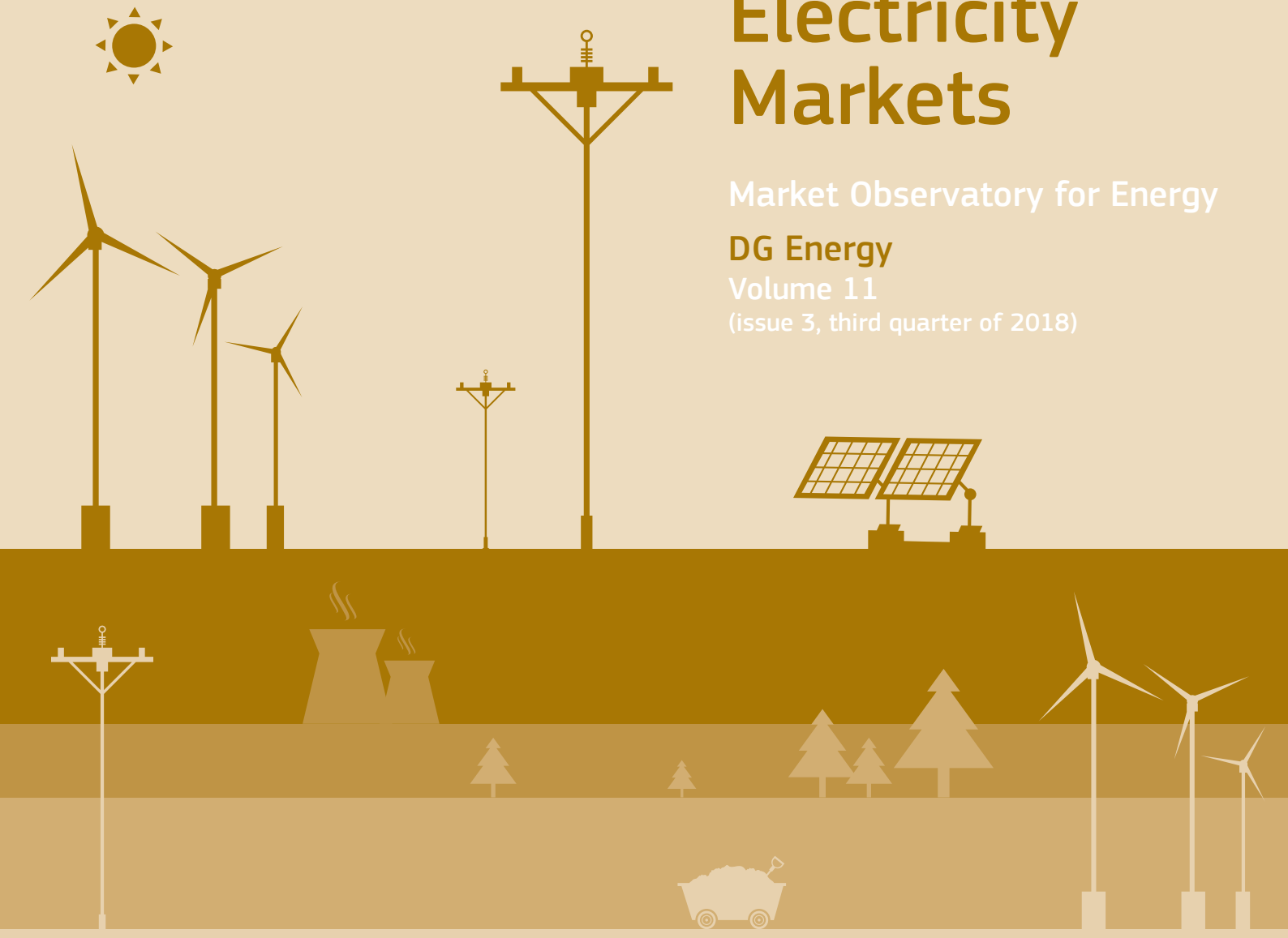
European Commission

Quarterly Report on European Electricity Markets



Market Observatory for Energy

DG Energy

Volume 11
(issue 3, third quarter of 2018)

Energy

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Contents

Highlights of the Report

- In September the re- opening of Belgian nuclear power plants was postponed until mid- 2019, leaving the country with only 1 of its 7 nuclear reactors operating. The extended outages raised concerns for power supply shortages during the winter.

- Prices across the Central- Western European region reacted to the decrease in nuclear power supply in Belgium, where the highest hourly price recorded in September 2018, rose above 400 EUR/MWh compared to the monthly average of 68 EUR/MWh.

- ETS allowance prices passed the 20 EUR/t pass mark for the first time in a decade. The initial price increase, resulting from the revision of the ETS Directive and its adoption in February 2018, was reinforced by weather driven increase in demand as well as by anticipation of regulatory changes with expected the entry into force of the Market Statbility Reserve mechanism.

- Retail price developments were mostly driven by changes in wholesale prices, contrary to most of the last decade when price increases were driven by taxes. Taxes and levies changed by less than 1% in half of the EU Member States from Q3 2017 to Q3 2018.

Executive Summary

- **Wholesale prices across Europe remained on an increasing trajectory** throughout the third quarter of 2018. On some markets the price increase even accelerated compared to the first half of the year. The average monthly EU wholesale price rose from 42 EUR/MWh in January 2018 to 63 EUR/MWh by September 2018,

- **Electricity demand grew both in the industrial and household sectors.** The EU's GDP grew by 1.9% in the third quarter of 2018 compared to the same period of the previous year. Increasing economic activity in manufacturing sectors had a appositive impact on electricity demand. Much like the hotter than usual summer had on household and commercial demand of electricity. In July and August temperatures across the continent were higher than the long- term average resulting in increased cooling needs.

- **Emission allowance, gas and coal commodity prices also continued to rise.** The rapid growth of emission allowance prices continued as ETS allowance prices rose from 5 EUR/t in September 2017 to 21 EUR/MWh in September 2018. Allowance prices passed the 20 EUR/MWh mark for the first time in a decade. Gas prices grew by almost 30%, while coal prices experienced a moderate increase of 11% in a year-on-year comparison. Despite such cost increases, the rise in wholesale prices resulted in coal and gas fired electricity generation becoming profitable in Germany during Q3 for the first time in 2018.

- **The EU's electricity mix remained largely unchganged, as renewables made up 30%** of all generation, less than 1% higher compared to the same period of the previous year. A minor shift is to be observed between the share of fossil fuel fired and nuclear generation: the latter gained 1 percentage point and made up 36% of the EU's generation while the share of nuclear generation fell to 27%. Hydro generation and reservoir levels albeit improved across the EU comapred to 2017, they still remained below the long term average in most regions.

- **The share of variable renewable energy sources increased by 2 p.p. in Q3 2018** compared to the same period of the last year**.** The combined share of wind and solar increased to 17.4% by September, the second highets value recorded in 2018. At the same time, hydro powered generation fell to the lowest level in 2018. Due to the unusually hot summer, hydro generation remained below 10% of the EU's total electricity generation by September.

- **Contrary to previous years, taxes were no longer the main price increase drivers of retail prices.** Taxes remained largely stable as they changed less than 1% in half of of the EU Member States in a year-on-year comparsion. The evolution of taxes and policy costs slowed down so much that in most countries price developments were set by the evolution of the the enrgy component, network charges or a combination of both. Notable exemptions were Germany and Denmark where taxes grew by 7 and 12 EUR/MWh respectively compared to September 2017.

- **Prices in the EU remained cheaper than Japan but more expensive than the United States** and other international competitors. This holds for both wholesale and retail markets and the EU retained its position in international comparison. The average EU retail price experienced a less volatile evolution than their counterparts in Turkey, Korea and Japan. On the wholesale level EU prices grew 60% above their US counterparts indicating an increasing EU price premium to the US once retail prices catch up with wholesale developemnts.

- **The highest retail prices[1] for industrial consumers[2] were recorded in the UK (171 EUR/MWh), followed by Germany and Italy.** Denmark (327 EUR/MWh) recorded the highest houshold retail price in September 2018, Germany took the second place for this consumer type too, followed by Belgium.

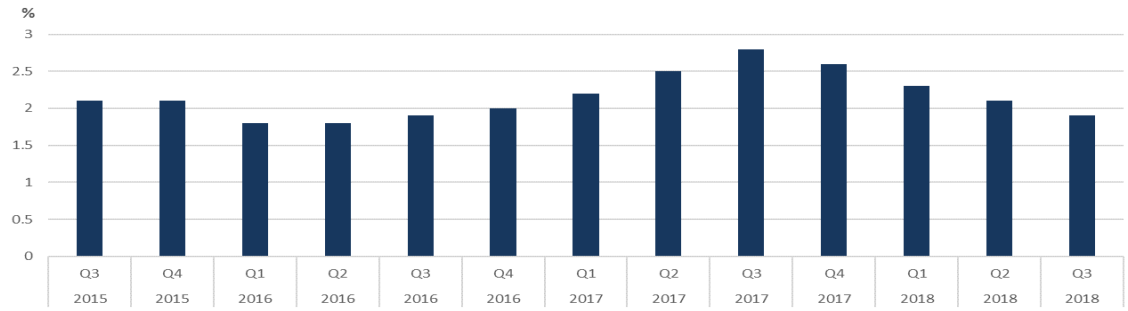
[11] Excluding non- interconnected island systems
[2] Band ID

1 Electricity market fundamentals

1.1 Demand side factors

- In the third quarter of 2018 economic growth in the EU-28 continued to decelerate for the fourth consecutive quarter as GDP grew by 1.9% in year-on-year comparison as opposed to the growth of 2.8% in Q3 2017. According to data of the European Network of Transmission System Operators (ENTSO-E), EU- wide consumption of electricity in the reference period stood at 666 TWh, showing a slight increase of 1.7% compared to the same period of the previous year. Growing electricity demand was mostly due to increased activity in important electricity consuming sectors such as manufacturing and construction. The construction sector experienced a GVA increase of 24% from the third quarter of 2017 to the third quarter of 2018. The manufacturing sector, which includes several energy intensive industries, grew by 2%. As the size of the second sector is much bigger, the combined impact of the two sectors was 7% increase.

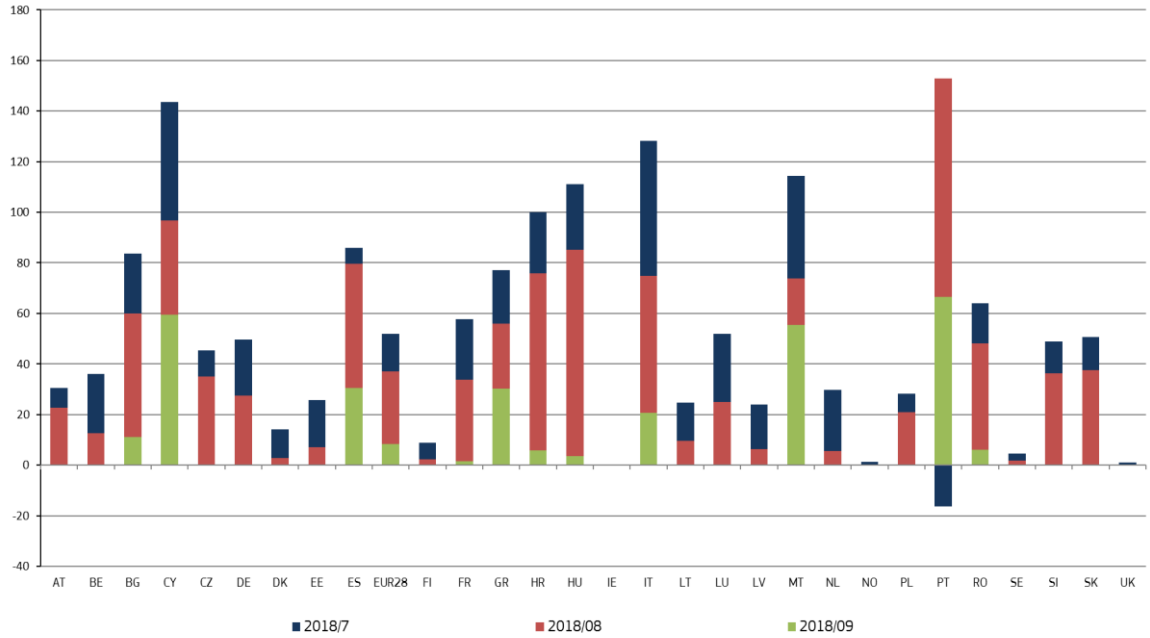
Figure 1 - EU 28 GDP, year-on-year change



Source: Eurostat

- The following figure shows the deviation of actual Cooling Degree Days recorded in the reference period from the long- term averages. Positive values indicate that more heating was needed in the reference period compared to the long term- average. In other words, temperatures were colder. The third quarter of 2018 covers mostly summer months, during which cooling needs are better indicators for weather related electricity consumption. Data shows positive values in all 28 Member States for all three months of the reference period, apart from July in Portugal. This means that temperatures were warmer all across the EU compared to the long- term average, indicating increased cooling needs. Therefore, electricity used to satisfy increased cooling needs, in addition to increased economic activity in energy intensive sectors, contributed to growing demand. Temperatures were warmer than the long- term average, especially in southern- Europe. Portugal, Cyprus, Malta and Croatia recorded the highest number of cooling degree days compared to the long- term average. August 2018 registered the highest number of cooling degree days across the EU. More details on regional wholesale electricity markets can be found in Chapter 3.

Figure 2 - Deviation of actual Cooling Degree Days from the long-term average



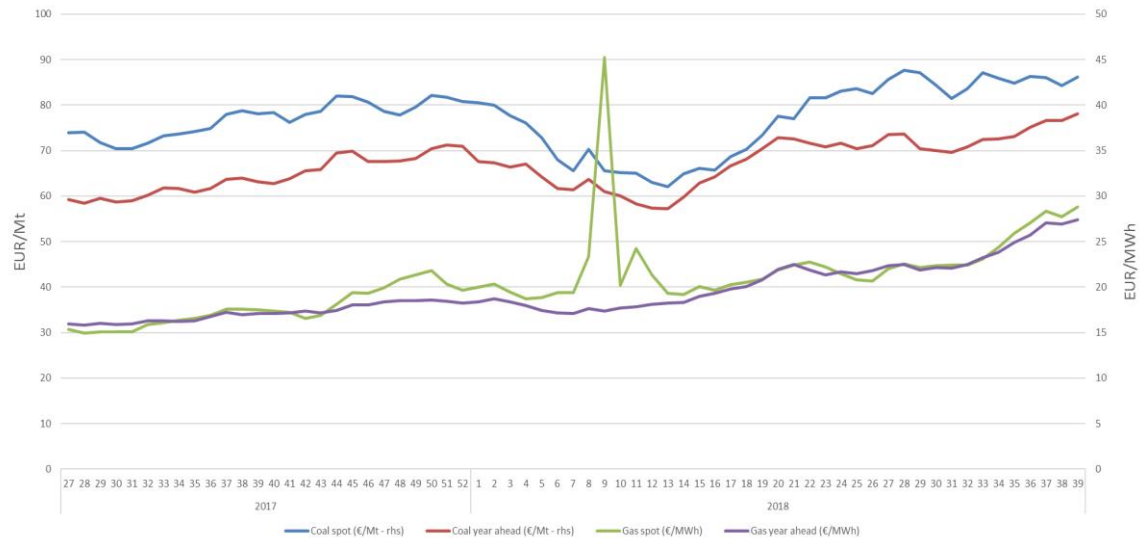
Source: JRC. The colder is the weather, the higher is the number of HDDs and the warmer is the weather during the summer, the higher is the number of CDDs. In this quarter in June 2018 cooling degree days are presented on the chart, as from the beginning of the summer period heating related demand does not apply any longer, instead increasing temperatures result in cooling needs, especially in southern EU countries.

1.2 Supply side factors

- Spot coal prices (represented by CIF ARA contracts, the most commonly used import price benchmark in North-Western Europe), showed, after the measurable decrease in Q1 2018 (weeks 1-13 on the charts), a steady increase throughout the second and third (weeks 27-39) quartes of 2018, reaching 87 EUR/Mt by the end of September. Prices on the global coal market received support from the strong demand in Asia, primarily owing to increasing coal consumption in power generation in China and India.
- Spot natural gas prices (represented by Title Trading Facility – TTF in the Netherlands, being the most liquid hub in North-Western Europe) rose faster throughout the third quarter of 2018, from 21 to 27 EUR/MWh. Increased cooling demand and economic activity increased demand for natural gas, thus driving prices of the commodity upwards. Spot natural gas prices in the third quarter of 2018 were 30% higher than in the same period of 2017 as they grew from 17 to 22 EUR/MWh on average.
- Year-ahead coal prices were in backwardation to spot contracts, reflecting lower future price expectations on the coal market.. By the end of Q3 2018 the difference between spot and year-ahead coal price contracts decreased to 8 EUR/Mt (from a difference of 12 EUR/Mt by the end of the previous quarter). Difference between spot and year-ahead gas prices remained negligible over the whole second quarter of 2018, reflecting the low price volatility on the European wholesale gas markets.
- Emission allowance prices recorded a significant increase throughout the refernce period, continuing the trend of strong growth that started in early 2017 and saw emission allowance prices triple by the end of September 2018. Emmission prices grew from 5.2 EUR/t CO2 in the 27th week of 2017 to 15 EUR/t in the 27th week of 2018 and to 21 EUR/t by the 39th week of 2018 (end of the reference period). Allowance prices rose above 20 EUR/t for the first time in a decade. The initial price increase can be explained by the revision of the ETS Directive adopted in February 2018 and the resulting confidence in the mechanism. Prices rose further during the reference period due to the summer heat wave, presented in section 1.1. A further factor supporting increases in the carbon price was the anticipation of the regulatory changes with the entry into force of the Market Statbility Reserve mechanism (January 2019)[3].

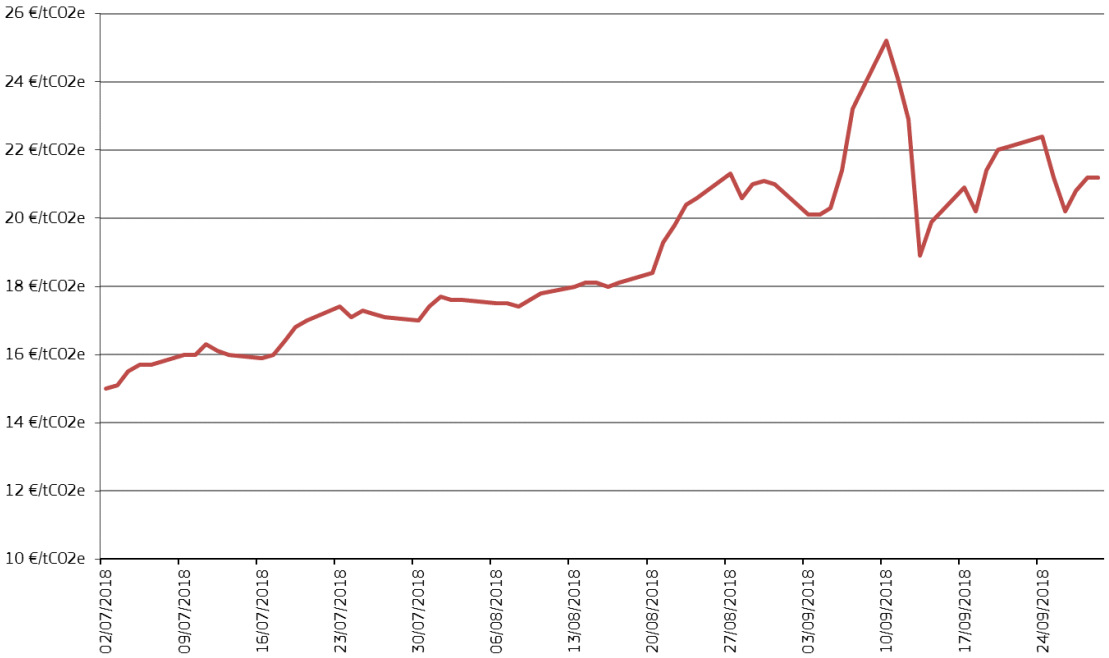
[3] See more in Quarterly Report on European Electricity Markets, Volume 11, issue 1

Figure 3 – *Weekly evolution of spot and year-ahead coal and gas prices*



Source: S&P Global Platts,
Coal is represented by CIF ARA, Principal coal import price benchmark in North Western Europe (in €/Mt)
Gas is represented by TTF hub - the Title Trading Facility (NL) gas spot price (in €/MWh)

Figure 4 – Evolution emission allowance spot prices



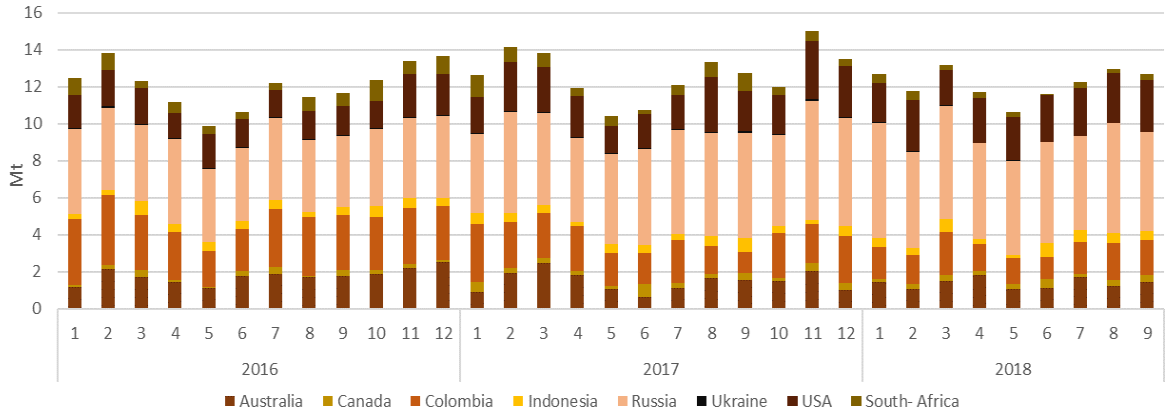
Source: S&P Global Platts

- **Figure 5** reports on the most important extra-EU hard coal[4] import sources as well as on the monthly amount of coal imported to the EU. In the third quarter of 2018 coal imports from outside the EU reached 37.9 Mt. The amount of imported coal in the reference quarter was 7% higher compared to the same quarter of 2016 but below the amount of imported coal in the third quarter of 2017.

[4] including both steam and coking coal

- In the third quarter of 2018 the largest share of extra- EU coal imports came from Russia, accounting for 42% of all coal imports. Russia significantly increased its import share since the third quarter of 2016 when Russian coal accounted for 33% of all imports. This development is partly due to favourable shipment costs. The second most important coal import source was the United States. Coal imports from the USA to the EU continued to reach record breaking levels, as they accounted for 22% of all coal imports (up from 14% in the same quarter of 2016). Colombia regained its position as the third most important coal trading partner of the EU as Colombian coal imports accounted for 15% of all imports. Australian coal imports made up 12% of total coal imports, while Indonesia and Canada accoundes for 4% and 3% respetively.
- In Q3 2018 the estimated EU import bill of hard coal from extra-EU sources amounted to €3.7 billion, while in the third quarter of 2017 the extra-EU import bill was also €3.7 billion, showing the stability of both average coal prices and imported coal amounts in year-on-year comparison.

Figure 5 – Coal imports to the EU



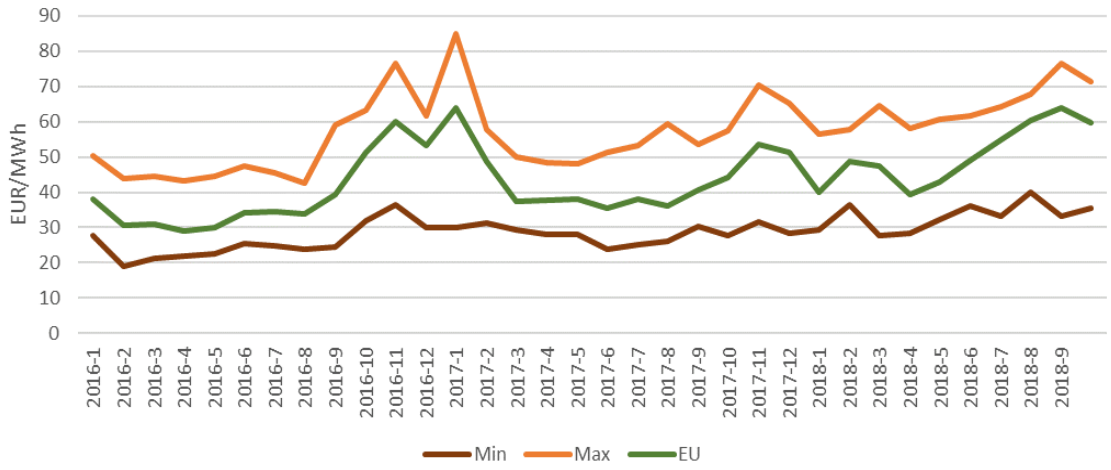
Source: Eurostat, COMEXT database

2 European wholesale electricity markets

2.1 European wholesale electricity markets and their international comparison

- As **Error! Reference source not found.** shows, there were significant price differences in the wholesale electricity prices across the EU during the third quarter of 2018. More details on drivers behind price changes in each market can be found in Chapter 3.
- The highest prices at the end of the third quarter of 2018 were reported by the United Kingdom (76 €/MWh), followed by Spain and Portugal (both 71 €/MWh) among interconnected countries. The lowest wholesale price of 33 EUR/MWh was reported by Bulgaria, followed by the Scandinavian counries Sweden, Denmark and Finland, all having reported prices around 50 EUR/MWh
- 3 non- EU member countries reported prices below those of any EU member State.. Norway, Switzerland and Serbia reported prices ranging from 47.61 and 40 EUR/MWh. In Norway and Switzerland wholesal eprices are largely driven by the availablility of relatively cheap hydro power.
- The following graph displays the lowest and highest national price as well as the EU average recorded in each month since the beginning of 2016. Price dispersion in the third quarter of 2018 was slightly higher than in the previous quarter of the years, but below price dispersion levels recorded throughout 2017, indicating relative stable alignment of prices across the EU.

Figure 6 – Wholesale price divergence across the EU



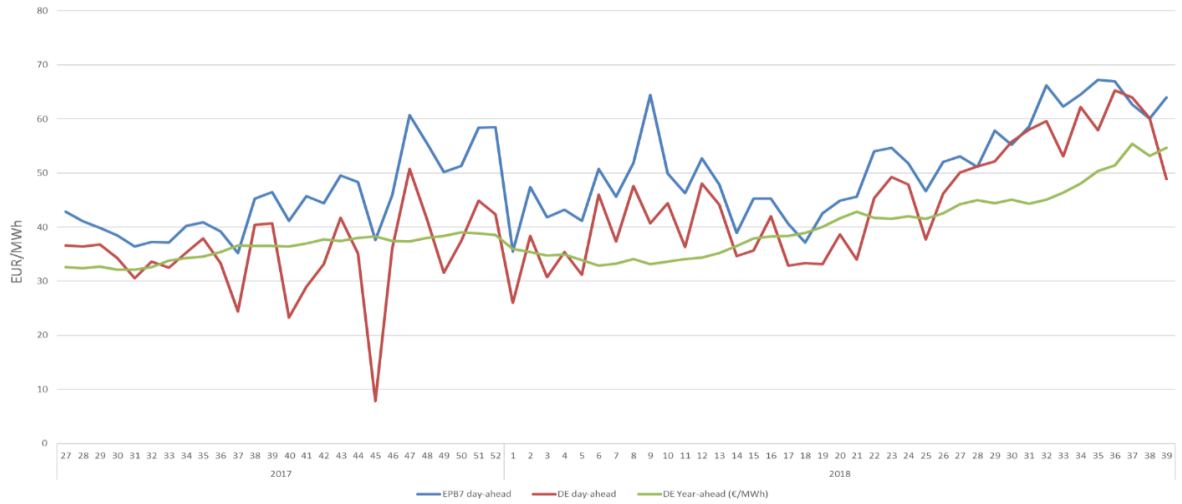
Source: European Wholesale Power Exchanges

Figure 7 – Monthly average wholesale baseload electricity prices

Source: European Wholesale Power Exchanges

- By September 2018 the pan European wholesale baseload electricity price index (European Power Benchmark) reached 63 €/MWh , a notable increase from 44 EUR/MWH in the previous quarter.
- The figure below shows the evolution of the European Power Benchmark (EPB) price against German day-ahead baseload and year-ahead prices. Germany serves as a good indicator as its market is one of the most liquid markets in Europe with available forward curve price quoatations. Both day-ahead EPB and German baseload contracts show the impact of increasing spot fossil fuel prices (mainly coal prices) in the third quarter of 2018. Year-ahead German prices follow the same trend at a slower pace and more balanced throughout the reference period.

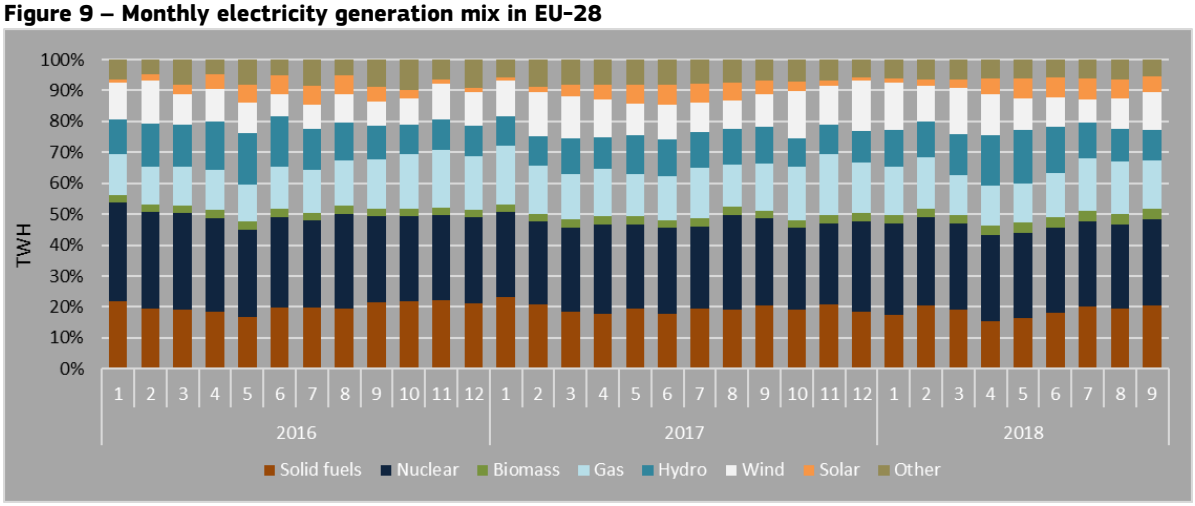
Figure 8 - Weekly evolution of day- ahead and year-ahead German electricity prices



Source: S&P Global Platts and DG ENER
EPB7 - European Power Benchmark (in €/MWh) is the replacement of the S&P Global Platts PEP as of January 2017.
See more detailed description in the Glossary.

- The next chart displays the evlution of the electricity generation mix of the EU-28. In Q3 2018 the share of fossil fuels (combined share of solid fuels and gas) averaged at 36%, slightly higher than 35% in Q3 2017. The share of fossil fuel fired generation follows the seasonal availability of renewable energy sources. Hydro resources are most available in early spring, penetration of solar power is the highest during the summer months and wind is most available during the winter. The share of renewables averaged at 29.8% during the three months of the third quarter of 2018, marginally higher than in the same period of the previous year (29.5%). At the same time the share of nuclear generation decreased by 1% percentage point to 27% of total generation.

Figure 9 – Monthly electricity generation mix in EU-28

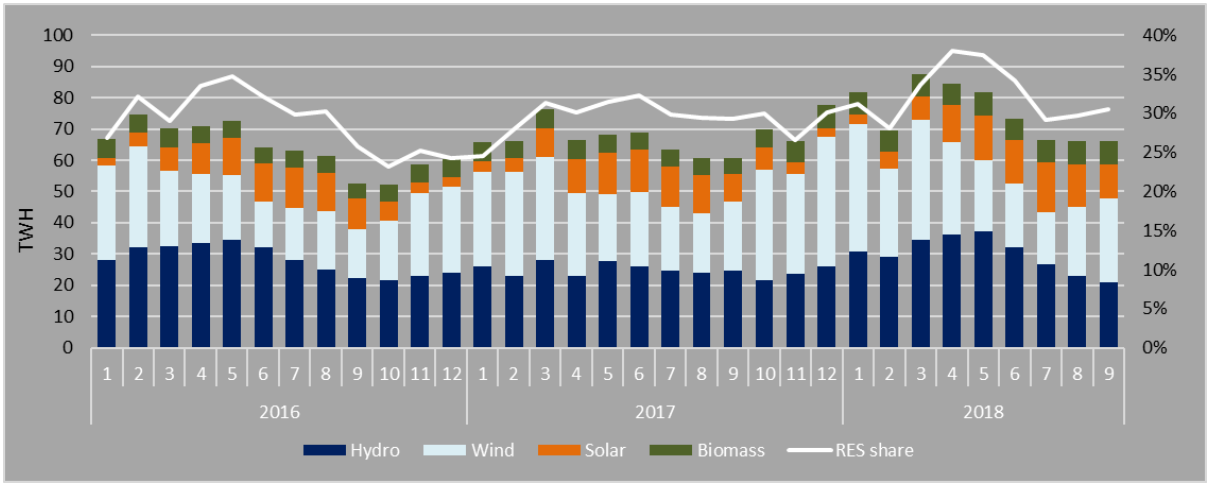


Source: ENTSO-E

- Figure **10** following figure displays the evolution of the monthly renewable generation in the EU, alongside the share of renewables in the electricity generation mix. By September 2018 the combined share of renewables (hydro, biomass, wind and solar) reached 30.5%, slighltly higher than 29.8% in the same period of the previous year. During the other

months of the quarter, RES powered generation remained below 30%. By the end of the third quarter of 2018 the share of hydro generation fell to the lowest of the year, below 10%. This is mostly due to low hydro reservoir levels after the hot summer months with low levels of precipitation. Wind powered electricity generation was volatile throughout the quarter, as its share in the total generation mix ranged from 7 to 12%. The share of solar generation slightly fell as the summer months with the highets number of solar radiation hours ended. The share but was still significantly higher of solar powered generation at 6.1% higher than during the same period of the previous year (5.5.%). The share of biomass experienced the highets relative growth, as it increased by 0.7% percentage points to 3.3% since Q3 2017.

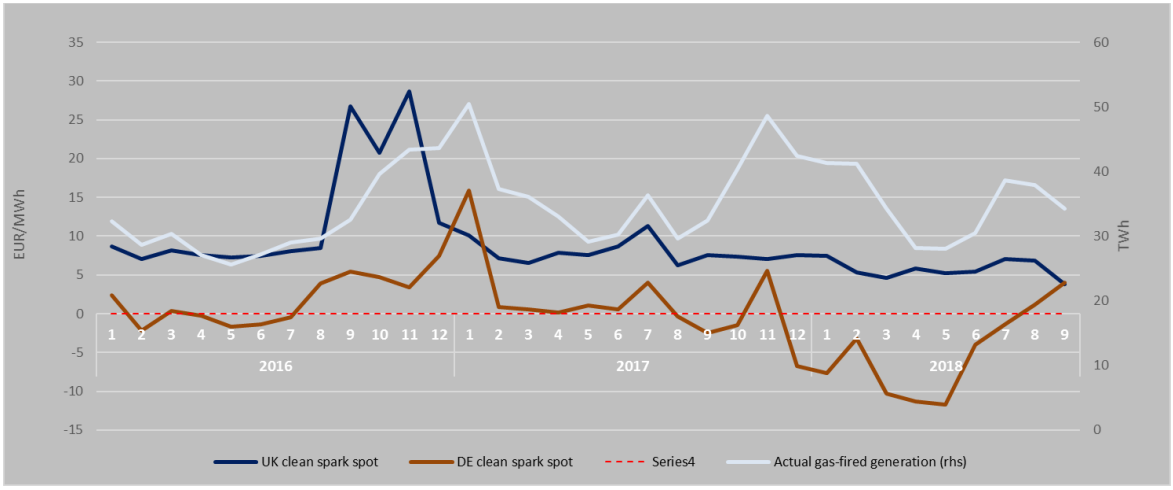
Figure 10 – Monthly renewable electricity generation in the EU and the share of renewables in all electricity production



Source: ENTSO-E

- The term spread is defined as the net revenue on power sales after the deduction of gas commodity costs and emissions allowance costs (further explanation can be found in the glossary). Data shows that gas fired generation was not profitable in Germany for all of 2018 apart from the last two months of the reference period. In August 2018, gas fired generation became profitable for the first time since late 2017, as the share of renewable energy powered generation with low marginal costs decreased. In the United Kingdom, where wholesale prices were significantly higher than in Germany, gas fired generation remained in the black throughout the whole period, albeit with a steadily decreasing profitability due to increasing commodity and ETS allowance prices. By September 2018 the UK clean spark spread reached 3 EUR/MWh, the lowest since late 2015. By the end of the reference period, the profitability of gas fired generation in Germany and the UK was almost equal. With gas fired generation becoming profitable in Germany and remaining profitable in the UK, it increased from 33 TWh in Q3 2017 to 37 TWh in the reference period.

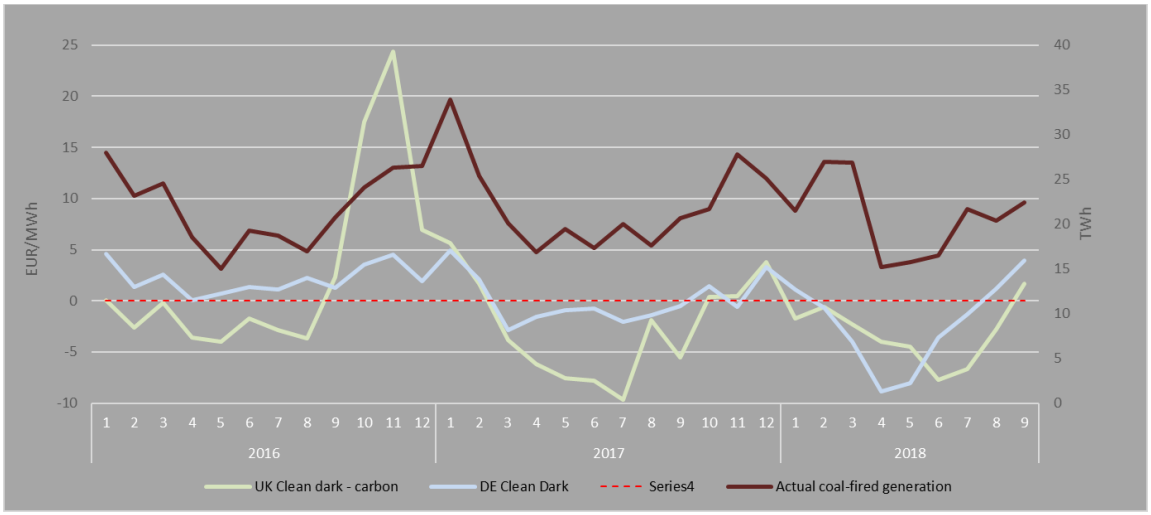
Figure 11 – Evolution of *clean spark sreads in the UK and Germany, and electricity generation from natural gas in the EU*



Source: S&P Global Platts and ENTSO-E

- The term spread is defined as the net revenue on power sales after the deduction of coal commodity costs and emissions allowance costs, which re typically higher for coal than for gas. Coal fired generation became profitable in the reference period for the first time since late 2017. In Germany coal fired generation became profitable in July 2018 , with the same development in the UK following a month later. This is due to the combined effect of wholesale prices growing faster than coal commodity and allowances prices. In Germany the clean dark spread rose from -8 EUR/MWH in May 2018 to almost +4 EUR/MWh by September. In the UK the rise of wholesale prices also outpaced rising commodity and emission costs, despite the UK the carbon price floor being imposed in addition to the ETS allowance costs. As a result, thermal coal fired generation is costlier in the UK than it is in Germany. This is reflected by its profitability of 1.6 EUR/MWh in the UK compared to almost 4 EUR/MWh in Germany in September 2018. The profitability of coal-fired generation was likely positive in most other European countries during the third quarter of 2018, given the local wholesale price premiums compared to Germany.
- In line with its increasing profitability, the share of coal fired generation in the EU28 generation mix increased marginally, from 19.7% to 20.0% or 44 TWh by September 2018. This represents a slight increase from 42 TWh in the same month of the previous year.

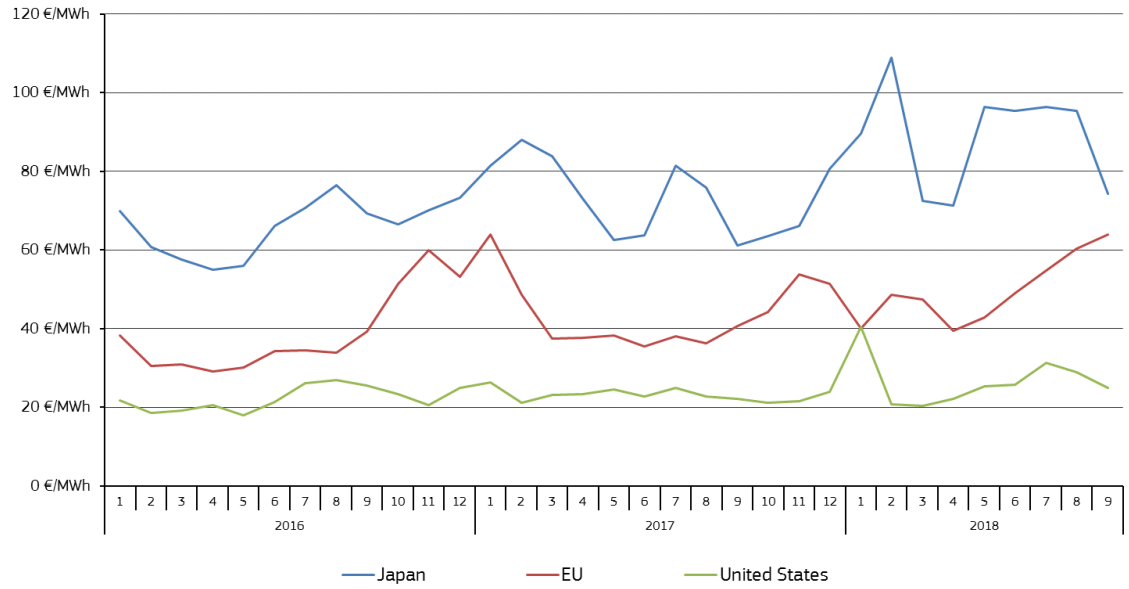
Figure 12 - Evolution of *clean dark sreads in the UK and Germany, and electricity generation from coal in the EU*



Source: S&P Global Platts and ENTSO-E

- The following figure compares the average EU wholesale price to the corresponding prices in the United States, Australia and Japan. The gap between the EU and the US price increased in the third quarter of 2018 as the EU price increase while the US price decreased. These changes follow a period in which the price gap remained fairly stable as prices in both regions were steadily increasing. By September 2018 the EU average wholesale price was 60% or 39 EUR/MWh higher than in the United States, as prices there stayed at a lower level.
- Wholesale prices in Japan experienced a volatile evolution in 2018. After a steep increase in May, they remained stable throughout August but fell again sharply in September 2018, lowering its premium to the EU average wholesale price. By September 2018 the average price in Japan was 16% or 11 EUR/MWh higher than in the EU.
- Wholesale prices in Australia remained fairly stable and the closest to the EU price. Their difference was at 10 EUR/MWh in September 2018.

Figure 13 – *Comparison of the monthly average wholesale electricity prices in Europe, US, Japan and Australia*

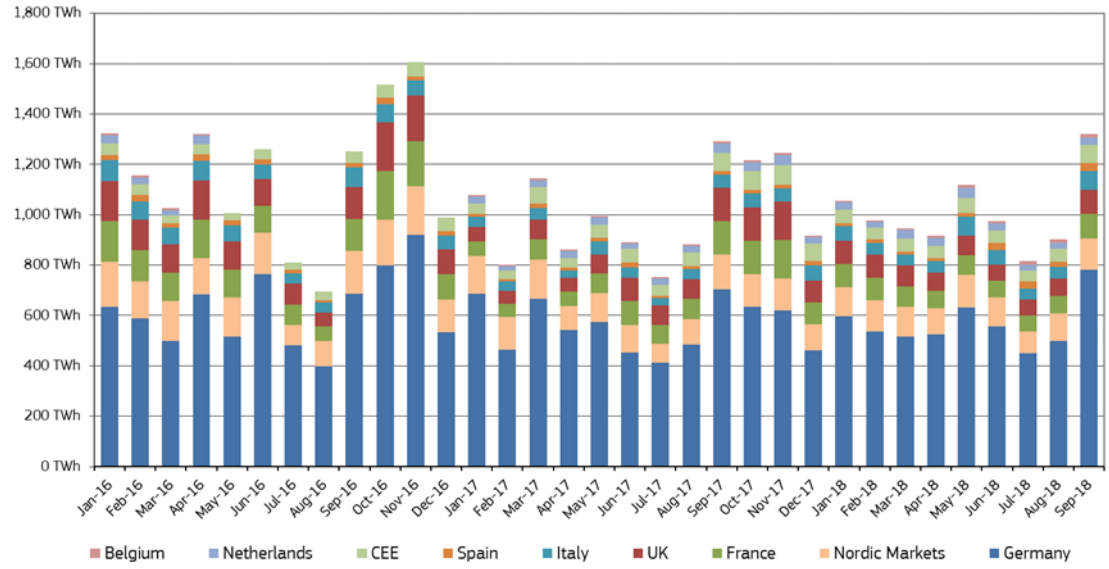


Source: Thomson Reuters. European Power Benchmark, JPEX (Japan), AEMO (Australia) and the average of PJM West and ERCOT regional wholesale markets in the United States.

2.2 Traded volumes and cross border flows

- Figure **14** figure below shows the monthly evolution of traded volumes, including exchange-executed trade and over the counter (OTC) market trade on the most liquid European hubs. Similarly to the last few years, in Q3 2018 the highest traded volumes could be observed on the German market, followed by the Nordic markets, UK, Italy and France. Traded volume of electricity shows a high degree of seasonality, following higher consumption during winter periods.

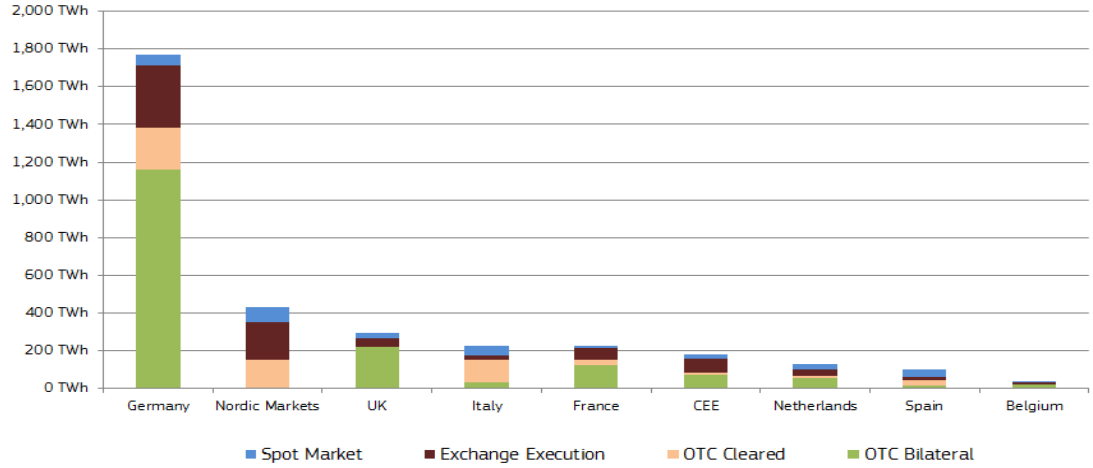
Figure 14 – *Monthly traded volume of electricity (incl. exchange executed and OTC) on the most liquid European markets*



Source: S&P Global Platts, wholesale power markets, Trayport, London Energy Brokers Association (LEBA) and DG ENER computations

- The following chart shows the comparison of volumes in different market segments of electricity trading on the most liquid electricity trading platforms in the EU. Traded volumes increased the most in Belgium (by 74%) and in Italy (by 44%) on a year-on-year basis. Traded volumes in Germany, the Nordic markets and in the Netherlands remained almost constant compared to the same month of the previous years. Declining amounts of traded electricity were registered in France (-28%), the United Kingdom (-16%) and Central- Eastern Europe (-9%).

Figure 15 - *Comparison of electricity traded volumes in some important day-ahead, forward and OTC markets, first quarter of 2018*

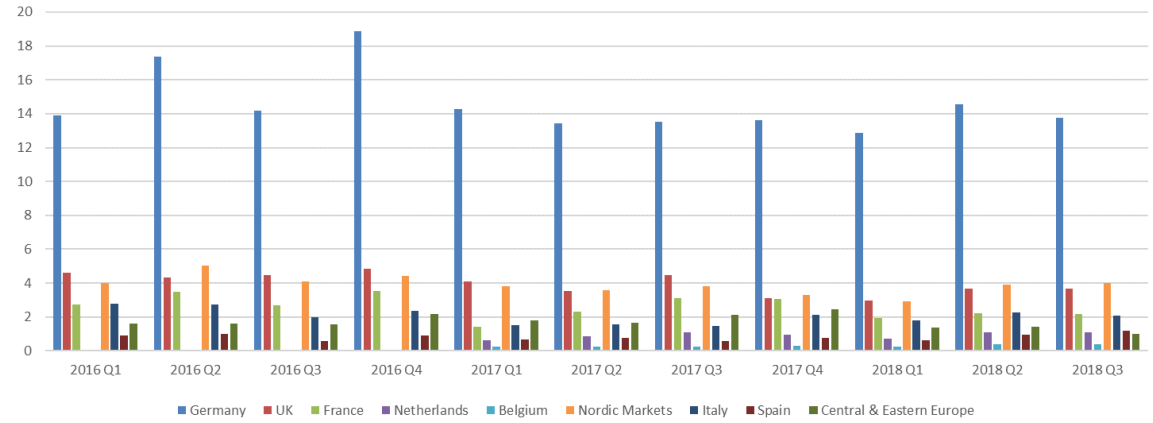


Source: S&P Global Platts, wholesale power markets, Trayport, London Energy Brokers Association (LEBA) and DG ENER computations

- Market liquidity can be measured by the churn rate. The indicator is calculated as the ratio of the total volume of power trade (including exchange executed and OTC markets on the spot and the curve) and electricity consumption in a given time period. In other words, the churn rate measures how many times a unit of electricity is traded before it is finally consumed.

- The figure below shows the evolution of the quarterly regional churn rates from early 2016 to the reference period, the third quarter of 2018. As the charts shows, Germany was by far the most liquid market in Europe, with churn rates 3 to 8 times higher than in other regional markets. Compared to the same period of the previous year, market liquidity increased in Germany (as the churn rate grew from 13.5 to 13.7). In line with the significant increase in the volume of electricity traded, market liquidity increased in Belgium. Market liquidity also increased in Spain, the Nordic Markets and Italy, while it fell in the Netherlands, France and Central- Eastern Europe.

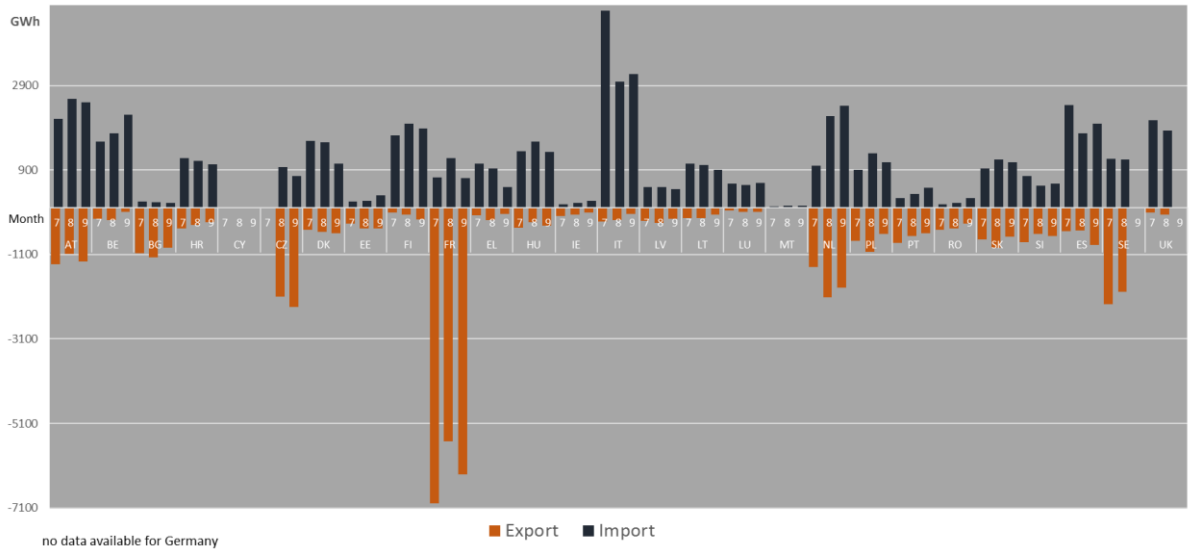
Figure 16 - Quarterly churn rates on selected European wholesale electricity markets



Source: Trayport, London Energy Brokers Association (LEBA), ENTSO-E and DG ENER computations

- The following graph displays imports and exports of each EU member State during the three month of the reference period. France remained the largest exporter, with a net exports of 5.6 TWh electricity in September 2018. The Netherlands, Sweden and Czech Republic also exported larger amounts of electricity. The largest net importers were Italy, Belgium, the United Kingdom, Finland and Hungary. Italy's net imports reached 3.6 TWh in September 2018, down from 4.6 TWh in July 2018. Austria both imported and exported larger amounts of electricity, resulting in a net importer status of 1.2 TWh in September 2018, roughly the same balance as Spain's.

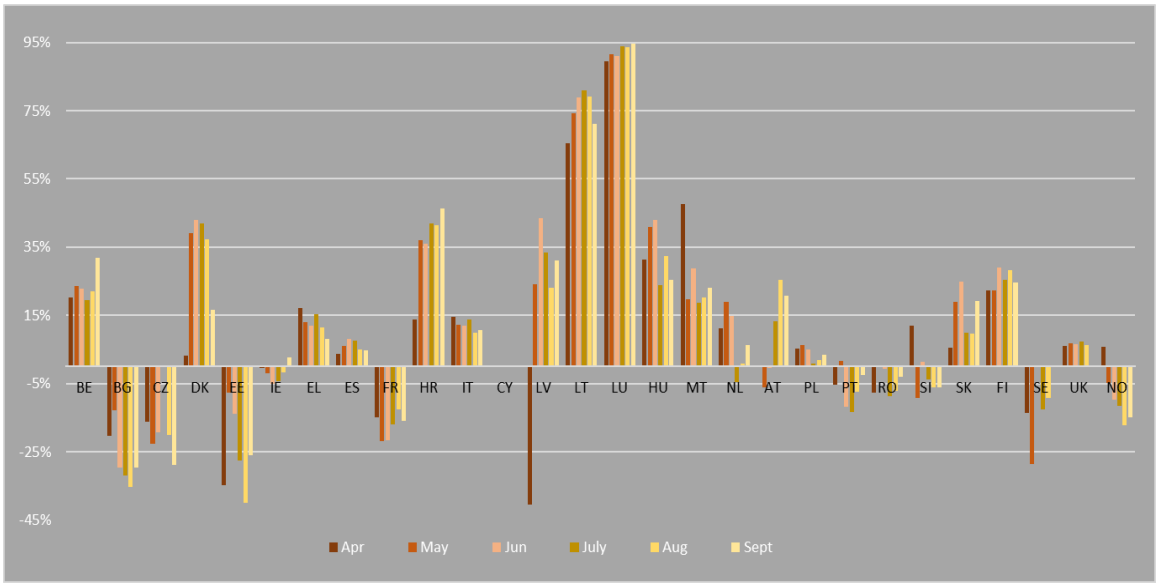
Figure 17 – Cross border electricity trade



Source: Eurostat

- The following graph displays what percentage of each EU Member State's electricity consumption was covered by imports. Positive values indicate that a country was net importer. Luxembourg for example met its electricity demand almost entirely (95%) by imports. Net imports also played an important role in Lithuania, exceeding 75% of domestic demand, as well as in Denmark, Croatia and Hungary, where on average a third of the countries' demand was met by imports. In several countries the role of imports in the month of May is significantly lower than in the following months. This is due to the availability of hydro resources and reservoirs, which deplete with rising temperatures and decreasing precipitation as summer progresses. An illustrative example is Latvia: In April 2018 the country's net exports reached 40% of its electricity consumption (simply put, its covered its own demand and exported 40% on top of it). The following month almost a quarter of Latvia's consumption was met by net imports as hydro generation fell from 606 TWh to 272 TWh. Negative values indicate that a country's net exports exceeded its domestic consumption. Bulgaria, Czech Republic and Estonia exported the largest volumes of electricity relative to their domestic generation. In absolute terms, France exported the most electricity.

Figure 18 - Import dependency



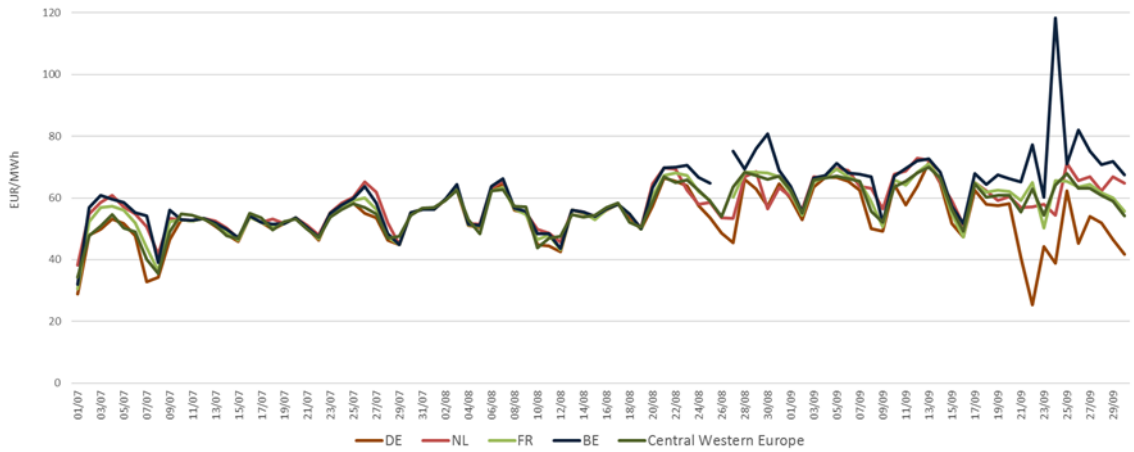
Source: Eurostat

3 Regional wholesale markets

3.1 Central Western Europe (Austria, Belgium, France, Germany, the Netherlands, Switzerland)

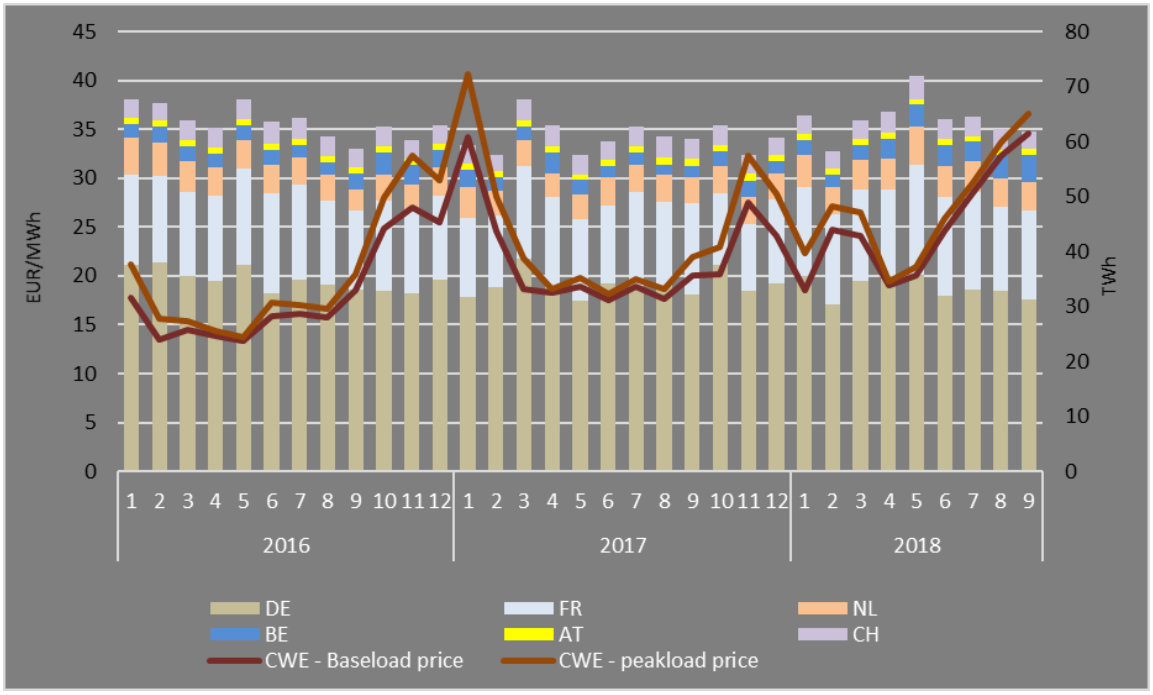
- The regional price of Central Western- Europe followed the general trend, as it rose from 50 EUR/MWh in July to 61 EUR/MWh by September. Prices in the region remained well alinged throughout the whole period until the last week of September, when Germany recorded prices below and Belgium prices above the average. During the third quarter of 2018 prices in all countries of the Central- Western- European region rose to the highest levels of the year. Prices by September ranged from 54 EUR/MWh in Germany to 68 EUR/MWh in Belgium with France inbetween, recording a 62 EUR/MWh, almost equalling the regional average.
- German wholesale prices were typically lower throughout the whole period than prices in other countries of the region, or prices in most other European countries. Price alignment is also underlined by the price premium of the country reporting the highets prices on average (Belgium) to the country reporting the lowest prices on average (Germany) averaging at 6 EUR/MWh and not exceeding 10 EUR/MWh in the months of July and August.
- The divergence In september results from a combination of factors, including the relatively high share of renewable energy in the generation mix.
- Belgium has two nuclear stations at Doel and Tihange, which provide half of the country's electricity generation. On 21 September 2018, the re- opening of several nuclear power plants was postponed., leaving the country with only one operable out of its seven reactors.
- In March 2018, two Belgian nuclear reactors were taken offline for repairs. These two reactors generate around 2 GWh electrcity , accounting for more than 10% of the country's electricity consumption. In September 2018 it was announced that Tihange 2 is now expected to restart on 1 June 2019, and not on 31 October 2018 as previously planned. Similarly, the re- opening of Tihange 3 was delayed until 2 March 2019 from of 30 September 2018.
- Belgium responded to the extended outages by securing additional gas fired electrcity in Vilvoorde. Exports from Germany and France also rose to record levels. These developments are reflected by the large increase in the volume of electrcity traded on the Belgium power exchange (see Figure 15). Rising wholesale prices in Belgium, with the highst hourly price recorded reaching above 400 EUR/MWh against the 60 EUR/MWh monthly average in September, are expected to translate into rising retail prices with a time lag.

Figure 19 – Daily average wholesale power prices in the CWE region



Source: S&P Global Platts, EPEX

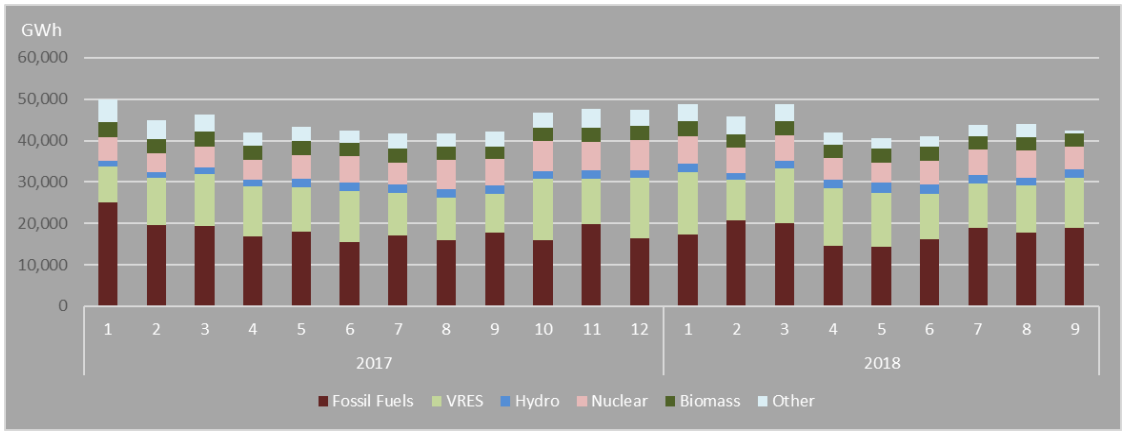
Figure 20 - Monthly exchange traded volumes of day-ahead contracts and monthly average prices in Central Western Europe



Source: S&P Global Platts

- In Germany renewables accounted for 38% of total electrciity generation during the third quarter of 2018, up from 36% during the same period of the previous year. The increase stems mostly from growth in wind and solar powered geneartion (VRES, variable renewables) as their combined share in total generation increased from 24 to 26%. Hydro powered generation decreased by 3.6% compared to Q3 2017. Low carbon generation (renewables and nuclear) remained above 50% througout the the whole quarter.

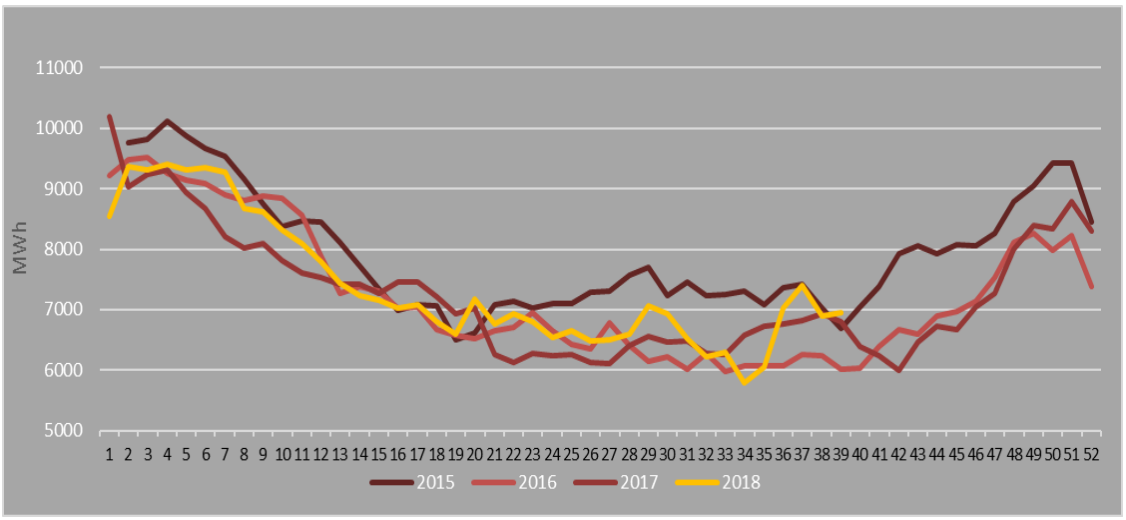
Figure 21 - German Electricity Mix



Source: ENTSO-E

- The level of electrciity generation from variable renewable energy sources (VRES) has an impact on wholesale prices as solar and wind powered electrcity has low marginal costs. The following graph displays the relationship between the wholesale price recorded on each day since the first day of 2017 until the end of the reference period (30 September 2018). A negative correlation (-0.65) is to be observed: the higher the level of VRES output in the German energy mix.

Figure 22 – The weekly amount of generated nuclear electricity in France

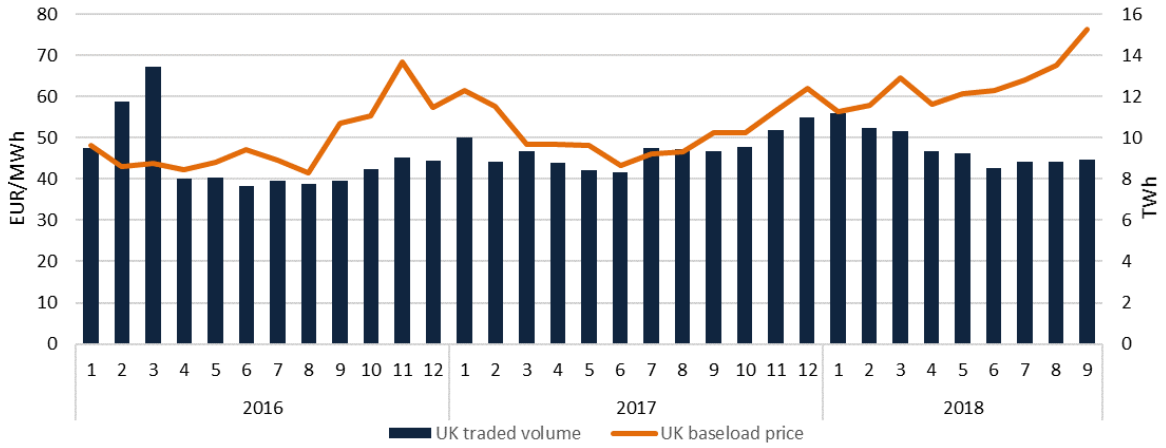


Source: ENTSO-E

3.2 British Isles (UK, Ireland)

- Wholesale electricity prices in the UK followed the trend observed on continental Europe as prices gradually rose from 61 EUR/MWh in June to 76 EUR/MWh by September, reaching the highest level of 2018. Daily prices during the third quarter of 2018 varied between 25 and 89 EUR/MWh.[5]

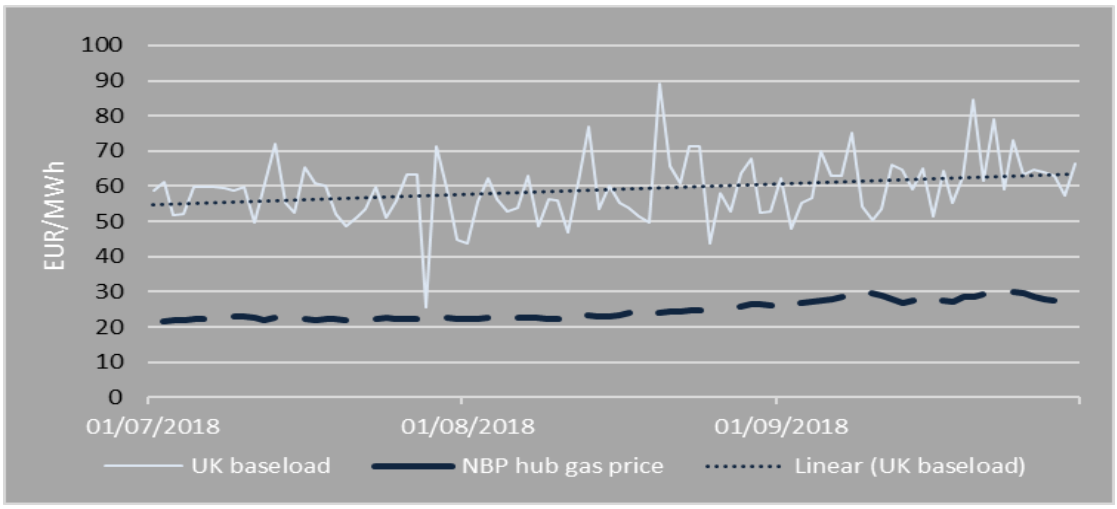
Figure 23 – Monthly electricity exchange traded volumes and average day-ahead wholesale baseload prices in the UK



Source: Nordpool N2EX

- Wholesale electricity prices in the UK moved in parallel with increasing natural gas prices on the NBP hub throughout the third quarter of 2018, continuing the trend to be observed since the beginning of the year. NBP hub gas prices rose from 21 EUR/MWh on the first of July to 27 EUR/MWH by the end of September. At the end of the reference period, wholesale prices followed the slight drop in gas prices, which fell to 27 EUR/MWh from a peak of 30 EUR/MWh.

Figure 24 – Daily average baseload electricity prices in the



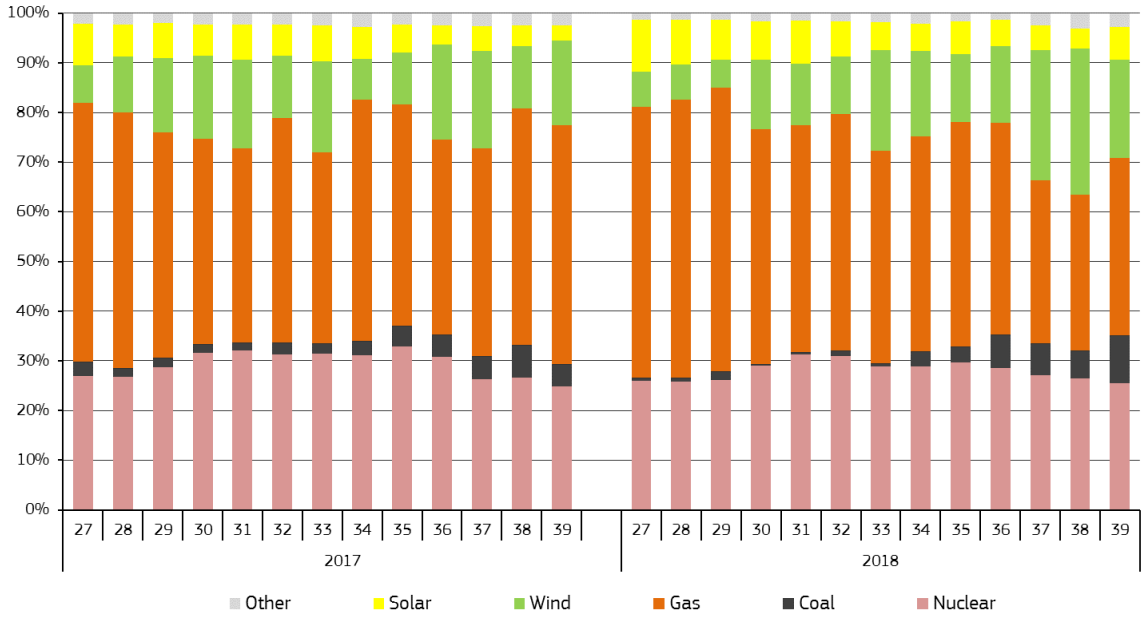
Source: Nordpool N2EX

- During the third quarter of 2018 the share of nuclear generation in the UK's electricity mix remained similar to the share observed a year ago, it accounted for about a quarter of total generation. The share of fossil fuel fired generation remained almost constant. Among fossil fuels, a shift is to be observed throughout the third quarter of 2018: the share of coal fired generation grew by a factor of 16, from 0.6% to almost 10% of the total generation. At the same time the share of gas fired generation declined: in the first week of Q3 2018 gas accounted for over half of total generation, by the last week of the quarter its share fell to 35%.

[5] Due to technical reasons no data for Ireland could be processed for this report

- The share of variable renewable energy sources in the UK's electricity mix increased by 2 percentage points from 20 to 22% as total solar and wind generation reached 3856 and 8861 GWh respectively. Hydro generation fell by 21% to 1056 GWh compared to the same period of the previous year. Given increasing demand and decreasing levels of hydro powered generation, the share of hydro in total generation fell by 5 percentage points to 17% compared to Q3 2017.

Figure 25 – Weekly evolution of the electricity generation mix in the UK



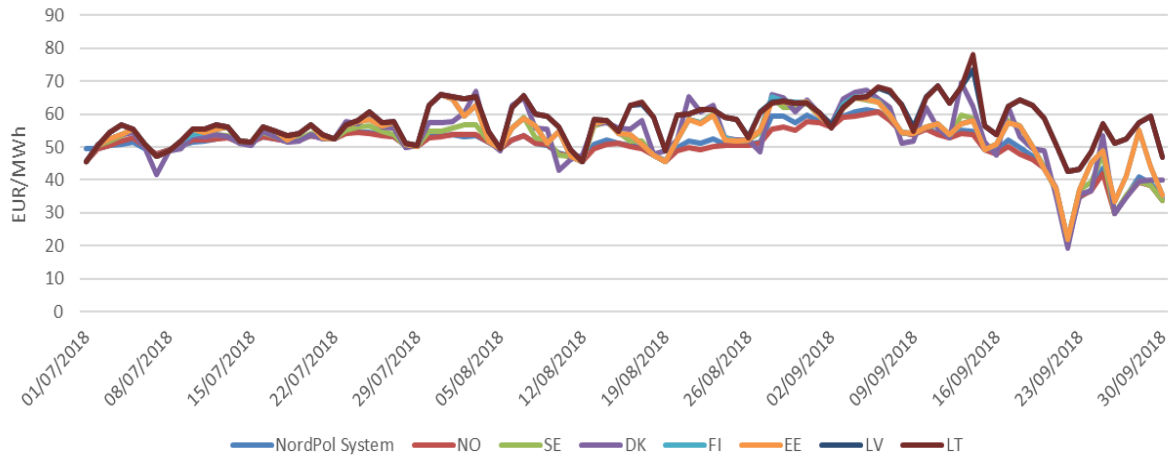
Source: ENTSO-E

- Throughout the third quarter of 2018 significant price convergence was to be observed between the UK and continental Europe. The UK did not retain its price premium of around 15 EUR/WMh as the average difference to French prices fell to 1.6 EUR/MWh and Belgian prices were above the UK price on average by almost 2 EUR/MWh, due to the extended outages of Belgian nuclear power plants.

3.3 Northern Europe (Denmark, Estonia, Finland, Latvia, Lithuania, Norway, Sweden)

- The monthly average price in the Nord pool system grew from 32 EUR/MWh in January 2018 to 52 EUR/MWh in July 2018. The average price then slightly decreased to 47 EUR/MWh by September 2018, the end of the reference period, during which daily prices varied between 20 and 61 EUR/MWh. Prices across the Nord pool countries remained aligned in Q3 2018 as the average quarterly standard deviation of prices across the 6 countries virtually did not change throughout 2018. By September 2018 monthly average prices ranged from 46 EUR/MWh in Norway to 53 EUR/MWh in Lithuania and Latvia.

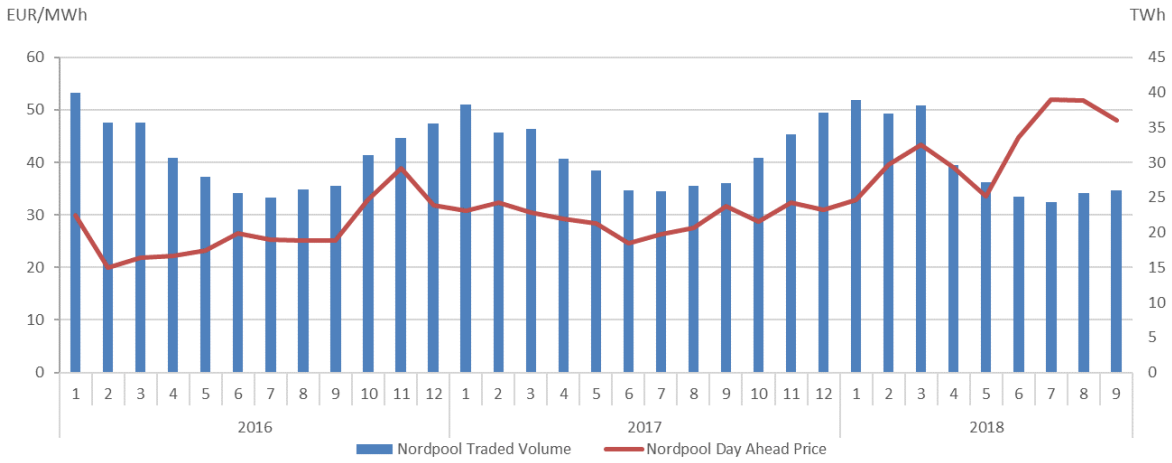
Figure 26 – *Daily average national prices and the system price in the Nordic region*



Source: Nordpool spot market

- The volume of electricity traded in the Nord Pool System decreased by 3% to 25.6 TWH. At large, the amount of electricity that changed owner in the Nord Pool system followed the typical seasonal cycle that can be observed each year. Traded volumes decreased from 37 TWh in the first quarter of 2018, to 27 TWh in the second quarter and as mentioned above, to 25 TWh by the third quarter.

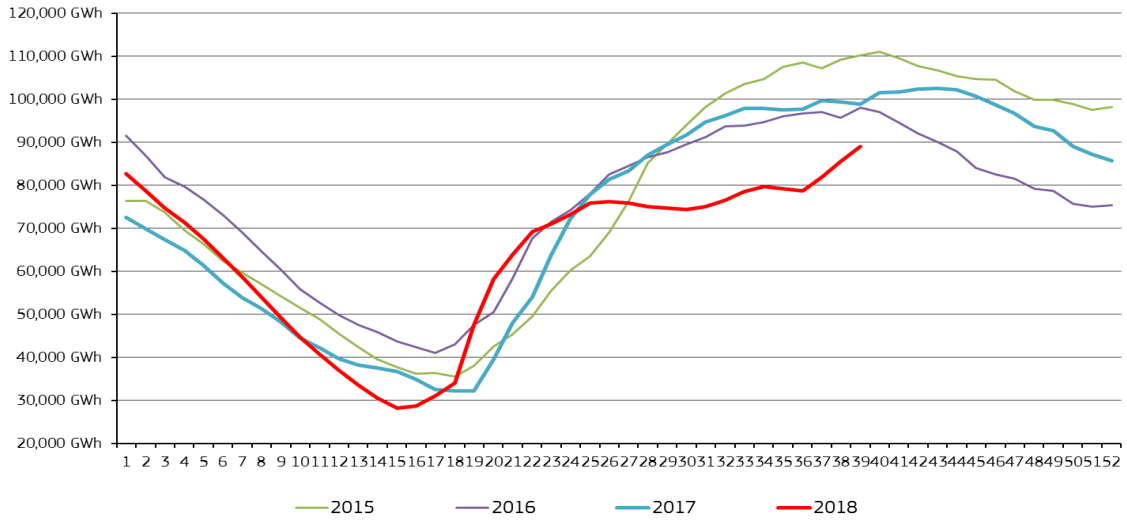
Figure 27 - *Monthly electricity exchange traded volumes of and the average day-ahead wholesale prices in Northern Europe*



Source: Nordpool spot market

- Combined hydro reserve levels increased throughout the third quarter of 2018, with much of the increase occurring in the last weeks of the period (calendar weeks 37 to 39). Hydro powered generation did not follow improving reserve levels as hydro powered generation fell to 13 TWh in Norway and Sweden combined in Q3 2018, down from 14.4 TWh in Q2 2018 and 21 TWh in Q1 2018. In a year-on-year comparison, hydro powered generation fell by 14% in the third quarter of 2018 and remained very low compared to the last five years. The level of hydro output might have been impacted by expectations of hydro power plants operators for higher wholesale price sin the coming months. Due to its share in Norway's electricity mix, the level of hydro generation has a significant impact on the level of wholesale prices as well as available exports. As the graph below demonstrates, the level of available hydro reservoirs were below those of previous years throughout the whole of Q3 2018.
- Neither Sweden nor Finland increased their nuclear production to cover decreasing hydro generation levels as the gap was covered by favourable wind conditions, which for example provided up to 377 GWh electrical energy in Norway in September, up from around 200 GWh in July. Norway, Sweden and Estonia remained net exporters of electricity throughout the whole quarter, while Latvia, Finland and Lithuania were net importers, the latter covering up to 75% of its domestic demand by net imports.

Figure 28 - Nordic hydro reservoir levels

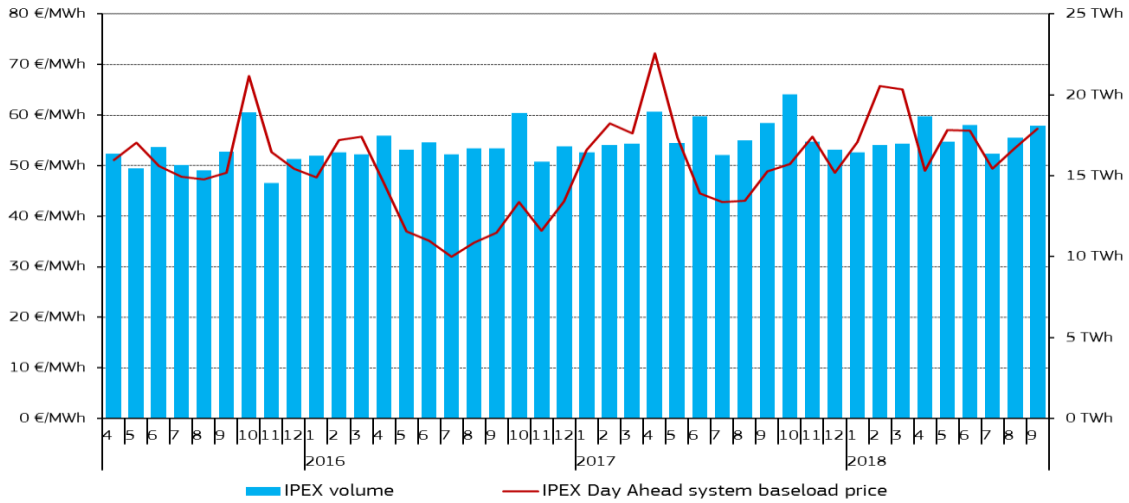


Source: Nordpool spot market

3.4 Apennine Peninsula (Italy)

- The Italian wholesale baseload electricity price, in line with developments on other observed European markets, increased from 57 EUR/MWh in June to 76 EUR/MWh in September 2018. The average price in September reached an all- year high and was 57% above the price recorded in September 2017. A factor contributing to the steep price increase was the unusually hot summer. Amongst other factors, high temperatures, especially in Southern countries like Italy, increased cooling demand, which in turn drove wholesale prices upwards. Daily average wholesale prices varied during Q3 2018 significantly more than in the previous quarter as they ranged from 51 to 92 EUR/MWh.

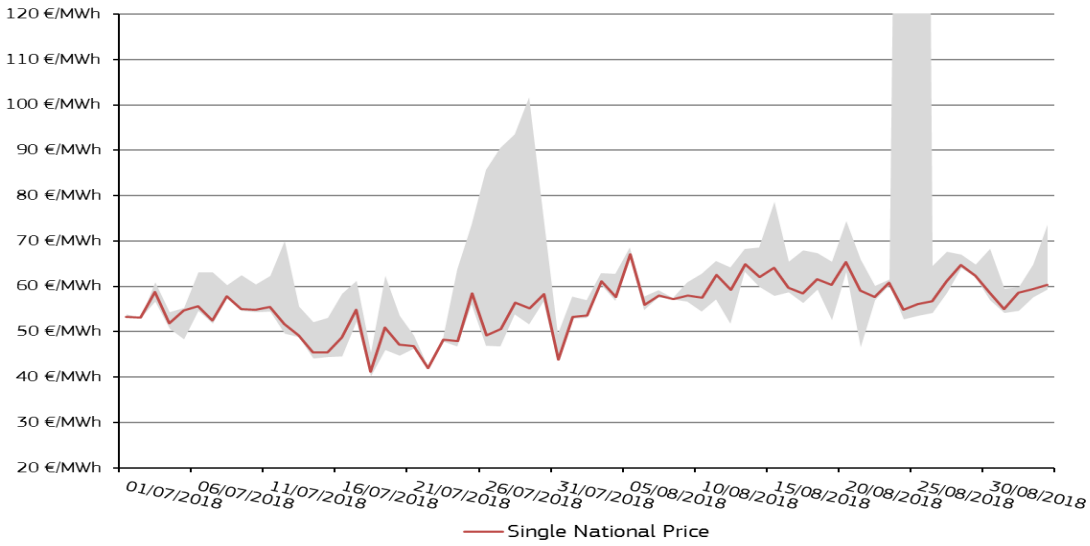
Figure 29 - *Monthly electricity exchange traded volumes of and the average day-ahead wholesale prices in Italy*



Source: GME (IPEX)

- The following graph shows that regional prices in Italy remained well-aligned to the national system price during most of the time in Q3 2018. The shaded area represents the difference between the smallest and largest regional price recorded each day. There were only few occasions, when in a given region the daily average price showed a sudden rise. During the summer period, prices in Italian islands prone to show sudden spikes, pointing to effects of isolation and interconnector limits.

Figure 30 – Daily wholesale national average and regional prices in Italy



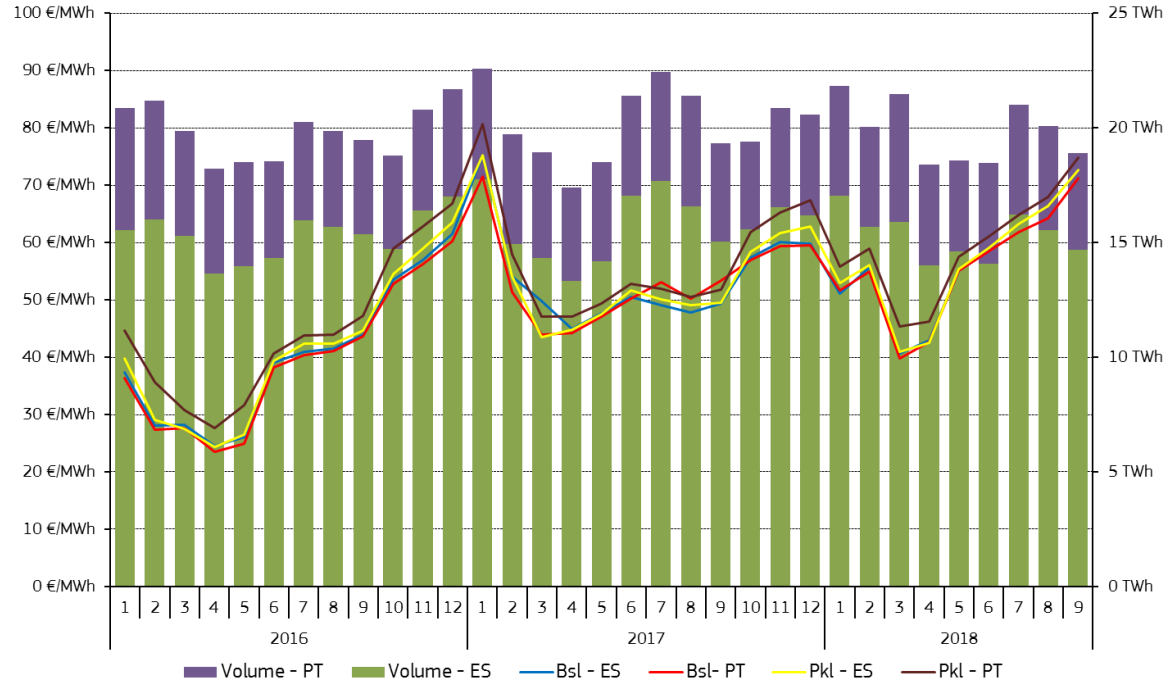
Source: GME (IPEX)

- Hydro power generation in Italy rose by 10% in the third quarter of 2018 in year-on-year comparison and made up 19% of the Italian electricity generation mix. On- shore wind generation decreased by 20% in the third quarter of 2018 compared to the same period of the previous year while biomass fired generation decreased by 13%. At the same time, gas fired generation increased by 20%. Growing gas commodity and emission prices combined with gas fired generation increasing by 850 GWh compared to the same period of the previous year and 1659 GWh compared to the previous quarter, contributed to the spike in wholesale prices.

3.5 Iberian Peninsula (Spain and Portugal)

- In the third quarter of 2018 the monthly average wholesale baseload prices in Spain and Portugal continued the upward trend that started in the second quarter. Increasing demand, that occurred due to the unusually hot summer and consequent cooling needs, were one of the factors contributing to prises rising from 62 to 71 EUR/MWh in both Spain and Portugal. Peak load prices experienced a similar trend as they grew from 63 to 73 EUR/MWH in Spain and to 75 EUR/MWh in Portugal.

Figure 31 - *Monthly electricity exchange traded volumes and average day-ahead prices in the Iberian Peninsula*

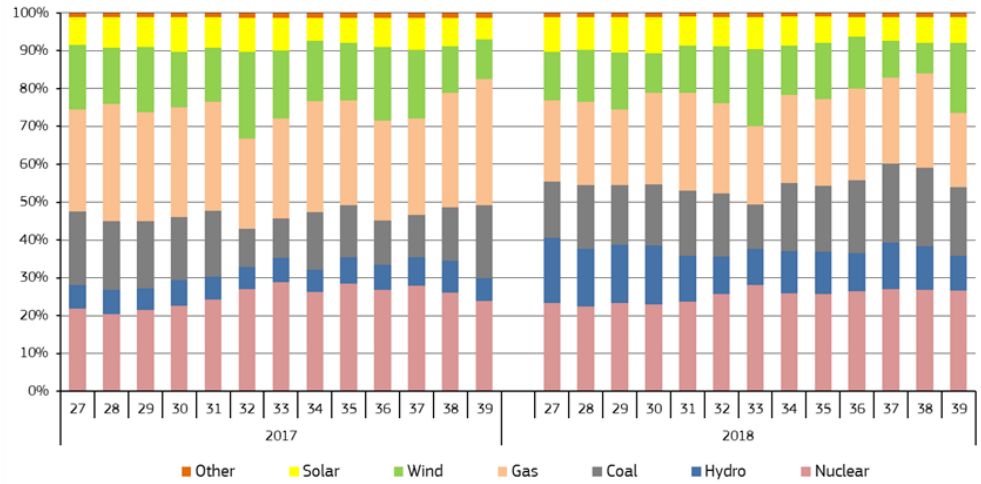


Source: S&P Global Platts, OMEL

- The following figure displays the evolution of the weekly electricity generation mix in Spain during the third quarter of 2018, as well as during the same period of the previous year. The combined share of renewable energy sources (hydro, wind, solar and biomass) averaged at 35% throughout the period. This share was 3 percentage points higher than the share of renewables during the third quarter of 2017. The share of variable renewable sources (VRES, solar and wind) decreased slightly from 24 to 21% of the electricity mix. This reduction mostly results from the decreased share of wind energy (-3 percentage points to 13% from the third quarter of 2017 to the same period of 2018) while the share of solar powered generation remained stable at almost 8%.
- The share of fossil fuel fired generation fell from 43% in Q3 2017 to 40% during the same period of 2018. Gas and coal experienced developments in opposite directions in terms of their role in Spain's energy mix. The share of gas fell from 28% to 22% on a year-on-year comparison. At the same time, the share of coal increased by 2 percentage points to 17%. These developments meant that the significant shift towards fossil fuels in the Spanish and Portuguese generation mixes came to a halt. Therefore, increases in gas and coal commodity prices had only a limited impact on wholesale prices on the Iberian Peninsula.
- The share of nuclear energy in Spain's energy mix remained constant from Q3 2017 to Q3 2018 after nuclear generation in Spain in the second quarter of 2018 fell by 13% in year-on-year comparison. This was to a large extent due to simultaneous outages of several nuclear capacities (e.g.: the extended outage for refuelling purpose of Vandellos-2 nuclear reactor, started back in Q1 2018). Almaraz-2, taken offline in mid-April, became available again

at the end of Q2 2018. By the end of May Asco-2 was also operating again. Nuclear generation in Spain grew from 3.8 TWh in April to 5 TWh in September.

Figure 32 – *Weekly evolution of the electricity generation mix in Spain in the second quarter of 2017 and 2018*

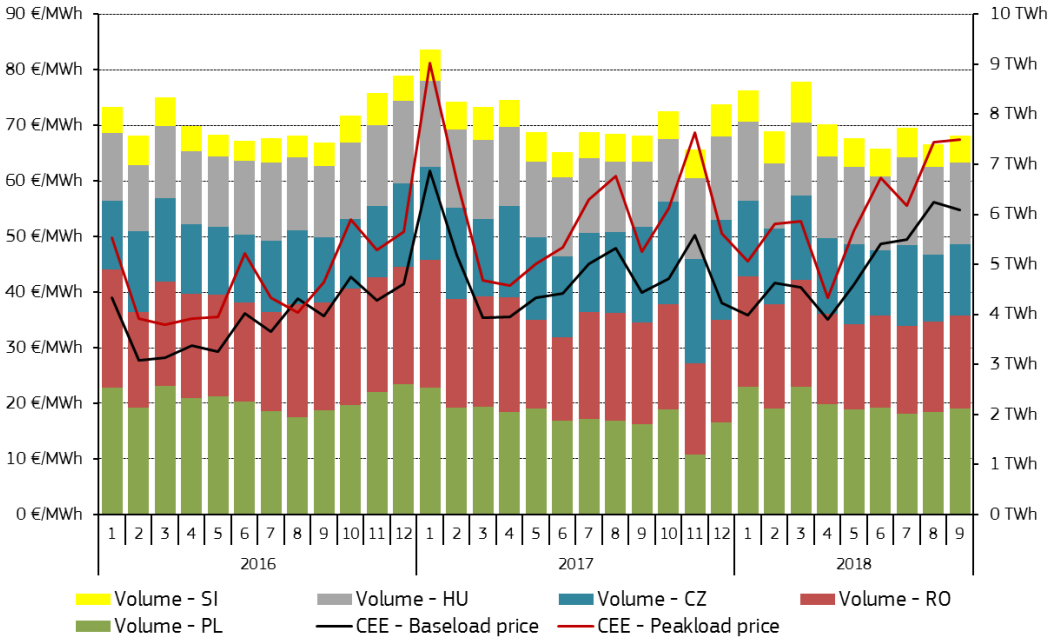


Source: ENTSO-E

3.6 Central Eastern Europe (Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia)

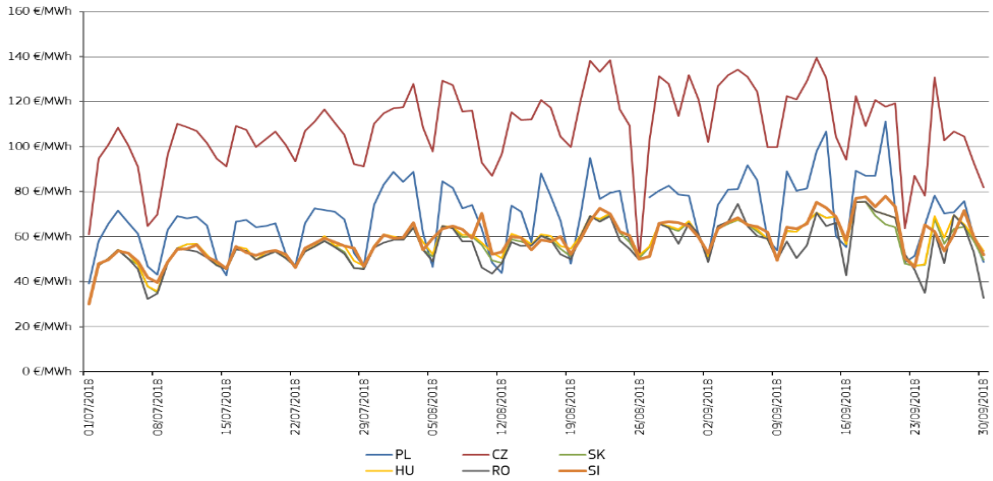
- The regional average wholesale price in Central and Eastern Europe (CEE) increased measurably between January and June 2018 and the trend of increasing wholesale prices continued through July to September. The monthly regional average baseload price rose from 35 €/MWh to 54 €/MWh. The monthly peakload average rose at a similar pace from 45 €/MWh to 67 €/MW. In the third quarter of 2018, the lowest price of 30.14 EUR/MWh was recorded in Slovenia on 1 July. The highest price of 139 EUR/MWh was reported by the Czech Republic on 13 September.
- The hot summer across Europe also impacted the CEE region. Temperatures 4-6 degrees higher than the long- term average increased cooling needs, which in turn increased electricity demand. Prices grew with growing demand. High temperatures and low river levels in Poland also put a limit on water cooling of power plants, resulting in reduction of electricity generation. The share of fossil fuel fired generation ranged up to 91% in Poland, up from 85% during the same period of the previous year. Poland reported also the highest share of variable renewables (on- shore wind) at 8% among all CEE countries during the third quarter of 2018. The share of variable renewables (solar and on-shore wind) increased in the Czech Republic from 2.8 to 4.2% in a year-on-year comparison. The Czech Republic remained a net exporter of electricity throughout the whole period, with net exports reaching as high as a quarter of the countries electricity consumption in September 2018. Hungary and Slovakia were net importers up to 20-30% of their domestic consumption.
- German price premium compared to both Poland and the Czech Republic averaged at 5 EUR/MWh throughout the third quarter of 2018.
- Hydro generation in Romania experienced a sharp fall from 2.1 to 1.2 TWh from July to September 2018 as reservoirs depleted and river levels decreased during the hotter than usual summer. The decreased availability of cheaper hydro powered electricity contributed to the fact that the average wholesale price in Romania grew from 44 EUR/MWh in June to 59 EUR/MWh by September.
- By September 2018 nuclear generation reached the highest level recorded in 2018 both in Hungary and the Czech Republic with 1.34 and 2.40 TWh respectively. In Slovakia nuclear generation continuously declined throughout the third quarter of 2018 to 1.03 TWh by September, down from 1.34 in the same month of 2017.

Figure 33 - *Monthly electricity exchange traded volumes and average day-ahead prices in Central Eastern Europe*



Source: Regional power exchanges, Central and Eastern Europe (CEE)

Figure 34 – *Daily average wholesale power prices in the CEE region*



Source: S&P Global Platts, CEE Regional power exchanges

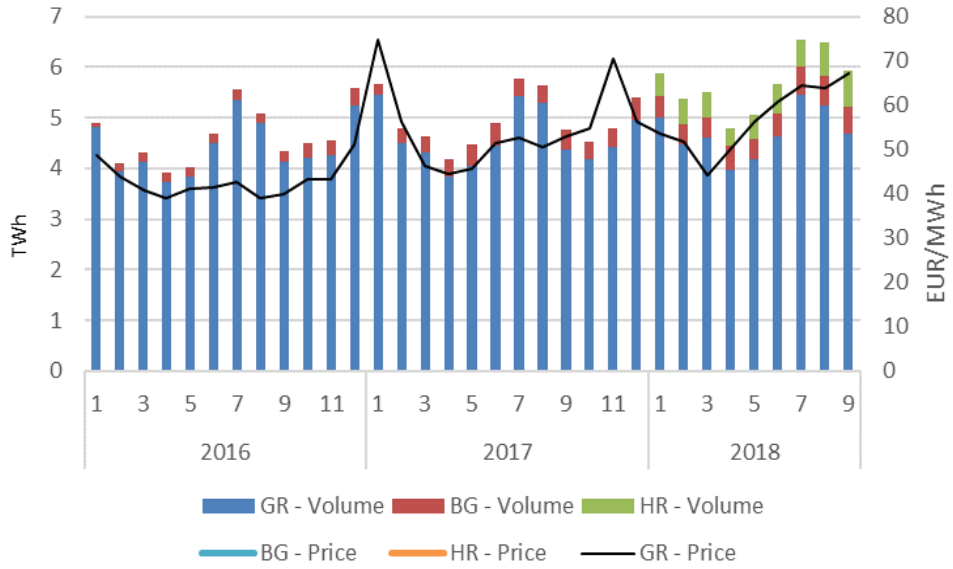
3.7 South Eastern Europe (Bulgaria, Croatia and Greece)

- Similarly to most of the European markets, wholesale electricity prices in the South-Eastern Europe (SEE) region increased in the third quarter of 2018. In Greece the average price grew from 60 EUR/MWh in June to 67 EUR/MWh by September. The growth was even bigger in Bulgaria where the monthly average price grew from 33 to 47 EUR/MWh throughout the same period. The quarterly average price of 63 EUR/MWH in Croatia was between the quarterly averages of Greece and Bulgaria (65 and 46 EUR/MWh respectively).

- In August 2018 Croatian prices decoupled from the other regional peers and showed a significant discount to Greece and Romania. Despite lower prices, Croatian electricity exports fell from 480 to 340 GWh from July to September.

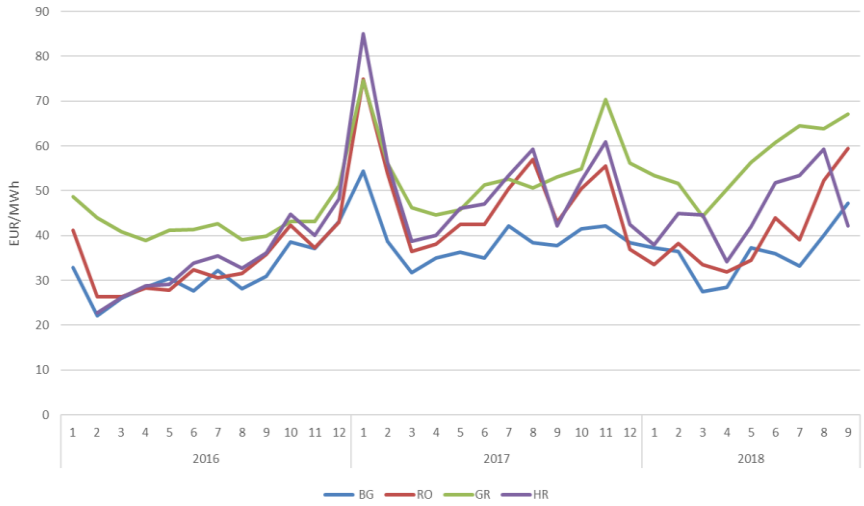
- As hydro reservoirs depleted and precipitation decreased during the hot summer, hydro generation in Bulgaria decreased throughout the quarter from in July 565 to 354 GWh in September. Still, hydro powered generation was 90% higher in September 2018 than in the same month of the previous yesr.

Figure 35 - *Monthly traded volumes and prices in South-Eastern Europe*



Source: LAGIE, IBEX

Figure 36 – Comparison of monthly average day-ahead prices in Bulgaria, Greece, Romania and Croatia

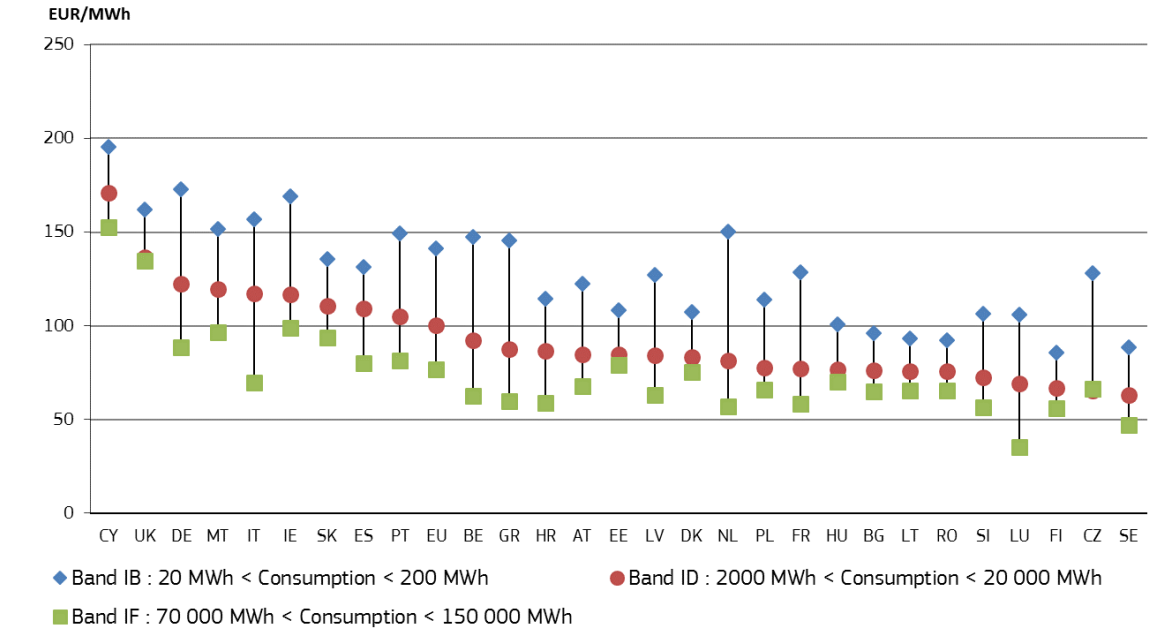


Source: IBEX, LAGIE, OPCOM, SEEPEX

4 Retail markets in the EU and outside Europe

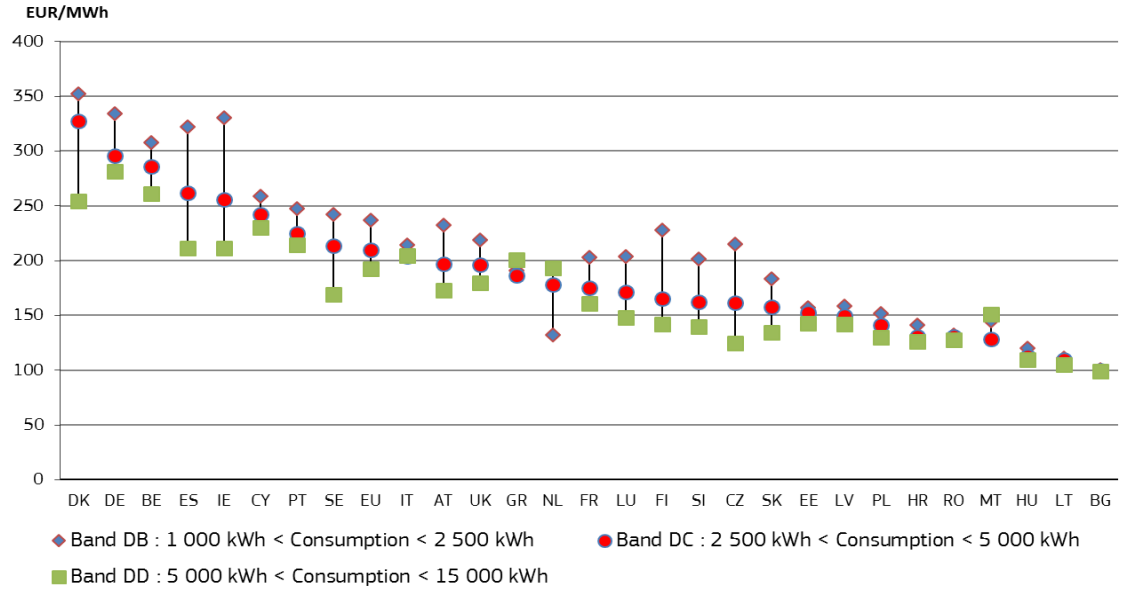
- The following graphs display estimated retail prices in September 2018 in the 28 EU Member States for industrial customers and households. Prices are displayed for three different levels of annual electricity consumption for both consumer types (Eurostat bands IB, IC and IF for industrial customers and bands DB, DC and DD for households). In most cases it holds for both consumer types that the lower the consumption, the higher the price of one unit of electricity (per kWh).
- Retail prices paid by households include all taxes, levies, fees and charges. Prices paid by industrial customers exclude VAT and recoverable taxes. Monthly retail electricity prices are estimated by using Harmonised Consumer Price Indices (HICP) based on bi-annual retail energy price data from Eurostat.
- Median industrial consumers (band ID) paid the highest prices in the United Kingdom (136 EUR/MWh), followed by Germany, Italy and Ireland (122 to 116 EUR/MWh), apart from the non-interconnected island system of Cyprus. The lowest prices were reported by Sweden (63 EUR/MWh), the Czech Republic, (65 EUR/MWh) and Finland (68 EUR/MWh). The ratio of the largest to smallest reported price was above 2:1. Industrial consumers with large annual consumption (IF), including most energy intensive users, paid the highest prices in the United Kingdom (134 EUR/MWh) followed by Malta and Slovakia. The smallest prices were reported by Luxembourg (35 EUR/MWh) followed by Sweden and Finland. The ratio of the largest to smallest price for large industrial consumers was even bigger, around 3:1 for this consumer type.
- In September 2018 Denmark (327 EUR/MWh) reported the highest median household price for electricity consumers, followed by Germany (296), Belgium (286) and Spain (262). The lowest price were reported by Bulgaria (99 EUR/MWh). Household electricity prices are even more impacted by taxes and levies than their industrial counterparts. The variety and level of taxes and levies differs significantly from country to country, therefore the ratio of the largest to smallest price was the highest for this consumer type, exceeding 3:1.

Figure 37 –*Industrial electricity prices, September 2018 –without VAT and recoverable taxes*



Source: Eurostat, DG ENER

Figure 38 – *Household electricity prices , September 2018 –all taxes included*

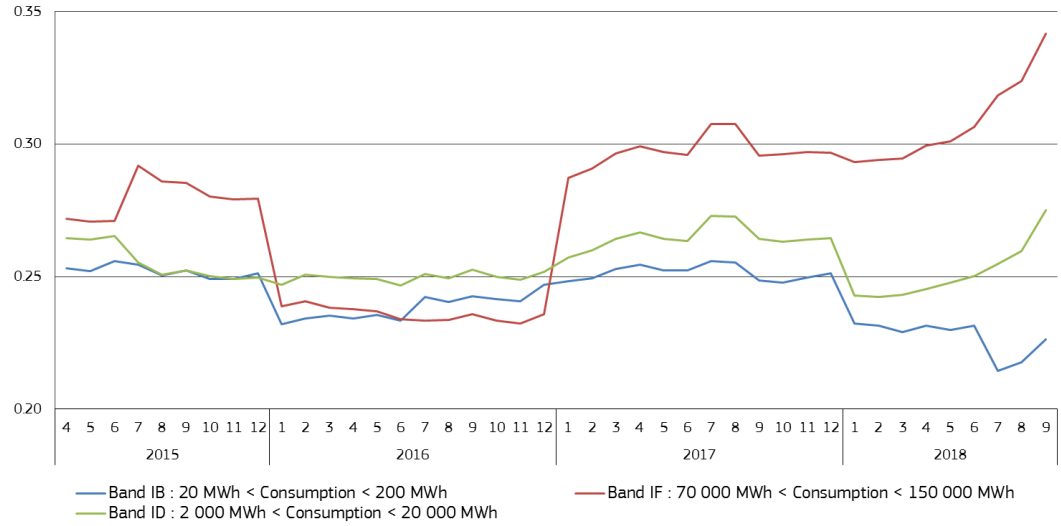


Source: Eurostat, DG ENER

- The following graphs display the convergence of retail prices across the EU over time, by depicting their relative standard deviation. Prices for all three levels of industrial consumption continued to become more divergent. Prices paid by industrial consumers with large volumes of consumption experienced the steepest dispersion. The energy component, which largely caused increasing dispersion for all three levels of consumption, account for less than 40% of prices paid by industrial consumers with small and medium volume consumption. Albeit price dispersion started to increase for small industrial consumers, its level was still significantly below levels observed in previous years.
- The evolution of household price convergence was less volatile as such prices are more impacted by regulated elements (network charges, taxes and levies) which make up on average 40% of the final bill. Household prices became less divergent throughout 2017. Beginning in early 2018 price dispersion started to increase slowly but

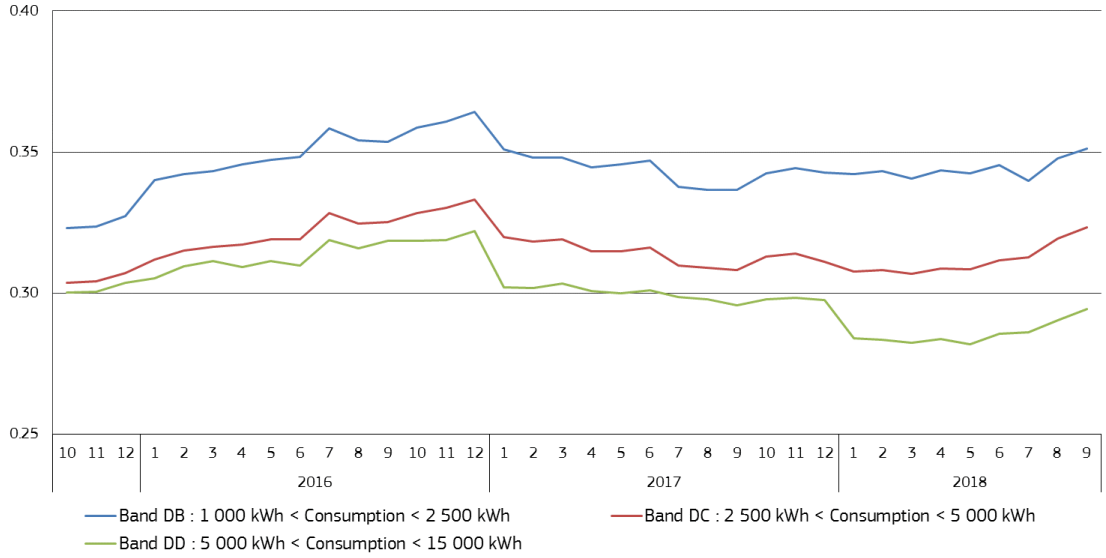
steadily again, mostly due to increasing differences in national energy components. In the third quarter of 2018 the divergence of household prices gained speed, yet dispersion for none of the three examined levels of household consumption reached levels observed at the end of 2016.

Figure 39 – ***Relative standard deviation of retail electricity prices in the EU Member for industrial consumers***



Source: Eurostat, DG ENER

Figure 40 - *Relative standard deviation of retail electricity prices in the EU Member States for household consumers*



Source: Eurostat, DG ENER

- The following maps display estimated electricity prices paid by households and industrial customers, with medium level of annual electricity consumption in the last month of the quarter.

Figure 41 – *Industrial Electricity Prices*

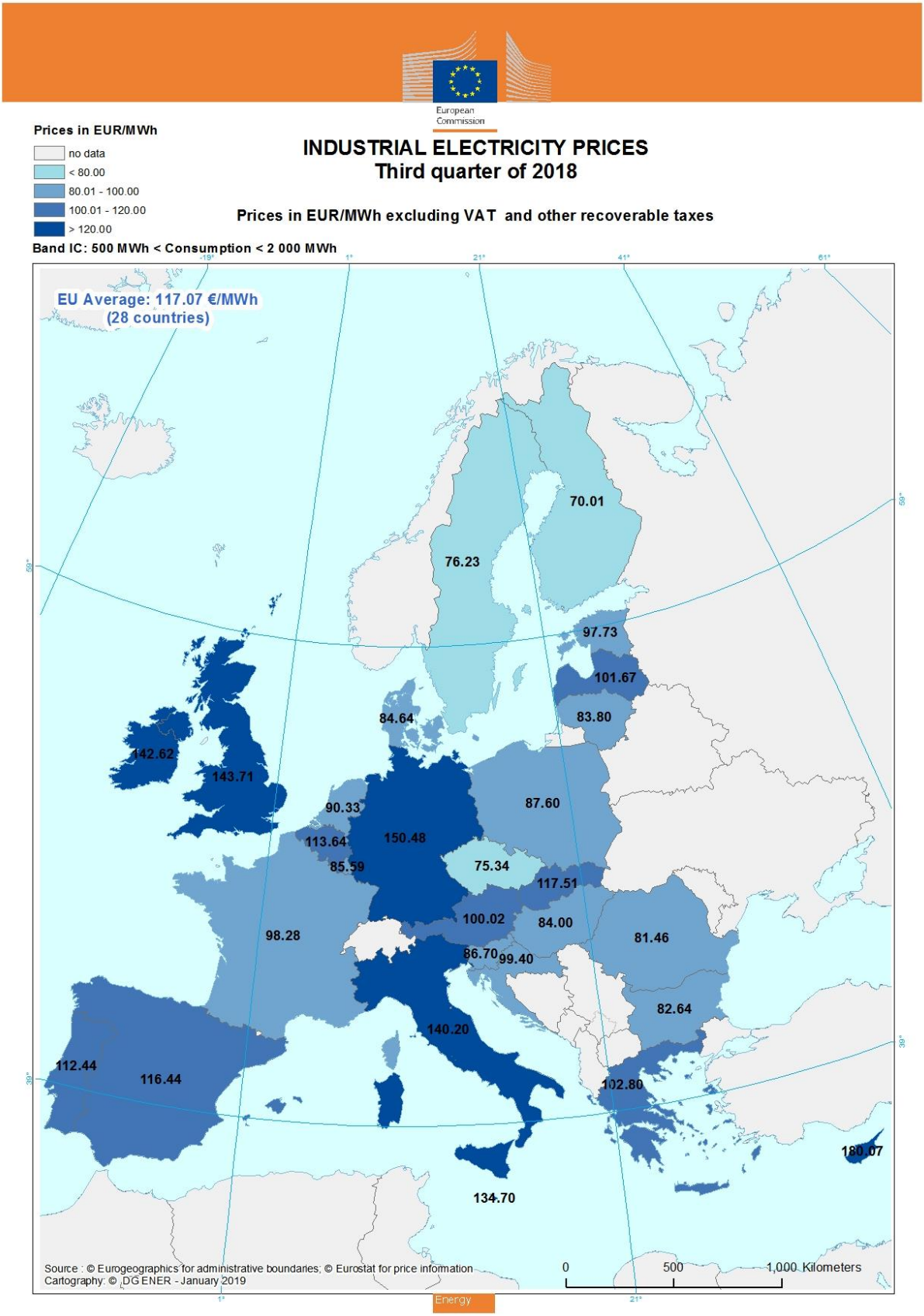
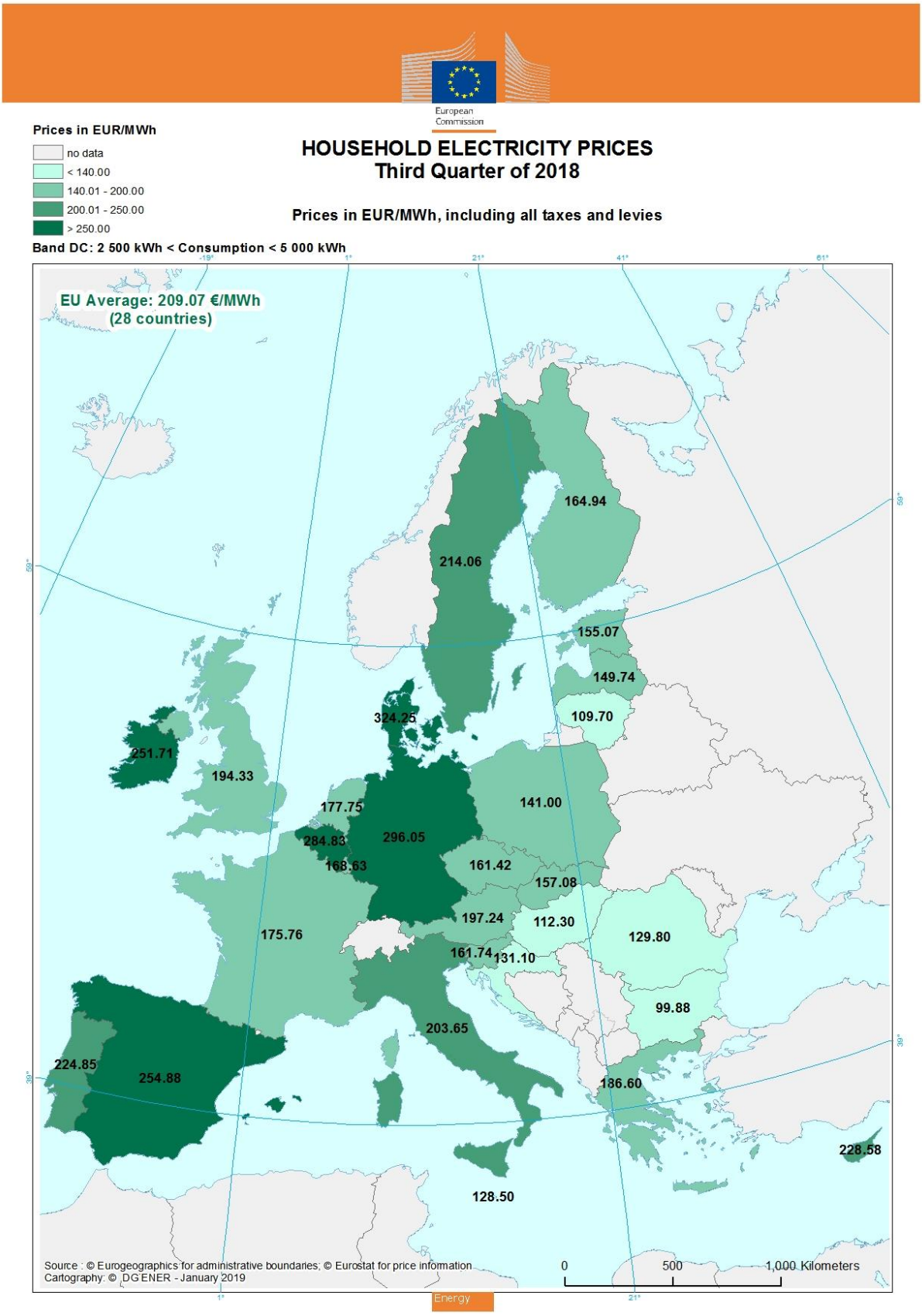


Figure 42- ***Household Electricity Prices***

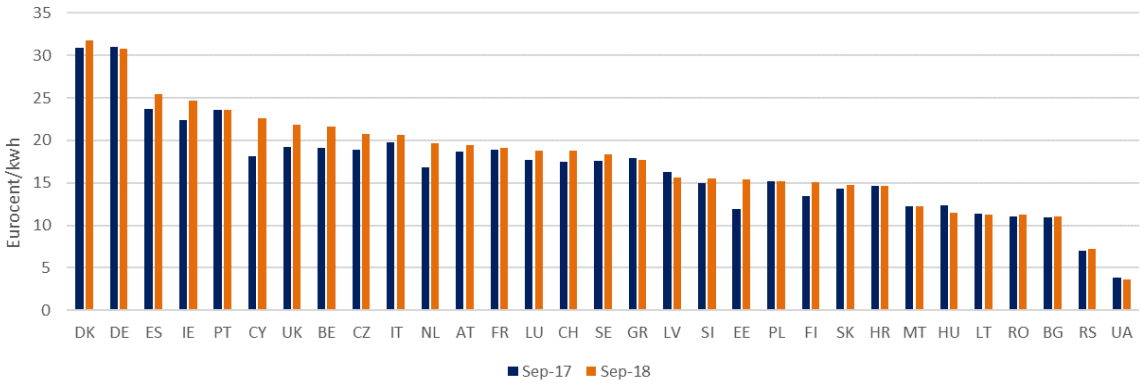


Source : Data computed from Eurostat half-yearly retail electricity prices and consumper price indices

4.1 Retail electricity prices in the EU capital cities

- The following graph shows retail electricity prices recorded in European capital cities. In September 2018 the highest prices were observed in Copenhagen and Berlin (31.8 and 30.8 Eurocent/kWh, respectively), much in line with the Eurostat data analysed above. The smallest prices were recorded in Sofia and Bucharest (11 Eurocent/KWh and 11.2 Eurocent/KWh respectively). Compared to the same month of the previous year, the largest price increases are observed in the capitals of Estonia (+29%) and the United Kingdom (+14%), apart from the non- interconnected capital of Cyprus where a year-on-year increase of 29% is to be observed . In Estonia the energy and network components contributed almost equally to the overall increase, while in the United Kingdom the increase can be attributed largely to the increasing network component and to a small extent to the energy component. In Cyprus the increase stems exclusively from a rising energy component. Four EU member States and the Ukraine reported prices smaller than in the same month of the previous year. Prices marginally decreased in Germany. Household prices in the capitals of Hungary, Latvia and Greece decreased by 7%, 4% and 1% respectively.

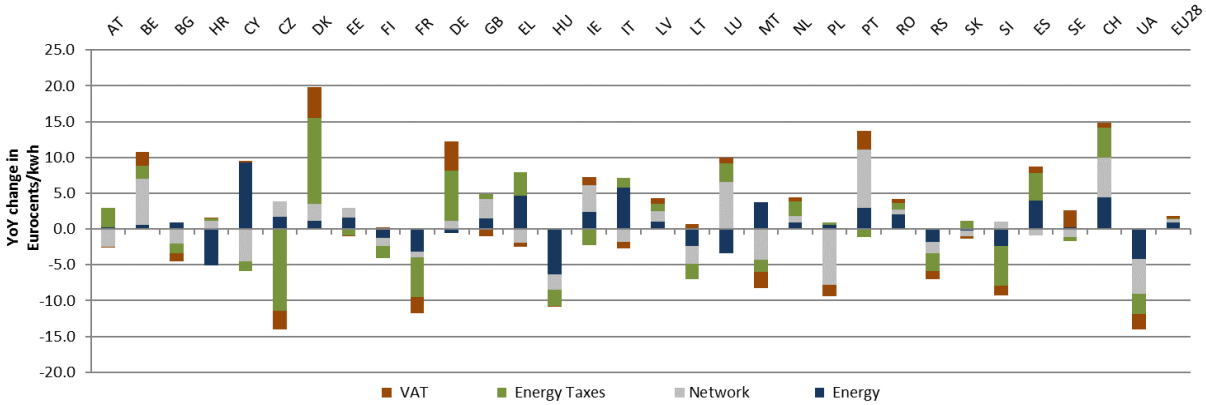
Figure 43 – *The Household Energy Price Index (HEPI) in European capital cities*



Source: Vaasaett

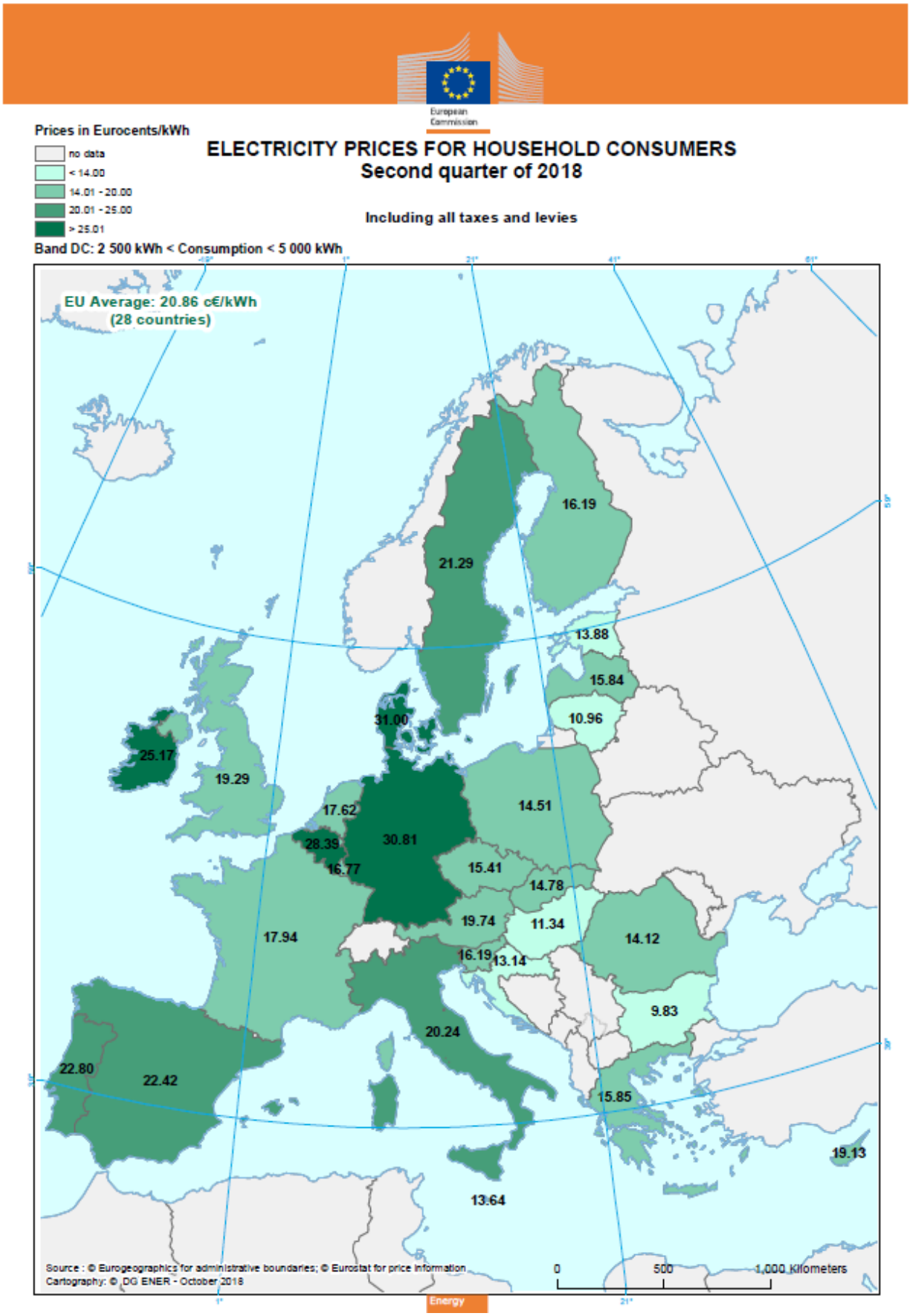
- The energy component increased in all but 8 EU Member States from September 2017 to September 2018. This reflects the trend of increasing wholesale prices, as such are part of the energy component. Italy reported the largest increase of 5 Eurocent/kwh among interconnected capitals, followed by Greece and Spain. Hungary and Croatia reported the largest decreases in energy components of 6 and 5 Eurocent/kwh respectively.
- Network charges decreased in half of the EU member States with Poland, Hungary and Lithuania reporting the largest year-on-year decreases. At the same time network charges significantly increased in Portugal, Belgium and Luxembourg (by 8 Eurocent/kwh in Portugal and 6 Eurocent/kwh in the latter two countries). In Germany taxes increased by 7 Eurocent/kwh compared to the same month of the previous year.
- While the energy and network components experienced larger changes in both directions across reporting countries, taxes remained largely stable. In half of EU capitals taxes on household electricity bills changed by less than 1 Eurocent/kwh (in either positive or negative direction). Exemptions were Denmark where taxes increased by almost 12 Eurocent/kwh as well as France and Slovenia where taxes decreased by almost half that amount.

Figure 44 – *Change in electricity prices by cost components in the European capital cities, between the reference quarter and the same month of the previous year*



Source: Vaasaett

Figure 45- ***Household electricity Prices in September 2018***



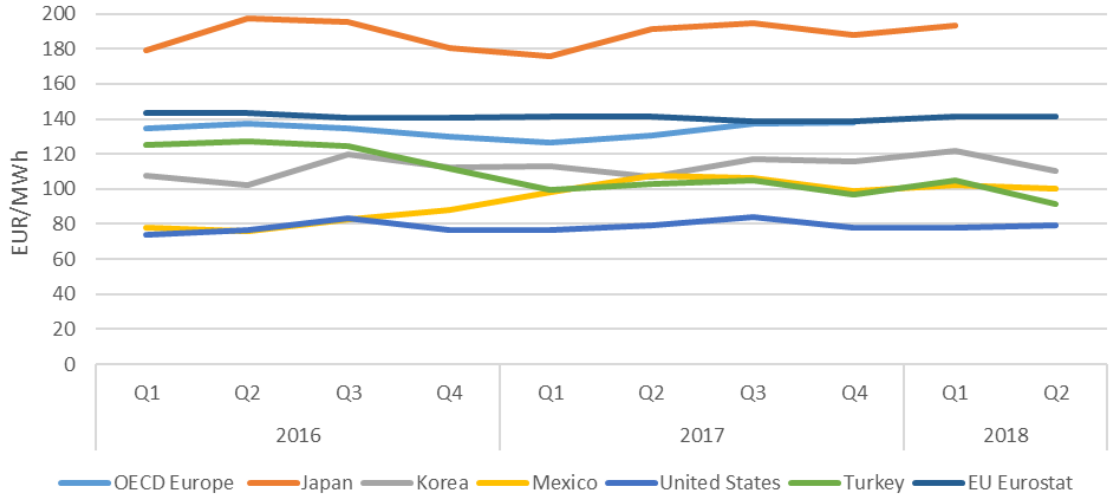
Source : Data computed from Eurostat half-yearly retail electricity prices and consumper price indices

4.1 International comparison of retail electricity prices

- The following graph displays industrial retail prices paid by consumers in Europe and in its major trading partners. Prices in the EU remained relatively high, second only to prices in Japan. In the case of Japan the decreasing price premium to EU wholesale electricity benchmark can also be tracked in the retail market. Differences between wholesale electricity prices in the EU and the US are mirrored by differences between EU and US retail prices.

- The evolution of Korean prices remained fairly constant and similar to the evolution of the EU benchmark. The premium of the EU average to Mexican prices decreased, as the Mexican price increased at a higher rate than its EU counterpart. The difference between the Turkish price and the EU average price started to increase as the Turkish price fell in Q2 2018 and the EU price remained stable.

Figure 46 – Retail electricity prices paid by industrial customers in the EU and its main trading partners



Source: Eurostat, IEA

5 Glossary

Backwardation occurs when the closer-to-maturity contract is priced higher than the contract which matures at a later stage.

Clean dark spreads are defined as the average difference between the price of coal and carbon emission, and the equivalent price of electricity. If the level of dark spreads is above 0, coal power plant operators are competitive in the observed period. *See dark spreads.*

Clean spark spreads are defined as the average difference between the cost of gas and emissions, and the equivalent price of electricity. If the level of spark spreads is above 0, gas power plant operators are competitive in the observed period. *See spark spreads.*

Contango: A situation of contango arises in the when the closer to maturity contract has a lower price than the contract which is longer to maturity on the forward curve.

Cooling degree days (CDDs) are defined in a similar manner as Heating Degree Days (HDDs); the higher the outdoor temperature is, the higher is the number of CDDs. On those days, when the daily average outdoor temperature is higher than 21°C, CDD values are in the range of positive numbers, otherwise CDD equals zero.

Dark spreads are reported as indicative prices giving the average difference between the cost of coal delivered ex-ship and the power price. As such, they do not include operation, maintenance or transport costs. Spreads are defined for a coal-fired plant with 35 % efficiency. Dark spreads are given in this publication for UK and Germany, with the coal and power reference price as reported by *S&P Global Platts*.

European Power Benchmark (EPB7) is a replacement of the former Platt's PEP index discontinued at the end of 2016, computed as weighted average of seven major European markets' (Belgium, France, Germany, Netherlands, Spain, Switzerland, United Kingdom) day-ahead contracts.

Flow against price differentials (FAPDs): By combining hourly price and flow data, FAPDs are designed to give a measure of the consistency of economic decisions of market participants in the context of close to real time operation of electrical systems.
With the closure of the day-ahead markets (D-1), the prices for each hourly slot of day D are known by market participants. Based on the information from the power exchanges of two neighbouring areas, market participants can establish hourly price differentials. Later in D-1, market participants also nominate commercial schedules for day D. An event named 'flow against price differentials' (FAPD) occurs when commercial nominations for cross border capacities are such that power is set to flow from a higher price area to a lower price area. The FAPD chart in this quarterly report provides detailed information on adverse flows, presenting the ratio of the number of hours with adverse flows to the number of total trading hours in a quarter.

Heating degree days (HDDs) express the severity of a meteorological condition for a given area and in a specific time period. HDDs are defined relative to the outdoor temperature and to what is considered as comfortable room temperature. The colder is the weather, the higher is the number of HDDs. These quantitative indices are designed to reflect the demand for energy needed to heat a building.

Long-term average for HDD and CDD comparisons: In the case of both cooling and heating degree days, actual temperature conditions are expressed as the deviation from the long-term temperature values (average of 1975-2016) in a given period.

Monthly estimated retail electricity prices: Twice-yearly Eurostat retail electricity price data and the electricity component of the monthly Harmonised Index for Consumer Prices (HICP) for each EU Member States to estimate monthly electricity retail prices for each consumption band. The estimated quarterly average retail electricity prices on the maps for households and industrial customers are computed as the simple arithmetic mean of the three months in each quarter.

Relative standard deviation is the ratio of standard deviation (measuring the dispersion within a statistical set of values from the mean) and the mean (statistical average) of the given set of values. It measures in percentage how the data points of the dataset are close to the mean (the higher is the standard deviation, the higher is the dispersion). Relative standard deviation enables to compare the dispersion of values of different magnitudes, as by dividing the standard deviation by the average the impact of absolute values is eliminated, making possible the comparison of different time series on a single chart.

Spark spreads are reported as indicative prices giving the average difference between the cost of natural gas delivered ex-ship and the power price. As such, they do not include operation, maintenance or transport costs. Spreads are defined for a gas-fired plant with 50 % efficiency. Spark spreads are given for UK and Germany in this publication, with the gas and power reference price as reported by *S&P Global Platts*.

Tariff deficit expresses the difference between the price (called a tariff) that a *regulated utility*, such as an electricity producer is allowed to charge and its generation cost per unit.