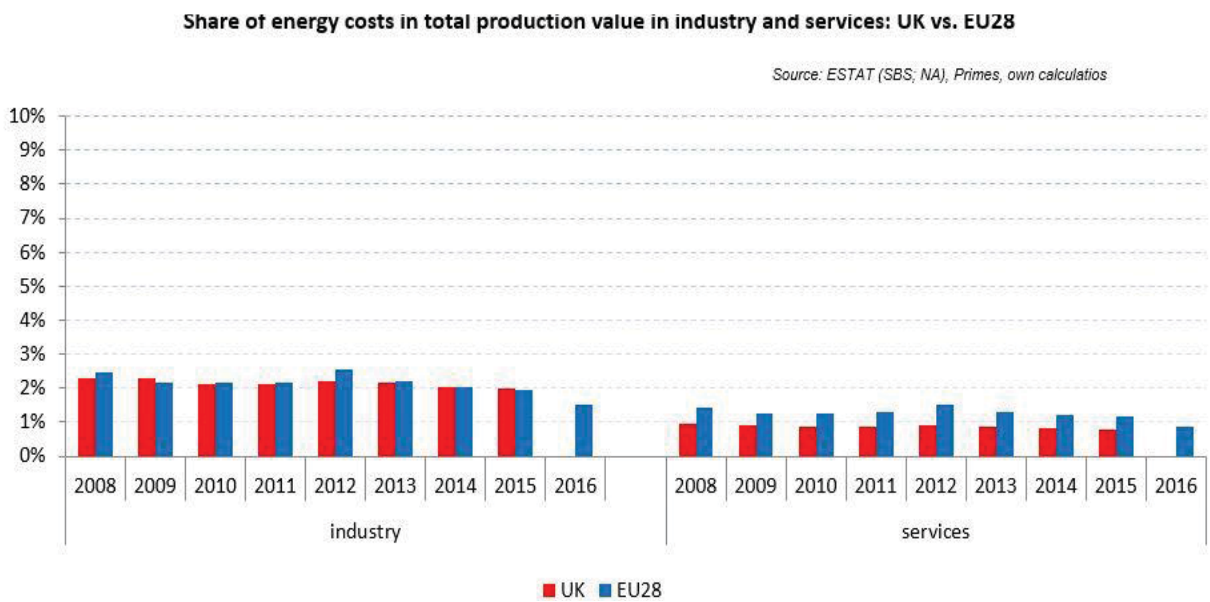
[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.

This country liberalised prices before 2008.
No social tariffs identified.

Oil products prices

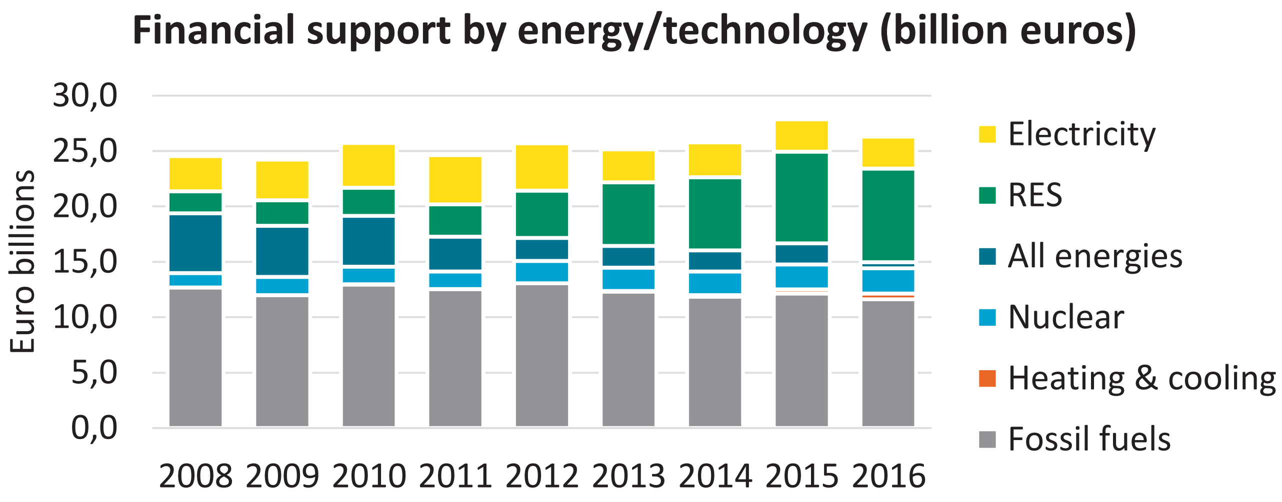


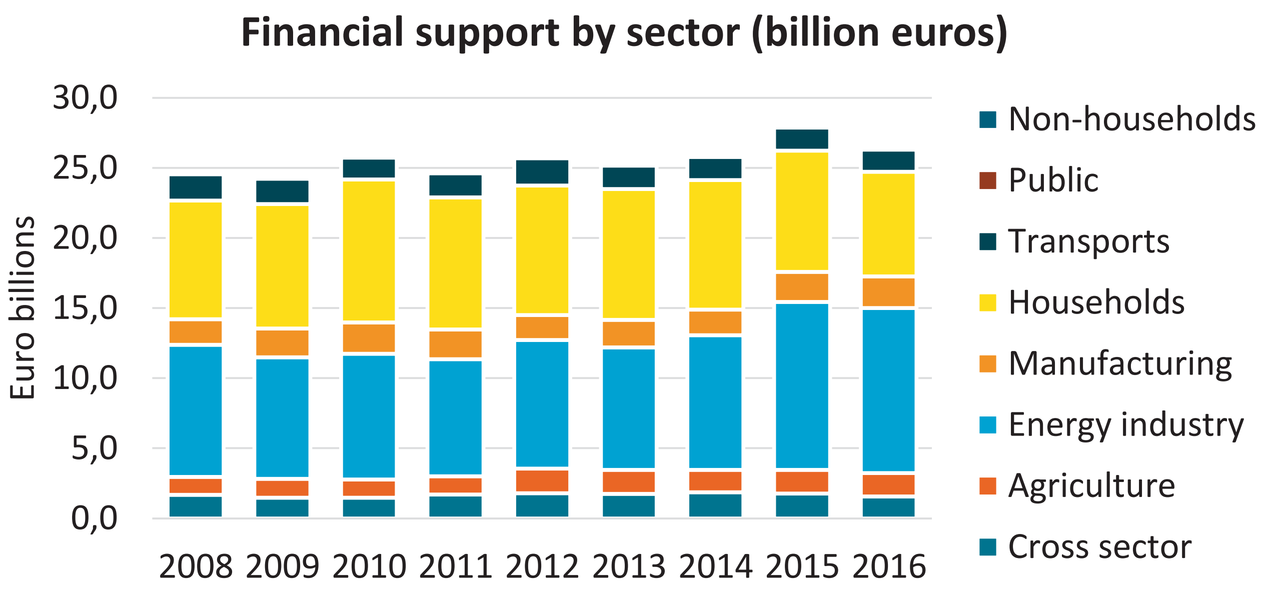
Energy costs shares in total production costs



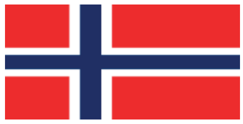
Notes: Data for Malta (prior to 2016), Poland (prior to 2015), Slovenia (prior to 2012) and Greece (prior to 2008) is not available. Data for Denmark, Sweden and the United Kingdom for 2016 was missing by the time of extraction

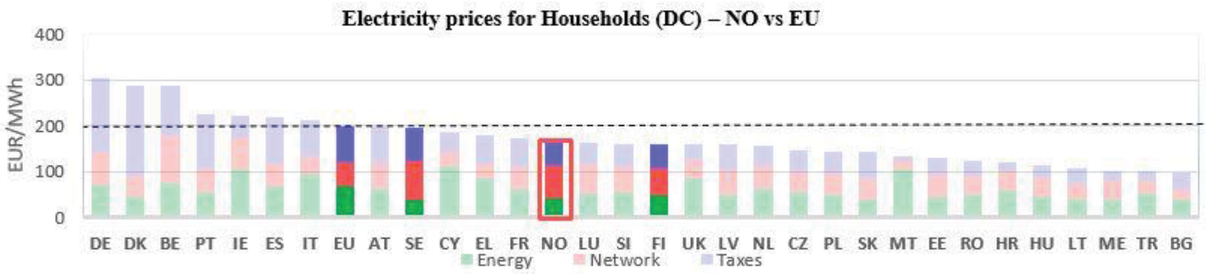
Financial support interventions



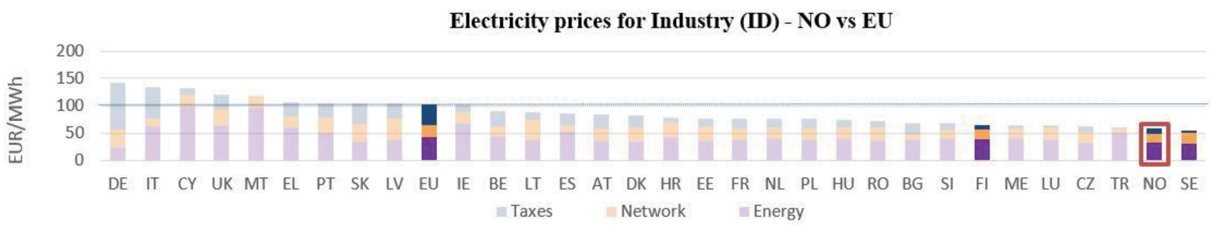


Norway





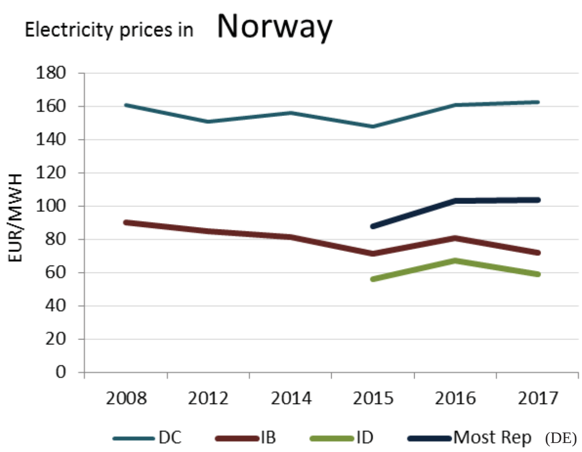
see footnote[1]



Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

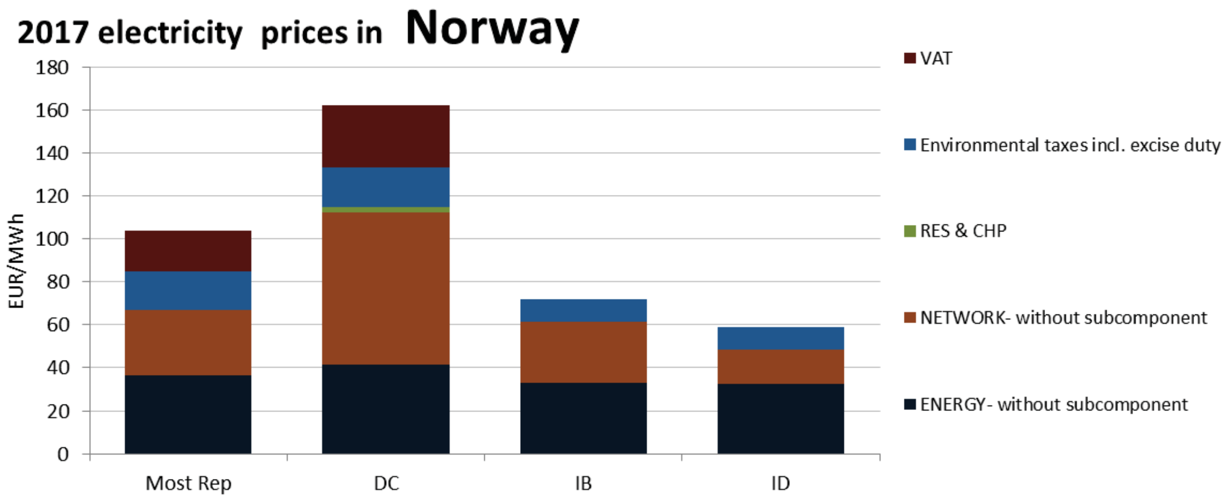
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote[2]



1 Neighbour countries and EU 28. No gas household prices available for Greece for 2017.

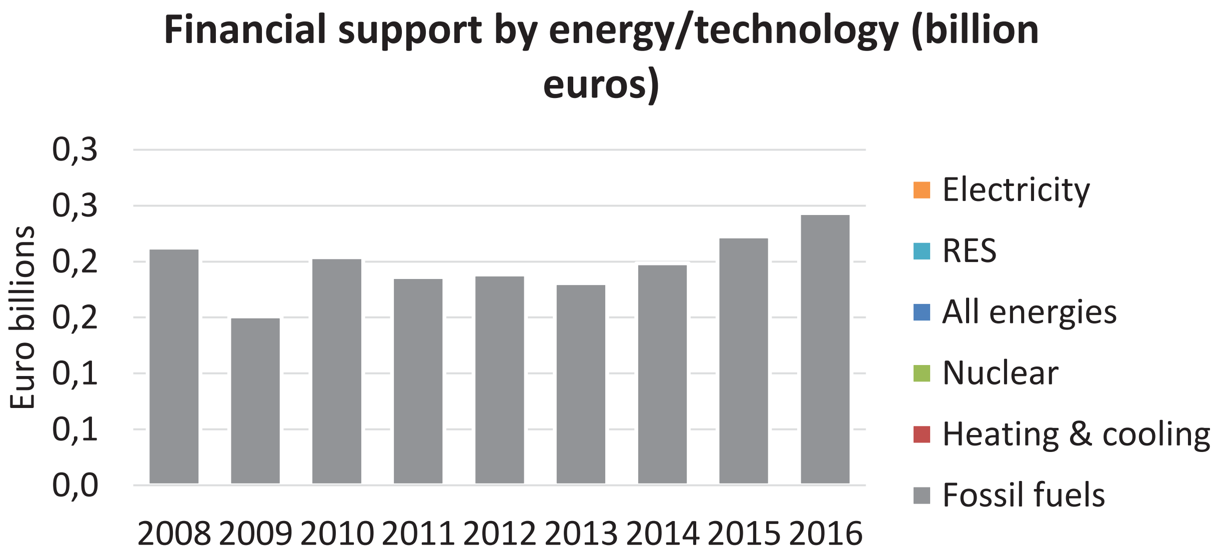
2 Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.



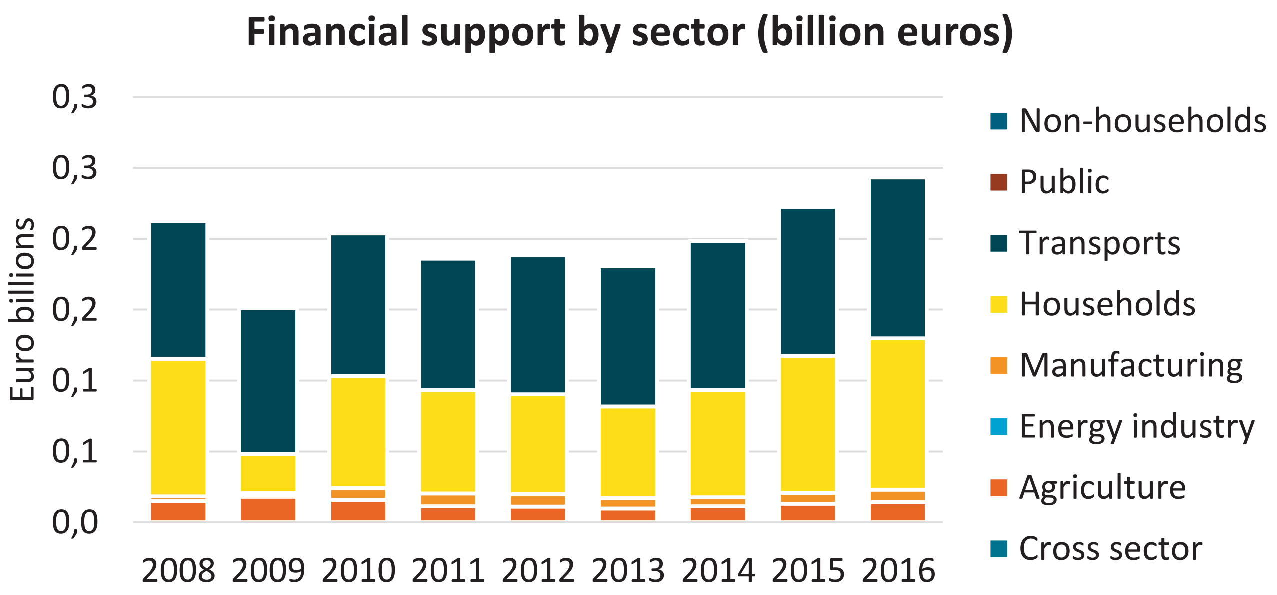
Source: European Commission, DG Energy in- house data collection

Oil product prices and Energy costs shares
are not available for this country

Financial support interventions

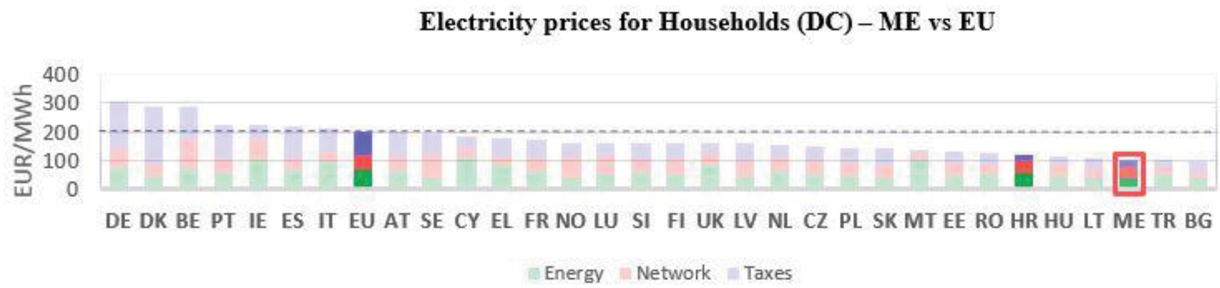


[1]

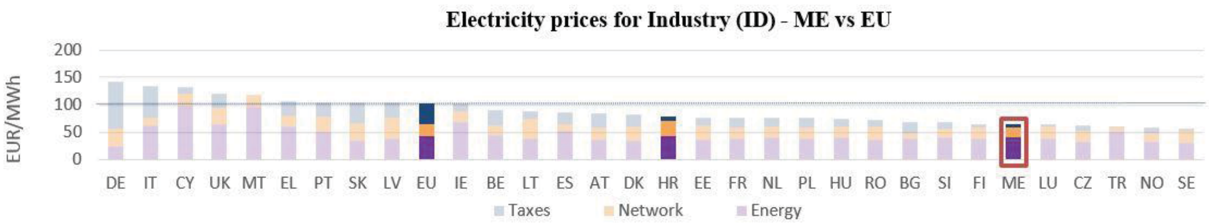


[1] Only fossil fuels data available

Montenegro



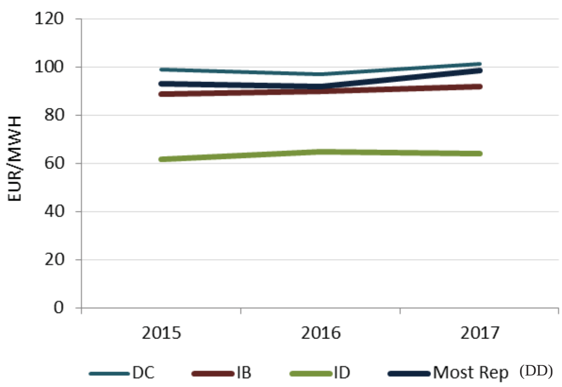
see footnote[1]



Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

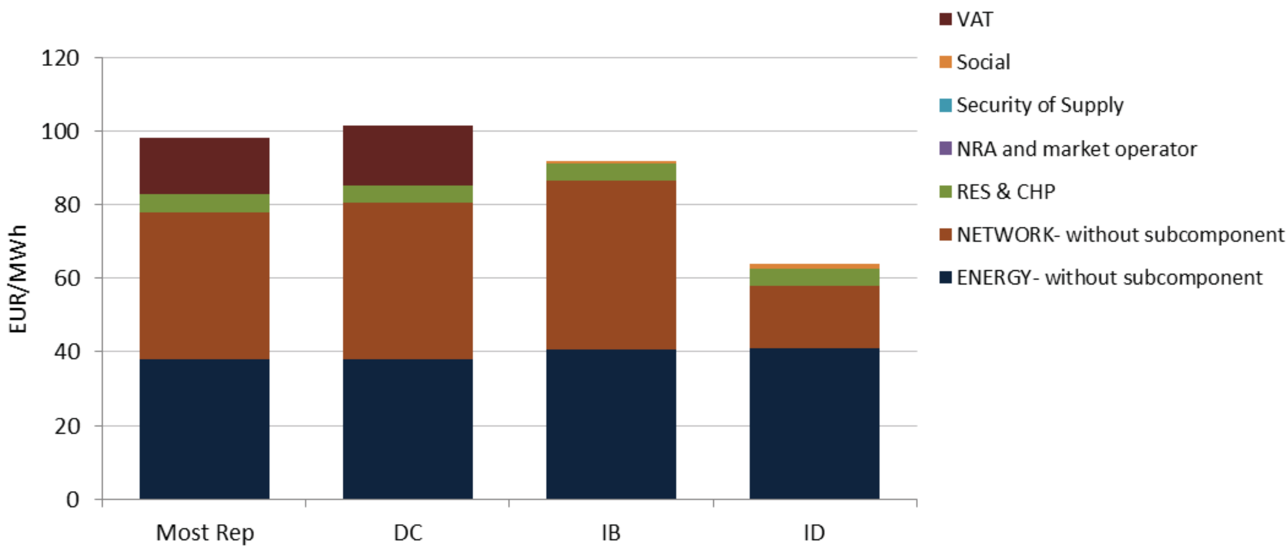
Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

See footnote [2]



[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.

2017 electricity prices in Montenegro



Source: European Commission, DG Energy in- house data collection

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Oil product prices and Energy costs shares are not available for this country

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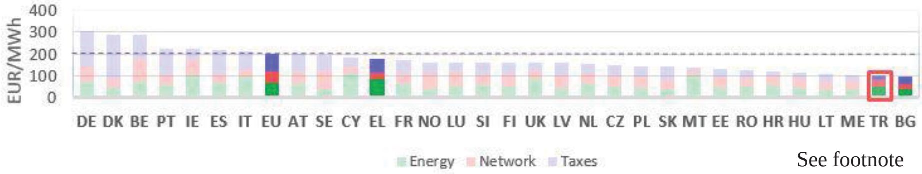
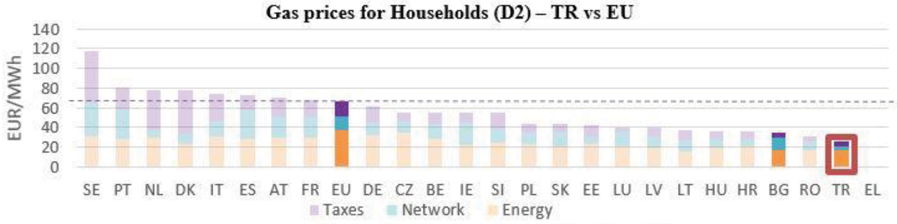
Turkey

Electricity prices for Households (DC) – TR vs EU

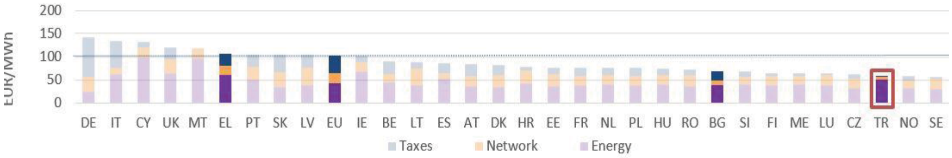


See footnote [1]

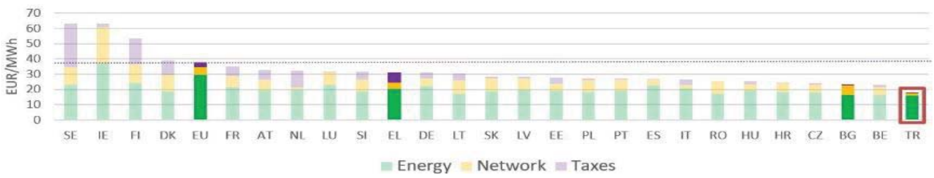
Gas prices for Households (D2) – TR vs EU



Electricity prices for Industry (ID) - TR vs EU



Gas prices for Industry (I3) – TR vs EU

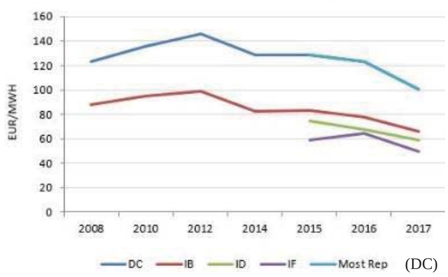


See footnote [2]

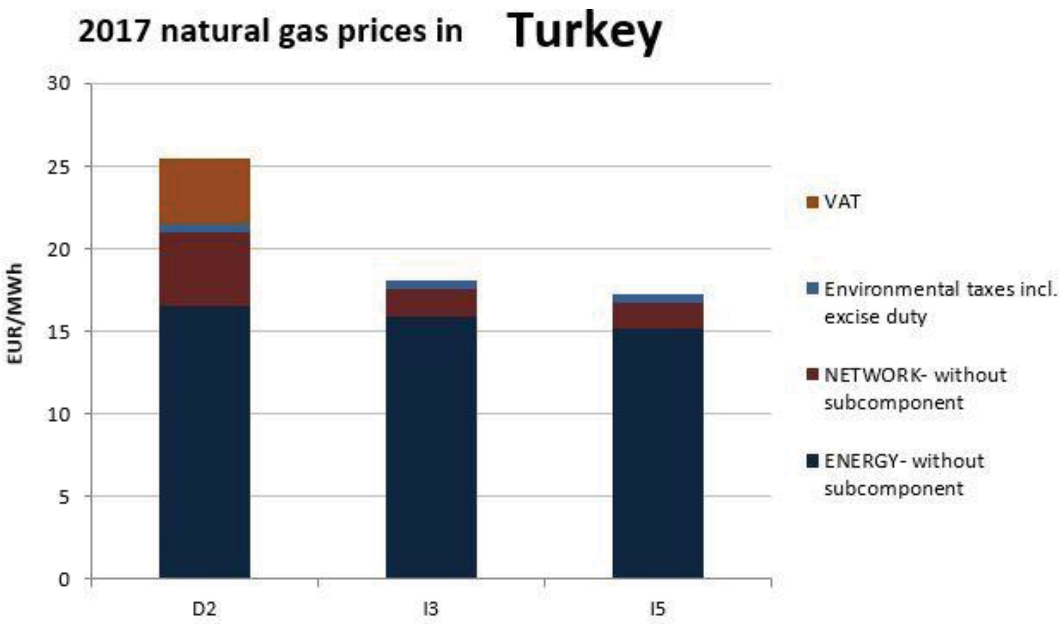
Electricity	DC	IB	ID	IF
	Household	Small Industry	Medium Industry	Large Industry

Gas	D2	I3	I5
	Household	Medium Industry	Large Industry

Electricity prices in Turkey



[1] Neighbour countries and EU 28. No gas household prices available for Greece for 2017.
[2] Annual electricity consumption: DB 1 - 2.5 MWh, DC 2.5 - 5 MWh, DD 5 - 15 MWh, DE above 15 MWh, IB 20-500 MWh, ID 2000-20000 MWh, IF 70000-150000 MWh. Annual Gas consumption: D2 20-200 GJ, I3 10000-100000 GJ, I5 1 mil - 4 mil GJ.



Oil product prices and Energy costs shares are not available for this country