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Quarterly Report on European Electricity Markets

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QUARTERLY REPORT ON EUROPEAN ELECTRICITY MARKETS

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HIGHLIGHTS OF THE REPORT

- **In the fourth quarter of 2017 wholesale electricity prices at EU level increased compared to the previous quarter and the European Power Benchmark index reached 50 €/MWh on average.**
- **Economic growth continued in Q4 2017 and GDP grew by 2.6% in year-on-year comparison in the EU**
- **Electricity consumption clearly decoupled from the economic growth over the last few years: since 2010 GDP grew by 11.6% in the EU, while electricity consumption decreased by more than 4%.**
- **In October and November 2017 significant nuclear generation capacities were taken offline in France, resulting in high wholesale electricity prices and turning the country into net electricity importer position in November.**
- **In December 2017 wind power generation in the EU reached the highest level ever, amounting to 41 TWh and representing a share of 16% in the monthly electricity generation mix.**
- **In spite of low profitability, the role of coal and gas fired generation increased in many EU countries in Q4 2017, especially in the periods of nuclear unavailability and dwindling renewable generation.**
- **Coal and gas prices showed a slight increase in Q4 2017 at the beginning of the winter period. Milder than normal weather conditions limited the energy demand in residential heating.**

EXECUTIVE SUMMARY

- **In the fourth quarter of 2017 the European benchmark day-ahead baseload wholesale electricity price index showed a measurable increase,** reaching 54 €/MWh in November 2017, which was the highest monthly average since January. On quartrerly average, the benchmark index was 50 €/MWh in Q4 2017, being definitely higher than 38 €/MWh in the previous quarter. In the Nordic countries the quarterly average price was barely more than 30 €/MWh, while in Souther European countries it reached 60 €/MWh.

- **Economic growth in the EU remained robust in the fourth quarter of 2017 and GDP grew by 2.6% in year-on-year comparison**, being slightly less than in the previous quarter (2.8%). Over the past few years electricity consumption clearly decoupled from economic growth in the EU. Since 2010 GDP in the EU-28 grew by 11.6%, whereas electricity consumption decreased by more than 4% signalling an improving energy intensity of the EU economy.

- **Coal and natural gas prices increased slightly in the fourth quarter of 2017,** reaching the levels by the end of the 2017 last seen at the beginning of the year. In the case of gas, demand was driven by increasing heating related needs at the beginning of the winter. However, relatively mild weather put a lid on demand for gas in the residential sector. Coal prices also showed a slight increase in Q4 2017. The share of both coal and gas increased in the EU power mix in October and November 2017, as significant nuclear capacities were off the grid in Western Europe, resulting in increasing use of fossil fuels in power generation.

- **The profitability of fossil fuel based electricity generation remained limited in most of the European markets**, however, in Southern Europe both coal and gas fired generation was profitable, due to high local wholesale electricity prices. However, amid missing operational nuclear capacities and variable renewables, the flexibility of electricity system requires the operation of fossil generation capacities, even if their profitability is not optimal. Coal imports in the EU from third countries only marginally increased in Q4 2017, however, Russia managed to export more coal to the EU, owing to the competitive coal price offer and favourable freight costs.

- **In October and November 2017 significant nuclear capacities were taken offline in France**, either due to planned maintenance works or unplanned shutdowns due to safety inspections, ordered by the national nuclear safety authority. Nuclear availability in Spain was also lower in this period. Lower nuclear availability resulted in high wholesale electricity prices in France, turning the country into net electricity importer in November 2017 for the first time since January.

- **In December 2017 electricity generation from wind reached the highest level ever, 41 TWh, ensuring 16% of the total generation mix in the EU-28.** Wind energy generation usually shows a significant increase at the beginning of the winter period with the arrival of storms. In November 2017 however, as wind generation receded in most of Europe in comparison to the good performance in October, wholesale electricity prices in Western Europe rose significantly as missing nuclear capacities and dwindling renewable production increased electricity generation costs.

- **Hydro electricity generation in the EU-28 remained at similarly low levels in the fourth quarter of 2017 as at the end of 2016.** Although in the Nordic countries and in Central Western Europe hydro reservoir levels were favourable and hydro generation picked up, in Spain and the Balkans hydro reservoir levels were lower than in the previous year, implying a limited share of hydro in the electricity mix, which resulted in higher electricity generation costs and wholesale electricity prices.

- **In 2017 as a whole, the total volume of electricity traded on the observed European markets amounted to 12,647 TWh, 13% less (or 1973 TWh lower) than in 2016,** covering both organised traded and over the counter (OTC) markets. The so-called churn rate, measuring market liquidity, was estimated to be 4, showing that traded volume of power was four times as much as the electricity consumption on the observed markets.

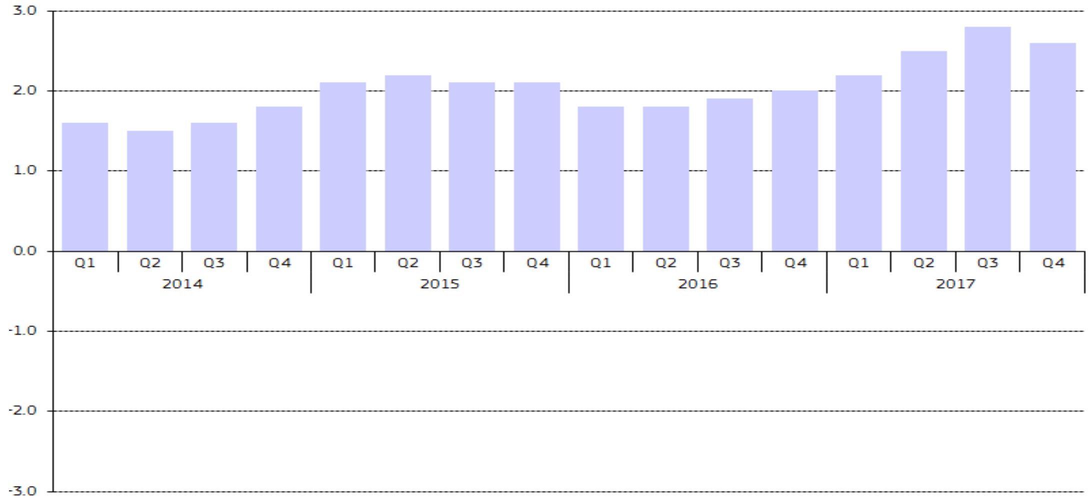
- **Retail electricity prices for household customers increased by 4.6% between December 2016 and December 2017 in the European capital cities on average.** Changes in retail electricity prices were mainly driven by increasing energy and supply costs and energy taxes, whereas changes in network costs had slightly downward impact on the final retail electricity prices.

1 Electricity market fundamentals

1.1 Demand side factors

- In the fourth quarter of 2017 economic growth in the EU-28, albeit being slightly lower than in Q3 2017, was still robust and GDP grew by 2.6% in year-on-year comparison. In Q4 2017, according to the data of the European Network of Transmission System Operators (ENTSO-E), consumption of electricity was up by 0.9% in the EU-28 in year-on-year comparison. It is worth to note that gross value added in manufacturing and construction sectors was up by 4.5% and 3.6% respectively, compared to Q4 2016, pointing to increasing energy need in important energy consuming economic sectors.

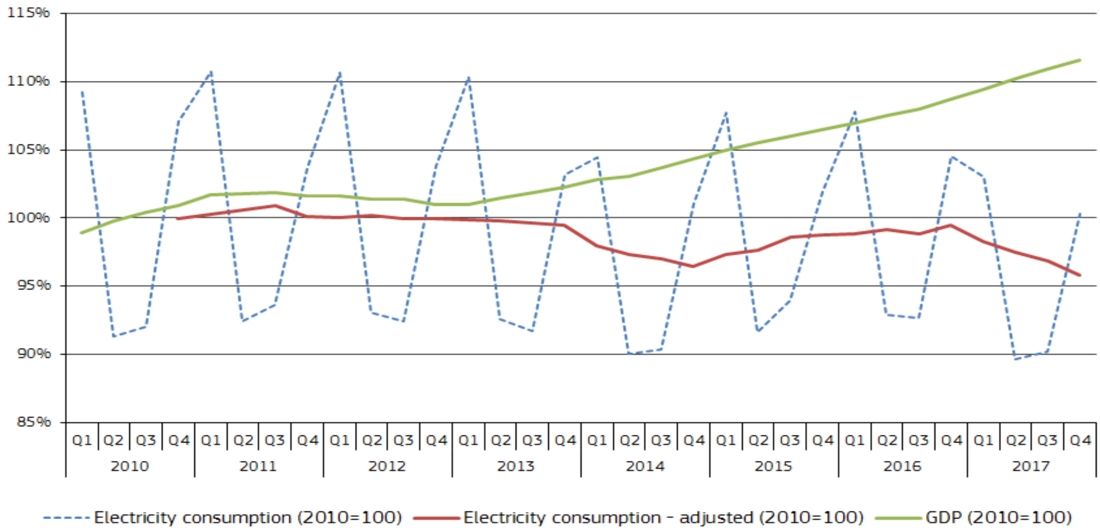
Figure 1 – *EU 28 GDP Q/Q-4 change (%)*



Source: Eurostat

Electricity consumption in the EU-28 clearly showed the signs of decoupling from economic growth over the last few years. By the end of 2017 GDP was up by 11.6% compared to 2010, at the same time consumption of electricity decreased by 4.2% since 2010. Although consumption of electricity can be influenced by several factors on the short run (e.g.: weather conditions, seasonal lighting, heating and cooling needs, etc.), the trend of decoupling is clearly visible on Figure 2.

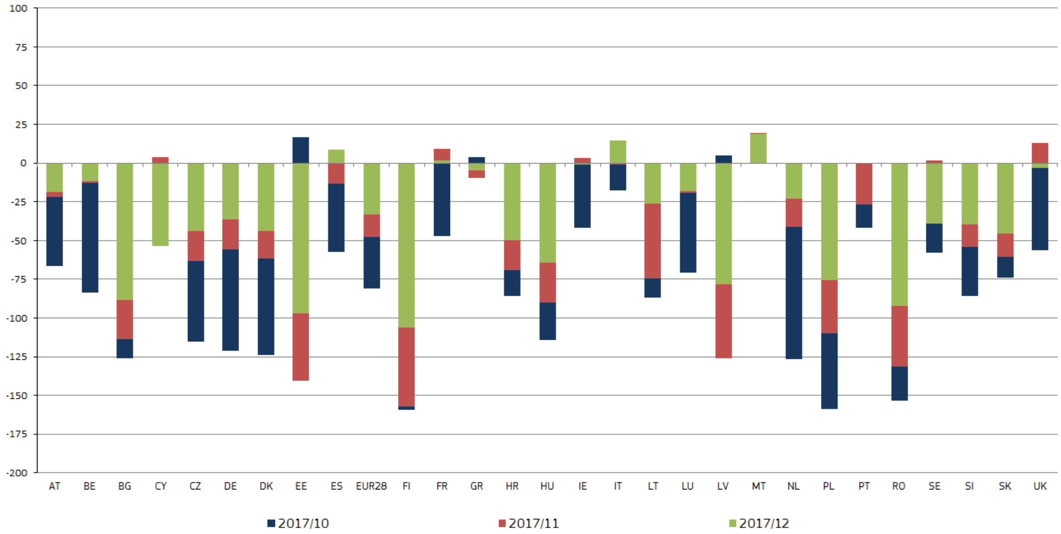
Figure 2- *The evolution of Gross Domestic Product (GDP) and electricity consumption in the EU-28*



Source: Eurostat

- Figure 3 shows the monthly deviation of actual Heating Degree Days (HDDs) from the long term averages in October-December 2017 in the twenty-eight Member States of the EU. In Q4 2017 the weather was generally mild in almost all EU countries, putting a lid on heating related energy needs and on wholesale electricity prices. However, temporary cold spells had measurable impact on the wholesale electricity price level in many markets.
- The assessment of temperature driven demand for electricity can be found for each region in Chapter 3.

Figure 3 – *Deviation of actual Heating Degree Days (HDDs) from the long-term average, in October-December 2017*

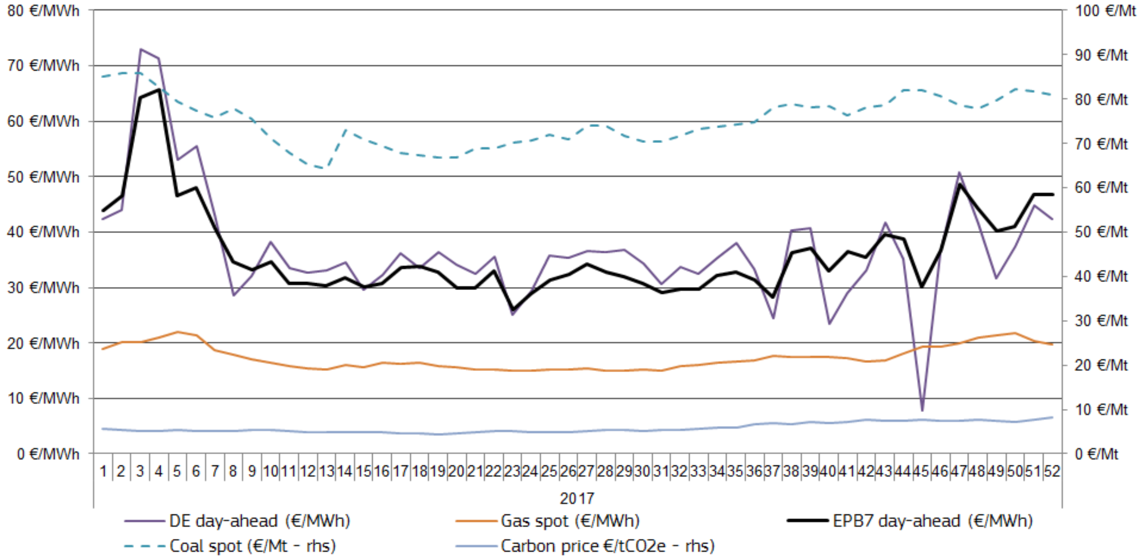


Source: JRC. The colder is the weather, the higher is the number of HDDs.

1.2 Supply side factors

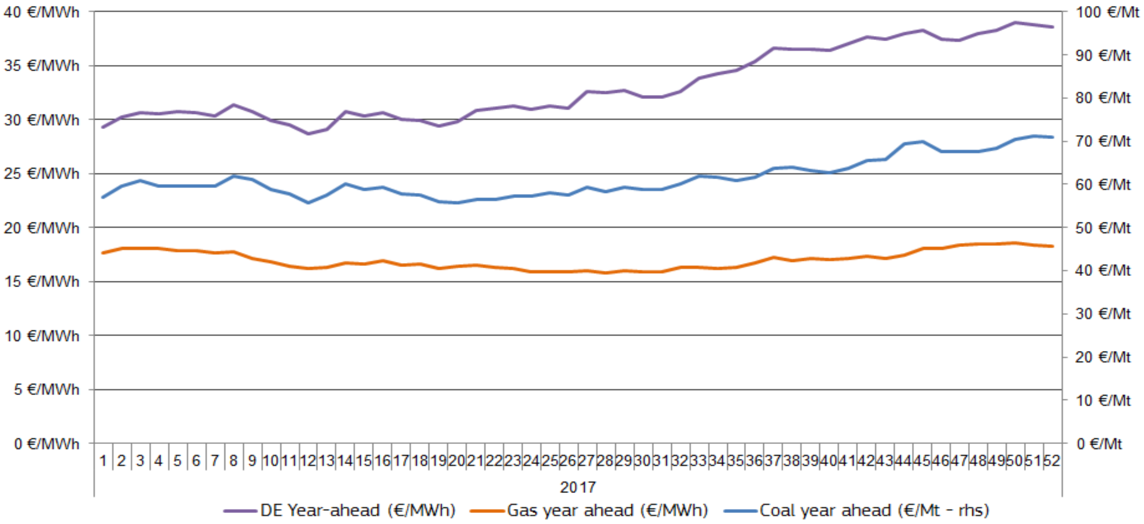
- Spot coal prices on Figure 4 (as represented by CIF ARA contracts, the most commonly used import price benchmark in North-Western Europe), showed a gradual increase during the fourth quarter of 2017 (week 40-52 on the charts), and rose above 80 €/Mt by the end of the year, being close to the level measured at the beginning of 2017. Demand for coal increased in Europe as ahead of the winter period, and there were significant nuclear capacities offline on the continent, increasing demand for coal in power generation. On the global market there was an increasing demand for coal as world economic growth also increased the need for energy.
- Spot natural gas prices (represented by Title Trading Facility – TTF in the Netherlands, being the most liquid hub prices in North-Western Europe) showed a gradual increase in the fourth quartrer of 2017 as with the onset of heating period demand for gas rose and the role of gas in power generation also increased during the winter period. European emission allowance contracts continued their price increase in Q4 2017 which started in the previous quarter and reached 8.2 €/tCO2e at the end of the year, anticipating the impact of European policy measures aiming at reducing the permanent oversupply on the carbon market experienced in the last few years.. However, the impact of increasing carbon emission alllowance prices was limited on the evolution of wholesale electricity prices in Q4 2017.
- The wholesale electricity benchmark price was impacted by increasing coal and natural gas contracts in Q4 2017, but more importantly, by the temporary outage of significant nuclear capacities which had to be replaced in many cases by fossil fuel generation, resulting in higher generation costs. The impact of higher generation costs were however mitigated by abundant wind generation in several periods during Q4 2017.
- On the curve, quarter-ahead and year-ahead coal and natural gas prices also increased during the fourth quarter of 2017, similary to the day-ahead contracts. This has also exerted an upward pressure on year-ahead wholesale electricity price contracts (Figure 5 shows the German contracts, being one of the most liquid markets in Europe with available forward curve price quoatations).

Figure 4 – *Weekly evolution of European average day-ahead wholesale electricity prices, compared with spot coal, gas and carbon prices in 2017*



Source: Platts,
EPB7 - European Power Benchmark (in €/MWh) is the replacement of the Platts PEP as of January 2017.
See more detailed description in the Glossary.
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)
Carbon price: EUA emission allowance spot pirce, in €/tCO_2e

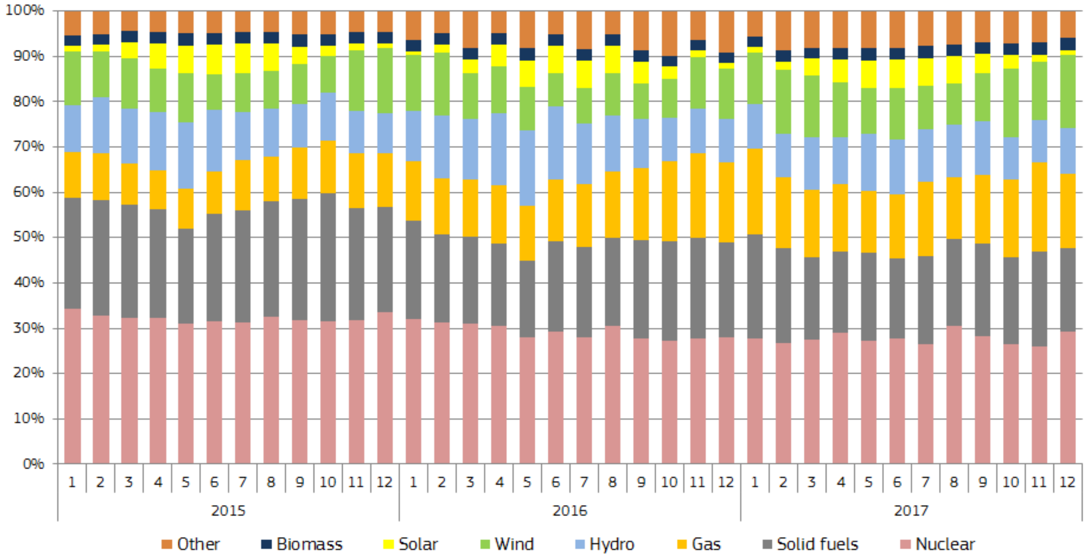
Figure 5 - *Weekly evolution of year-ahead German wholesale electricity prices, compared with coal and gas year-ahead contracts in 2017*



Source: Platts

- The next chart shows the evolution of the electricity generation mix in the EU-28. Compared to the previous quarter, in Q4 2017 the share of wind energy measurably increased in the EU generation mix, as the this is the usual case during the wintry period. However, in November 2017 the share of wind energy temporarily droped. In this month the share of nuclear in the EU generation mix fell to the lowest in the last three years. The share of hydro aslo decreased in Q4 2017 compared to the previous quarter and amid shortening daylight hours solar geneation became insignificant.
- These developments in the EU generation mix have left more room for fossil generation sources, resulting in higher generation costs and wholesale electricity prices. However, as in December 2017 wind generation picked up again, reaching the highest monhly production ever (41 TWh, ensuring 16% of the EU-28 electricity generation mix), the share of coal and gas decreased and wholesale prices become lower again.

Figure 6 – *Monthly electricity generation mix in EU-28*



Source: ENTSO-E

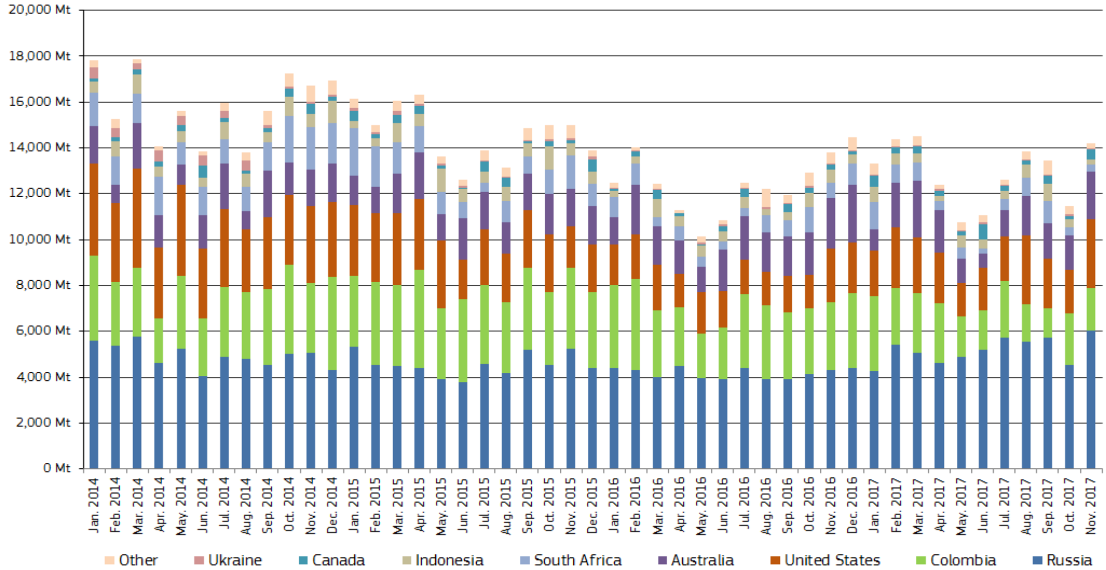
- Figure 7 shows the major extra-EU coal import sources and the monthly amount of imported coal in the EU. In September-November 2017 coal imports from outside the EU reached 39,129 Mt, whereas in the same period in 2016 extra-EU imports amounted to 38,722 Mt. In year-on-year comparison this means a slight increase of 1.1%, however, compared to the same three months of 2015 coal imports were still down by 13%, and by 21% if we compare to the same period of 2014. This implies a decreasing import trend over time, and given the dwindling domestic coal production in the EU it points to the decreasing role of coal in power generation in many European countries (which also can be followed on Figure 6), as the competitiveness of coal-fired generation diminished over time.

- In September-November 2017 the largest chunk of extra EU coal imports came from Russia, with a share of 42% in the total. The second most important import coal import source was the United States (18%), followed by Colombia (14%) and Australia (13%) All other import sources had a share below 5% in this period, such as South Africa and Indonesia (4% each) and Canada (2%).

- The high share of Russian coal imports can be explained by the competitive price, as Figure 8 shows. The estimated import price of Russian steam coal was comparable with that from Colomba and South Africa over the last few years and was during most of the time lower than the import price from the United States. However, it is also worth noting that freight rates of Russian imports are also lower, providing an advantage for Russian coal imports.

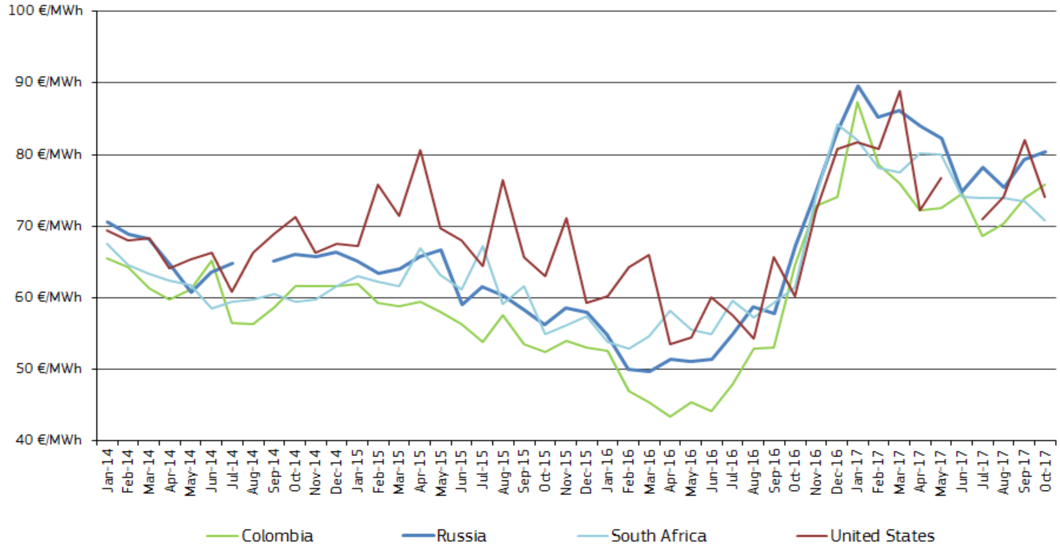
- In September-November 2017 the estimated EU import bill of hard coal from extra-EU sources amounted to €4 billion, while in the same period of the 2016 the extra-EU import bill was €2.9 billion, showing the impact of higher coal import prices and slightly increasing coal import volumes.

Figure 7 – *The most important extra-EU hard coal import sources and monthly imported quantity in the EU-28*



Source: Eurostat, COMEXT database

Figure 8 – *Estimated monthly steam coal import prices in the EU from different import sources*



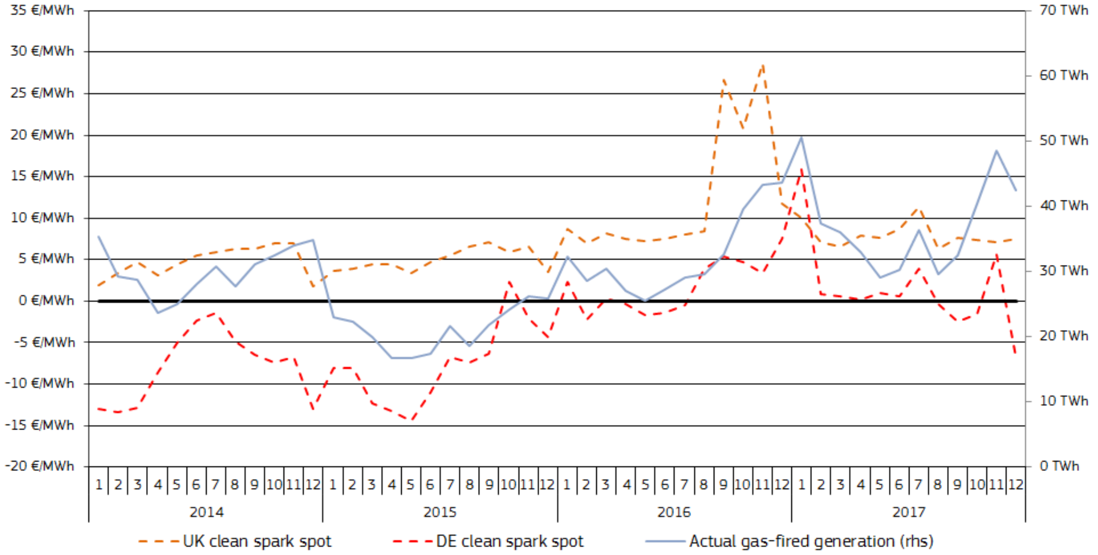
Source: Platts International Coal Report monthly statistics

- In the fourth quarter of 2017, as both wholesale electricity and natural gas prices in the United Kingdom showed a steady increase, in parallel with slightly increasing carbon prices, clean spark spreads remained stable, ensuring profitanility for gas fired electricity generation in the UK - see Figure 9. At the same time in Germany, where wholesale electricity prices are lower compared to the UK, gas fired generation was only profitable in November 2017, as both in October and December clean spark spreads were in the negative range. Most of the European markets in Central and Eastern Europe might have faced clean spark spreads being similar to the German metric, primarily depending on the local wholesale electricity price. However, in Southern Europe, having higher wholesale electricity prices in the local markets, gas-fired generation must have still been profitable.

- Clean dark spreads, measuring the profitability (through reflecting the variable costs) of coal-fired generation showed a slight increase in December 2017 in both Germany and the UK, as coal prices increased slowlier than wholesale electricity pricres, as Figure 10 shows. Coal-fired generation must have been profitable in most of the European countries in Q4 2017, as wholesale prices were in most cases higher in the local markets than in Germany.

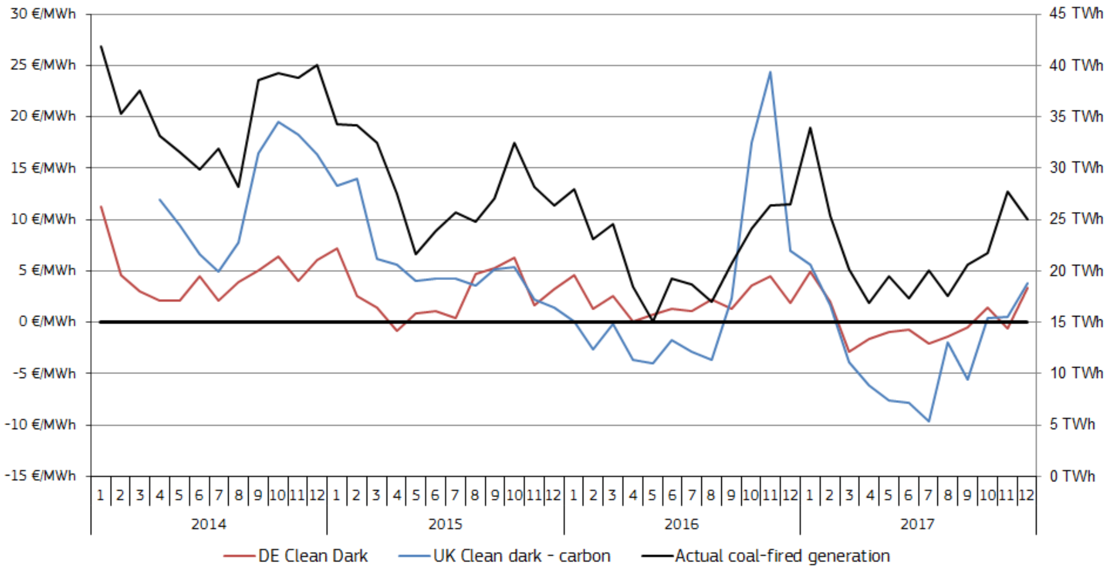
- In parallel with increasing profitability of gas-fired generation in November 2017, electricity generated from gas in the EU-28 reached 48 TWh, being the.highest since December 2016. The profitability of coal-fired generation also increased and in November 2017 power generated from coal amounted to 28 TWh. During the winter period, fossil fuel based electricity generation increased in most of the European countries irrespectively of the profitability, due to flexibility requirements of the electricity system, as variable renewable sources or nuclear generation capacities often operated on reduced availability.

Figure 9 – Evolution of *clean spark sreads in the UK and Germany, and electricity generation from natural gas in the EU*



Source: Platts and ENTSO-E Data are not available for Malta

Figure 10 - **Evolution of *clean dark sreads in the UK and Germany, and electricity generation from coal in the EU***



Source: Platts and ENTSO-E Data are not available for Malta

2 European wholesale electricity markets

2.1 Comparisons of wholesale electricity prices across European markets

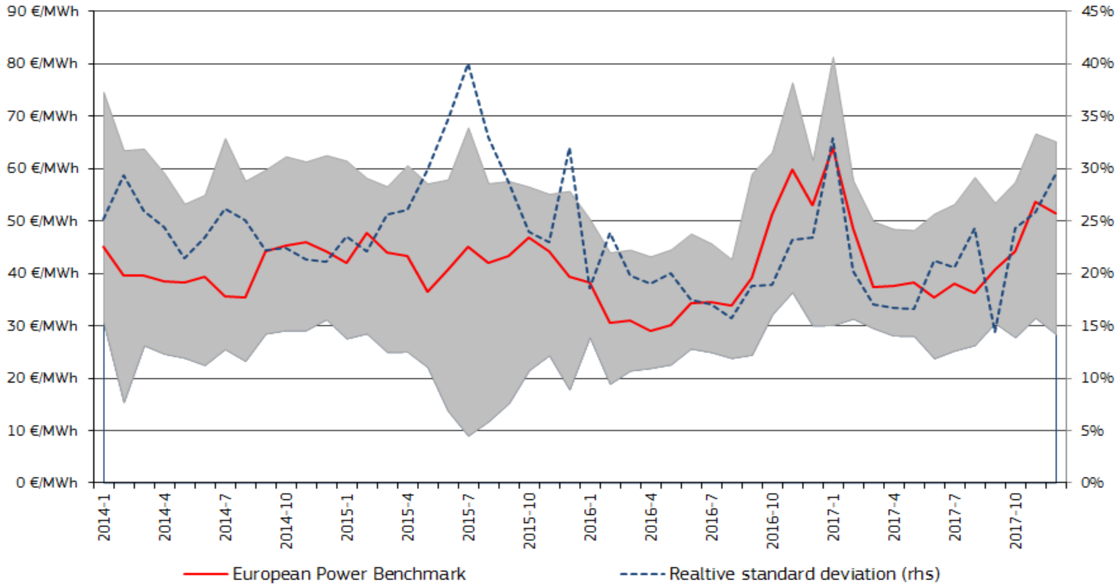
- As the next map (Figure 11) shows, there were significant price differences in the wholesale electricity prices across the EU in the fourth quarter of 2017. More details on the drivers behind price changes in each market can be found in Chapter 3.
- The highest quarterly average wholesale electricity prices in the EU could be observed in Q4 2017 in Italy (62 €/MWh), Portugal and Greece (both 61 €/MWh). At he same time the lowest quarterly wholesale averages could be found in Denmark and Sweden (both 31 €/MWh). Norway, being not an EU Member State, faced the lowest price in whole Europe in Q4 2017 (30 €/MWh on quarterly average), whereas the average price in Switzerland (60 €/MWh) was one of the highest in Europe, being slightly higher than in France (57 €/MWh) and close to the Italian average.
- In the fourth quarter of 2017 wholesale baseload electricity prices reached 50 €/MWh (European Power Benchmark) on average in Europe, which represented a decrease of 9% in year-on-year comparison. Comparing with Q4 2016, in the fourth quarter of 2017 prices increased by the most in Greece (32%), Romania (17%) and Slovenia (13%), whereas the biggest decrease could be observed in Sweden (15%), followed by Finland, Denmark and Estonia (each by 12%).

Figure 11 – *Comparison of average wholesale baseload electricity prices, fourth quarter of 2017*

Source: European wholesale power exchanges

- In Q4 2017 wholesale day-ahead electricity prices increased in most of the European electricity regions, however prices in the Nordpoolspot[1] market remained practically stable. Wholesale prices in Central Western Europe[2] (CWE) showed a discount to the European Power Benchmark (EPB), however, this was mainly due to the low German prices as in France and Belgium prices were above the EPB. In Central Eastern Europe[3] (CEE) prices were also lower than the European benchmark The UK has retained its price premium to North Western Europe. The highest wholesale electricity prices could be observed in the Southern European markets (Spain, Portugal, Italy and Greece).
- Figure 12 shows the European power benchmark index and as the two lines of boundary of the shaded area the lowest and the highest regional prices in Europe, as well as the relative standard deviation of the regional prices.
- Both the shaded area with minimum-maximum differentials and the relative standard deviation metric show that in the fourth quarter of 2017 wholesale electricity prices across different markets in Europe became slightly more divergent. Increasing price differentials were primarily owing to changes in the electricity generation mixes in different countries (e.g.: significant nuclear capacities were offline in Central .Western Europe, being replaced by fossil fuels and renewables).

Figure 12 - *The evolution of the lowest and the highest regional wholesale electricity prices in the EU and the relative standard deviation of the regional prices*



Source: Platts, European power exchanges – As of January 2017 Platts PEP has been replaced by a calculated EU average (European Power Benchmark)

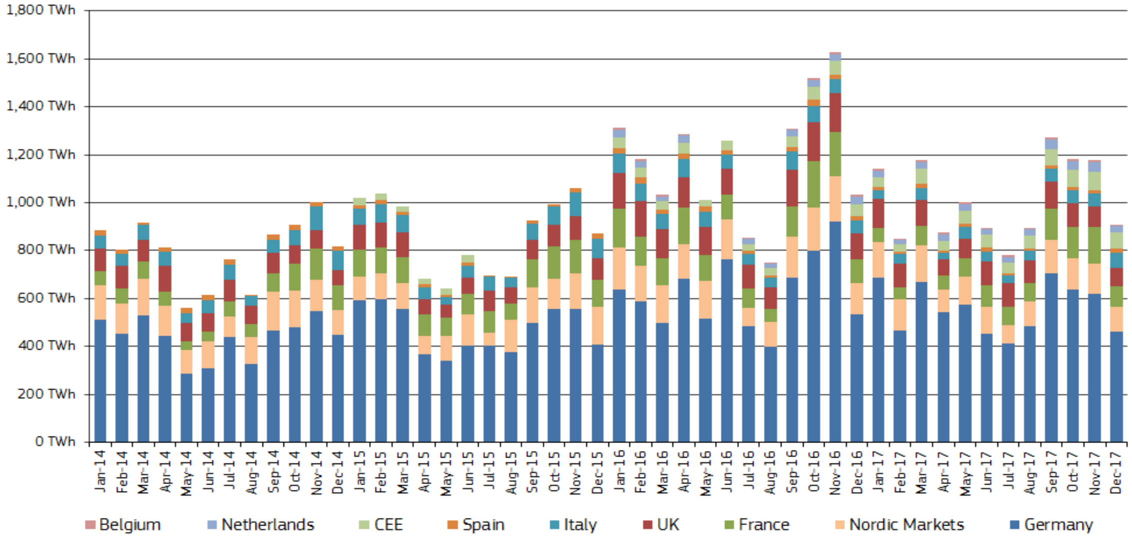
2.2 Traded volumes on wholesale trading platforms and cross border electricity trade

- Figure 13 shows the monthly evolution of electricity traded volumes, including exchange executed trade and over the counter (OTC) market trade on the most liquid European hubs. Over the last few years, and in Q4 2017 as well, the highest trade volumes could be observed on the German market, followed by the Nordic markets, France and the UK. Traded volume of electricity shows a high degree of seasonality, following the higher consumption during winter periods.
- In December 2017, similarly to earlier years, the total monthly traded volume of electricity (952 TWh) decreased compared to the earlier autumn months. In Q4 2017 as a whole, the traded volume of electricity on the observed platforms amounted to 3,425 TWh, up from 3,072 TWh in Q3 2017 but decreasing by 21% compared with Q4 2016, when the total traded volume was 4,325 TWh.
- In 2017 as a whole, the total volume of electricity traded on the observed markets amounted to 12,647 TWh, 13% less (or 1973 TWh lower) than in 2016. Behind the decreasing volume the possible anticipation of lower price volatility, decreasing the need for hedging activities, or less speculative trade might be suspected.

[1] Nordpoolspot includes Denmark, Estonia, Finland, Latvia, Lithuania, Norway and Sweden
[2] Central Western Europe includes Austria, Belgium, France, Germany, the Netherlands and Switzerland
[3] Central Eastern Europe includes Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia

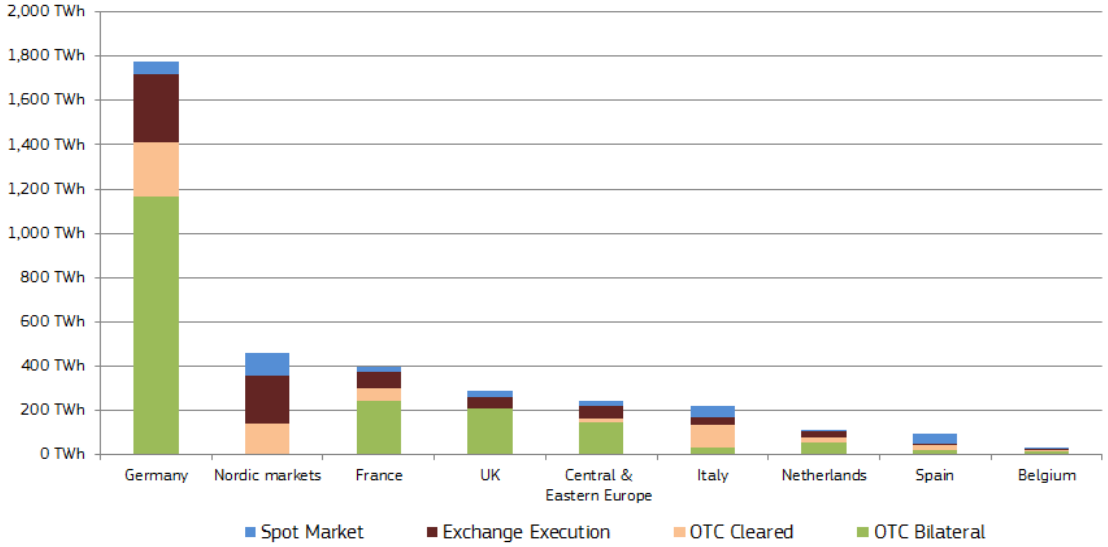
- Figure 14 shows the comparison of volumes in different market segments of electricity trading on the most liquid electricity trading platforms in the EU. In Q4 2017 in year-on-year comparison the total traded volume of electricity decreased in Germany (by 24% or 534 TWh), United Kingdom (by 40% or 172 TWh), France (by 21% or 102 TWh), in the Nordic markets (by 29% or 147 TWh). In Italy and Spain the total traded volume of electricity also went down in year-on-year comparison (respectively by 9% and 22%, or by 16 TWh and 13 TWh). In contrast, the total traded volume of electricity increased in Central and Eastern Europe (by 34% or 55 TWh), the Netherlands (by 19% or 16 TWh) and Belgium (by 16% or 3 TWh).
- There was a general decrease across all trading segments behind the decrease of 21% in the overall traded volume of electricity: The volume of OTC Bilateral contracts went down by 18% and the volume of exchange executed trade decreased by 28%, shifting the focus of trade from the exchange markets to the over-the-counter trade. In consequence, the share of OTC trade rose further from 75% in Q4 2016 to 77% in Q4 2017.
- Market liquidity can be measured by the so-called churn rates, providing information on the ratio of the total volume of power trade (including exchange executed and OTC markets) and electricity consumption in a given time period. Figure 15 shows the evolution of the quarterly regional churn rates between the beginning of 2014 until the third quarter of 2017. In Q3 2017 churn rates in the majority of the observed electricity markets did not change too much compared to the previous quarter; in the UK it went up from 3.5 to 4.5, in France it changed from 2.3 to 3.1 and in the CEE region it rose from 1.7 to 2.1. In year-on-year comparison the churn rate decreased in Germany (from 14.2 to 13.6), and in France and the CEE region it rose respectively from 2.7 to 3.1 and from 1.6 to 2.1.

Figure 13 – *Monthly traded volume of electricity (incl. exchange executed and OTC) on the most liquid European markets*



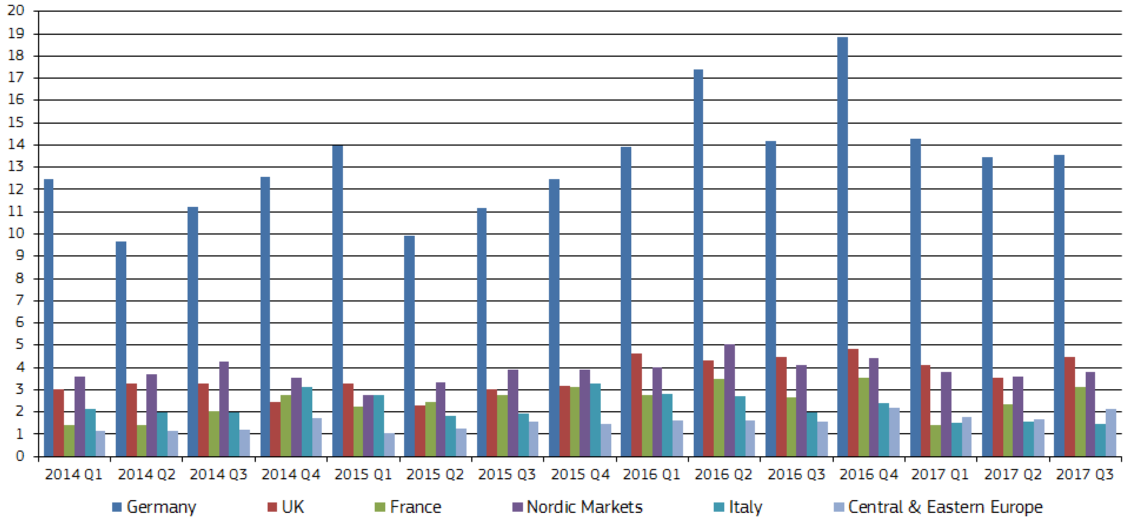
Source: Platts, wholesale power markets, Trayport, London Energy Brokers Association (LEBA) and DG ENER computations

Figure 14 - *Comparison of electricity traded volumes in some important day-ahead, forward and OTC markets, fourth quarter of 2017*



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

Figure 15 *Quarterly churn rates on selected European wholesale electricity markets*



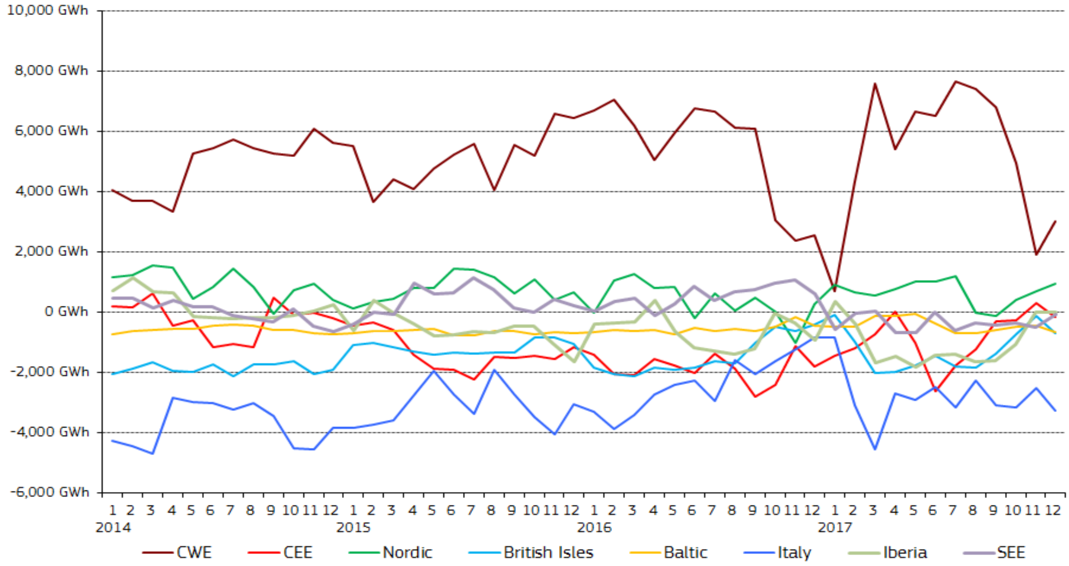
Source: Trayport, London Energy Brokers Association (LEBA), ENTSO-E and DG ENER computations

2.3 Cross-border trade of electricity

- As Figure 16 shows, in the fourth quarter of 2017 the net export position of Central Western Europe (CWE) power region changed significantly. While in September 2017 the region exported 6.8 TWh more electricity than it imported, by November the net exporter position dropped to 1.9 TWh, and in December 2017 there was only a slight recovery (3 TWh). Instead of exporting electricity to the UK, to the CEE region or to Italy, power flew within the CWE region, as in France or Belgium the local wholesale price was high, ensuring better profitability if the electricity is sold in these markets (implying that local outages resulted in replacement of domestic generation with imports).
- In parallel, the traditionally net importer position of the UK, CEE, Iberian regions got closer to the import-export equilibrium, and the CEE region even switched to net exporter position for a short period in November, which was last seen in September 2014.
- Italy retained its strong net importer position during Q4 2017, though local wholesale prices rose significantly in the lack of competitive import opportunities to costly local generation. The Nordic region managed to improve its

net exporter position, however, having the current interconnections (e.g.: Nord-Ned link), its exports to high-priced countries of the CWE region remained limited.

Figure 16 – *EU cross border monthly physical flows by region*



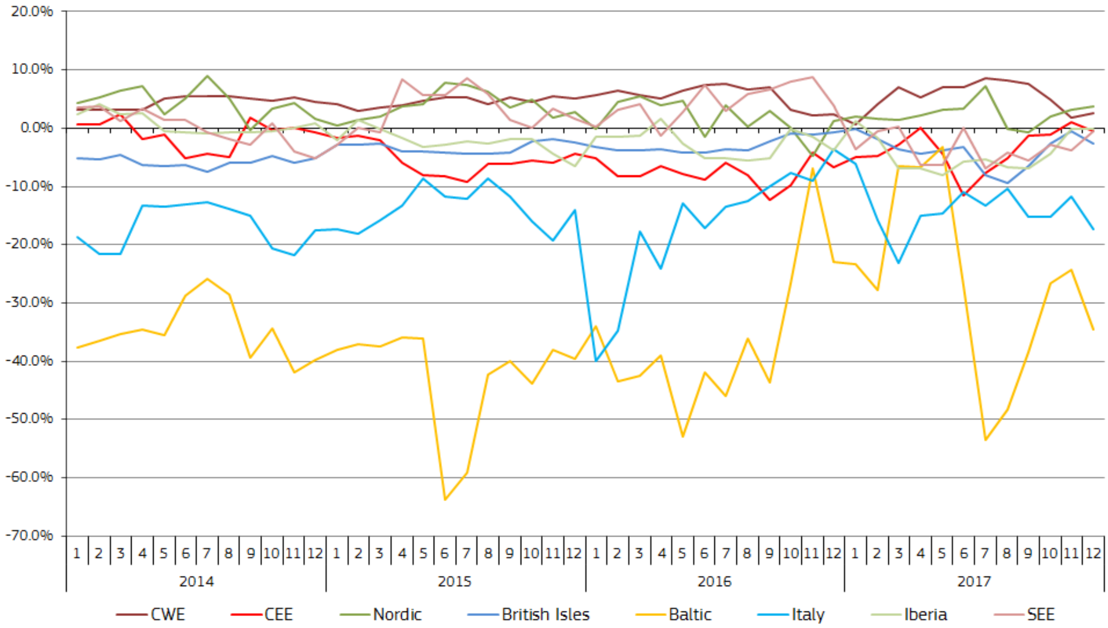
Source: ENTSO-E

European countries are grouped in the following regions:

Central Western Europe	*DE, NL, FR, LU, BE, AT, CH*	*Nordic*	*SE, FI, DK, NO*
Central Eastern Europe	*PL, CZ, HU, SK, HR, SI*	*British Isles*	*UK, IE*
Iberian-Peninsula	*ES, PT*	*Apennine Peninsula*	*IT*
South Eastern Europe	*RO, BG, GR, RS, BA, ME, FYROM, AL*	*Baltic*	*EE, LT, LV*

- Figure 17 shows the ratio of net electricity flow position to the domestic electricity generation in each region. By the end of the fourth quarter of 2017 the net importer position compared to the domestic consumption got close to zero (implying import-export equilibrium) in most of the markets due to the aforementioned reasons.
- However, the Baltic-states and Italy remained in strong net importer position. The Baltic countries importer almost 30% of their total electricity consumption, while in Italy the share of imports in electricity amounted to 15% in the fourth quarter of 2017. These countries are strongly exposed to import electricity supply, especially during the winter period.

Figure 17 – *The ratio of the net electricity exporter position and the domestic generation in the regions*

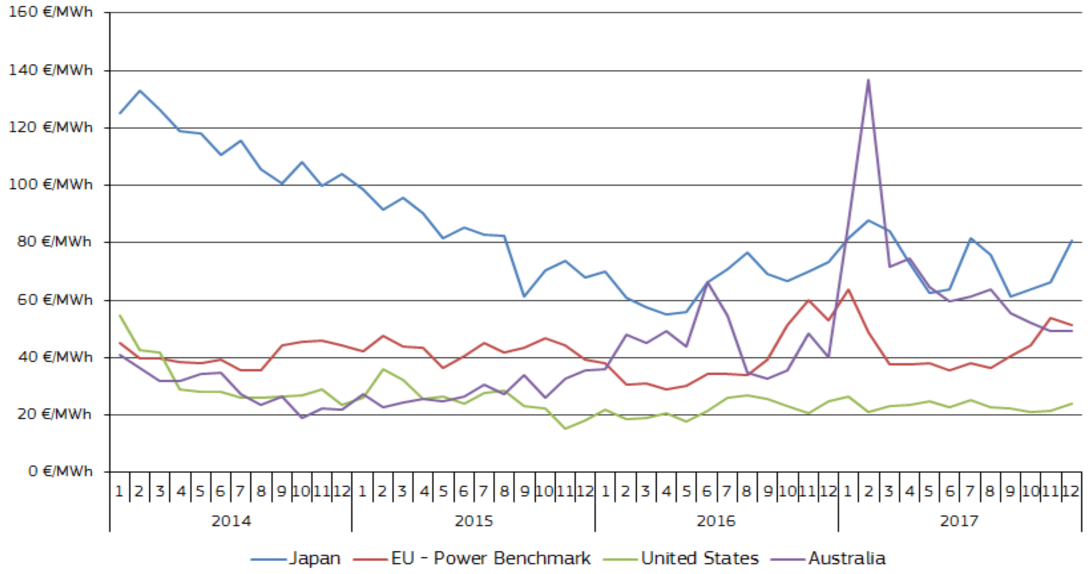


Source: ENTSO-E, own computations

2.4 Comparison of the EU wholesale electricity prices with international peers

- As Figure 18 shows, in the fourth quarter of 2017 the gap between wholesale electricity prices in Europe and the US widened again, as prices in Europe increased measurably, while in the US they remained stable. As result, between the third and fourth quarter of 2017 the quarterly average EU/US wholesale price ratio rose from 1.6 to 2.2. In November 2017 the monthly price ratio between the EU and the US even reached 2.5, which was last seen two years before, in November 2015.
- Wholesale electricity prices in Japan showed a significant increase between September and December 2017, rising from 60 €/MWh to 80 €/MWh. This might have been related to increasing LNG import prices in that country In Australia wholesale prices continued their downward trend and in Q4 2017 they fell below the European peer, though they were still higher than a year before.

Figure 18 – *Comparison of the monthly average wholesale electricity prices in Europe, US, Japan and Australia*



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

3 Regional wholesale electricity markets

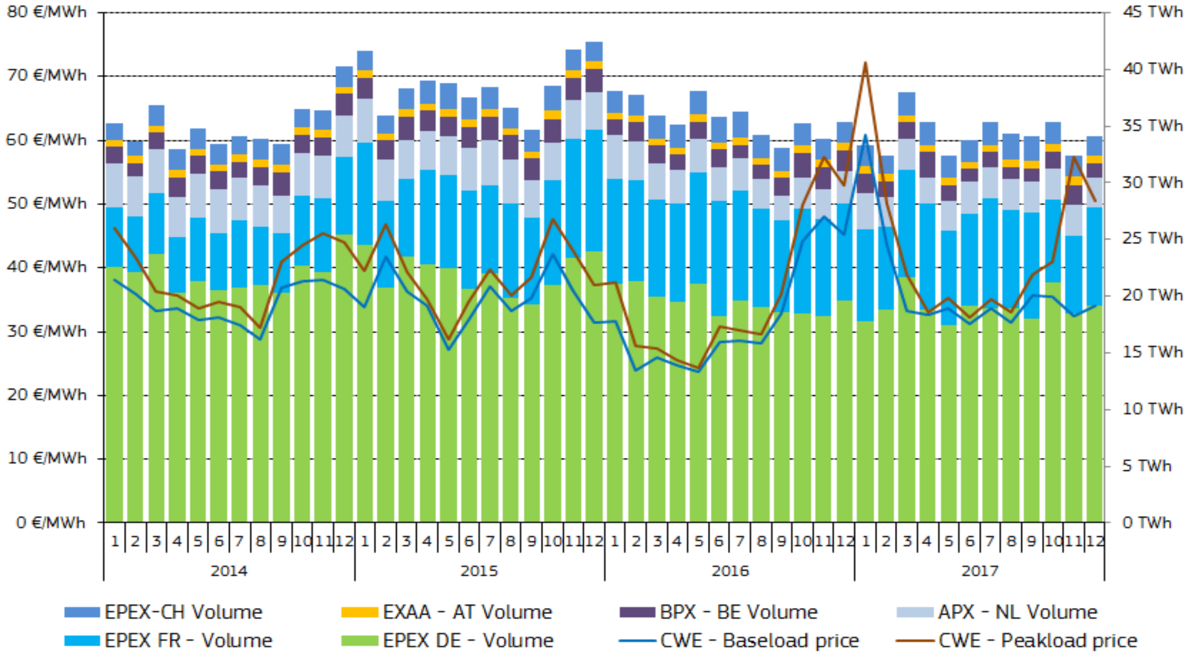
3.1 Central Western Europe (Austria, Belgium, France, Germany, the Netherlands, Switzerland)

- In the fourth quarter of 2017 the monthly average wholesale baseload electricity price in the CWE region fluctuated in a narrow range of 33-35 €/MWh on monthly average. However, the monthly average peakload showed a significant increase and in November 2017 it rose to 57 €/MWh from 41 €/MWh in October, as Figure 19 shows. In December 2017 the monthly average baseload price was 34 €/MWh and the peakload fell back to 50 €/MWh. However, such ongoing significant double-digit peakload price premiums over the baseload contracts have not been seen in the countries of the CWE markets for several years.
- The daily average regional day-ahead baseload price varied between 23 €/MWh and 56 €/MWh during Q4 2017. Baseload contracts reached their quarterly highs in France and Belgium in the first half of November 2017 (92 €/MWh and 122 €/MWh respectively), whereas in Germany on a Sunday on 29 October 2017 the daily average price fell deeply in the negative range (-51 €/MWh), similarly to the second day of Christmas (when it fell to -5 €/MWh). Figure 20 shows that the daily average baseload contracts started to diverge at the beginning of Q4 2017, and as of November with the onset of heating season the French and Belgian markets showed a significant price premium to Germany and the Netherlands in some periods.
- Although the weather was generally milder across the countires of the CWE region during almost all of the fourth quarter of 2017, occasional cold snaps in November and in the first half of December 2017 resulted in increasing

heating related demand, especially in France, where domestic heating is highly reliant on electricity, which affected the demand side of the wholesale electricity market. However, in the second half of December 2017, during the Christmas holiday period, temperatures were generally higher than usual and this, combined with dwindling industrial demand for electricity, resulted in lower prices on the wholesale market.

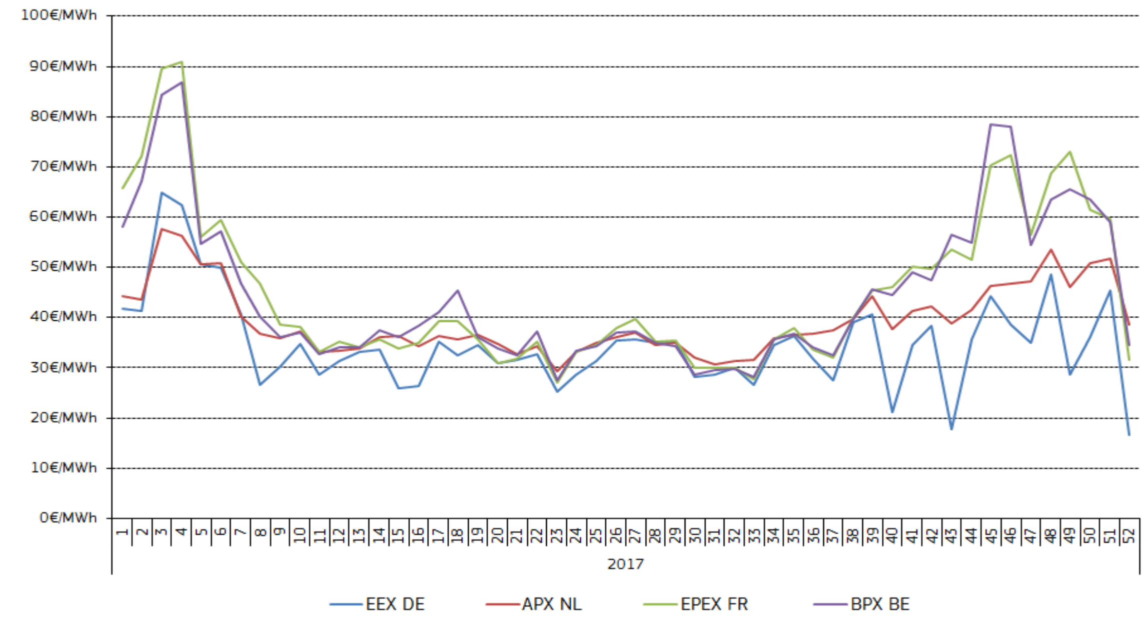
- Nuclear availability and generation in France (see Figure 21), was lower again during most of Q4 2017 (week 40-52 on the chart) compared to the fourth quarter of the previous two years.This was mainly due to extended planned maintenace works and shutdown of signficant nuclear generation capacities for ongoing safety checks (e.g.: reactors of Tricastin 1,2 and 4), ordered by the French nuclear authorities. In October 2017 operating nuclear generation capacities were lower by 3 GW (37.5 GW) comapred to September. Nuclear capacities only started to return to the grid only at the end of the year, adding to the pressure from the supply side of the market during most of Q4 2017.
- Reduced availabity of baseload generation capacities in France turned the country into a net electricity importer position in November 2017 for the first time since the beginning of 2017. On the top of this, lower baseload capacity availability increased the reliance on other technologies, such as fossil fuels and wind power. In October 2017 wind power generation reached 12.6 TWh in Germany, being all-time high, however, in November it fell back, contributing to increasing regional wholesale electricity prices.
- Lower wind generation amid tighter supply from conventional sources increased the price volatility and the difference between baseload and peakload prices, as Figure 22 shows. On 8 and 29 November, low wind generation and cold temperatures measurably reduced the supply of electricity, resulting in a peakload price premium being more than 20 €/MWh.
- Both coal and gas prices showed a gradual increase in the fourth quarter of 2017, also adding to electricity generation costs. Hydro generation in Austria, Switzerland and France was up in Q4 2017, compared to the same quarter of 2016.

Figure 19 - *Monthly exchange traded volumes of day-ahead contracts and monthly average prices in Central Western Europe*



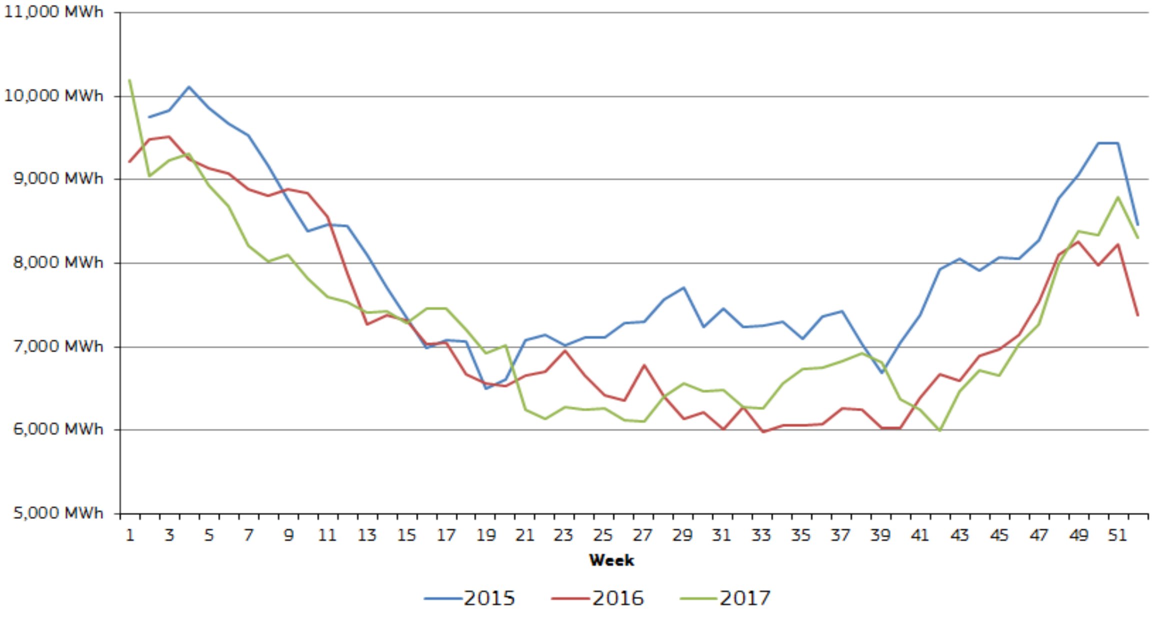
Source: Platts, EPEX

Figure 20 – *Weekly average wholesale power prices in 2017 in the CWE region*



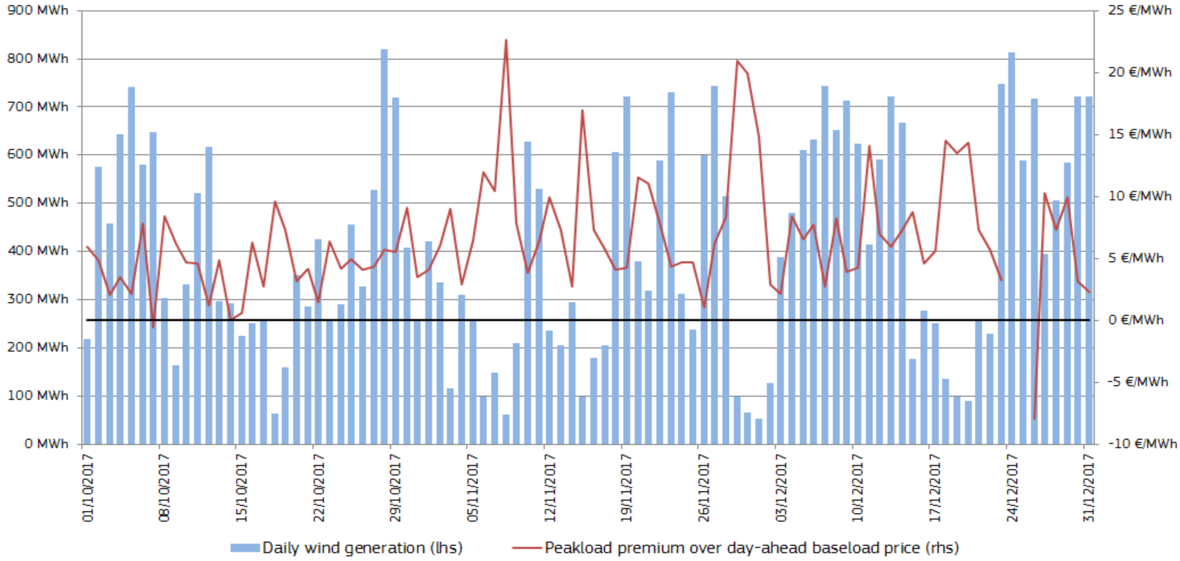
Source: Platts.

Figure 21 – *The weekly amount of generated nuclear electricity in France*



Source: ENTSO-E

Figure 22 – Daily wind power generation in Germany and the premium of the daily peakload electricity price to the baseload contracts

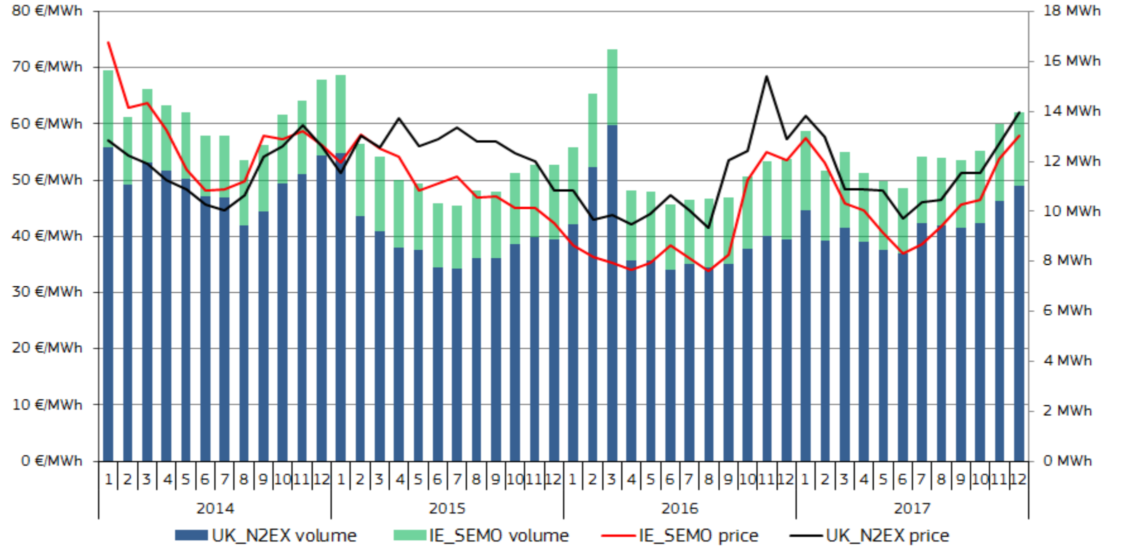


Source: Platts, ENTSO-E

3.2 British Isles (UK, Ireland)

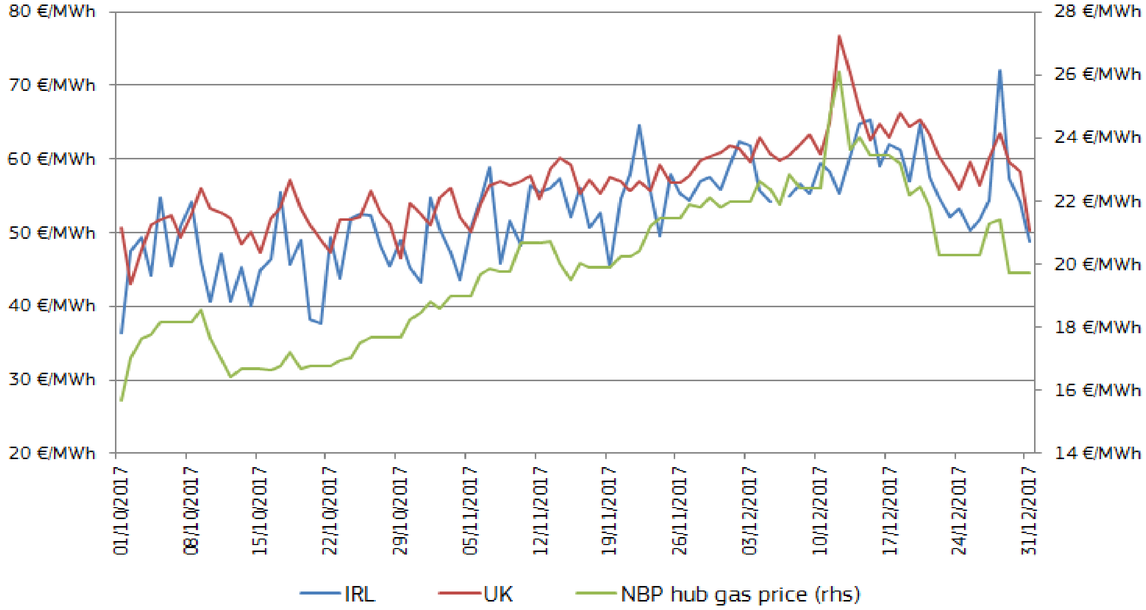
- In the fourth quarter of 2017 wholesale baseload electricity prices both in the UK and Ireland continued the increase that could be observed in the third quarter of the same year. While in September 2017 the monthly average baseload price was 46 €/MWh in the Ireland and was 51 €/MWh in the UK, by December 2017 they respectively rose to 58 €/MWh and 62 €/MWh, being the highest since the end of 2016, as Figure 23 shows.
- From the beginning of October 2017 until mid-December natural gas prices at the NBP hub in the UK showed a significant increase, rising from 16 €/MWh to 26 €/MWh (see Figure 24), which impacted daily average wholesale electricity prices in the UK, increasing from 50 €/MWh to the peak of 77 €/MWh measured on 12 December. However, by the end of December both gas prices and the wholesale electricity price in the UK fell back significantly, owing to the lower industrial demand for power and milder-than-usual weather conditions. Wholesale electricity prices in the Irish market showed similar movements, though in periods of high wind generation Irish wholesale prices are less dependent on natural gas contracts than in the UK, enabling lower generation costs in Ireland and lower wholesale electricity prices than in the UK.
- The year-on-year change in the UK weekly domestic electricity generation mix between the fourth quarter of 2016 and 2017 can be followed on Figure 25. The most important change in the country's electricity generation mix over this period occurred in the share of wind: within a year it went up from 11% to 18% on quarterly average, while in some periods,, e.g.: at the beginning of October 2017 on week 40 wind ensured more than a quarter of the total electricity generated in the UK. This development underlines the game-changer role of renewables in the UK wholesale electricity market, traditionally determined by coal-gas competition. At the same time the share of gas in the UK power generation went down from 48% to 44% between the fourth quarter of 2016 and 2017.
- The share of coal in the UK generation mix showed a measurable increase in November 2017 in year-on-year comparison (from 9% to 14%). In spite of high continental prices primarily owing to lower than usual availability of nuclear capacities in France, wholesale prices in the UK did not show such sharp increases. Consequently, the traditional UK price premium to France turned to discount, enabling the country to ramp up its electricity exports to France, especially during the daily peak periods.
- Beside the improving renewable generation the introduction of the new capacity mechanism in the UK (the so-called early capacity market) as of the 2017/2018 winter period also contributed to keeping wholesale electricity prices under control in the country. This enabled UK power generators to ramp up coal fired generation and to make profits by exporting electricity to France. In the fourth quarter of 2017 the UK exported more than 1.5TWh electricity to France, being more than 50% higher than in the last quarter of 2016.

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



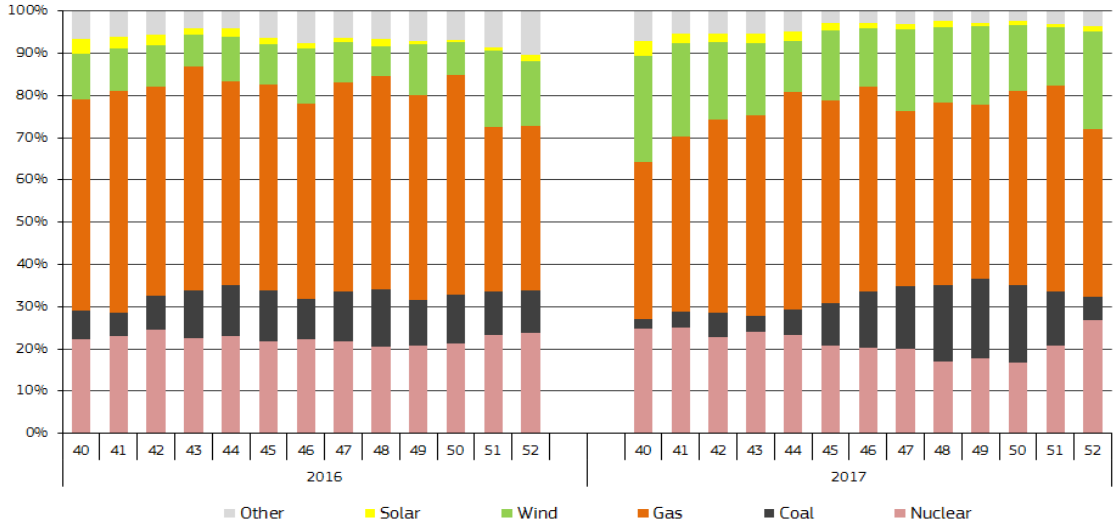
Source: Nordpool N2EX, SEMO

Figure 24 – *Daily average baseload electricity prices in the UK and Ireland*



Source: Nordpool N2EX, SEMO

Figure 25 – *Weekly evolution of the electricity generation mix in the UK in the fourth quarter of 2016 and 2017*

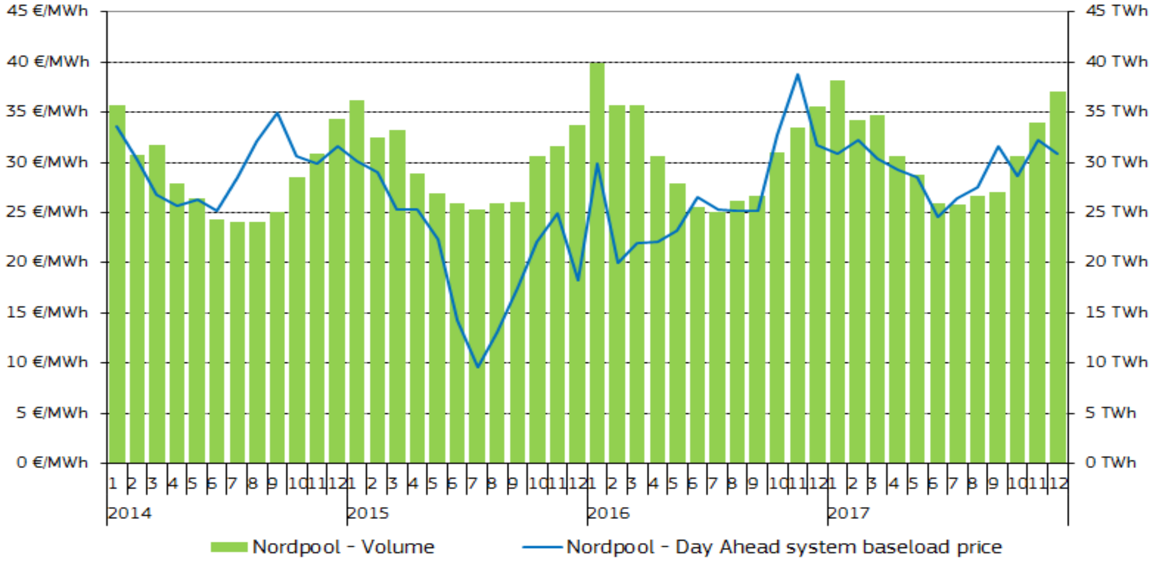


Source: ENTSO-E

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

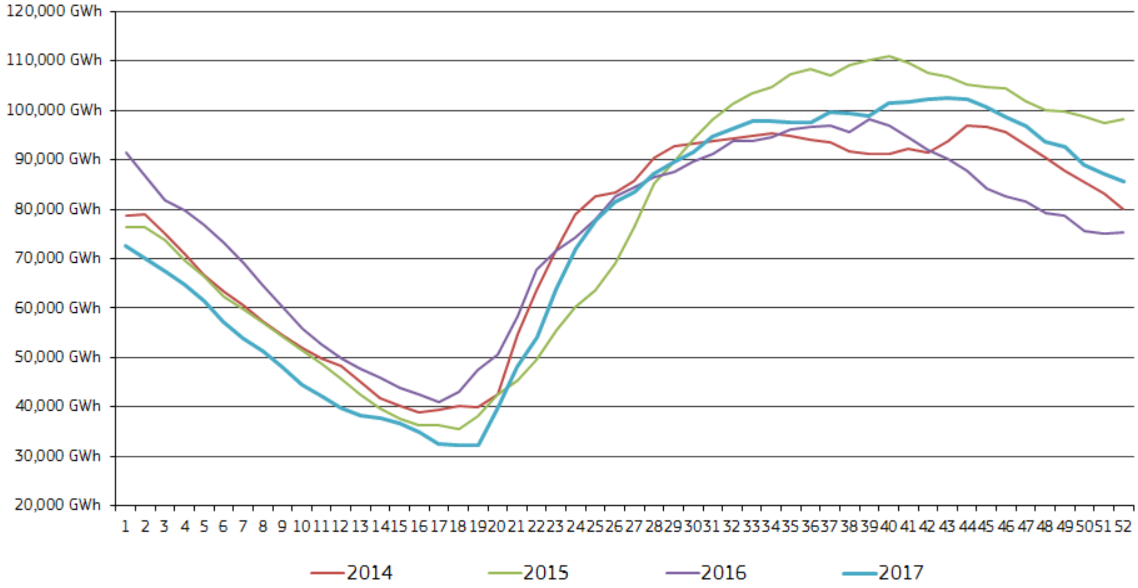
- In the fourth quarter of 2017 the monthly average wholesale system electricity baseload price in the Nordpoolspot market proved to be fairly stable and fluctuated in a narrow range of 29-32 €/MWh, as Figure 26 shows. Unlike in the fourth quarter of the previous year, sharp upturns in the wholesale system price did not occur during the autumn months of 2017.
- This could have been related to better hydro availability in the fourth quarter of 2017 than in the similar periods of the last two years (see Figure 27). Besides increasing hydro generation in Q4 2017 in year-on-year comparison, wind power generation also went up, squeezing out costly fossil fuel generation sources from the regional electricity mixes. The shift towards cheaper electricity sources helped in keeping regional wholesale prices under control.
- At the same time temperatures were milder across the Nordic region during almost all of the fourth quarter of 2017, which contributed to lower demand for electricity for residential heating purposes. Improving domestic electricity generation in the Nordic region coupled with limited demand for power enabled the reduction of electricity imports from Russia: while in Q4 2016 3.2 TWh of electricity was imported from that source, in Q4 2017 the total imports fell to 2.6 TWh.
- The impact of competitive domestic electricity generation vis-à-vis imports from Russia also impacted regional electricity price differentials. In Q4 2017 the price premium of Finland and the Baltic states diminished compared to the two previous quarters and regional prices in the Nordic region showed an improving convergence, as can be followed on Figure 28.
- Danish regional prices could even fell below the traditionally cheapest Norwegian regional peers during periods of high wind generation (e.g.: week 49 at the beginning of December 2017 or the last week of the year starting with Christmas) and Denmark increased its electricity exports electricity to Norway where it could also be stored in pumped hydro facilities.

Figure 26 - *Monthly electricity exchange traded volumes of and the average day-ahead wholesale prices in Northern Europe*



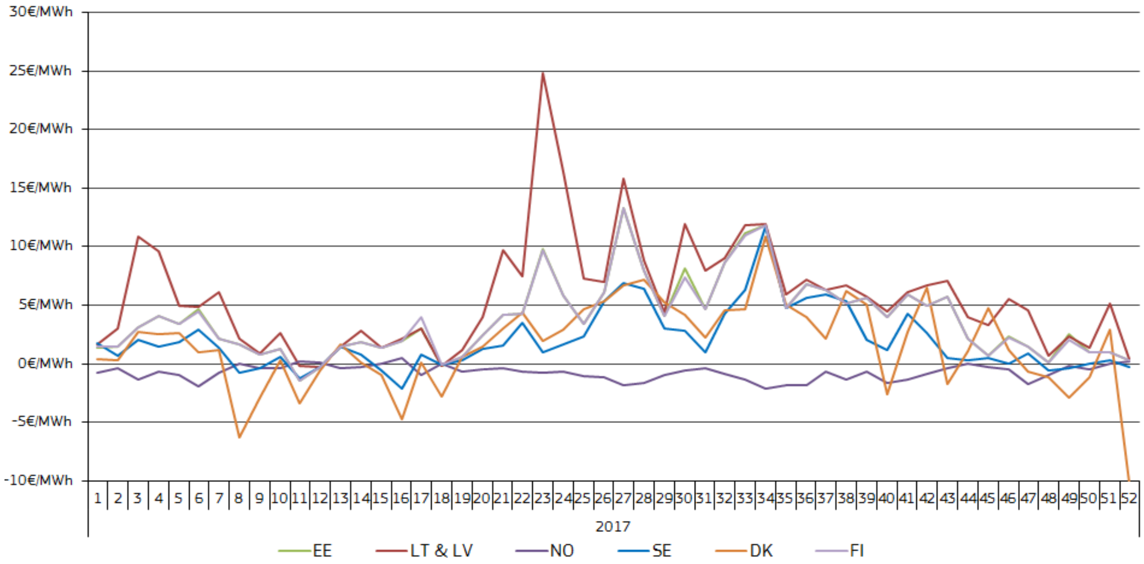
Source: Nordpool spot market

Figure 27 –*Weekly combined hydro reservoir levels (Norway, Sweden and Finland) in the Nordic region in different years*



Source: Nordpool spot market

Figure 28 – *Weekly average regional price deviations from the system price in the Nordic region*



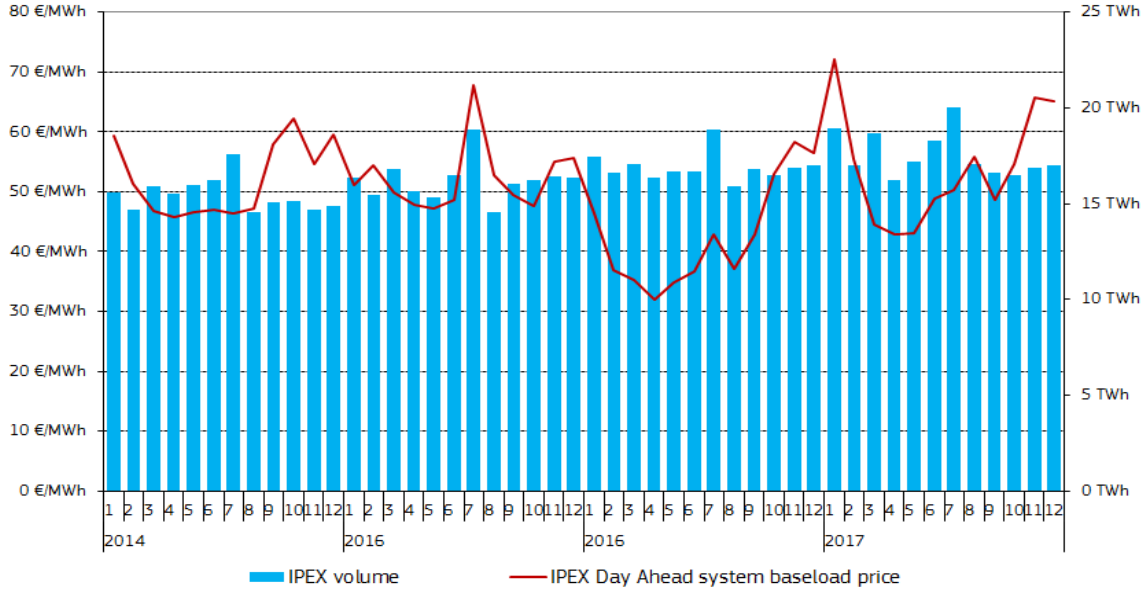
Source: Nordpool spot market

3.4 Apennine Peninsula (Italy)

- The Italian wholesale baseload electricity price, (see Figure 29) showed a significant increase during the fourth quarter of 2017: while the average baseload price was 49 €/MWh in September 2017, in October it rose to 55 €/MWh, to give further room for increase in November and December (reaching 65-66 €/MWh, being the highest in whole Europe in these two months).
- On the demand side, though daily average temperatures in October and November2017 were slightly higher than the long term daily averages during most of the time in Italy, anticipation of colder weather conditions and the decrease in temperatures in December contributed to the increase in wholesale electricity prices, taking into account the domestic needs for heating.
- On the supply side increasing natural gas prices (the spot gas price at the PSV hub in Italy went up from 19 €/MWh measured at the beginning of October 2017 to 29 €/MWh before the Christmas holidays) significantly impacted electricity generation costs and thus wholesale electricity prices in the country. Moreover, the quarterly share of hydro power decreased from 14% to 10% in year-on-year comparison, and as other forms of generation remained stable in the electricity mix, the share of gas increased. In the consequence of reduced availability of nuclear capacities in France, import sources of electricity became also more expensive, adding to the upward price pressure on the Italian wholesale electricity market.
- Figure 30, shows the daily evolution of the national average price and area prices in the Italian market. A sudden price spike could be observed on 12 December 2017 when an accident at the Baumgarten gas hub in Austria sparked fears on gas security of supply in several countries in Europe, including Italy, having direct gas interconnections with Austria. On this day the gas-price-sensitive Italian wholesale electricity price rose to 110 €/MWh, however, in the following days fears of gas supply problems were quickly priced out from electricity contracts.
- At the beginning of October 2017 regional prices in Corsica, having limited interconnection capacities[4] with mainland Italy, fell back close to the national average and in the rest of Q4 2017 area prices in Italy remained relatively well-converged compared to earlier quarters.

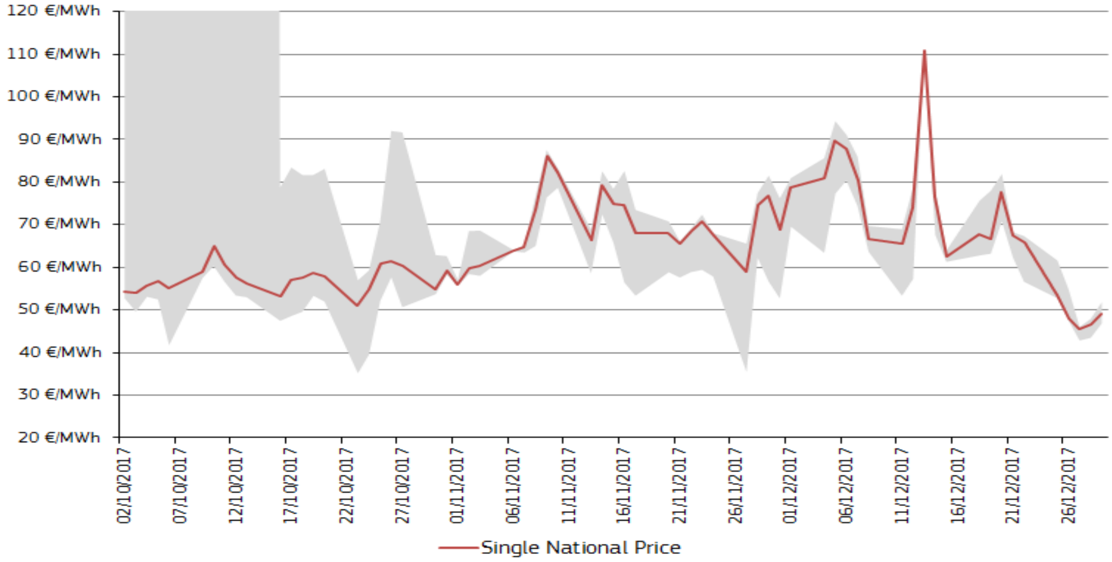
[4] The Clean Energy for EU Islands initiative aims at reducing the energy imports dependency of islands by making better use of their own renewable energy sources and embracing more modern and innovative energy systems. This will help reduce energy costs and at the same time improve air quality and lower greenhouse gas emissions : https://ec.europa.eu/energy/en/news/clean-energy-eu-islands-launched-malta

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



Source: GME (IPEX)

Figure 30 – *Daily average wholesale electricity prices in the Italian market, within the range of different area prices*



Source: GME (IPEX) – Shaded area reaching out towards the top of the chart implies that in some regions the local price was beyond the scale of this chart

3.5 Iberian Peninsula (Spain and Portugal)

- In the fourth quarter of 2017 the monthly average wholesale baseload contracts in Spain and Portugal showed a measurable increase compared to the end of the previous quarter: while in September 2017 the monthly baseload day-ahead contract was 49 €/MWh in Spain and 53 €/MWh in Portugal, in December it was close to 60 €/MWh in both markets. At the same time peakload contracts went up from 50 €/MWh to 63 €/MWh in Spain and from 52 €/MWh to 67 €/MWh in Portugal - see Figure 31.
- In October and November 2017, similarly to most of the European countries, weather was milder than usual in Spain and Portugal, however, in December the monthly average temperature fell below the seasonal values, adding to the upward pressure on natural gas and wholesale electricity prices.
- Figure 32 shows the evolution of the weekly electricity generation mix in Spain, comparing the fourth quarter of 2017 with the same quarter of 2016. On quarterly average the share of hydro decreased from 10% to 6%

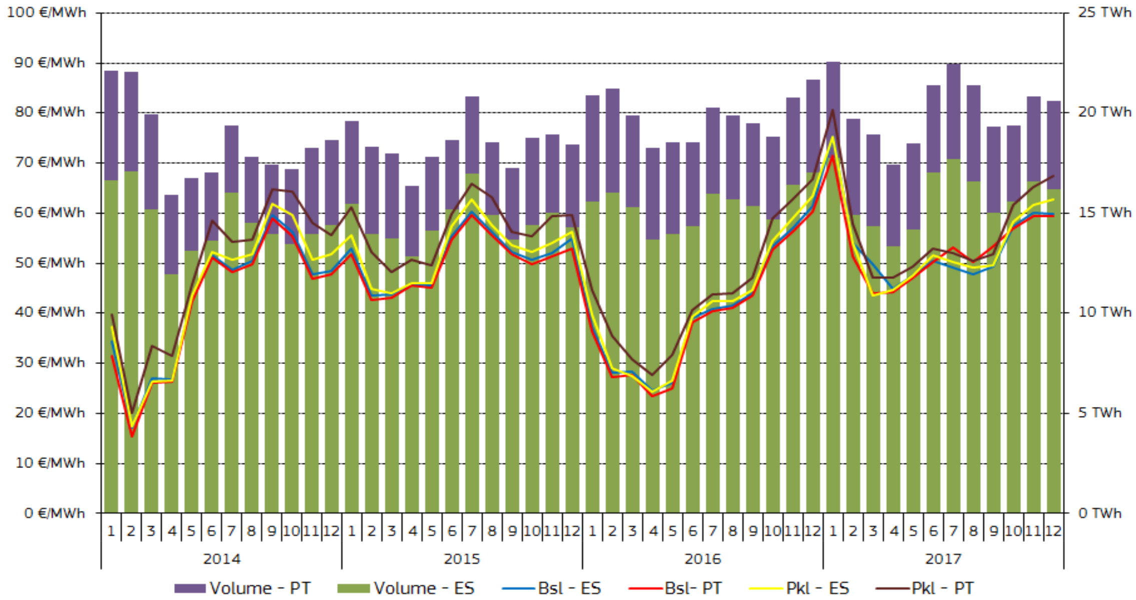
between 2016 and 2017, signalling that Q4 2017 was a dry period in the Iberian-peninsula compared to the previous year. At the end of November hydro reservoir levels in Spain fell to the lowest since 2011, putting an upward pressure on wholesale electricity prices.

- On the other hand, the share of wind power generation in the Q4 2017 was 20%, higher by 5% than in Q4 2016. Similarly to many other countries in Europe, wind energy has an increasing importance in the Spanish and Portuguese electricity mix. In the last week of 2017 wind ensured 40% of power generated in Spain while in Portugal its share was 45%, in both countries being the highest in the last two years.

- In November 2017 nuclear availability in Spain decreased compared to the previous month, as reactor Asco-II, having a nameplate capacity of 1 GW, was taken offline for refuelling and reactor Cofrentes-I (with a capacity of 1.1 GW) was shut down for security reasons at the end of October. The two reactors represent almost 30% of the country's nuclear fleet, and these missing generation capacities resulted in increasing share of fossil fuels during these weeks. In the first two weeks of December 2017 both reactors returned to the grid.

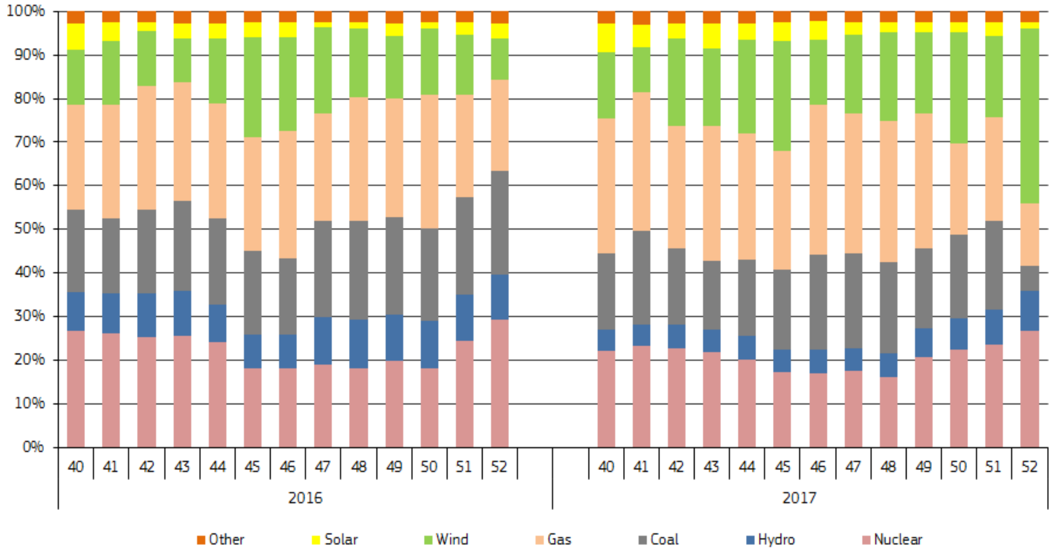
- In the second half of November 2017 and in the first week of December the combined share of gas and coal was above 50% in the Spanish electricity generation mix, which, combined with retreating wind generation, reduced nuclear and low hydro availability, resulted in high wholesale electricity prices, reaching their peak on 5 December (77 €/MWh) In contrast, in the last week of the year as wind generation surged, the share of fossil fuels in the generation mix dropped below 20%, resulting in low wholesale prices. Similarly to other European markets, wind became a real competitor.

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



Source: Platts, OMEL

Figure 32 - *Weekly evolution of the electricity generation mix in Spain, comparing the fourth quarter of 2016 and 2017*

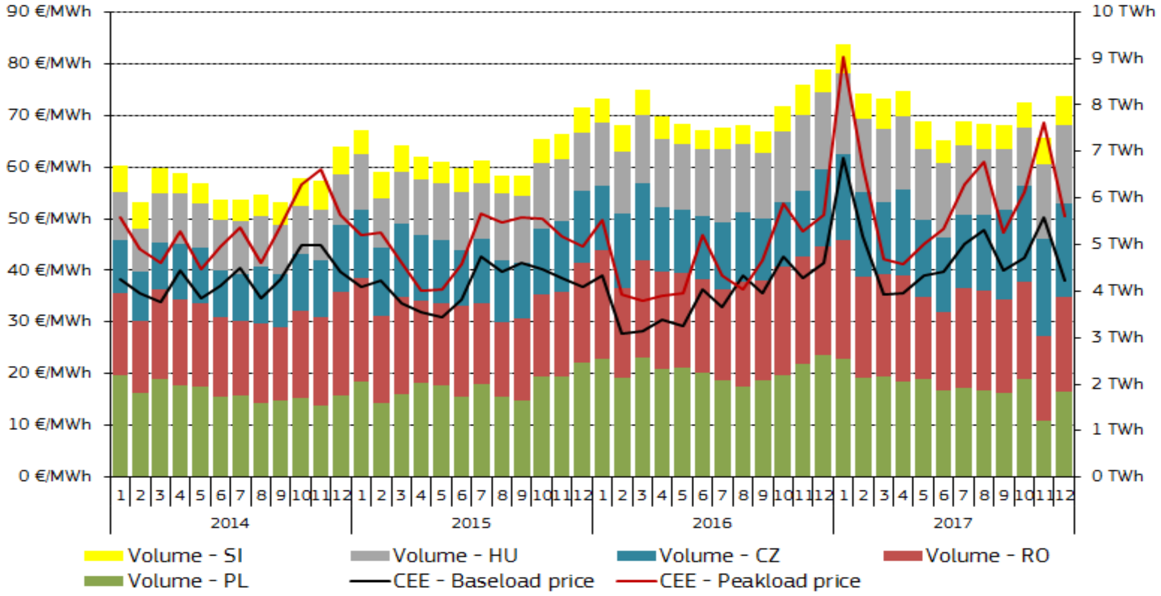


Source: ENTSO-E

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

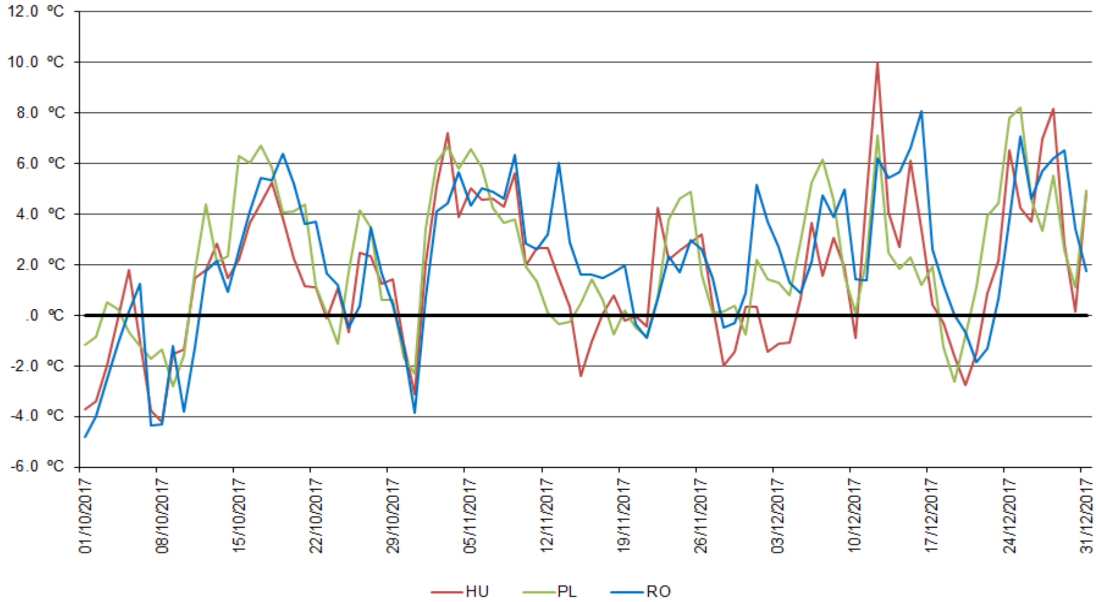
- The regional monthly average price in Central and Eastern Europe (CEE) rose from 40 €/MWh to 50 €/MWh between September and November 2017, however, in December it fell back to 39 €/MWh. At the same time peakload contracts reached 69 €/MWh in November 2017 on average, being the highest since January, and in the last month of 2017 they also fell back to 50 €/MWh, as Figure 33 shows. The regional weighted average of daily market prices reached its peak on 29 November (69 €/MWh), while the lowest price could be observed on 24 December (8 €/MWh). In the Czech Republic and Slovakia for the first time ever the daily average wholesale price fell below zero on 29 October.
- In the first two weeks of October 2017 temperatures were generally lower across the CEE region compared to the long-term averages, as it can be followed on Figure 34. However, during the rest of the fourth quarter of 2017, with the exception of some short-lived cold spells in early and late November and before Christmas, the weather was generally milder than usual, putting a lid on demand for heating and regional wholesale electricity prices.
- After recoupling at the end of Q3 2017, regional market prices showed signs of divergence again during the fourth quarter of 2017. As it can be followed on Figure 35, weekly average wholesale prices in the Czech Republic were the lowest during Q4 2017, while prices in Hungary and Slovenia were the highest, followed by the Romanian and Polish day-ahead contracts. During the Christmas holiday period, owing to the decreasing demand for electricity, wholesale prices across the region re-converged again, amid a general price decrease.
- Hydro availability during the fourth quarter of 2017 was generally lower in Central and Eastern Europe and in the Balkans compared to the last quarter of 2016. In Romania for example, hydro electricity generation in Q4 2017 was 3.6 TWh, being almost 20% lower than a year before. Lower level of hydro reservoir in the Balkans resulted in less competitive import opportunities, upwardly impacting wholesale electricity prices in Hungary and Slovenia.
- The availability of generation capacities was fairly good across the region, though some capacities in October (Dukovany-3 in the Czech Republic and one of the four reactors of Paks nuclear plant in Hungary) were taken offline for maintenance works, similarly to one of the blocks of the Temelin nuclear plant in the Czech Republic in December. However, both in Hungary and the Czech Republic nuclear generation in Q4 2017 rose (respectively by 45% and 15%) in year-on-year comparison, as in 2016 more capacities were taken offline in this period of the year.
- In October and December 2017 wind power generation in Poland reached the highest ever, ensuring almost 14% of the electricity generation mix in the country. Good nuclear availability and increasing wind generation in some countries of the CEE region might have also contributed to relatively low wholesale electricity prices in European comparison. Central Western Europe normally exports more electricity to the CEE region than it imports, however, in November 2017 the CEE region was net electricity exporter vis-à-vis the CWE region (primarily owing to reduced nuclear capacity availability in France – see Chapter 3.1).

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



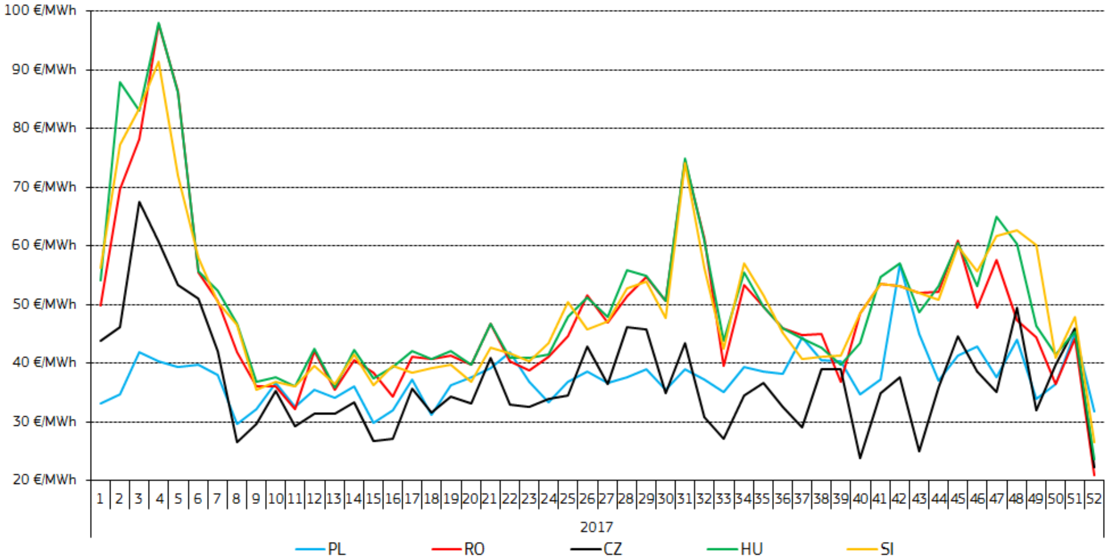
Source: Regional power exchanges, Central and Eastern Europe (CEE)

Figure 34 – *Difference between the actual daily average temperature and the long term average (1975 – 2016)*



Source: JRC, DG ENER own computations

Figure 35 – *Weekly average wholesale power prices in the CEE region*

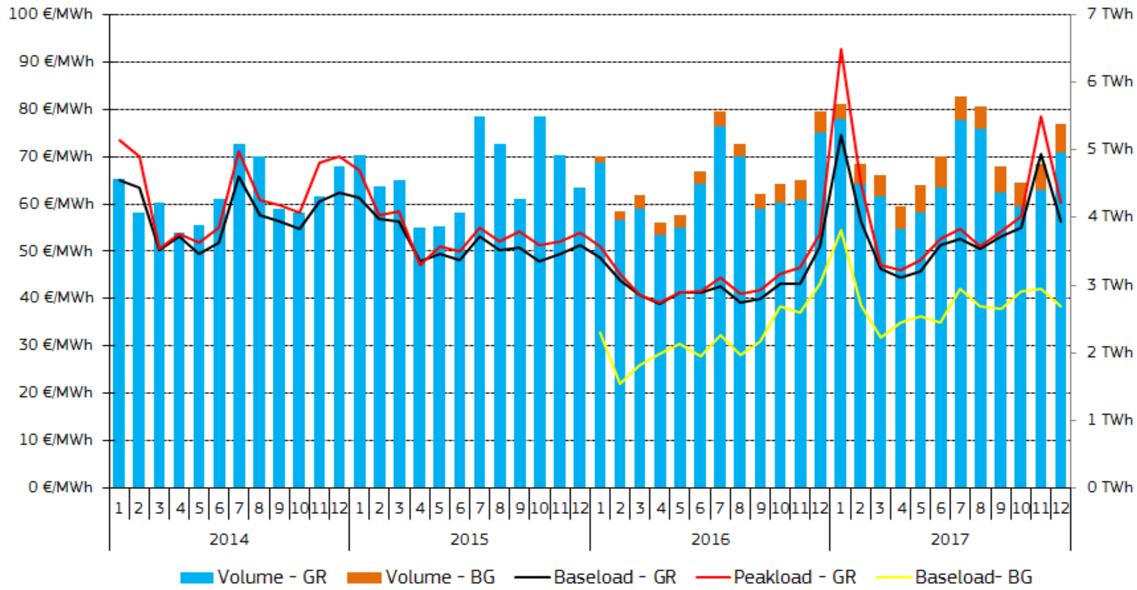


Source: Platts, CEE Regional power exchanges

3.7 South Eastern Europe (Greece and Bulgaria)

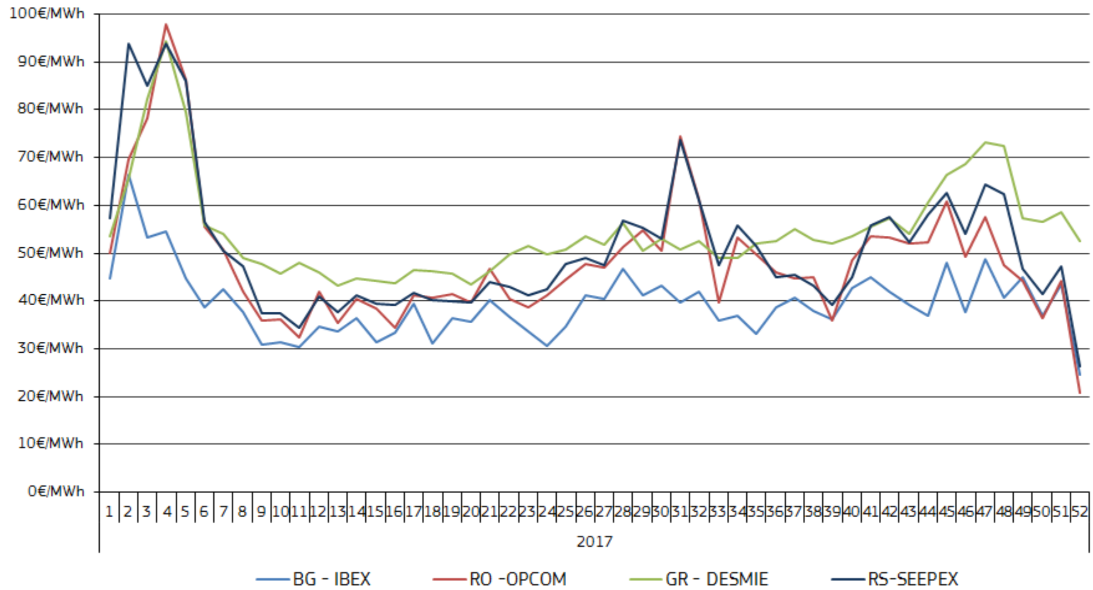
- Wholesale electricity prices in Greece rose significantly in the fourth quarter of 2017: Compared to September 2017, when the average baseload stood at 53 €/MWh and the average peakload was 54 €/MWh, in November they reached 70 €/MWh and 79 €/MWh respectively. Then in December the baseload fell back to 56 €/MWh and the peakload to 60 €/MWh, as it can be followed on Figure 36. At the same time the monthly average baseload price in Bulgaria fluctuated in a narrow range of 38-42 €/MWh during Q4 2017.
- With the exception of the first two weeks of October, and some days in November and December, temperatures in Q4 2017 in Greece and Bulgaria were generally higher compared to the long term daily averages, implying that heating related demand for electricity and natural gas that could not exert a singnificant pressure on wholesale electricity prices remained limited.
- Looking at the weekly average price contracts (see Figure 37), Greek prices fluctuated between 53 €/MWh and 73 €/MWh during Q4 2017, and the daily average contract reached its peak on 29 November (100 €/MWh). The baseload contracts in Serbia and Romania were well aligned during Q4 2017, showing a discount to Greek prices, but the cheapest were the price in Bulgaria, being around 40 €/MWh during most of the quarter and dropping below 30 €/MWh at the end of the year. Romanian and Serbian prices were more affected by the generally low hydro availability in the Balkans, whereas in Bulgaria hydro levels were higher than usual during the fourth quarter of 2017.
- The share of wind in Q4 2017 in the Greek electricity generation mix slightly increased compared to the same quarter of 2016 (12% vs. 9%), while at the same time the share of hydro decreased (from 7% to 4%). The share of fossil fuels (gas and lignite) did not change too much in year-on-year comparison. The net importer position of Greece slightly increased in Q4 2017 compared to the same period of 2016 (964 GWh in Q4 2016 vs. 1,028 GWh in Q4 2017). As there were only minor changes in the domestic generation mix in year-on-year comparison, increasing costs of electricity imports (higher market prices in the import source countries) might have had more important impact on the Greek wholesale electricity market.

Figure 36 - *Monthly traded volumes and prices in Greece and Bulgaria*



Source: LAGIE, IBEX

Figure 37 – Comparison of weekly average day-ahead prices in Bulgaria, Greece, Romania and Serbia



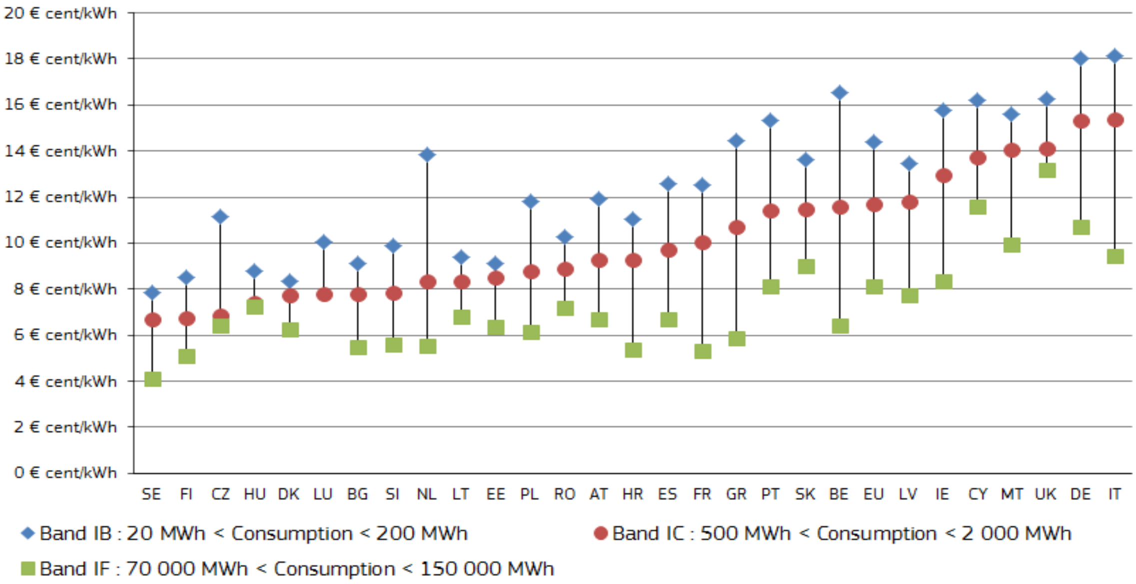
Source: IBEX, LAGIE, OPCOM, SEEPEX

4 Retail electricity prices in the EU

4.1 Retail electricity prices in the EU Member States

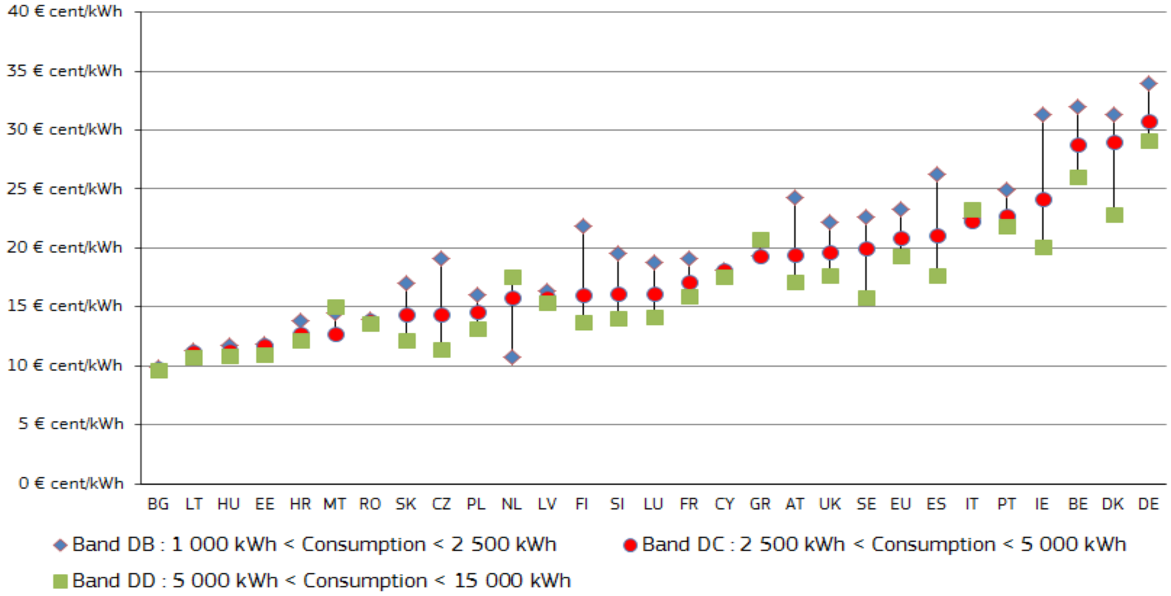
- Figure 38 and Figure 39 show the monthly estimated retail electricity prices in December 2017 in the 28 EU Member States for industrial customers and households for three different levels of annual electricity consumption (Eurostat bands I_B, I_C and I_F for the industrial customers and bands D_B D_c D_d for households). Normally the lower is the annual electricity consumption of a given customer, the higher price this customer needs to pay per kWh.
- Retail prices paid by households include all taxes, while retail prices paid by industrial customers are prices without VAT and recoverable taxes and levies. Monthly retail electricity prices are estimated by using the Harmonised Consumer Price Indices (HICP) based on the time series of twice-yearly retail energy price data from Eurostat.
- In the case of industrial customers with low annual consumption in December 2017 Italy was the most expensive country (with a price of 18.2 Eurocent/kWh), while Sweden was the cheapest (7.9 Eurocent/kWh). At the same time in the case of households with low annual consumption retail electricity prices were the lowest in Bulgaria (9.9 Eurocent/kWh), while households had to pay the most in Germany (34.0 Eurocent/kWh).
- In the case of industrial customers, having medium level annual electricity consumption (Band I_C), the monthly ratio of the highest and the lowest price in the EU was 2.3 (6.7 Eurocent/kWh and 6.8 Eurocent/kWh in Finland and Sweden, 15.4 Eurocent/kWh in Germany and Italy), while in the case of large industrial customers it was 3 (4.1 Eurocent/kWh in Sweden, 13.2 Eurocent/kWh in the United Kingdom) in December 2017. In the same month, in the case of households with medium level annual consumption (Band D_C) the highest-lowest price ratio was 3.1 (9.8 Eurocent/kWh in Bulgaria, 30.8 Eurocent/kWh in Germany).

Figure 38 – *Estimated industrial retail electricity prices, December 2017 –without VAT and recoverable taxes and levies*



Source: Eurostat, DG ENER

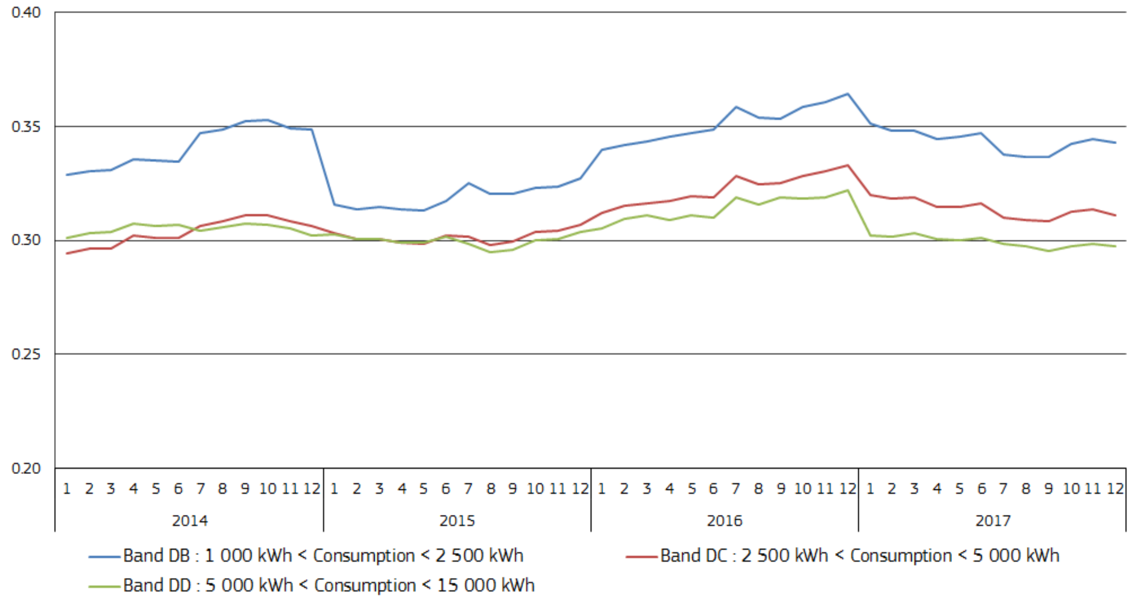
Figure 39 - *Estimated household retail electricity prices, December 2017 –all taxes included*



Source: Eurostat, DG ENER

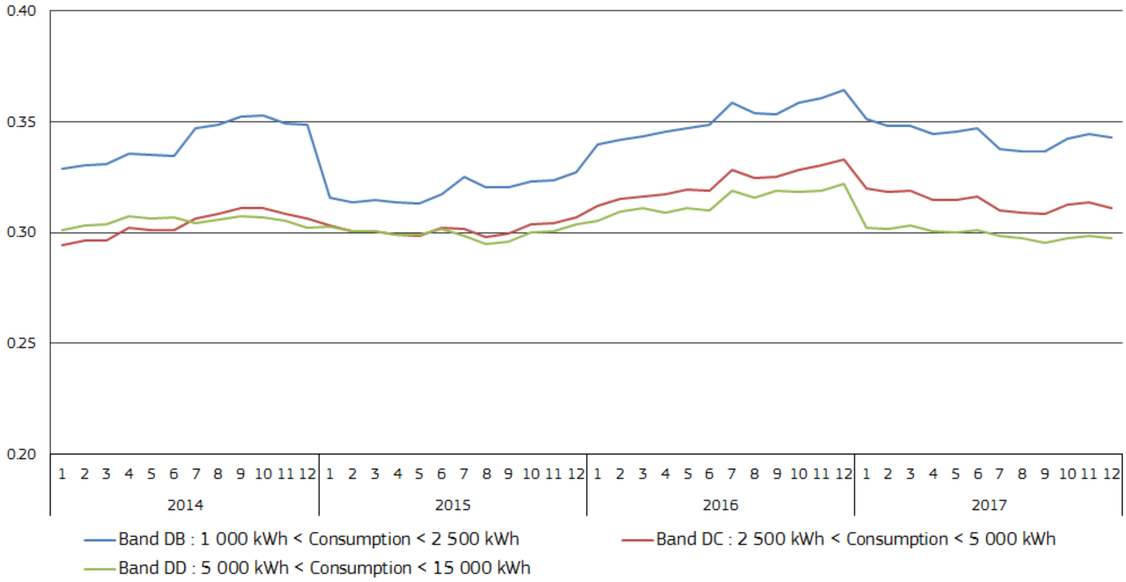
- Figure 40 and Figure 41 show the different behaviour of industrial and household retail price convergence across the EU, using relative standard deviation of retail electricity prices as metric. In the case of industrial customers the last quarter of 2017 showed a high degree of stability regarding the retail electricity price differentials across the European countries. Therefore, by the end of the year differences in retail electricity prices across the EU were still higher than in 2016, in parallel with higher and more divergent wholesale electricity prices in the European markets.
- The slight convergence of retail electricity prices paid by household customers, after evolving in the first three quarters in 2017, did not continue in Q4 2017 and the standard deviation indicator even slightly increased between October and December, especially for household customers with smaller annual electricity consumption. Price convergence developments on the wholesale electricity markets have normally higher impact on the industrial retail prices, as in the case of these customers the share of energy supply costs is higher in the final price than in the case of household customers, and consequently and the share of the so-called non-market elements (network charges and taxes and levies) is lower.

Figure 40 – ***Relative standard deviation of retail electricity prices in the EU Member States in three industrial customer consumption groups***



Source: Eurostat, DG ENER

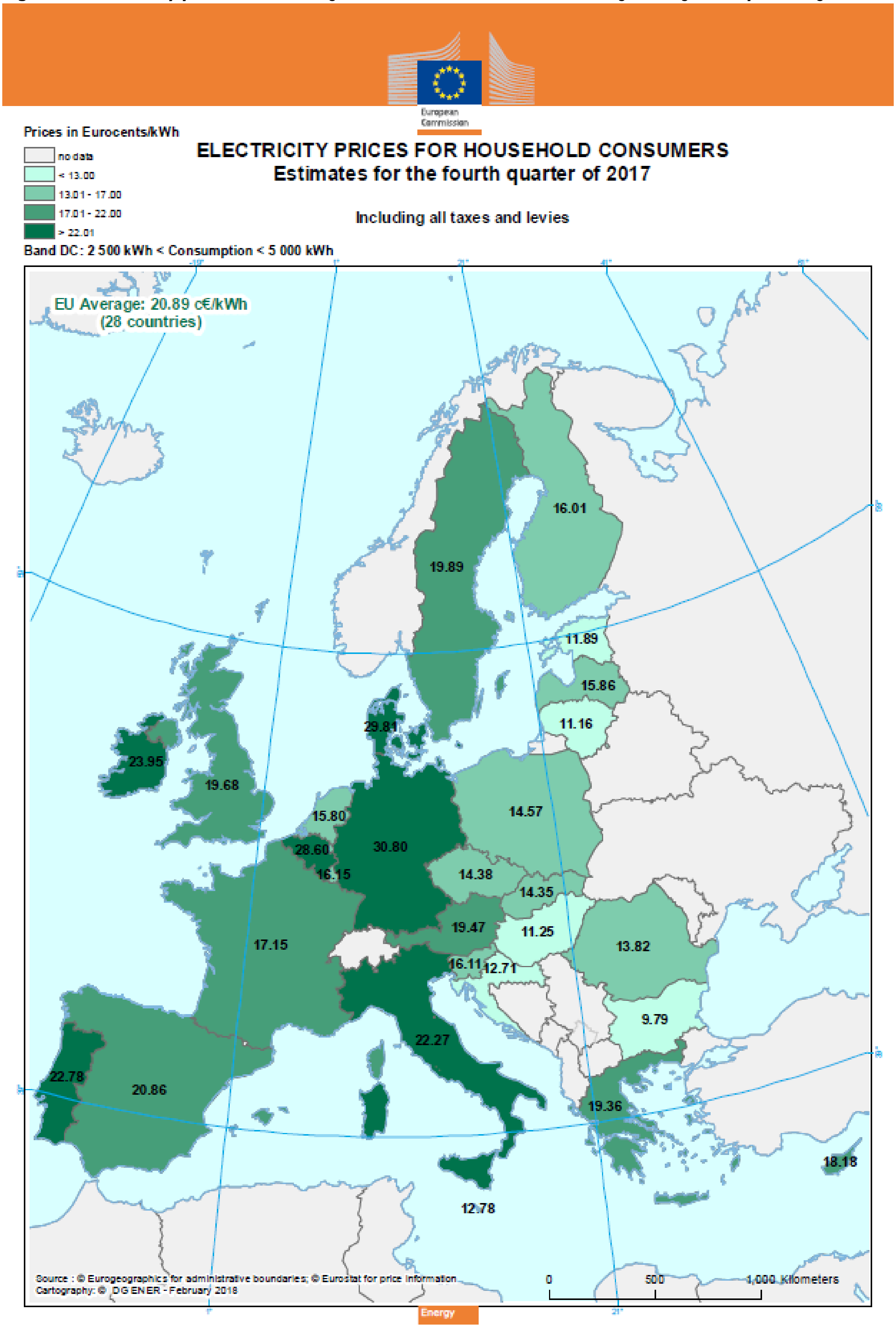
Figure 41 – *Relative standard deviation of retail electricity prices in the EU Member States in three household customer consumption groups*



Source: Eurostat, DG ENER

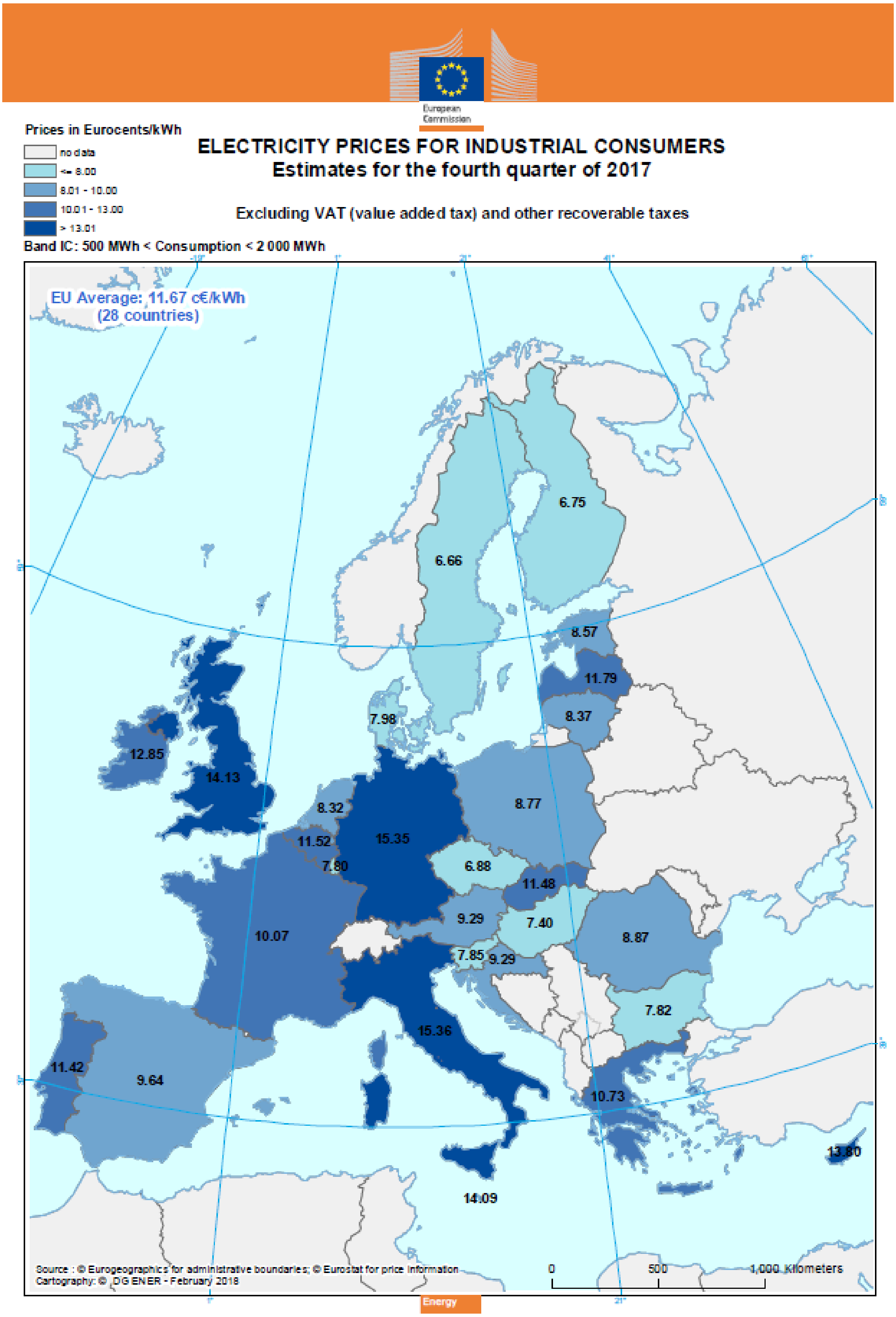
- The two maps (Figure 42 and Figure 43) show the estimated quarterly average retail electricity prices paid by households and industrial customers, having medium level of annual electricity consumption, in the fourth quarter of 2017.

Figure 42- ***Electricity prices (inclusive of taxes) – Households – Estimated for the fourth quarter of 2017***



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

Figure 43 – *Electricity prices (without VAT and non-recoverable taxes) – Industrial consumers – Estimated for the fourth quarter of 2017*

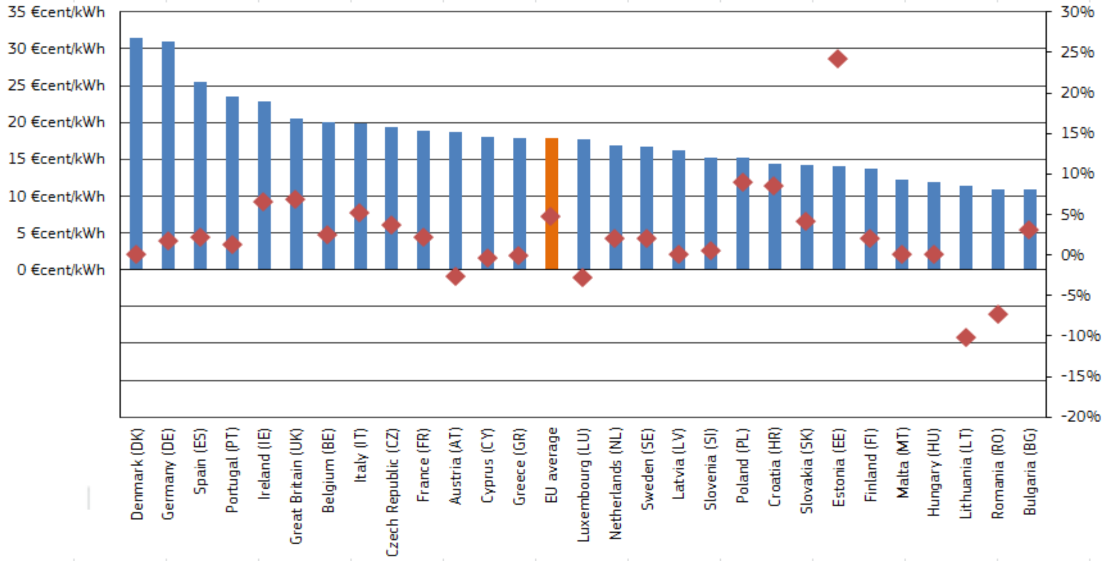


Source : Data computed from Eurostat half-yearly retail electricity prices and consumer price indices

4.2 Retail electricity prices in the EU capital cities

- Figure 44 shows the retail electricity price element of the so-called Household Energy Price Index (HEPI), calculated with a methodology developed by Vaasaett on the basis of monthly collection of electricity invoices in the capital cities of the EU. In December2017 the highest retail electricity prices paid by households could be observed in Copenhagen and Berlin (31.5 Eurocent/kWh and 30.9. Eurocent/kWh, respectively), while the cheapest capitals in the EU were Sofia and Bucharest (10.9 Eurocent/kWh, and 11.0 Eurocent/kWh, respectively). Compared with December 2016, a significant price increase could be observed in Tallinn (24.2%). Prices also went up in Warsaw (9%), and Zagreb (8.5%). Retail electricity prices decreased the most in Vilnius (10.2%) and in Bucharest (7.3%).

Figure 44 – *The Household Energy Price Index (HEPI) in the European capital cities - Electricity prices in December 2017, and changes in household electricity prices compared to December 2016*



Source: Vaasaett

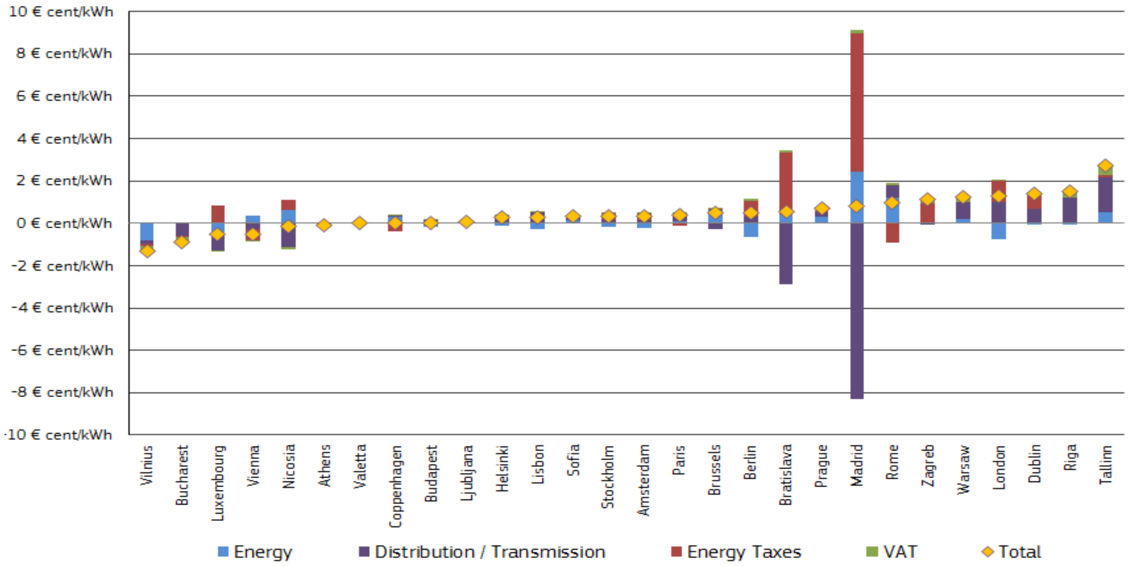
- Figure 45 shows the change in household retail electricity prices between December 2016 and December 2017, expressed in Eurocent/kWh, and the contribution of the cost components (energy costs, transmission and distribution costs, energy taxes and VAT) to the price change in the European capital cities. Energy supply costs went up the most in Madrid and Rome (respectively by 2.4 Eurocent/kWh and 1.2 Eurocent/kWh), and they decreased measurably in London (0.8 Eurocent/kWh) and Vilnius (0.8 Eurocent/kWh).

- Energy taxes increased measurably in Madrid and Bratislava, (by 6.6 Eurocent/kWh and 2.9 Eurocent/kWh, respectively), though it was the consequence of reclassification of retail price components between taxes and network costs, resulting in the decreases in transmission and distribution costs (by 8.3 Eurocent/kWh and 2.9 Eurocent/kWh, respectively) in these two cities[5]. In London energy taxes also increased by 1 Eurocent/kWh. In contrast, in Rome, where energy taxes went down by 0.9 Eurocent/kWh, the distribution costs went up by 0.6 Eurocent/kWh.

- Transmission and distribution costs, beside the aforementioned examples, had the biggest upward impact on the final retail prices in Tallinn (1.6 Eurocent/kWh) and Riga (1.2 Eurocent/kWh), whereas in Nicosia network costs decreased by 1.1 Eurocent/kWh).

[5] See also in the Quarterly Report on European Electricity Markets, Vol. 10, third quarter of 2017

Figure 45 – *Change in electricity prices and their cost components in the European capital cities, between December 2016 and December 2017, in* Eurocent/kWh

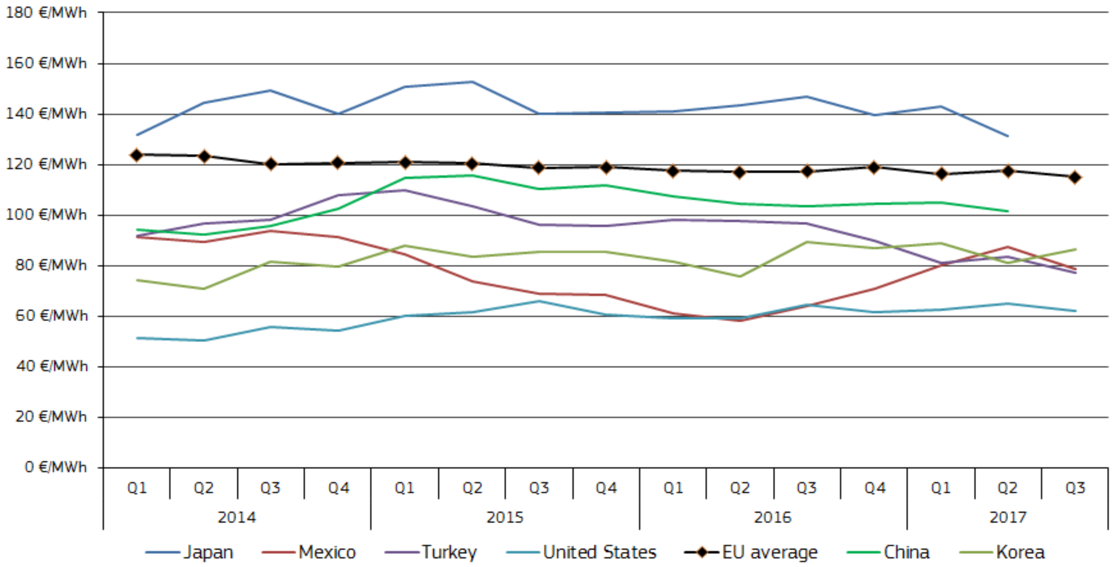


Source: Vaasaett

4.3 International comparison of retail electricity prices

- Retail electricity prices paid by industrial customers in the EU are relatively high, if compared with industrial electricity prices in the main trading partners of Europe, as the next chart (Figure 46) shows. Differences between wholesale electricity prices in the EU and the US are perfectly reflected in differences between EU and US retail electricity prices paid by industrial customers. In the case of Japan the difference in wholesale prices with the EU was bigger than in the case of retail industrial electricity prices in the last few quarters.
- Retail electricity prices in China were 10-15% lower than in the EU in the first three quarters of 2017. In the case of Turkey, Korea and Mexico the price discount to the EU was around 25-30% in the same period. In Q3 2017, similarly to the previous quarters, retail industrial electricity prices were the cheapest in the US, being around 45% lower than the EU on average. Retail electricity prices in Japan were higher in Q1-Q3 2017 than in the EU, though they decreased and the Japanese price premium was around 10-15%.

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



Source: Eurostat, IEA, CEIC, DG ENER estimations

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 *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.

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 *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.