

Annual Market Update 2019

Electricity market insights





Introduction

Annual Market Update 2019, an electricity market review focused on the Netherlands and Germany, including wider European trends

This Annual Market Update (AMU) is focussed on relevant developments on the Central Western European electricity markets, and the Dutch and German electricity markets in particular. This is the second edition of the TenneT Annual Market Update. In the past, TenneT published the TenneT Market Review annually to share its insights on last year's developments in the electricity market for everyone interested (see [link](#) for previous editions). The structure and topics of the AMU are largely comparable to the TenneT Market Reviews, but the format is different.

The developments in the Annual Market Update are structured alongside several main topics. The chapter *Wholesale market prices* discusses wholesale day-ahead, intraday and futures prices and identifies price trends. As our electricity system is still highly dependent on fossil-fuelled power, the chapter *Fuel prices* describes developments in hard coal, natural gas and emission allowance prices, as well as the margins for generators. The chapter *Capacity & generation* focuses on the supply side of the electricity system and discusses developments in installed capacity and generation. Support for renewables in the Dutch system is discussed in the chapter *RES support schemes*, by looking at budget distribution, awarded capacity and generation of the SDE+ schemes. In the chapter *Wholesale Market integration* the storyline zooms out and includes the interactions of the Dutch electricity system with neighbouring systems. Additionally, the ongoing efforts of coupling EU electricity markets are discussed in this chapter. The last two chapters focus on mechanisms in place to ensure the stability and functioning of the electricity system: *Balancing* measures, to ensure supply and demand is equal at all times; and *Redispatch* measures, to resolve congestion in the grid.


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Fuel prices & generators


Capacity & generation


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Main Findings (1/3)

Lower wholesale electricity prices across Europe in 2019, prices within CWE had a higher convergence. Coal-to-gas switching since spring.

Wholesale electricity prices across Europe decreased in 2019. The average day-ahead electricity price decreased in the Netherlands by 21.5% to 41.2 €/MWh and decreased within the CWE region with 21.7% to 39.7 €/MWh. Additionally wholesale prices within the CWE region also converged more than in 2018. For the Netherlands the amount of hours with full price convergence increased with all neighbours and reaching 50% full convergence with Germany. For Germany an increase of full convergence with most of its neighbours was reached, reaching the highest full convergence with Denmark (DK1) by 66%.

This decrease in wholesale electricity prices across Europe is mainly explained by a significant decrease in natural gas (36%) and coal prices (28%), the annual average carbon emission allowance price stabilised around 25 €/t CO₂ an average increase of 61% compared to 2018. The effect of these changes in fuel and carbon prices resulted since March in coal-to-gas switching due to higher generator margins for gas-fired power plants compared to coal-fired power plants in both the Dutch and German markets.



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Main Findings 2/3

Installed Solar capacity in NL increased by 2.4 GW. NL net positions switching from a more dominant import position towards a more balanced import/export position.

Total generation in the Netherlands increased due to less imports and increased exports. As a consequence of coal-to-gas switching, generation based on natural gas significantly increased and generation based on coal significantly decreased. Renewable generation slightly increased by 13.9% to 16.7 TWh for wind and solar generation. Additionally around 1.7 TWh of biomass co-firing in coal-fired power plants was certified, meaning 1.7 TWh of total generation in coal-fired power plants can be attributed to the biomass co-firing.

In 2019 round I, less funds were made available for SDE+ subsidies compared to previous SDE+ rounds. The available budget was not fully allocated due to incomplete requests or lack of appropriate permits. For 2019 round II, another 5 B€ was made available, bringing the total available budget for 2019 to 10 B€. At the time of writing, the budget distribution of 2019 round II had not yet been published. Solar projects still had the largest share in allocated SDE+ subsidies by 2.54 B€ in 2019 round I. The cumulative development of awarded projects in SDE+ show more than 20 GW of renewable capacity is expected to be installed which accounts for an annual generation of around 45 TWh, of which 7 TWh by unsubsidised offshore wind.

Physical net import and export positions in the CWE region changed significantly in some countries in 2019 compared to 2018. The Netherlands increased its export position due to improved competitiveness of gas-fired power plants resulting in a near equal amount of annual imports and exports over 2019. First flows between DK1 and NL were realised due to the go-live of the DK1-NL interconnector COBRACable in September. The German net position remained predominantly exporting but a significant increase in hours with an importing net position can be observed. Increased availability of Belgium nuclear plants resulted in a more balanced import and export position over 2019 after a dominant importing position over 2018.



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Main Findings (3/3)

Capacity prices for NL FRR balancing products decreased significantly during 2019. Redispatch costs up in NL and DE.

Capacity prices for Frequency Restoration Reserves (FRR) decreased again in 2019 after a steep increase in 2018 as a result of an increase in the amount of contracted capacity in order to comply with the EU Electricity Balancing Guideline. Prices almost returned to pre-2018 levels indicating a significant response from the market. Capacity prices for Frequency Containment Reserves (FCR) decreased as well. Furthermore, since July 2019, FCR capacity is auctioned daily instead of weekly and marginal pricing was introduced in the FCR auctions. The daily auctions led to more volatile prices.

Since 2013, a trend was observed: a decreasing number of ISPs with a low net imbalance volume and an increasing number of ISPs with high net imbalance volume. This trend seems to have stopped in 2019 compared to 2018. Similar to 2018, the 2019 imbalance volume shows a more symmetrical distribution of ISPs with long and short imbalance volumes. This is also seen in the imbalance price delta, which reached a near equal level for long and short systems in 2018 and 2019.

In September the first Intraday Congestion Spreads (IDCONS) were activated via the Grid Operators Platform for Congestion Solutions (GOPACS). GOPACS is a TSO-DSO coordinated market-based congestion management platform that enables intraday bids with a geo-tag to be used for congestion management as well (see for more info www.gopacs.eu). Costs for congestion management in the Netherlands increased to €61 million in 2019 (+12%). Most costs were related to redispatch, and a smaller share can be attributed to restriction contracts, which are contracts with market parties to withhold a share of production for a certain period. Across the border in Germany, cost for congestion management in the first three quarters (Q4 data unavailable yet) of 2019 were in the order of €1 billion.



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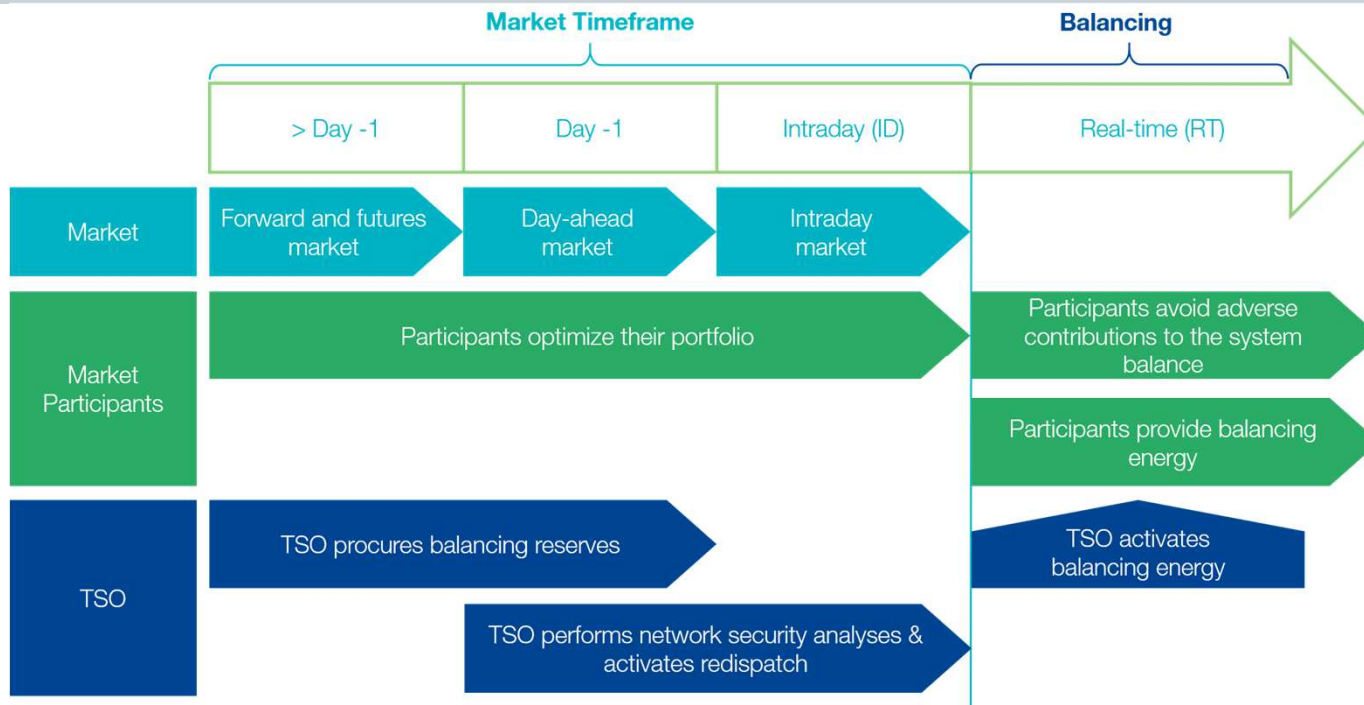
Wholesale Market Prices



Market Timeframes

The wholesale market consists of several sub-markets

Market Timeframe and Balancing



- The figure above shows the relation between the different timeframes of the wholesale market and the balancing market. In wholesale markets, electricity generators sell electricity to large industrial consumers and electricity suppliers. The electricity suppliers sell electricity to the final consumer in retail markets. The scope of this Annual Market Update is on wholesale markets.
- Balancing and redispatch are system services that are important features of the electricity system. TSOs procure balancing reserves that can be activated in real-time to resolve disruptions in system balance. Also, TSOs perform network security analyses to identify congestion, which is resolved by activating redispatch.

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Bar chart icon
Wholesale market prices

€ icon
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Lightbulb icon
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Wind turbine icon
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Globe icon
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Scales icon
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Downward arrow icon
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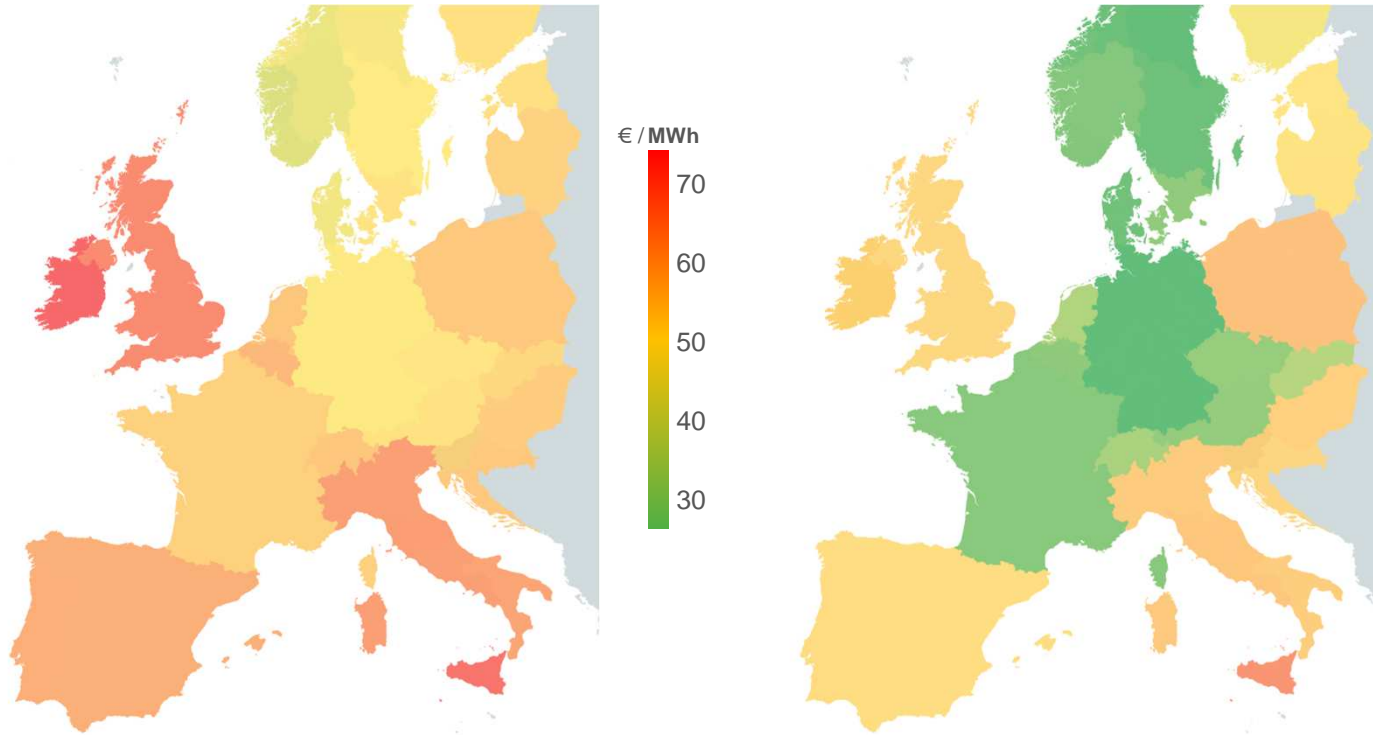


Day-ahead prices Europe

2019: significant decrease of day-ahead prices across Europe

Yearly Average DA Prices Europe
2018

2019



- Annual average day-ahead prices of almost all European countries significantly decreased from 2018 to 2019.
- The Netherlands, Ireland, the UK and France experienced the steepest decline in the range of 20% - 30%.
- Germany, the Southern European countries and Sweden experienced a decrease of around 15%.

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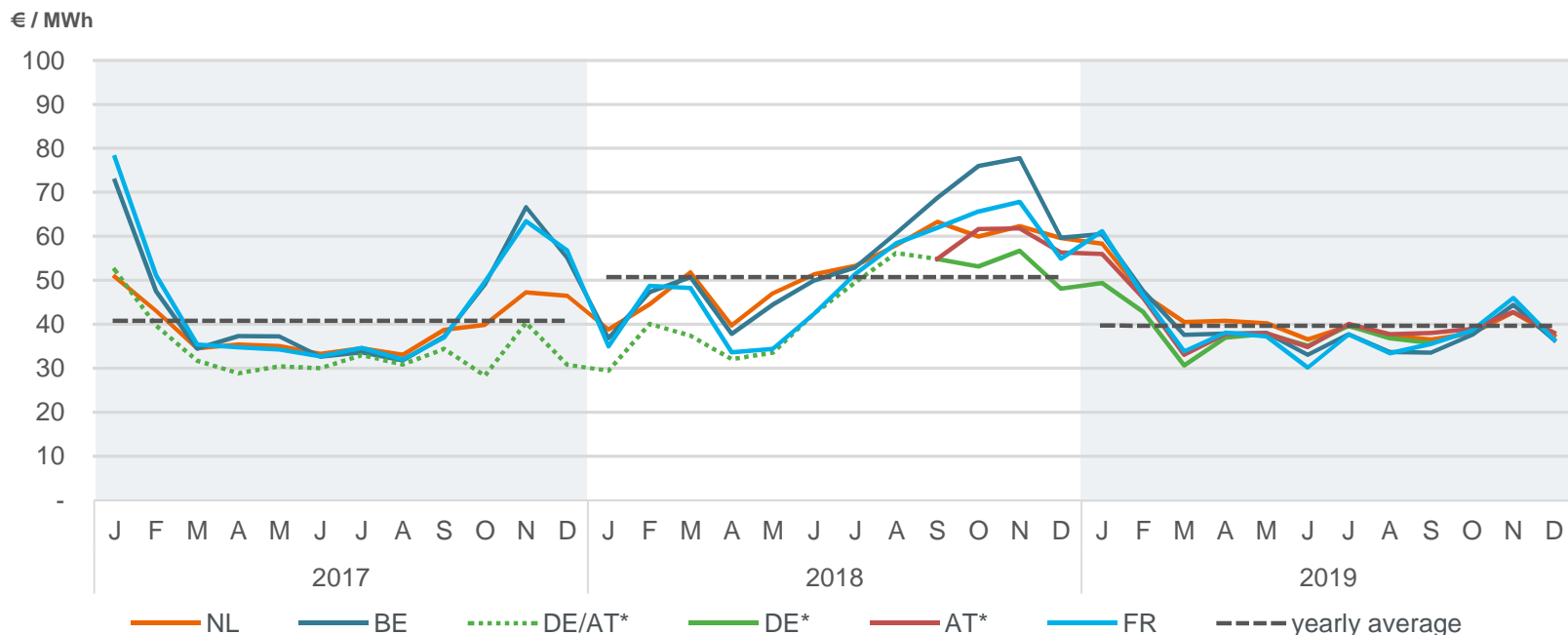
Congestion management



Day-ahead prices CWE

Prices significantly decreased and converged within CWE

Monthly Average Day-ahead Wholesale Prices in the CWE region



* On October 1st, 2018 the German/Austrian bidding zone split into two separate bidding zones

- The average day-ahead (DA) electricity price decreased in the Netherlands by 21.5% to 41.2 €/MWh and decreased within the Central Western European (CWE) region by 21.7% to 39.7 €/MWh.
- Overall, DA prices in the CWE region decreased, mainly due to lower fuel prices (see *Fuel Prices & Generators*). Additionally within the CWE region DA prices converged significantly in comparison to previous years.
- A typical peak in monthly average DA prices in Q4, typically observed in previous years, was absent in 2019. This absence is likely the result of higher availability of nuclear power plants in both Belgium and France, and relatively mild temperatures which dampened the demand in France which has of a large share of electric heating.

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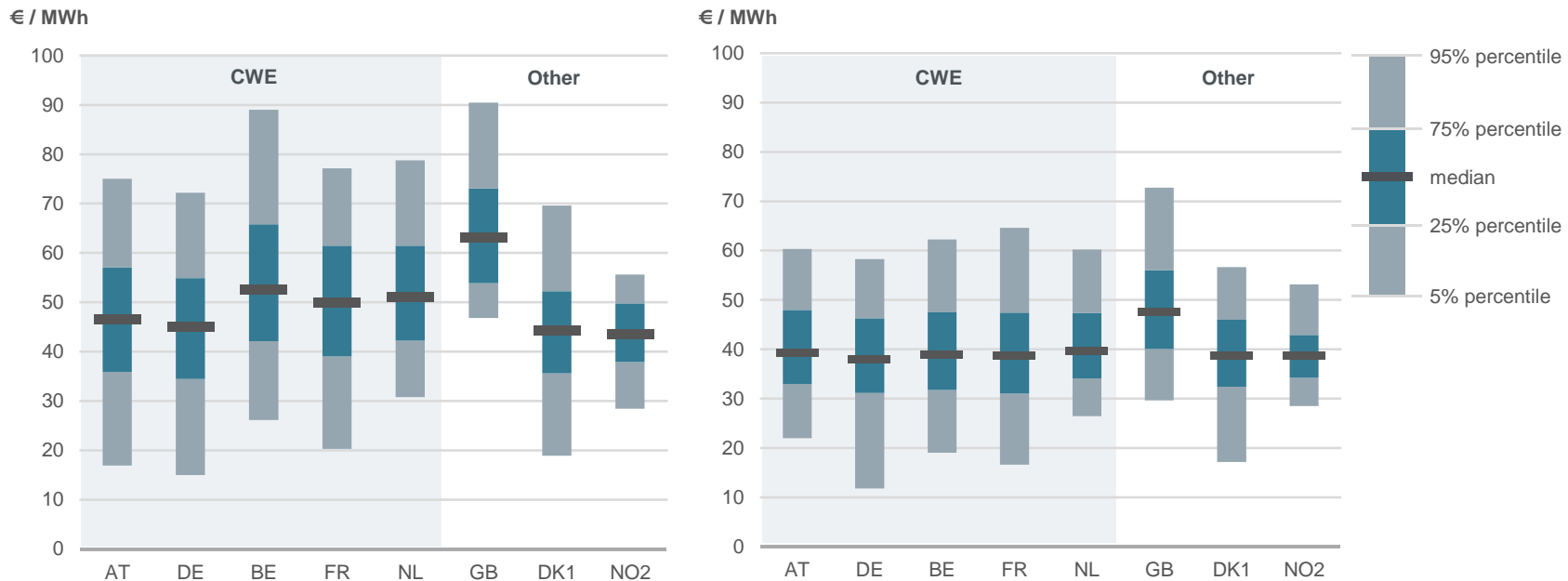
Congestion management



Price volatility

Price volatility decreased in 2019

Spread of Day-Ahead prices in selected European countries
2018 2019



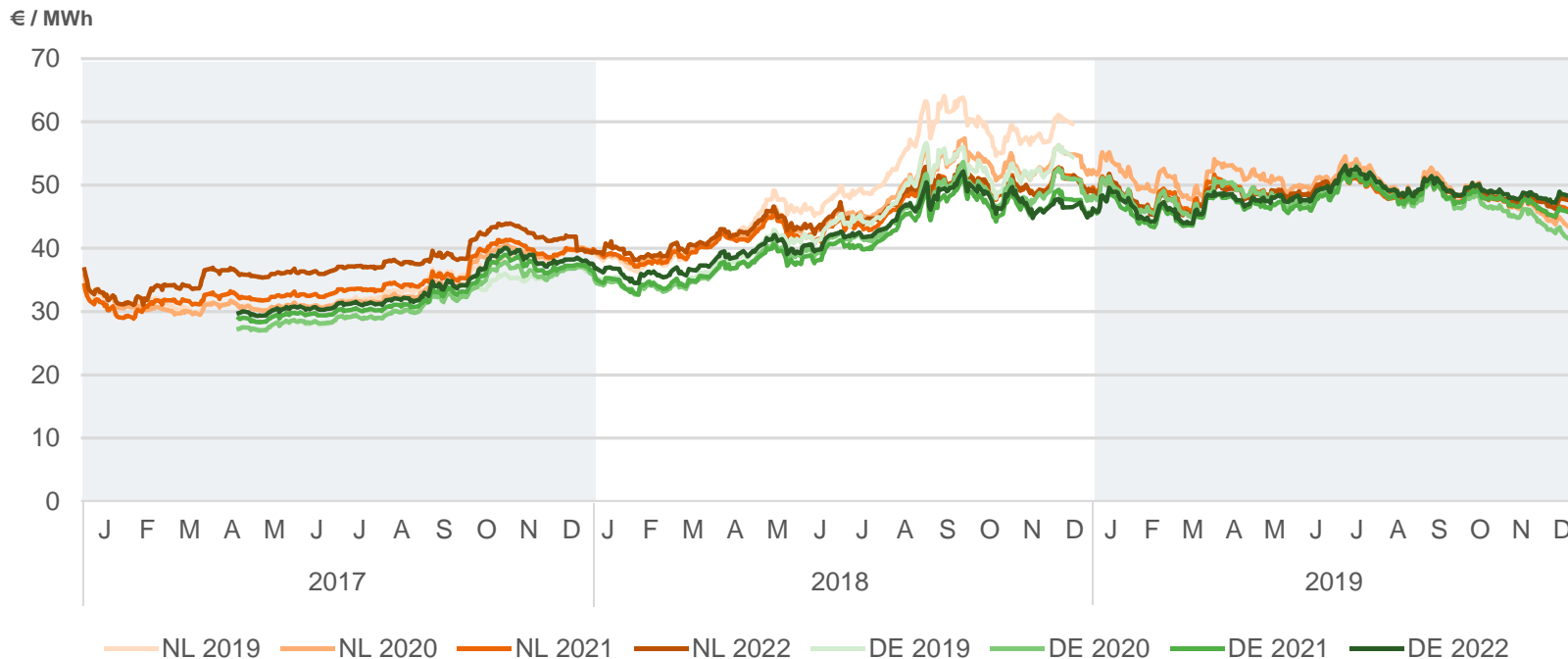
- Lower volatility in general in almost all selected countries and smaller differences in volatility between countries in 2019 compared to 2018. These effects are likely a consequence price damping effects such as higher availability of nuclear power in Belgium and France and lower fuel prices (see *Fuel Prices & Generators*).
- Electricity prices in the Netherlands are strongly influenced by gas fuel price developments, because gas-fired power plants most of the time set the electricity price in NL. In countries such as Germany, Belgium, France and Denmark nuclear or renewables (typically lower marginal costs than gas) are more often price setting, especially on low demand days such as weekend or holidays. This effect of this difference in generation mix is seen in the volatility in the lower price range (below the median up to the 5% percentile) for these countries that reach lower prices than in the Netherlands.

Futures Prices NL & DE



Futures prices became more volatile and were converging up to Q3 2019

Dutch and German Baseload Year Futures



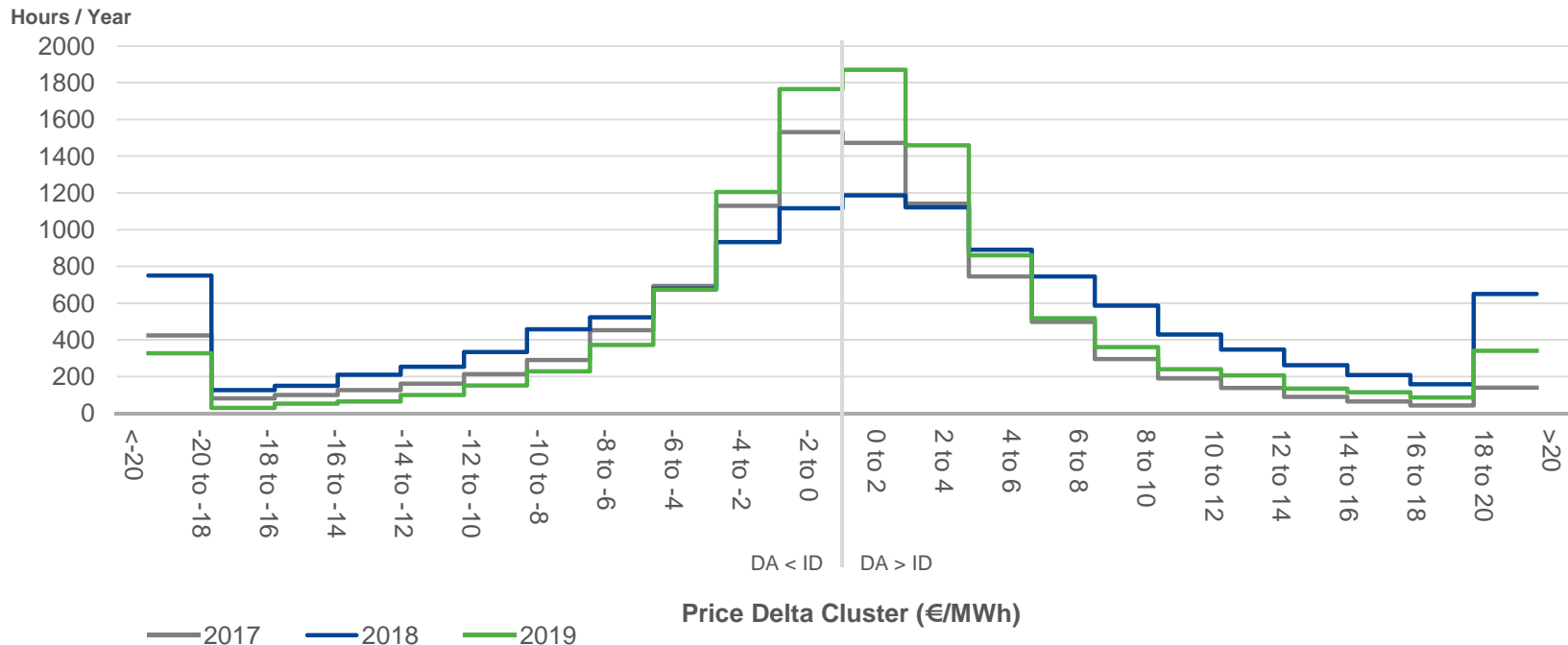
- Baseload Year Futures prices stabilised at the start of 2019 around 50 €/MWh with a slightly decreasing trend after July 2019 after a relatively strong increase in prices during 2018.
- Futures prices between Germany and the Netherlands were converging in 2019 up to Q3 which suggests that market parties expected that the average price spread between the Netherlands and Germany will decrease in the future. This converging development is contrary to the diverging observations of the futures for 2020-2022 traded in 2018. From Q3 onwards prices were diverging again.



Intraday Prices

In 2019: Smaller differences between DA and ID prices

Differences between Dutch Day-ahead and Intraday Prices



ID trade takes place in a continuous auction, so there is no single price per hour as in the DA market. Therefore, ID prices per hour were determined by taking hourly average prices weighted on trading volumes.

- The results show more hours with a smaller difference between day-ahead (DA) and intraday (ID) prices in 2019 compared to 2018 and 2017. Furthermore, there is a steep increase in hours with a relatively low price delta (-2-0 and 0-2).
- Historically, as well as in 2019, the above graph has been skewed to the right, indicating that there were more hours in which the DA price was higher than the ID price, than there were hours with higher a ID price than DA price. This effect was slightly less pronounced in 2018.

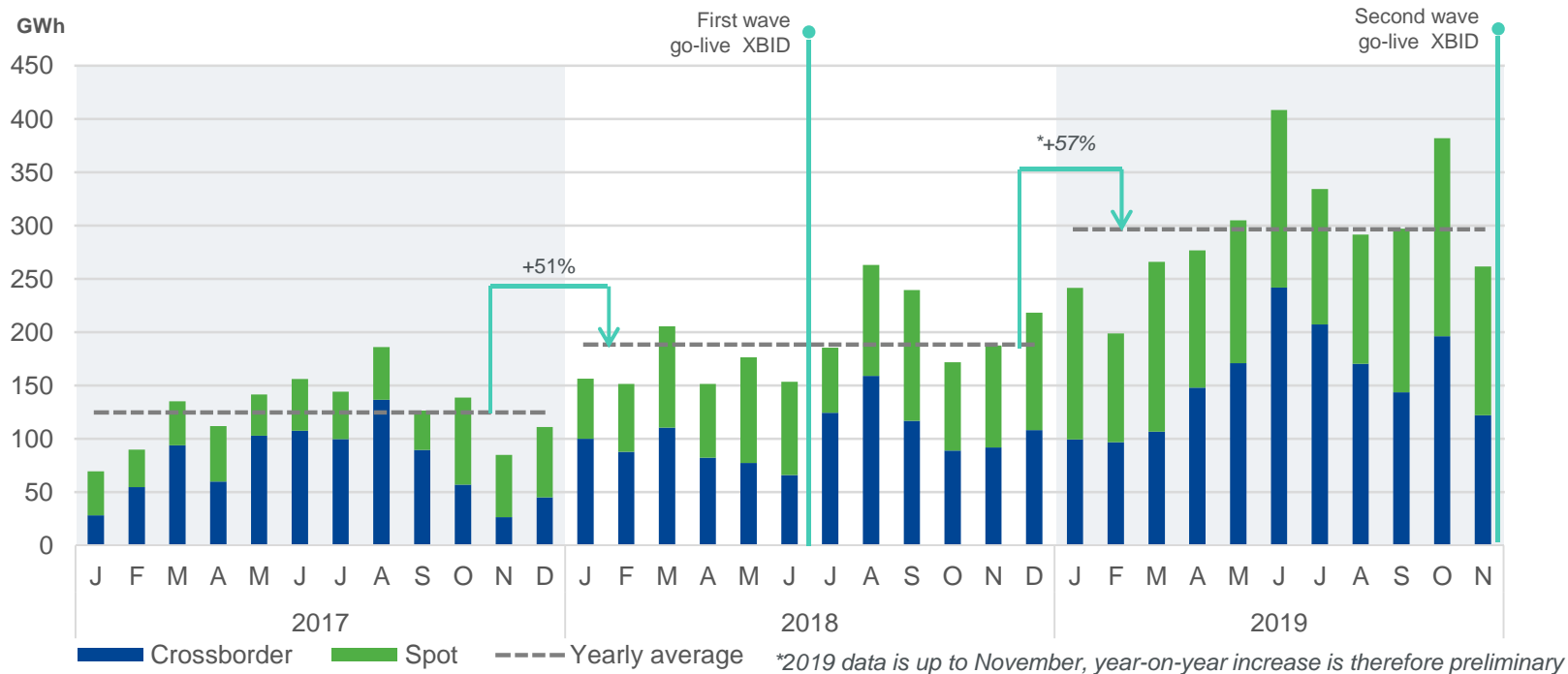
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Intraday Trading Volumes

57% increased ID volume in 2019 compared to 2018

Monthly Intraday Trading Volumes in the Netherlands



- Significant increase in intraday (ID) trades in 2018 (51%) and in 2019 (57%). A likely explanation is the larger share of variable renewable generation. Market participants use the intraday market to optimise their position, since new information (e.g. better renewable feed-in forecasts, better demand forecasts, unexpected outages) becomes available after closure of the DA market. More variable renewable generation thus leads to a shift of trade closer to real-time.
- Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania and Slovenia joined the Cross-Border intraday platform (XBID) with the second wave go-live in November 2019. This increases liquidity for intraday trading providing that there is available transmission capacity.



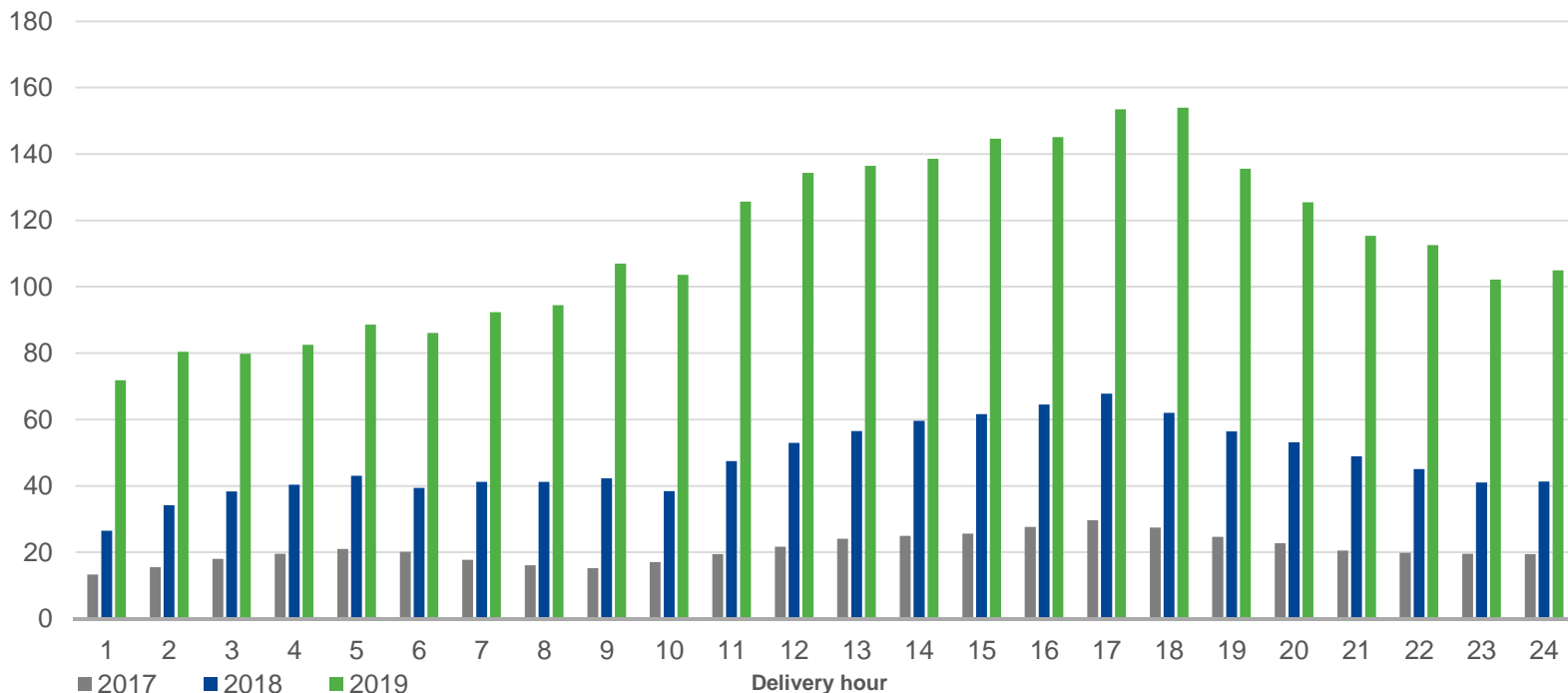
Intraday Trades

Number of trades more than doubled for all delivery hours in 2019

Most intraday trades for the evening peak

Average Amount of Intraday Trades per Delivery Hour

Number. of trades



- The above figure shows the average amount of trades per delivery hour of the day.
- Intraday trades were highest after midday and peaking in the evening. This could be related to a decrease in solar infeed after noon and the increase in electricity consumption in the evening hours.
- The number of trades more than doubled for all delivery hours, whereas the annual average traded volume increased by 57%, indicating lower volumes per trade.

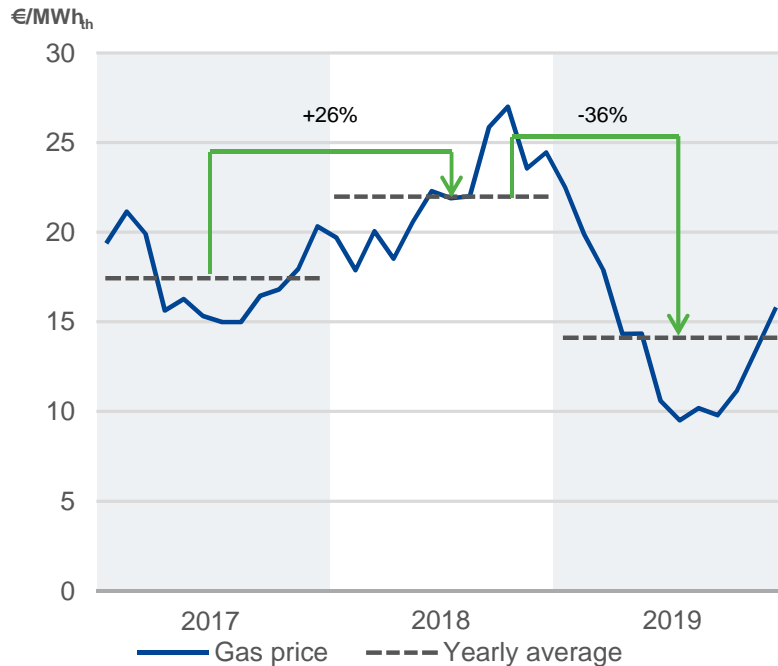
Fuel Prices



Fuel Prices

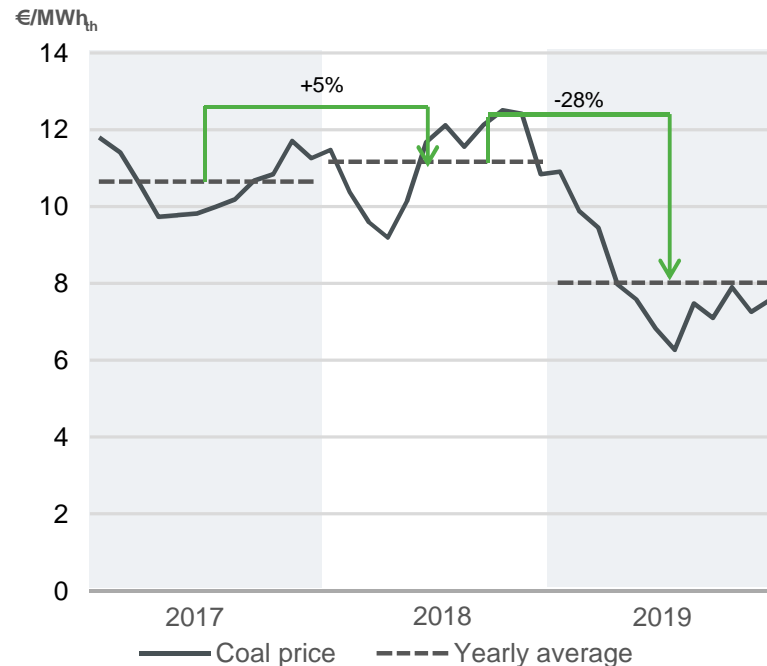
Major drop in fuel prices up to mid 2019

Natural Gas Prices



Gas prices are based on OTC natural gas prices at the Dutch virtual exchange Title Transfer Facility (TTF).

Coal Prices



Coal prices are based on the over the counter API#2 price index.

- The annual average gas price decreased by 36% from 22.3 €/MWh_{th} in 2018 to 14.1 €/MWh_{th} in 2019. This decreasing price effect is partly the result of relatively high stock levels of gas at the start of 2019 due to mild temperatures (and consequently less demand for heating) in the 2018-2019 winter. Additionally LNG imports in Europe significantly increased since September 2018 increasing the supply of gas which also had a decreasing effect on prices.
- The annual average hard coal prices decreased as well by 28% from 11.2 €/MWh_{th} in 2018 to 8 €/MWh_{th} in 2019. This is likely the result of a drop in coal demand for electricity generation due to the lower gas prices.



Carbon Prices

Carbon prices stabilised around 25 €/tCO₂ in 2019

Year-on-year carbon price increased by 61% in 2019

CO₂ Emissions Allowance (EU ETS) Prices



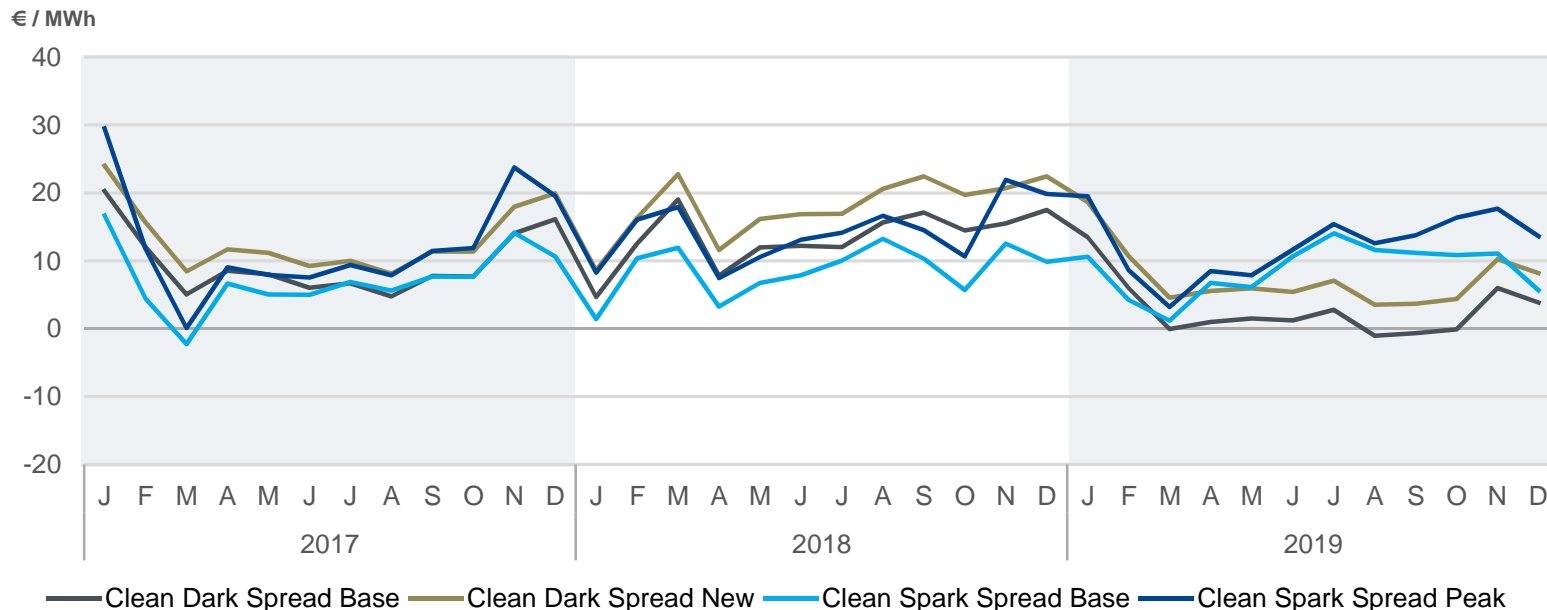
- After the CO₂ Emission Allowances price more than doubled during 2018, the price roughly stabilised by the end of 2019 around 25 €/tCO₂. The annual average year-on-year price increased by 61% in 2019 compared to 2018.
- 2018 price volatility was partly driven by Brexit and by the run-up to the Market Stability Reserve that came in effect in January 2019.
- The volatility during 2019 can partly be attributed to speculation on CO₂ Emission Allowances prices, fuelled by political uncertainty in the UK over Brexit, and developments and speculation regarding the German coal phase out.



Generator Margins NL

Coal-fired power plants' margins significantly decreased Coal-to-gas switching since March/April 2019

Dutch Monthly Average Clean Dark Spread and Clean Spark Spread



Assumptions

Coal: efficiency Base 40%, New 45%, emission factor 91.7 tCO₂/TJth, heating value 25.1 MJ/kg; **Gas:** efficiency Base & Peak 55% emission factor 55.6 tCO₂/TJth.

- Around March/April the Clean Dark Spread Base and new (for modern high efficient coal-fired power plants) decreased below the Clean Spark Spread Base suggesting coal-to-gas switching. This indicates the point at which it is more profitable to produce electricity from natural gas than from coal.
- The effects of coal-to-gas switching in the actual monthly generation mix (*Generation in the Netherlands*) shows a significant decrease in generation from coal-fired power plants and an increase in the generation of gas-fired power plants.

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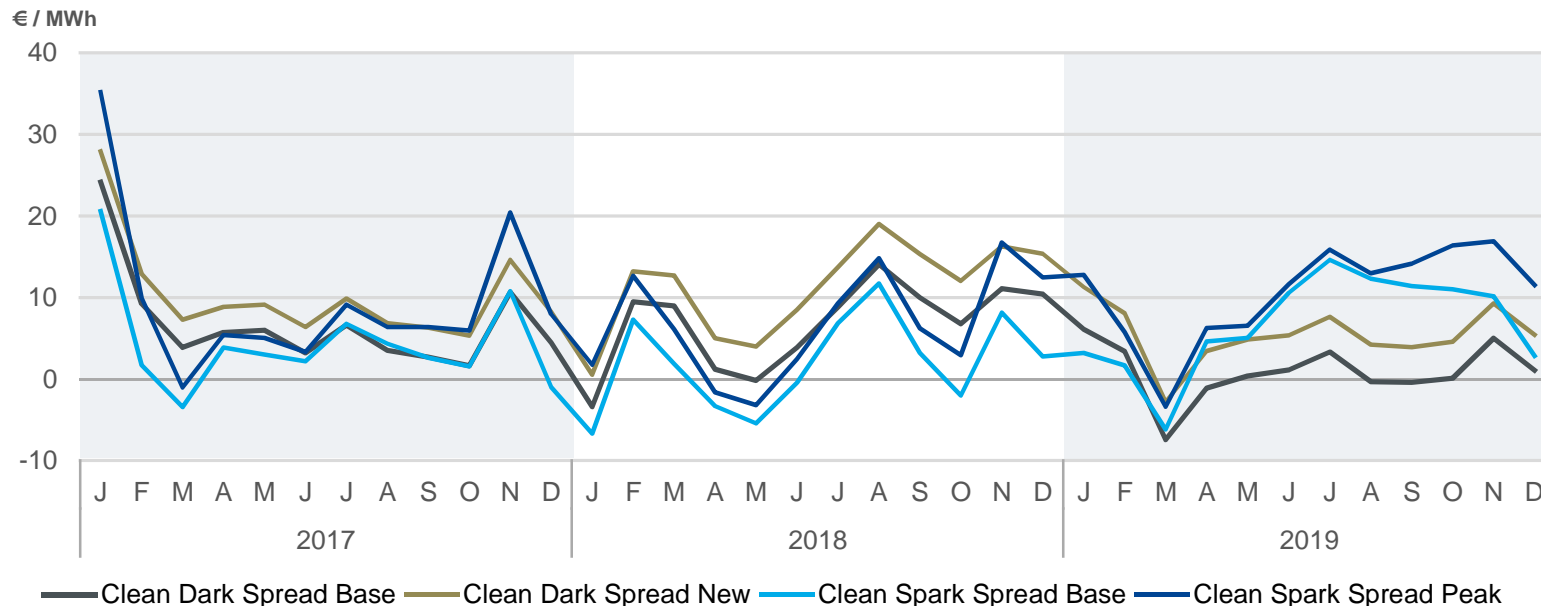
Congestion management



Generator Margins DE

Negative Margins in March 2019

German Monthly Average Clean Dark Spread and Clean Spark Spread



Assumptions

Coal: efficiency Base 40%, New 45%, emission factor 91.7 tCO₂/TJth, heating value 25.1 MJ/kg; **Gas:** efficiency Base & Peak 55% emission factor 55.6 tCO₂/TJth.

- The German Clean Dark and Clean Spark Spreads show a similar pattern. Coal-to-gas switching occurs in March as well. Exception to the Dutch pattern is the negative margins in March as a result of high renewable in-feed in Germany suppressing monthly average day-ahead prices down below healthy margins of both coal- and gas-fired power plants.

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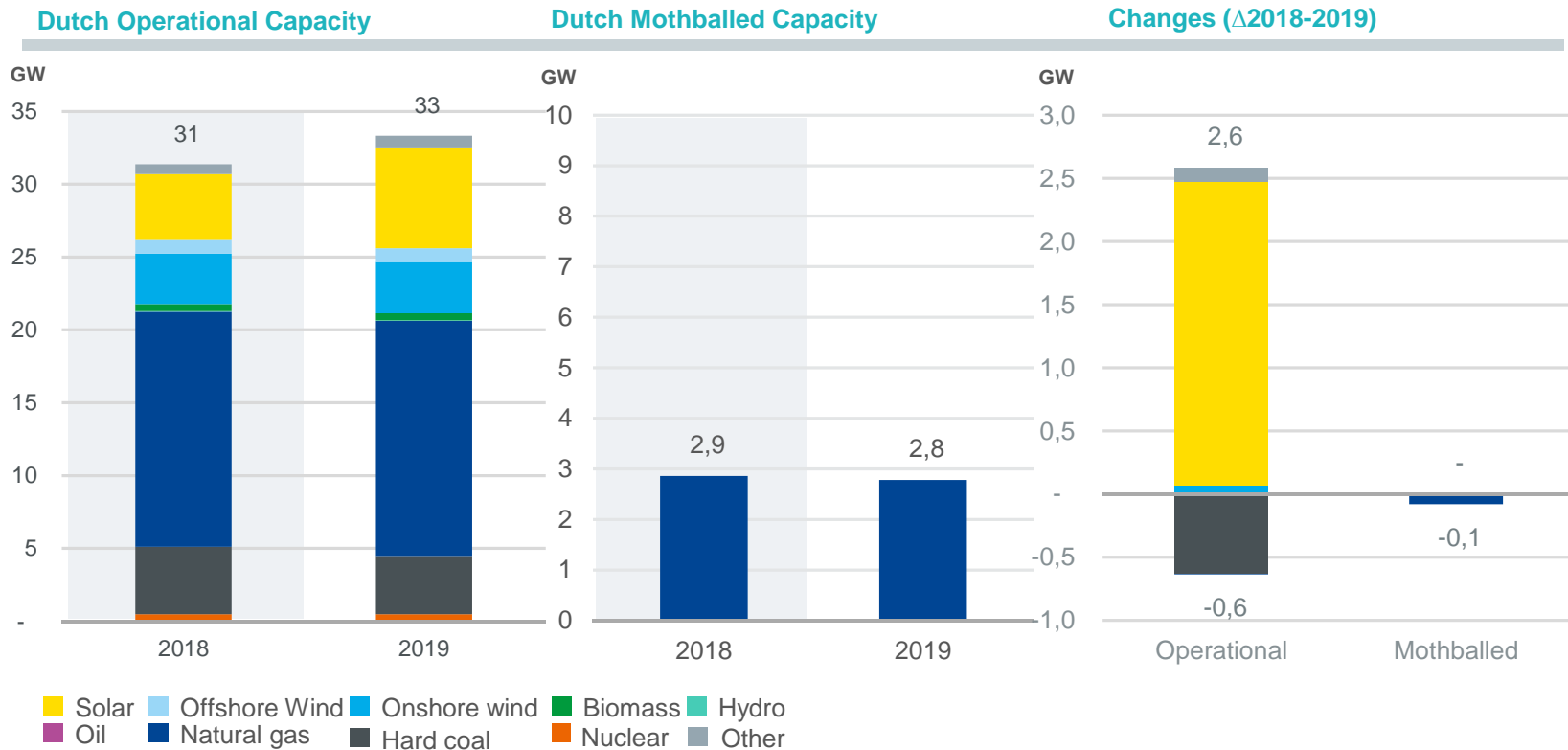
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Capacity & Generation

Capacity in the Netherlands



Main capacity increase by Solar PV, which grew by 2.4 GW



The figures represent the end-of-year installed capacity as observed on December 31st of 2018 and 2019

- Operational capacity increased by 2.6 GW, almost fully the result of solar PV which grew by 2.4 GW in 2019. Onshore wind capacity grew by a modest 70MW in 2019.
- Closing the Hemweg coal-fired power plant resulted in a 600MW decrease in operational capacity (see *Capacity in the Netherlands*).
- Mothballed capacity dropped by 100 MW due to permanent decommissioning of *Centrale Merwedekanaal*.

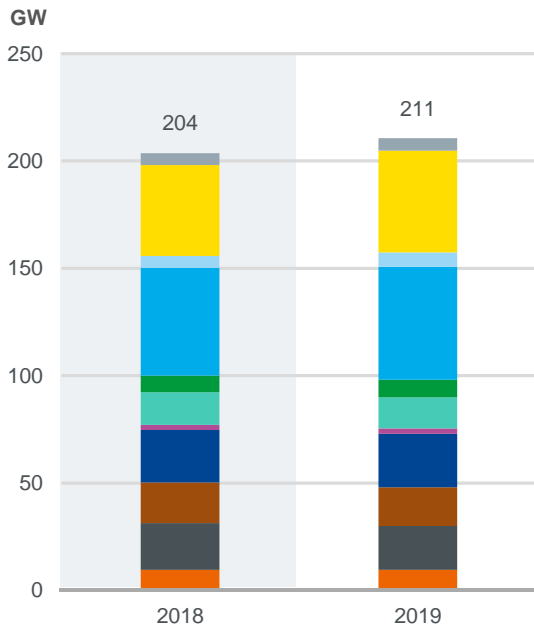
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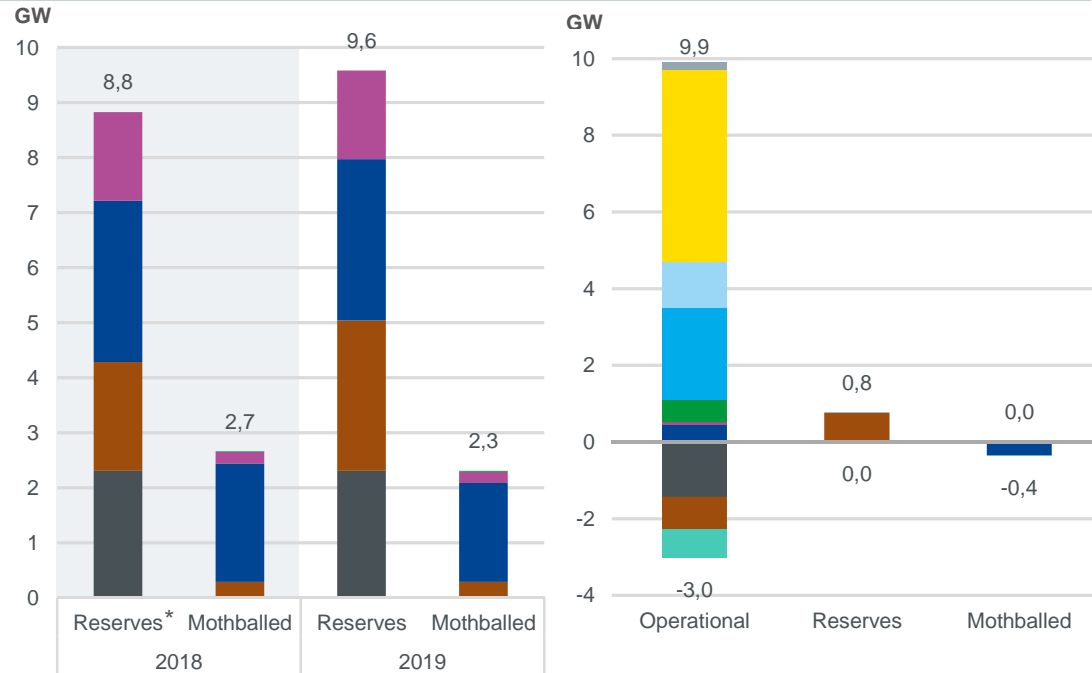
Capacity in Germany

Capacity growth mainly from renewables

German Operational Capacity



German Reserve and Mothballed Capacity Changes (Δ2018-2019)



■ Solar ■ Offshore Wind ■ Onshore wind ■ Biomass ■ Hydro ■ Other
■ Oil ■ Natural gas ■ Lignite ■ Hard coal ■ Nuclear

* Consist of 'Sicherheitsbereitschaft' outside market back-up capacity, and 'Netzreserve' used for congestion management

- As in previous years, the majority of the increase in operational capacity between 2018 and 2019 came from renewables, of which 5 GW Solar and 3.6 GW Wind (on- and offshore).
- In 2019, 800 MW of lignite capacity was taken out of operation and transferred to the Reserves which now totals 9.6 GW.
- The decrease of mothballed gas capacity is due to a decommissioning of a 400 MW gas-fired power plant. The 500 MW increase in operational gas-fired power is new-build.

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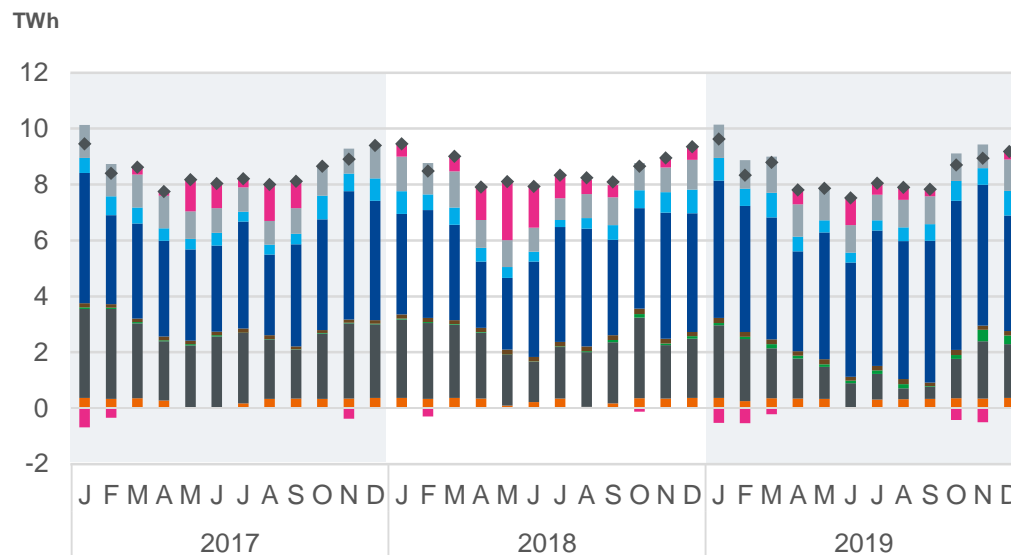
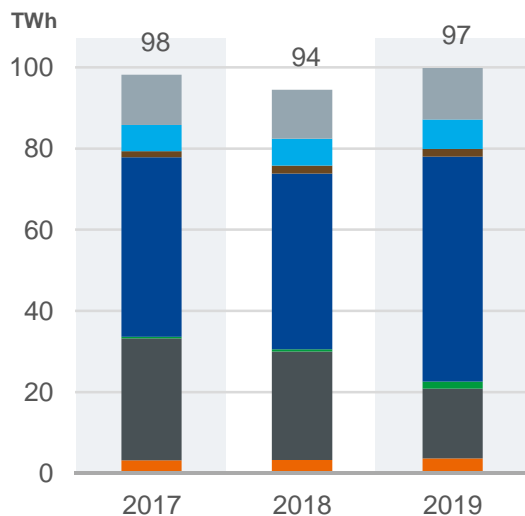
Generation in the Netherlands



Coal-to-gas switching resulted in increased generation from gas and decreased generation from hard coal

Dutch Yearly Gross Electricity Generation

Dutch Monthly Generation, net Imports and Exports



■ Nuclear ■ Hard coal ■ Certified co-fired biomass ■ Waste ■ Natural gas ■ Wind ■ Uncategorized
◆ Net import (+) / export (-) ◆ Load + grid losses

*Generation shown is electricity infeed measured on public grids: ~82-85% of total NL generation. Uncategorized: units <10MW. Solar generation and some onshore wind not available in measurements.

- Generation from coal-fired power plants decreased and generation from gas-fired power plants increased, mainly the result of coal-to-gas switching (*Generator Margins NL*) and closing a 600 MW coal-fired power plant (*Capacity in NL*).
- Overall increase in gross generation due to improved competitiveness of gas-fired power resulting in less net imports and therefore more generation within NL.
- Despite subsidies awarded for biomass co-firing in coal-fired power plants only 1.7 TWh was certified at CertiQ, the authority that issues Guarantees of Origin. This is 9% of all power produced by originally coal-fired power plants or 26% of the expected annual generation of the grant decision (6.7 TWh for biomass co-firing, see *RES support schemes*).

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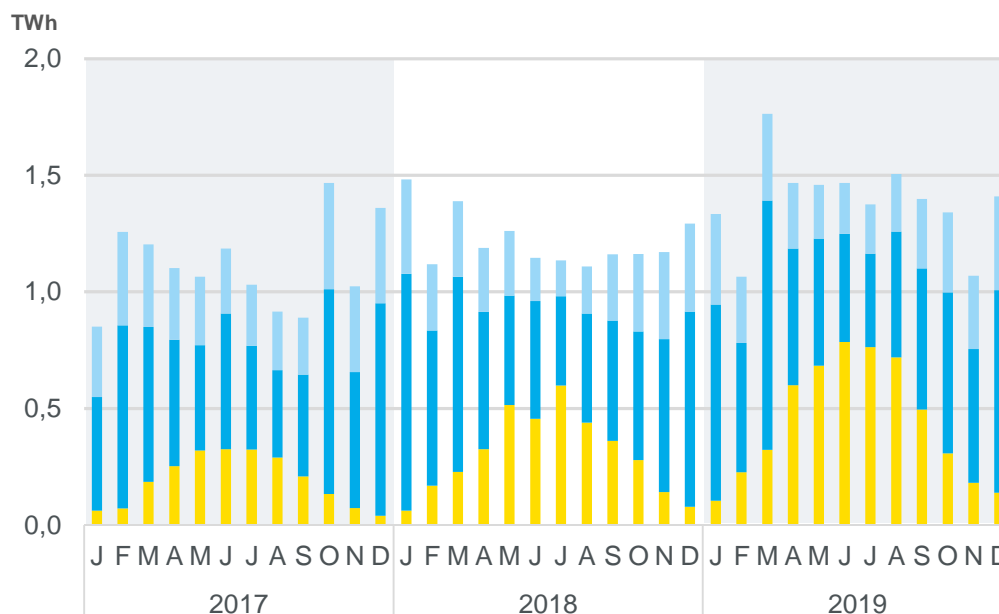
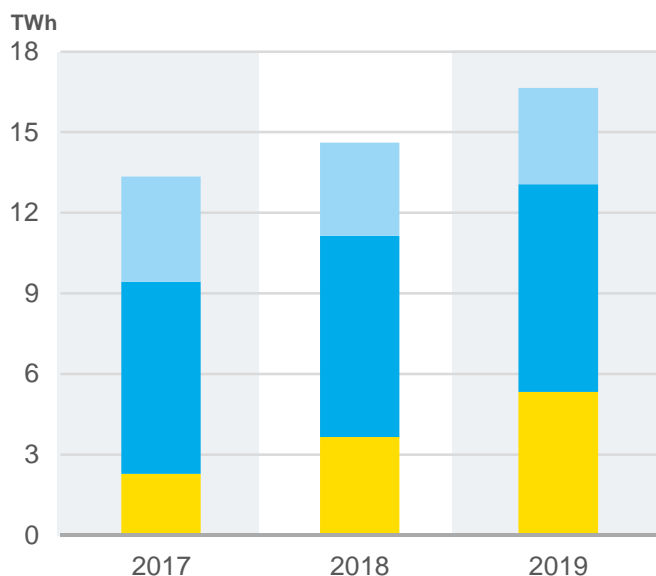
Renewable Generation NL



Solar generation increased to 5.3 TWh in 2019

On- and offshore wind generation 2019 was comparable with 2018

Dutch Solar and Wind Generation annually and monthly



■ Solar ■ Onshore wind ■ Offshore Wind

- Solar generation increased most of the weather dependent renewable generation sources in the Netherlands by 5.3TWh (+31.5%) , a logical consequence of the 2.4 GW installed capacity increase in 2019.
- In 2019 both on- and offshore wind in generated roughly the same amount of electricity as in 2018 which is also a logical consequence of only 70 MW addition of onshore wind and no additions in offshore wind in 2019. Differences in wind related generation between 2018 and 2019 are therefore mainly weather related.
- The monthly pattern shows that wind and solar were complementary on a monthly aggregated level with typically more solar in the summer and more wind in the winter. Variability on an hourly or daily level is significantly larger.

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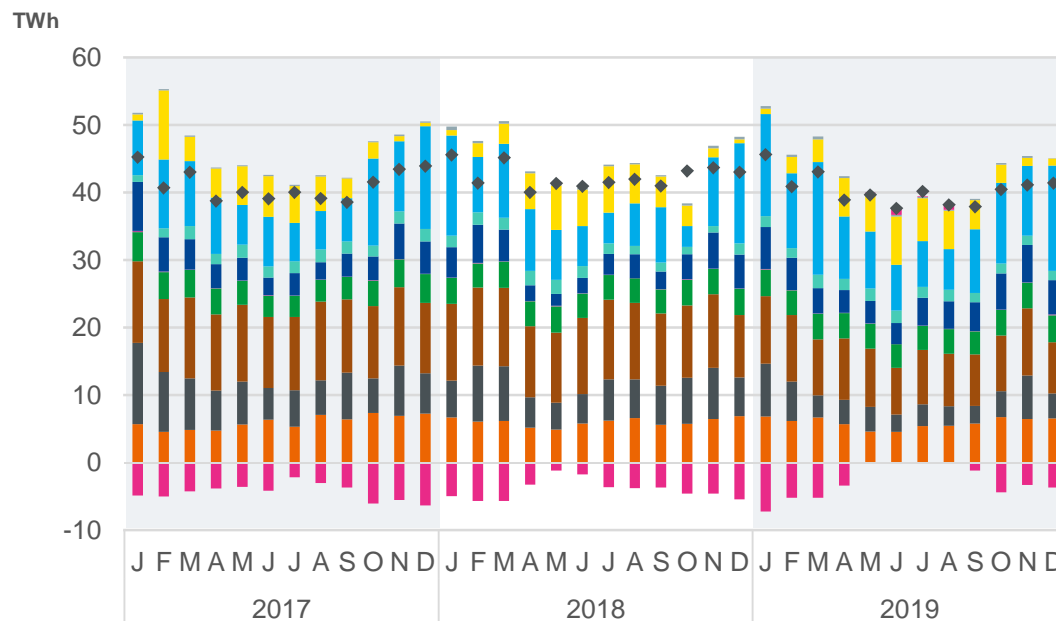
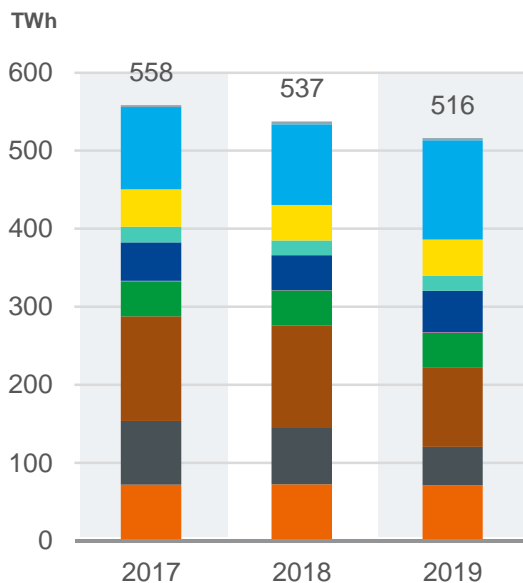
Generation Germany



Coal-to-gas switching resulted in decreased generation from hard coal and Lignite, generation from gas and renewables increased

German Yearly Gross Electricity Generation

German Monthly Generation, net Imports and Exports



■ Nuclear ■ Hard coal ■ Lignite ■ Biomass ■ Oil ■ Natural gas ■ Hydro ■ Wind ■ Solar ■ Uncategorized
■ Net import (+) / export (-) ◆ Load

- Coal-to-gas switching mostly affecting of coal based generation -23 TWh (-32%) and lignite -30 TWh (-22%). Gas increased by 8.5 TWh (19%) but not enough to cover for the reduced generation of coal and lignite. This was covered by increased renewables and reduced exports.
- Nuclear, biomass and hydro based generation remained a similar generation output over the past three years.
- 2019 exports in Q2 and Q3 were almost zero indicating a less competitive electricity mix in DE compared to neighbours than in previous years.

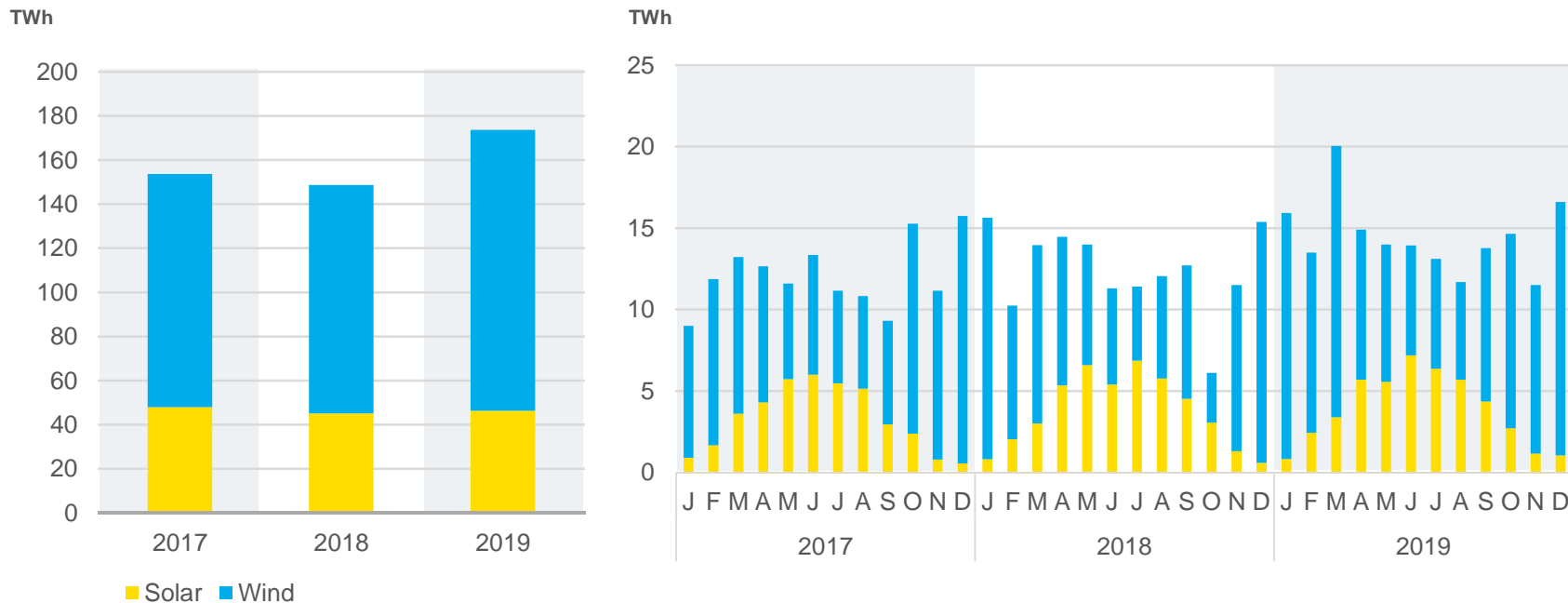
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Renewable Generation DE



Wind generation increased with 14% in 2019 compared to 2018

Annual and Monthly Solar and Wind Generation Germany



- In 2019 wind generation was up 14% compared to 2018, reaching 127 TWh which was a logical consequence of the 3.6 GW additions in on- and offshore wind. Solar generation increased only marginally up to 46 TWh (+2%)
- The monthly pattern shows that wind and solar were complementary on a monthly aggregated level by typically more solar in the summer and more wind in the winter. Variability on an hourly or daily level are likely to be significantly larger.

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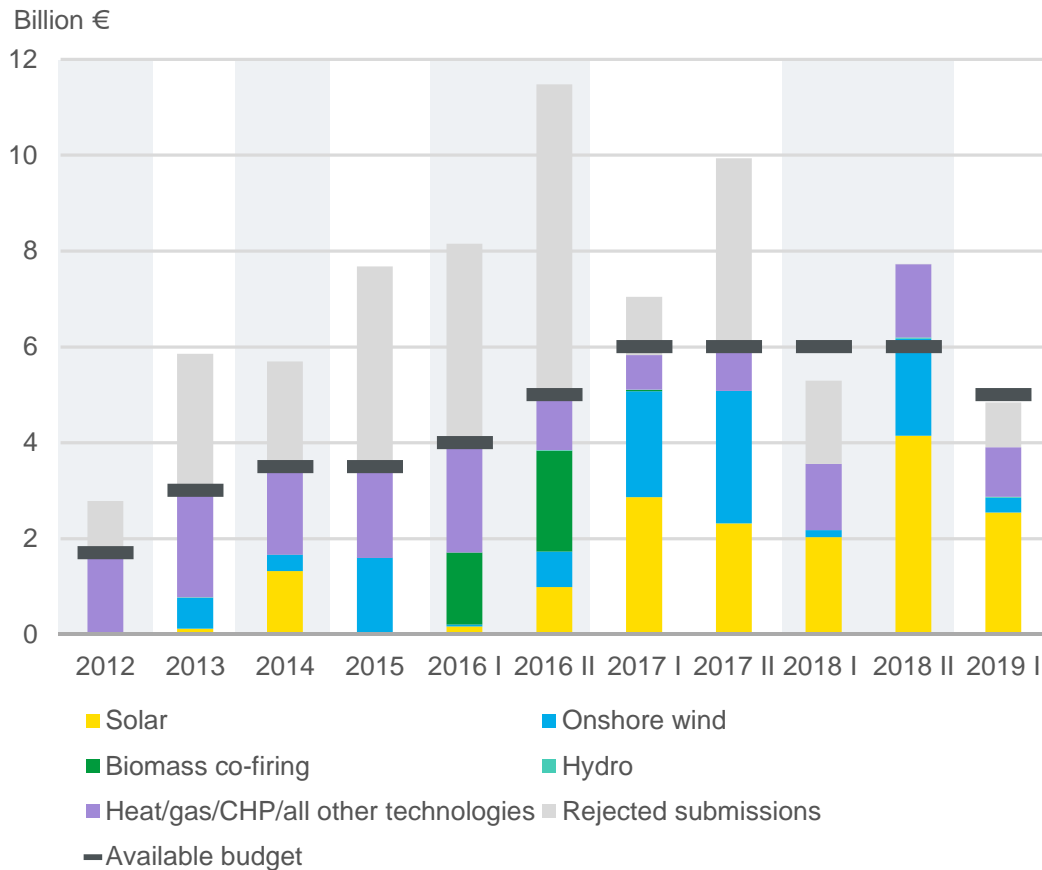
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RES Support Schemes

Budget Distribution SDE+

Lower available budget for SDE+ in 2019

Budget Distribution per SDE+ Round



- The SDE+ is an operating (feed-in-tariff) subsidy. Producers receive a guaranteed payment (subsidy) for the energy they generate from renewable sources.
- In relation to the expected technological improvements and associated cost reductions, the available SDE+ budget is decreasing. This decision was made to ensure sufficient competition in development of renewable energy projects.
- In 2019 round I, several subsidy requests were rejected due to insufficient adherence to requirements set by the Netherlands Enterprise Agency (RVO).
- Available grid capacity was not part of the requirements yet will become part of the project assessments in 2019 round II.



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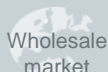
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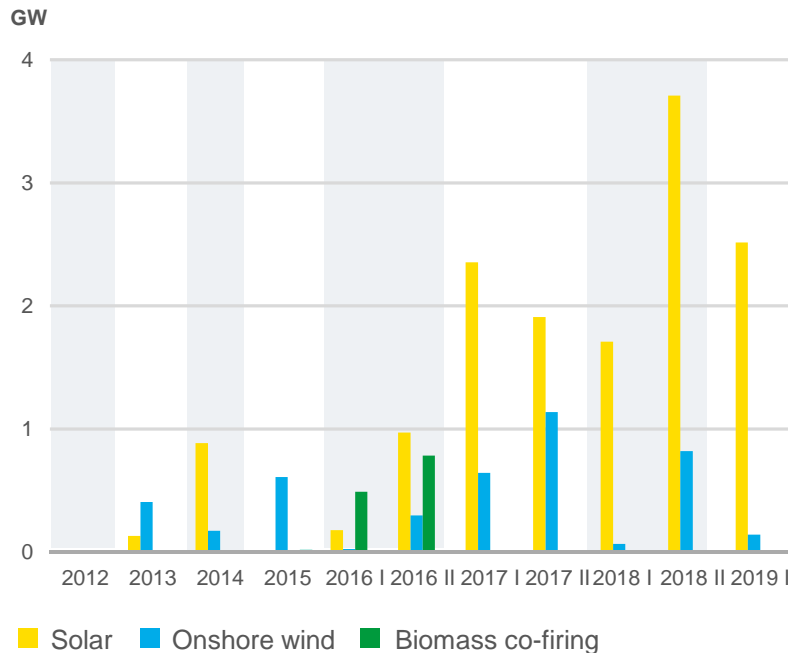
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Capacity & Generation SDE+

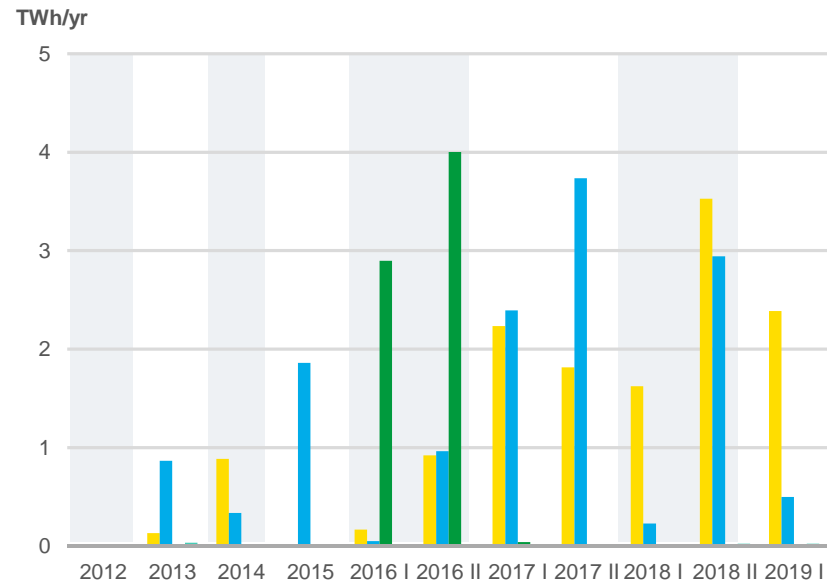


2019 round I SDE+ subsidy allocation resulted mostly in solar capacity

Subsidised Capacity per SDE+ Round



Subsidised expected yearly generation per SDE+ Round



- 2019 round I resulted mostly in SDE+ subsidised solar capacity. In each round except 2015, the SDE+ budget allocation resulted in a majority of solar capacity.
- A clear discrepancy is seen between awarded capacity and awarded electricity generation per SDE+ round. Even though the majority of capacity was awarded to solar in recent years, electricity generation from wind or biomass co-firing is higher. This can be attributed to the higher load factor of these technologies.

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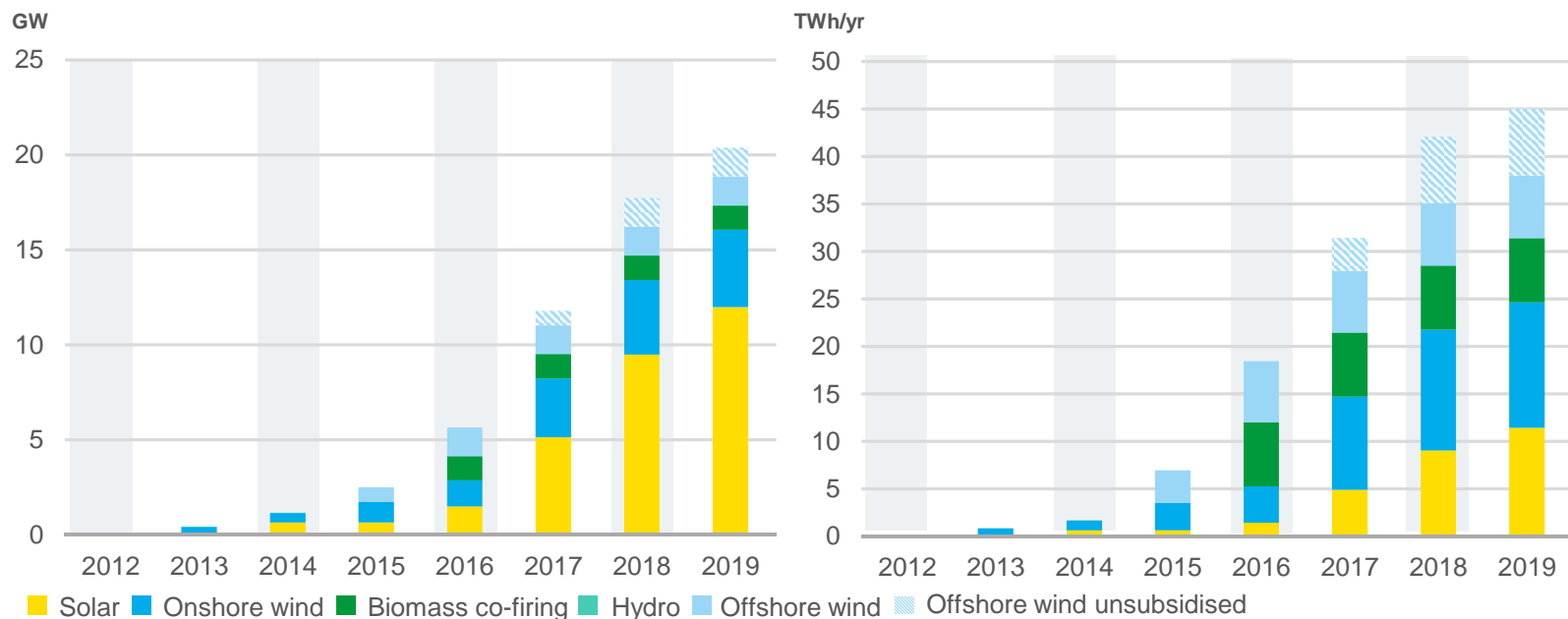
Cumulative development SDE+



Over 20 GW renewable electricity capacity is projected to be installed under the SDE+ subsidy scheme

End of Year Cumulative Capacity to be installed under SDE+

End of Year Cumulative Electricity Generation to be generated annually under SDE+



*Note that 2019 round II is excluded in 2019 figures

- After 7.5 years of SDE+ subsidy schemes, more than 20 GW, of awarded capacity of solar, on- and offshore wind, hydro, biomass co-firing is in operation or is planned to be installed. 1.5 GW of this capacity is unsubsidised offshore wind.
- This cumulative capacity is good for 45TWh annual generation of which 7 TWh from unsubsidised offshore wind. With an annual consumption of 117 TWh in 2018 (AMU 2018), renewable generation resulting from SDE+ subsidies (excluding the unsubsidised offshore wind) would correspond to 32% of total annual consumption.

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Wholesale Market Integration

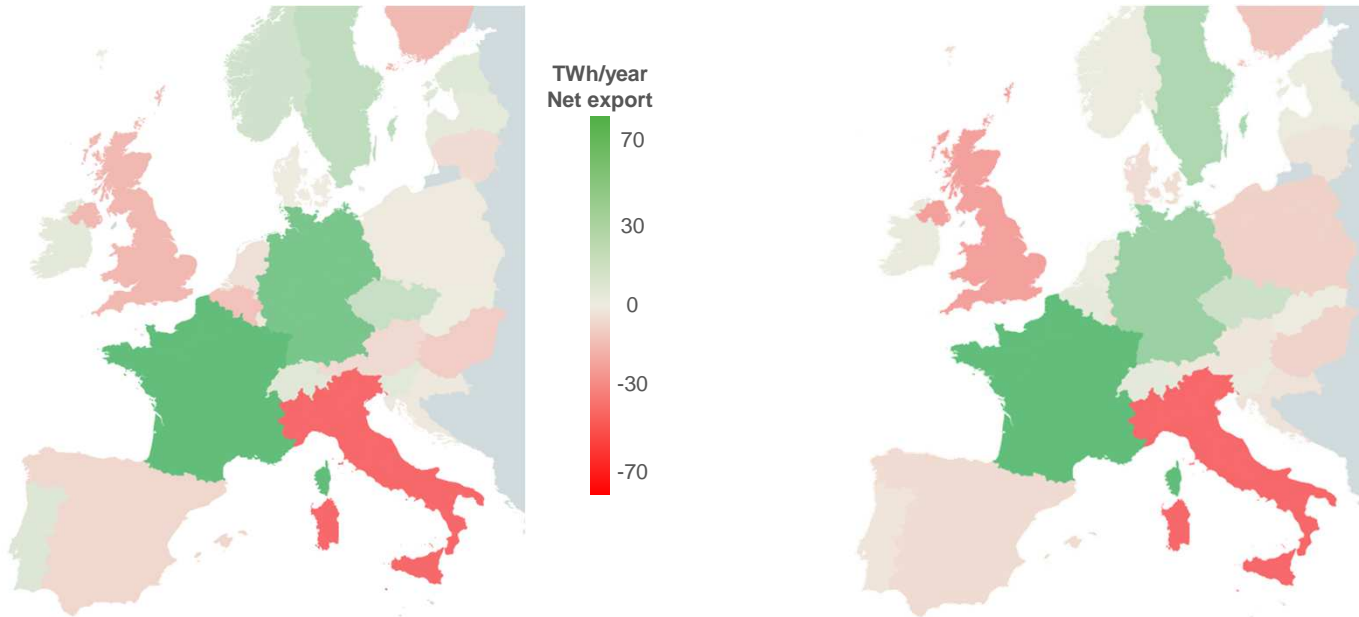


Aggregated Exchange EU

Less imports by Belgium and the Netherlands, less exports by Germany

Yearly Aggregated Import and Export Volumes
2018

2019



- The Netherlands is a net importing country. Net import decreased from 8.2 TWh in 2018 to 0.3 TWh in 2019 (-96%). Germany is typically a net exporting country due to large capacity of wind and coal (typically low marginal costs), but this has changed due to coal-to-gas switching. As a result net exports decreased from 51.1 TWh to 33.8 TWh (-34%).
- In 2019 France was again Europe's largest electricity exporter. Whereas the Belgium net export position became more balanced due to increased nuclear availability.
- Poland changed from a more balanced import/export position to a more pronounced import position. Lower export positions were seen for Norway due to the summer drought that resulted in lower hydro stocks.

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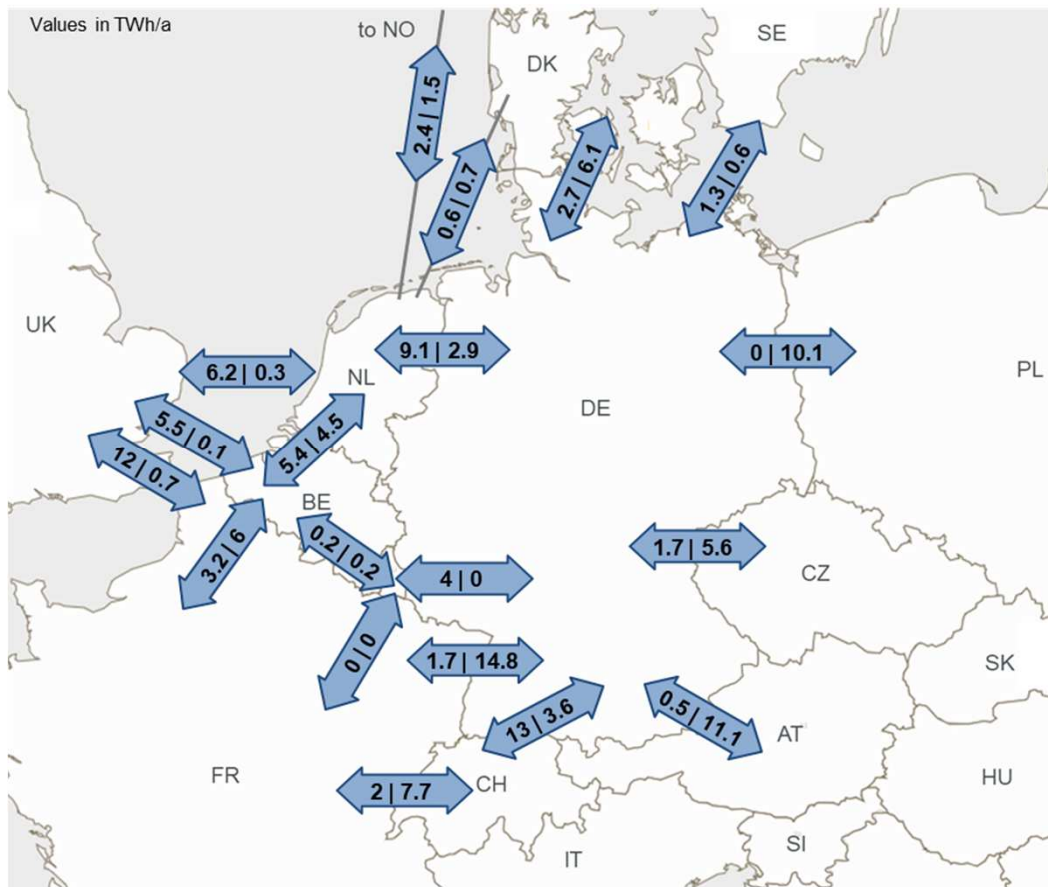
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Cross-border Flows 2019

Less cross-border flows in 2019 | Go-Live of COBRA in September

Physical Cross Border Flows 2019



- In general less cross-border flows in 2019 compared to 2018. By less flows a higher convergence was reached (see *DA Price Convergence 2018 and 2019*). This is most likely a consequence of the impact fuel prices had by the market decreasing the differences in cost prices between the marginal generators in different countries.
- NL – BE imports and exports were more balanced in 2019 after two years of nuclear unavailability issues leading to dominantly exports towards BE.
- Imports from Germany decreased from 20.9 TWh in 2018 towards 9.1 TWh in 2019.
- Go-live of Nemo Link interconnector between BE and UK end of January and the COBRACable between NL and DK in September resulted in the first BE-UK and NL-DK flows respectively. There was no dominant direction of the flow on COBRACable.



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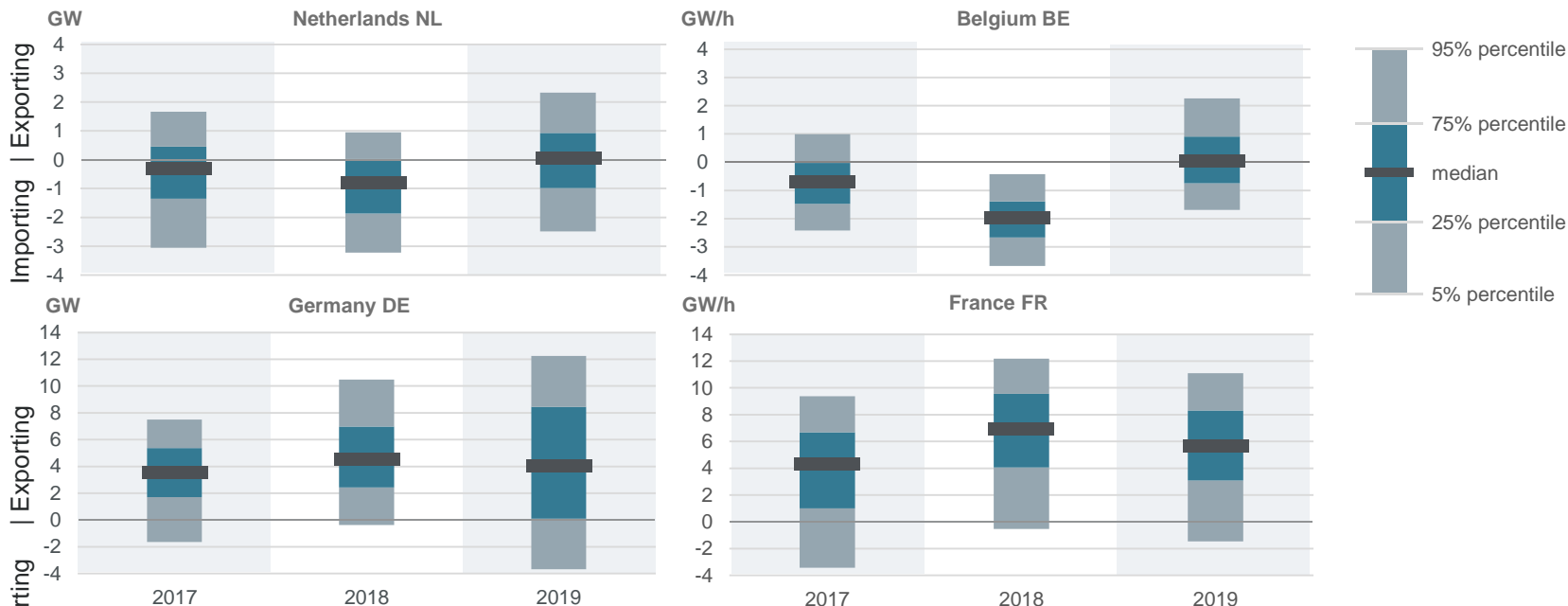
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Net Positions CWE

Annual net position distribution of NL and BE more balanced
Distribution of DE net positions more volatile

Spread of day-ahead net position in CWE



'Net Position' means the netted sum of electricity exports and imports for each market time unit (hourly in above graph) for a bidding zone

- Both NL and BE increased their annual export position significantly in 2019 compared to previous years by an increased amount of hours with a positive net position (which reflects a net export of electricity). Additionally both positions were neither dominating towards either imports or exports but were more evenly spread during the year.
- FR and DE had a decreased, but still dominant, annual export position. In addition, the net positions of Germany in 2019 became more volatile, including around 25% of the hours an importing position. The DE-AT split from October 2018 could explain the hours with a higher net exporting position for DE since DE-AT exchanges were made visible in the net positions. The hours with a lower and importing position were most likely the result of coal and lignite power losing competitive advantage to foreign gas power resulting in more imports.

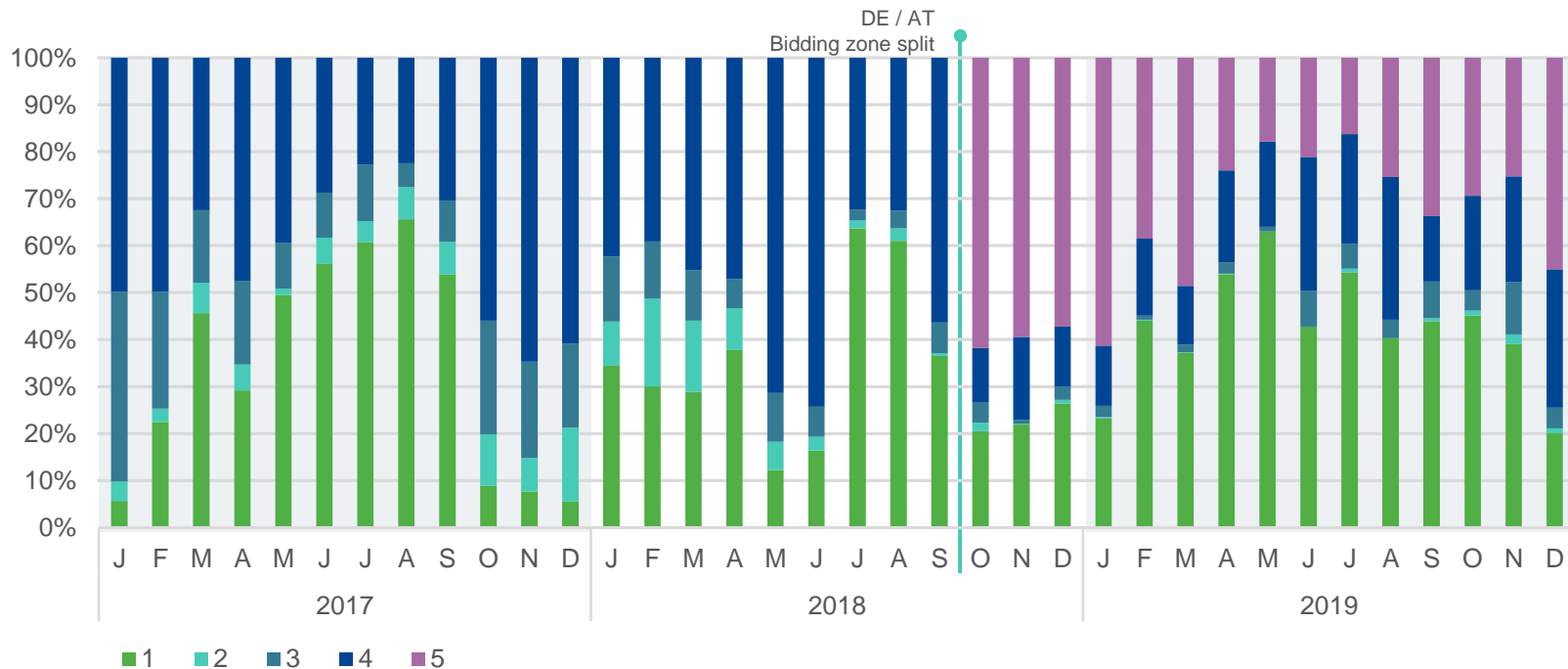
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Price Areas in CWE

Increased amount of hours with full price convergence in 2019 compared to 2018

Monthly Distribution of Day-ahead Price Areas in the CWE Region



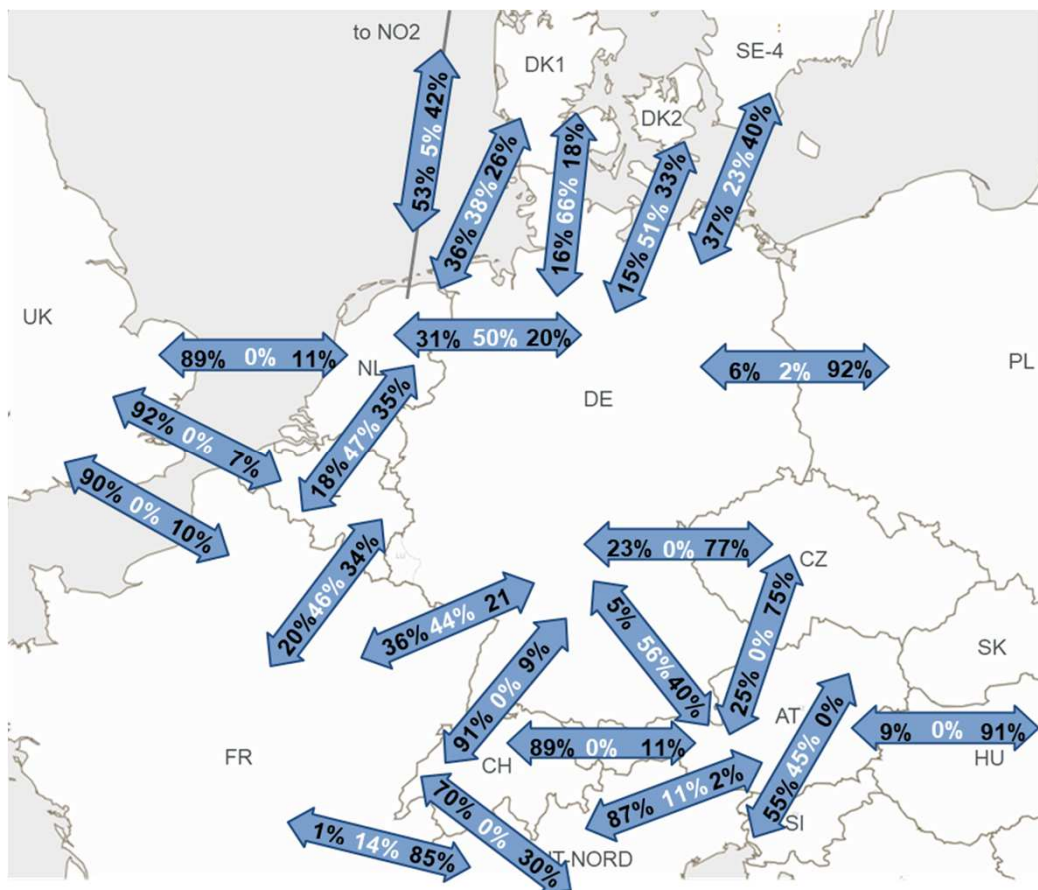
- The figure shows the time distribution of the number of day-ahead price areas in the CWE region bidding zones. When there is one price area, full price convergence occurs (all bidding zones have the same price).
- There was full price convergence (1 price area) for 42% of the time in 2019, a significant increase compared to the 33% in 2018. This higher convergence has emerged by less cross border exchanges (see cross border flows 2019). It is therefore likely that the decreasing fuel prices and coal-to-gas switching has led to less differences between the marginal operating units in the several CWE countries. As a consequence prices could converge with less exchanges. Additionally the higher availability of nuclear power plants in France and Belgium allowed for higher convergence.

DA Price Convergence 2019



Increased DA price convergence on CWE borders

Day-ahead Price Convergence for Selected Countries in 2019



- 2019 DA price convergence increased on all CWE borders
- Full convergence for NL with DE in 50% of the time(+14%pp), and 20% of the time DE prices were higher than NL(+16%pp).
- Between DE and DK full convergence increased up to 66% (+13%pp)
- BE prices less often higher than FR (-21 %pp) and less often higher than NL (-15 %pp).

Notes for figure:

- DA price convergence in white, black numbers show how often the DA price was higher in that country.
- Percentages do not always count up to 100% due to rounding

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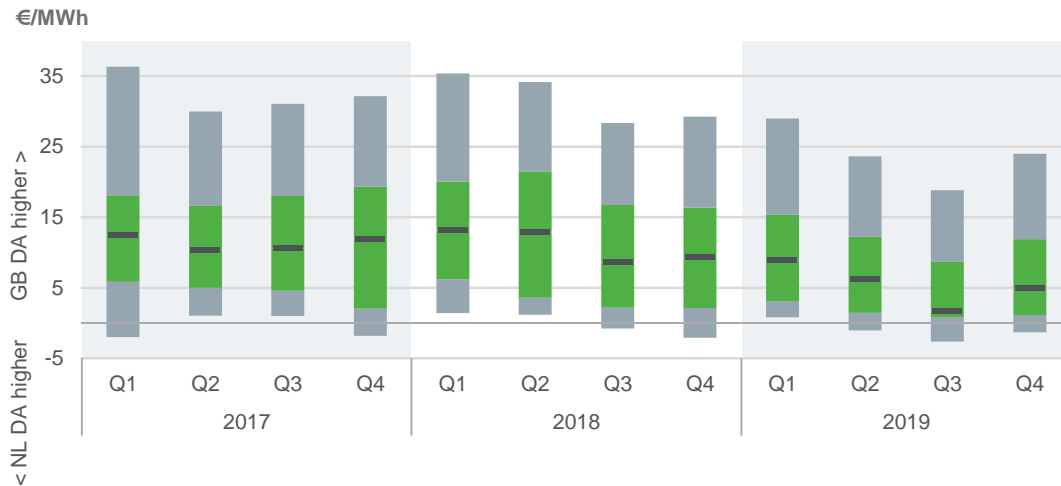
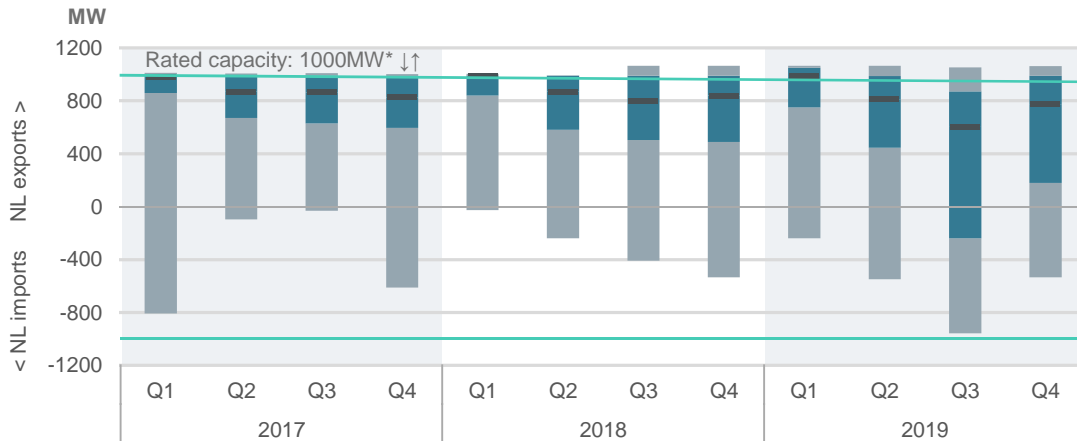
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DC Interconnectors – BritNed



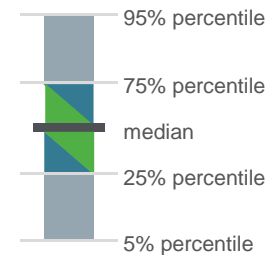
Decreasing NL to GB export dominance

BritNed Flow Distribution and NL-GB Day-Ahead Price Spread Distribution



- The BritNed flow distribution shows that flows were typically often in an export position from NL to GB. Further, in 2019 the volume distribution is increasing and the median trend is downwards. Finally more hours of importing flows from GB to NL were observed in 2019.
- These observations can be explained by the spread between the DA prices between GB and NL. These spreads show a decreasing trend as well as increase of hours in which NL DA prices were higher than GB.

- *Hours exceeding rated capacity are due to trials for increasing the capacity of BritNed.



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DC Interconnectors – NorNed

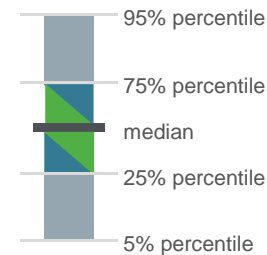


Direction of the flow on the NorNed cable was more volatile in 2019

NorNed Flow Distribution and NL-NO2 Day Ahead Price Spread Distribution



- The NorNed flow distribution shows that flows were typically often in an Import position from NO to NL. Further, in 2019 the volume distribution is increasing and the median trend is downwards. Finally more hours of exporting flows from NL to NO are observed in 2019.
- These observations can be explained by the spread between the DA prices between NO and NL that shows a median around zero. These spreads further show a decreasing trend as well as increase of hours in which NO DA prices were higher than NL.



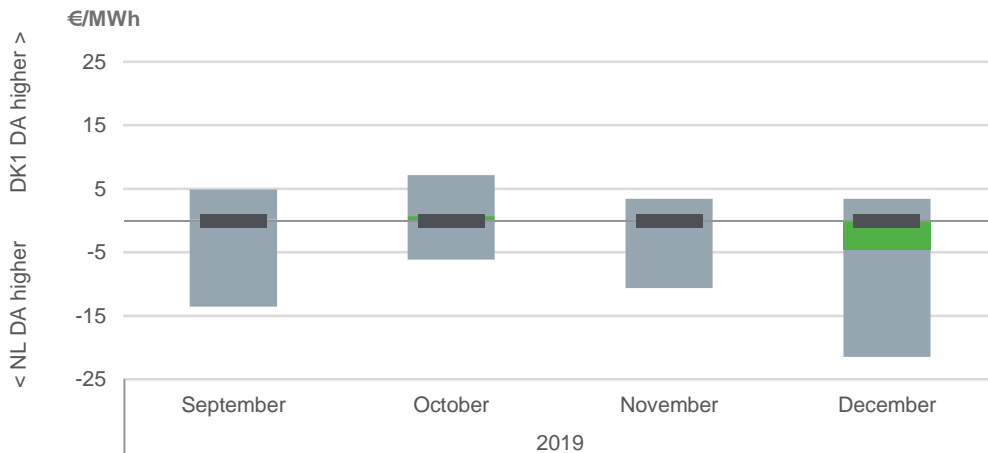
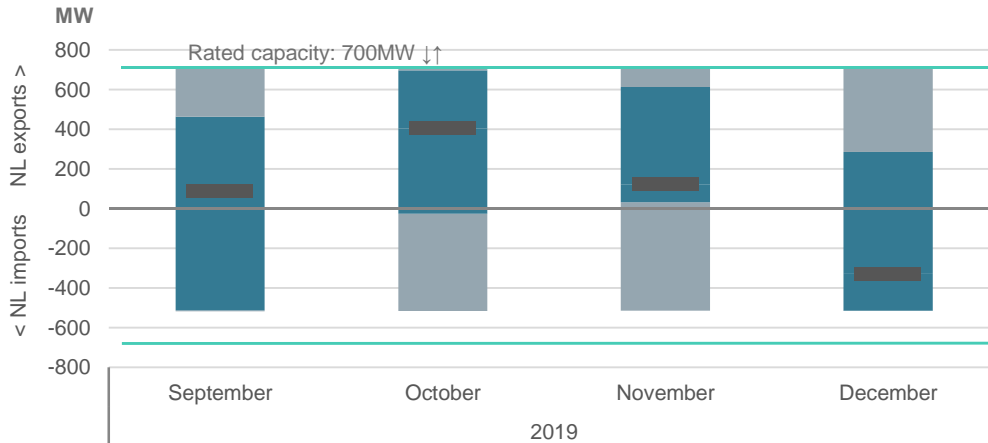
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DC Interconnectors – COBRA

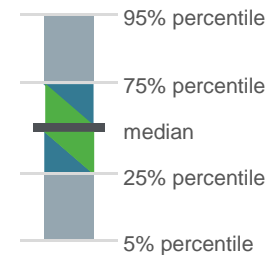


Go-Live of the COBRACable in September 2019

COBRACable Flow Distribution and NL-DK1 Day Ahead Price Spread Distribution



- On September 7th, the COBRACable between DK1 and NL started operating.
- The COBRACable flow Distribution shows that there is no typical import or export direction. Further the volume distribution is spread over the full import and export which could indicate that flexibility facilitated has a complementary character.
- These observations can be explained by the spread between the DA prices between DK1 and NL. These spreads show for the majority of hours a zero or near zero spread, indicating high convergence between DK1 and NL.



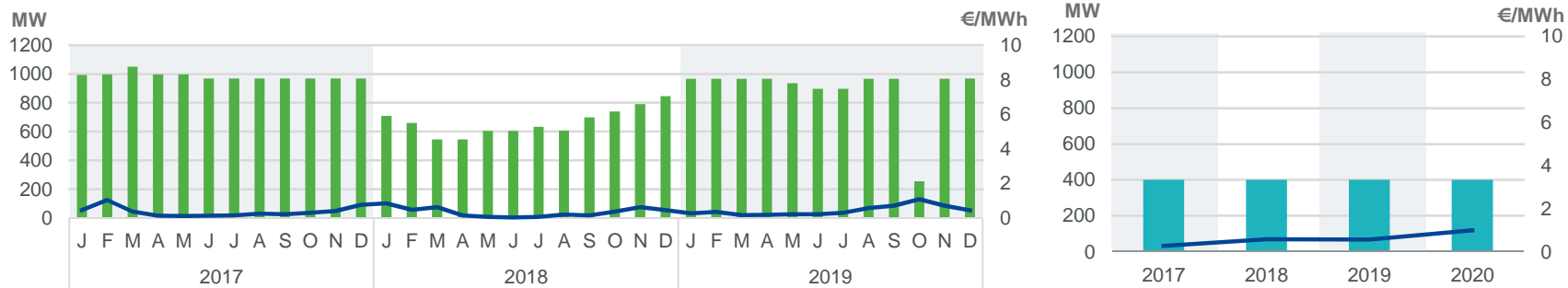
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Transmission Rights (LTTRs)

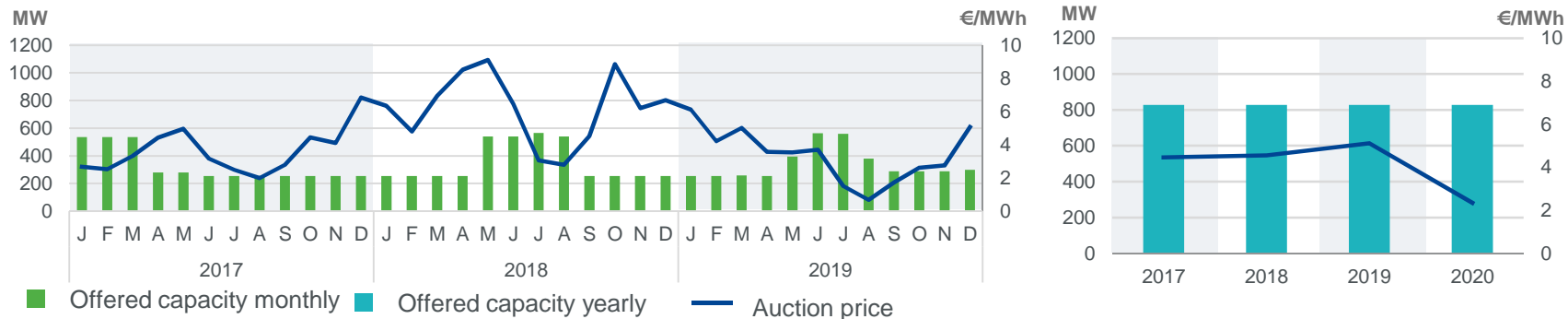


DE → NL LTTR's higher than NL → DE

NL → DE monthly and yearly Long Term Transmission Rights (LTTR) auction volume and price



DE → NL monthly and yearly Long Term Transmission Rights (LTTR) auction volume and price



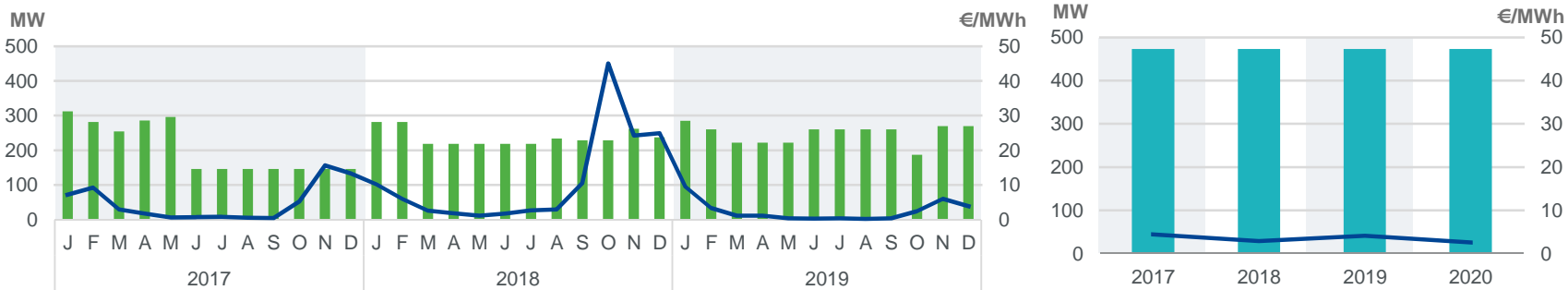
- A LTTR is a Long Term Transmission Right that allow the holder to be paid the price differential between coupled markets. A LTTR reflects the expectation of the value of price differentials for the next month or next year based on the underlying transmission constraint.
- The monthly DE/NL LTTRs show higher prices and a more volatile pattern for the LTTR in the DE → NL direction and a much lower and near zero value for the NL → DE direction. This indicates higher NL than DE prices were expected.
- From the yearly LTTRs it can be seen that price differential expectations for 2020 indicates a higher value for DE → NL 2.34 €/MWh versus NL → DE 0.99 €/MWh.

Transmission Rights (LTTRs)

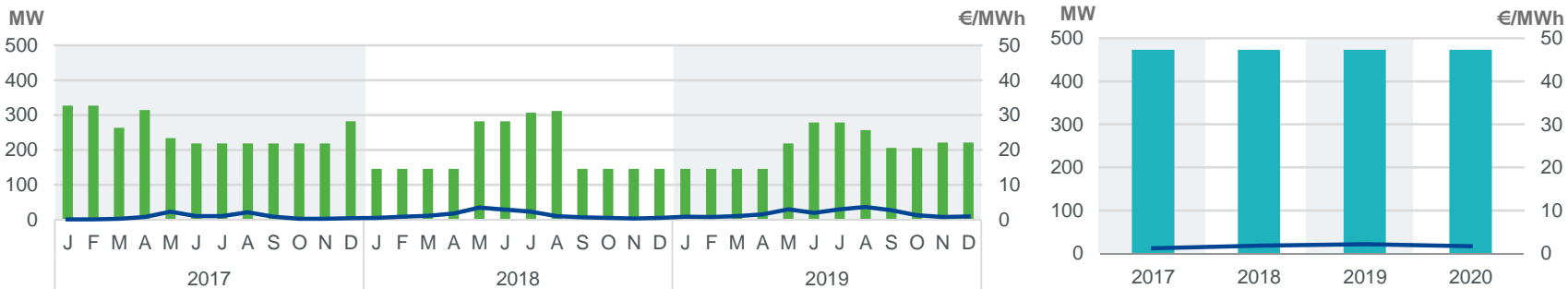


Q1 & Q4 NL→BE LTTR's higher than BE→NL, vice versa in Q2 & Q3

NL→BE monthly and yearly LTTR auction volume and price



BE→NL monthly and yearly LTTR auction volume and price



■ Offered capacity monthly ■ Offered capacity yearly — Auction price

- A LTTR reflects the expectation of the value of price differentials for the next month or next year based on the underlying transmission constraint.
- The monthly BE/NL LTTRs show a seasonal pattern value for the LTTR in the BE → NL direction, higher in Q2 and Q3, and NL → BE direction, higher in Q1 and Q4. The 2018 Q4 peak for NL → BE is the result nuclear unavailability and consequently expectation of a higher value for the price differential.
- From the yearly LTTRs it can be seen that price differential expectations for 2020 indicates a slightly higher value for NL → BE 2.56 €/MWh versus BE → NL 1.73 €/MWh.

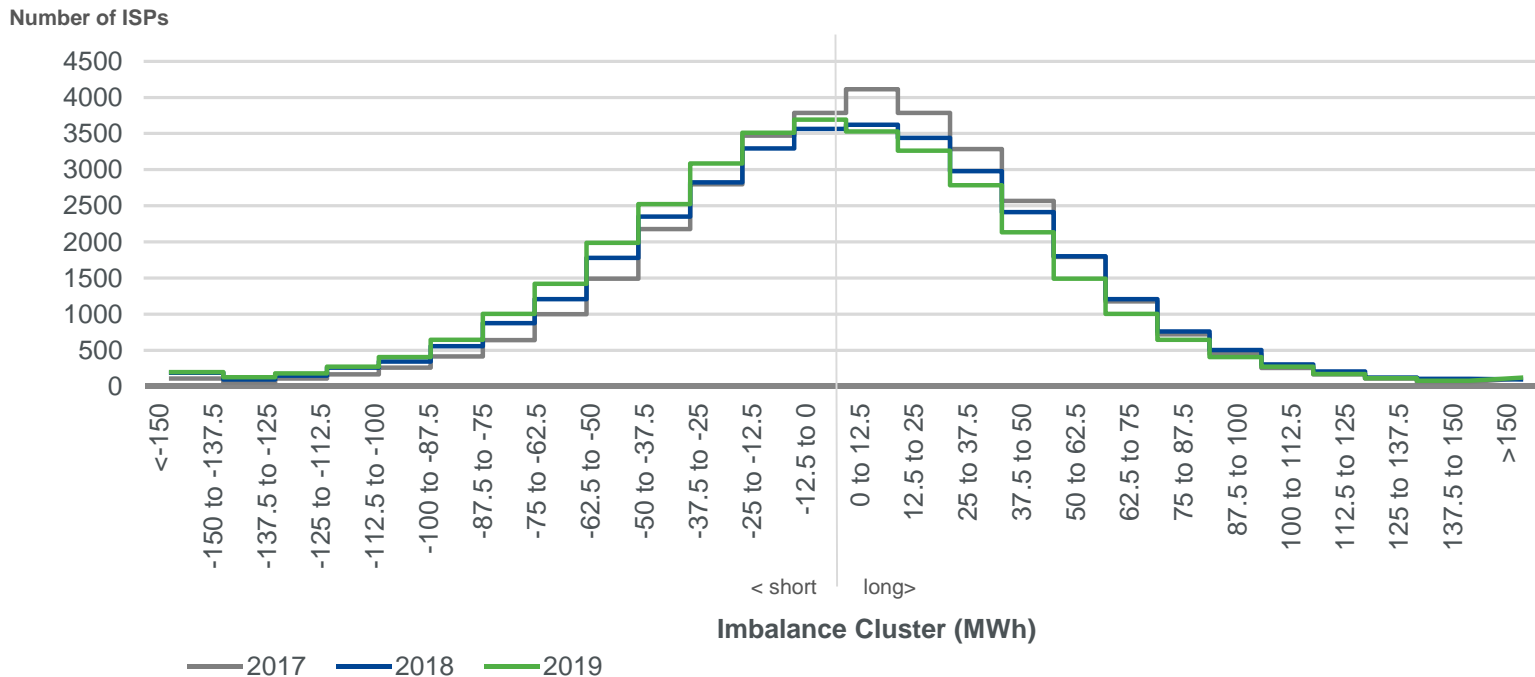
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Net Imbalance Volumes

Increased number of ISP's in short system Imbalance Cluster

Imbalance Volume Distribution in the Netherlands



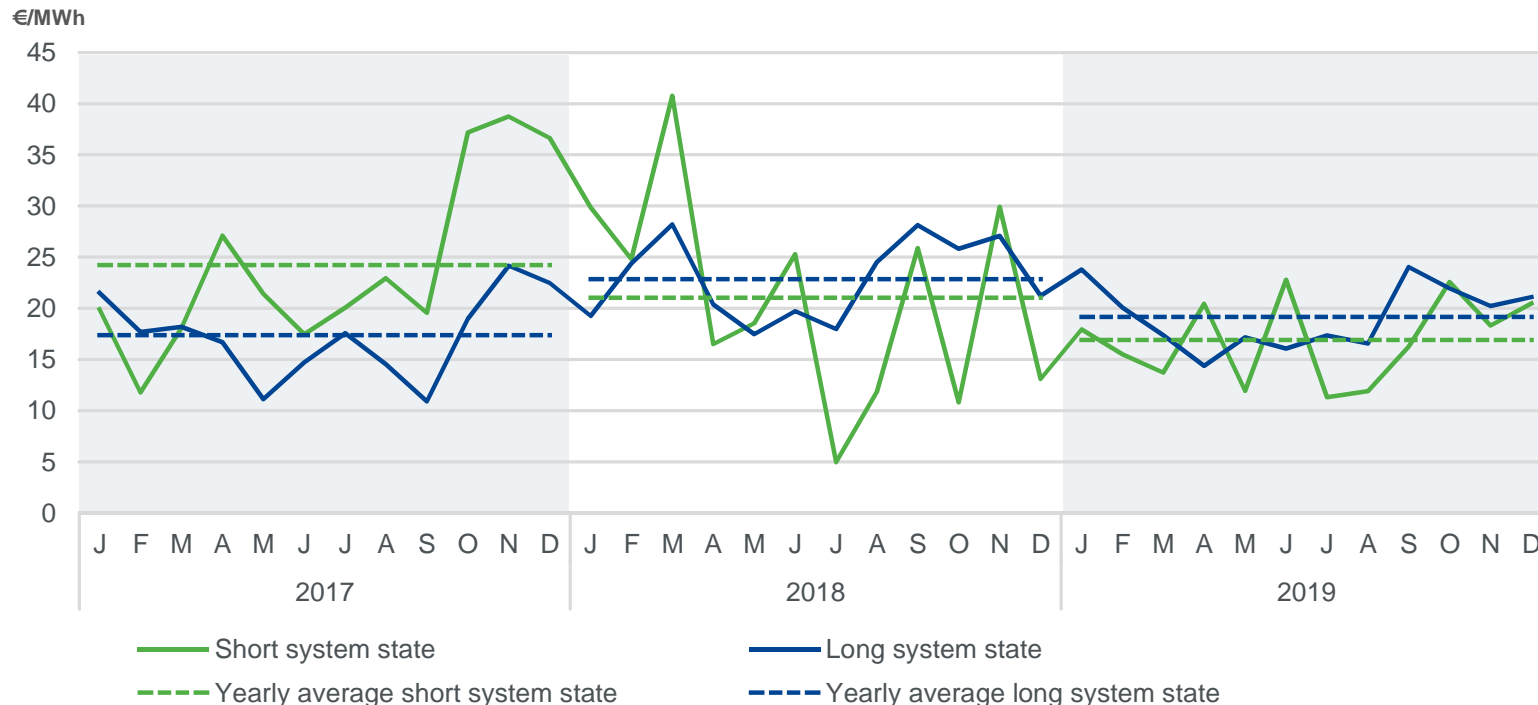
- This figure shows the total number of Imbalance Settlement Periods (ISPs) per year in which the net system imbalance volume fell within a certain cluster of net imbalance volumes.
- The imbalance Volume distribution in 2019 shows some more skewedness towards the left side indicating an increase of the number of ISP's in a short system Imbalance Cluster compared to the previous years.
- Since 2013, a continuing trend was seen: a decreasing number of ISPs with low net imbalance volumes and an increasing number of ISPs with high net imbalance volumes. This trend seems to have stopped in 2019 compared to 2018.



Imbalance Price Delta NL

Average long and short system prices decreased in 2019

Average Imbalance Price Delta in the Netherlands



In the AMU 2018 ISPs with dual pricing were not included. In the AMU 2019 these are included using the weighted average ISP price.

- The imbalance price delta is the difference between the imbalance price and the day-ahead price and can be considered as the penalty for being in imbalance.
- The average imbalance price delta of short system state (imbalance shortage) and of long system state (imbalance surplus) were lower in 2019 than in 2018, most likely due to decreasing fuel costs over 2019.

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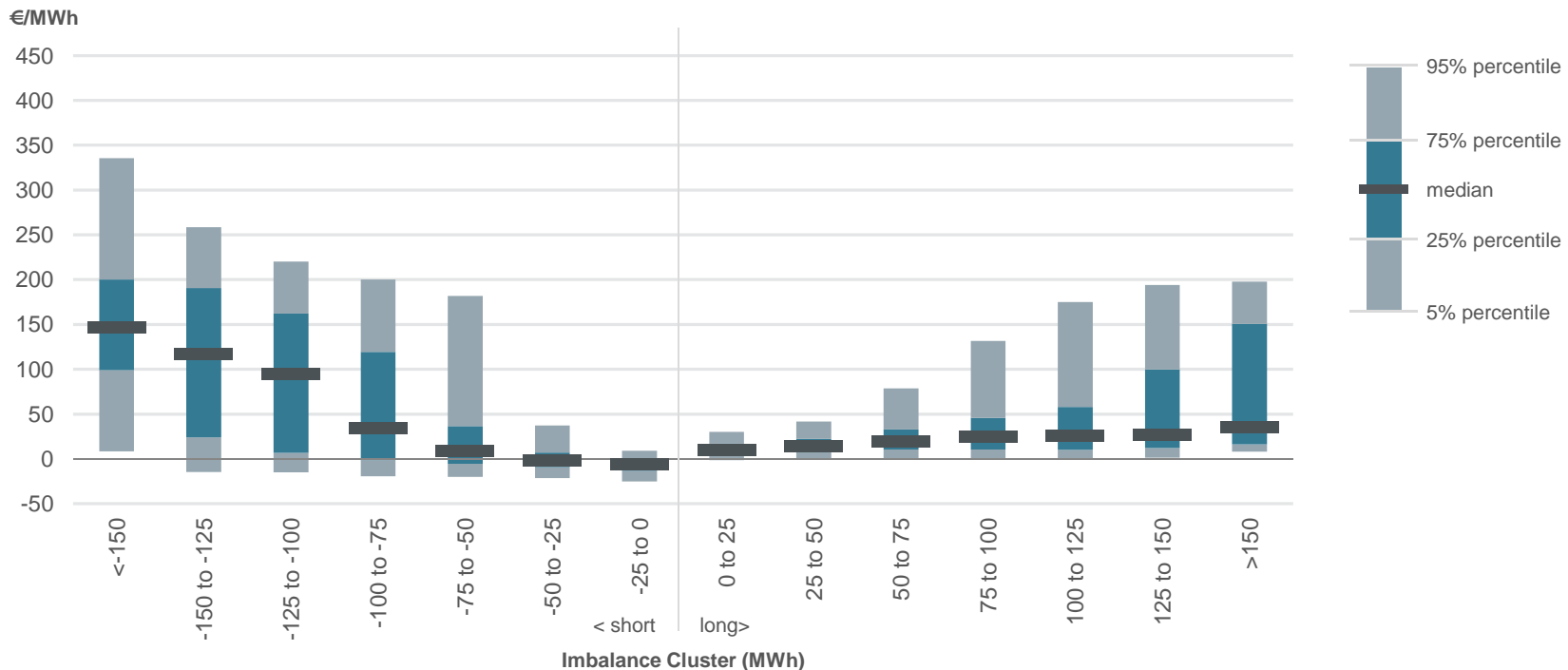
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Imbalance price delta spreads



Higher prices at higher imbalance volume clusters

Spread of Dutch Imbalance Price Delta 2019



- The figure shows the spread or variability in imbalance price delta for certain imbalance clusters.
- The spread is higher at larger imbalance volume clusters, which corresponds to the principle that the incentive to stay balanced or to help restore the system is larger with larger system imbalance volumes.
- As was the case last years as well (see TMR 2017 and AMU 2018), the imbalance price spread includes negative values in most imbalance clusters. This can be attributed to the depressing price effect of IGCC (cooperation between TSOs to exchange imbalance volumes in opposite directions).

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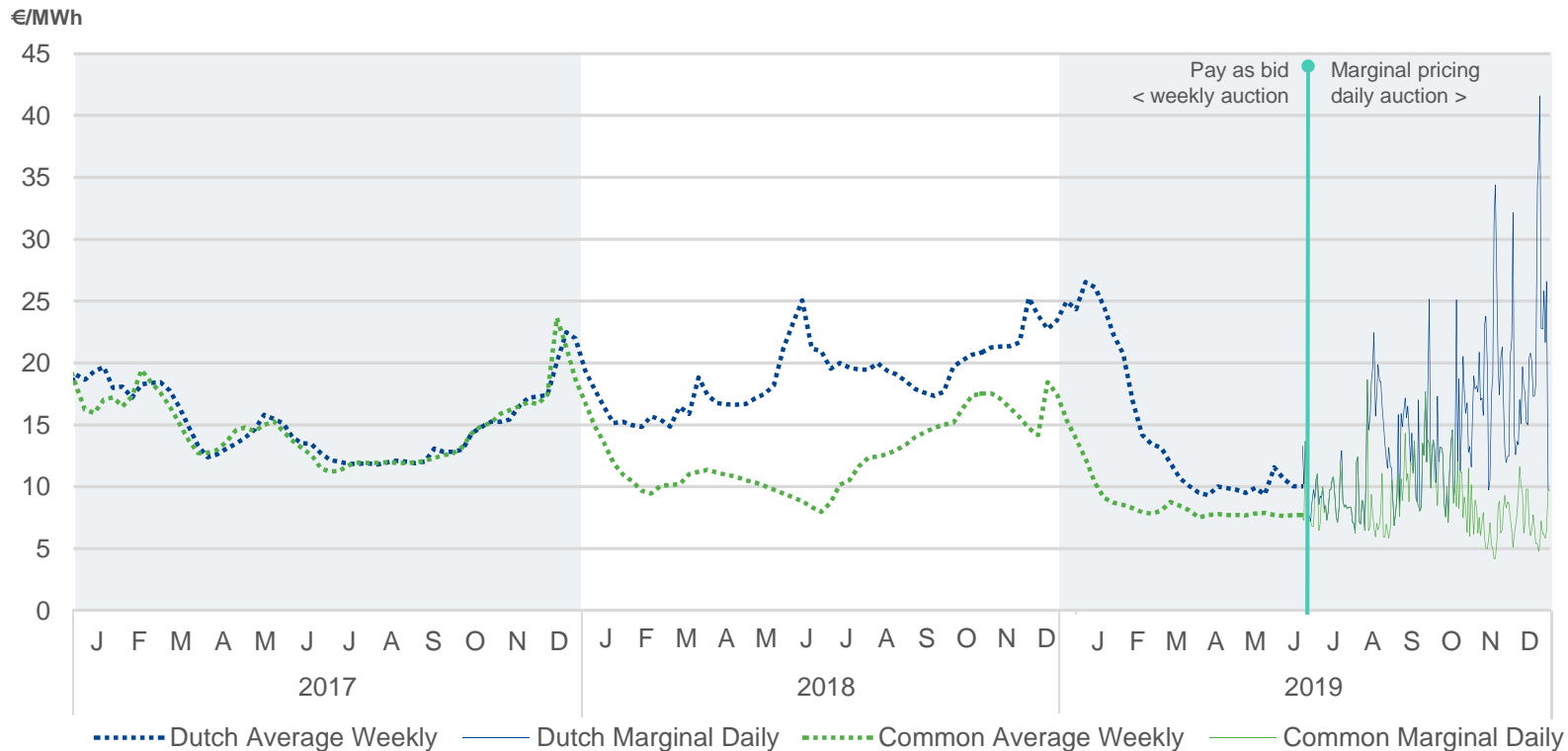
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FCR common & Dutch auction



Marginal pricing and daily auctions since July 2019

Frequency Containment Reserve (FCR) Capacity Prices in the Common and Dutch Auctions



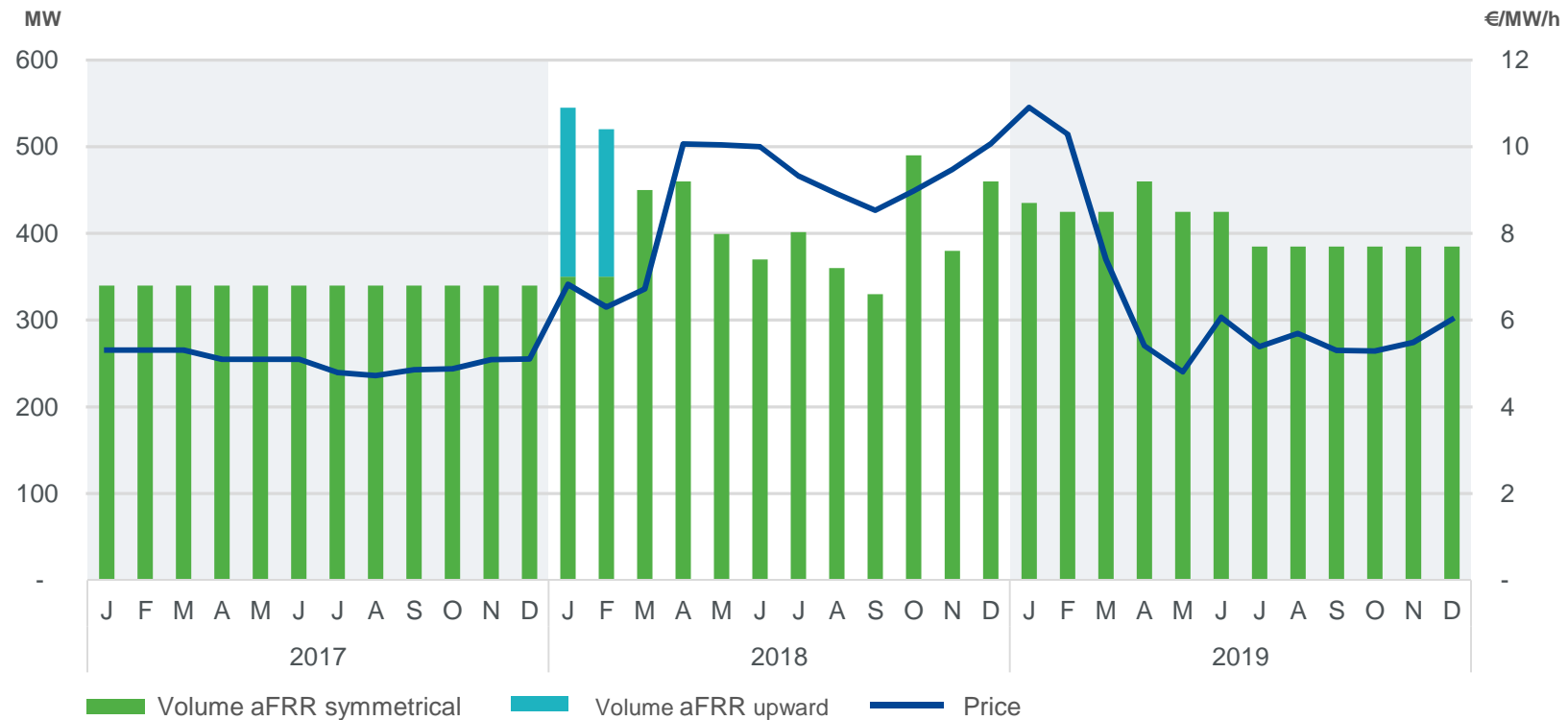
- From July 2019 the auction systematics changed in two ways for both the Common and Dutch Auction. Firstly the pay-as-bid system was replaced by a marginal pricing system. Secondly, the auctions are now held every day, two days before the delivery day (D-2).
- FCR prices became more volatile due to daily instead of weekly auctions. The prices for the common auction reached a record low price of 4.17 €/MW/h at 20/11/2019 whereas the Dutch auction price significantly increased for most auction days since July.



aFRR in the Netherlands

Prices for aFRR decreased during 2019

Contracted automatic Frequency Restoration Reserve (aFRR) Capacity Volumes and Prices in the Netherlands



- Prices for aFRR significantly decreased in 2019 almost returning to pre-2018 levels. In 2018 prices increased because of a tighter balancing market caused by increased capacity contracted for mFRRda (see next slide).
- Since 2018, a fixed amount of capacity for aFRR and mFRRda (see next slide) combined is contracted, contracting the least costly combination, instead of fixed amounts for aFRR and mFRRda products separately. Therefore, 2018 and 2019 show more variation in aFRR volumes. Since July 2019 these volumes stabilised due to the significant decrease in mFRRda prices.

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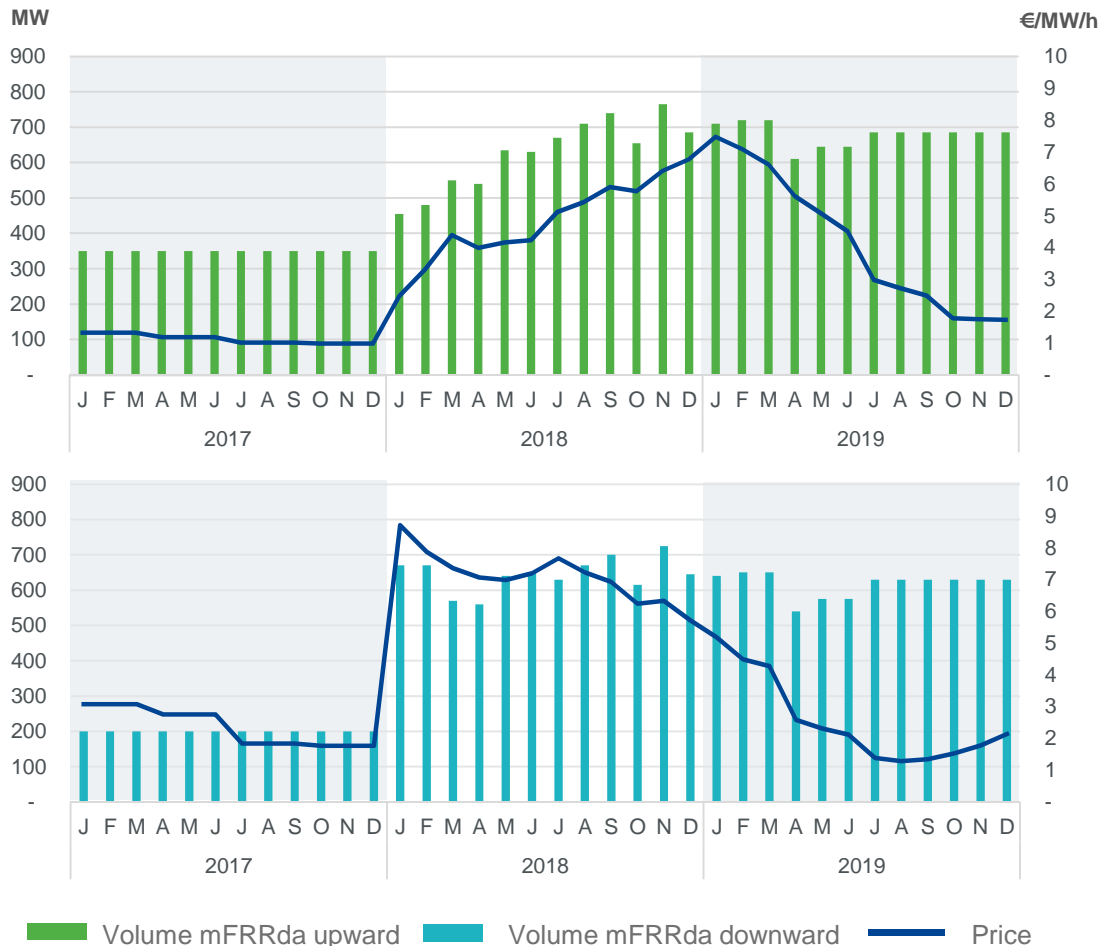
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mFRRda in the Netherlands



Prices for mFRRda decreased during 2019

Manual Frequency Restoration Reserve directly activated (mFRRda) Capacity Volumes and Prices in the Netherlands



- Prices for mFRRda decreased in 2019 for both upward and downward reserves.
- Both upward and downward reserve prices returned to almost the same price levels of 2017 when significantly less reserves needed to be contracted. The increase in contracted mFRRda volumes was a direct result from new requirements in the EU Electricity Balancing Guideline that came into force in 2018.
- The decreasing prices observed during 2019 reflect an increased competition for these reserve products decreasing the costs for the TSO for ancillary services.

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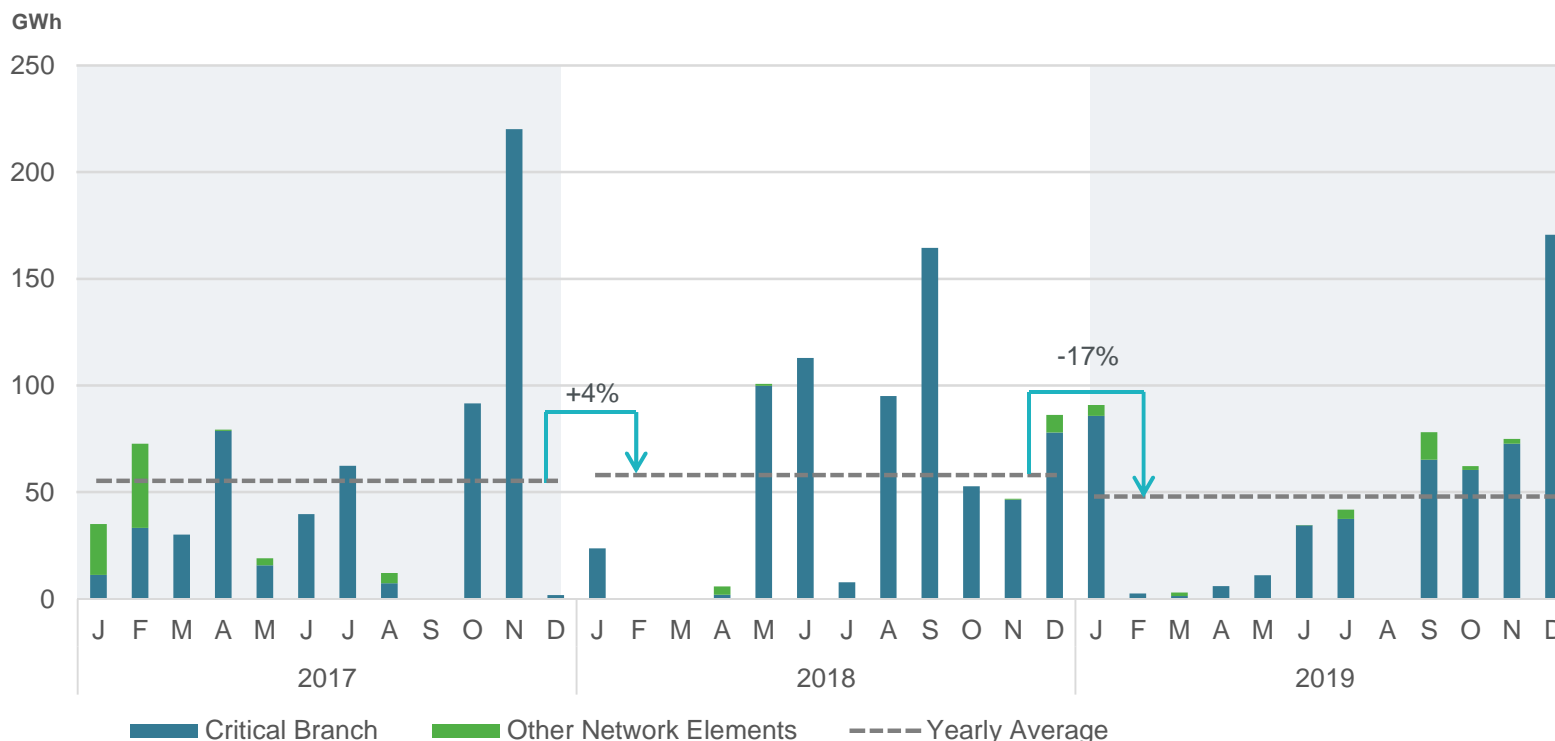


Redispatch Volumes NL

17% decrease in Redispatch Volume in 2019 compared to 2018

Most Redispatch required on critical branches

Redispatch upwards and downwards volumes in the Netherlands



- Critical branches are lines that are included in CWE flow-based market coupling, as they significantly impact and are impacted by CWE cross-border exchanges. Redispatch takes place to ensure that grid operation remains within operational security limits.
- Average redispatch volumes decreased in the Netherlands from 58 GWh/month in 2018 to 48 GWh/month in 2019.

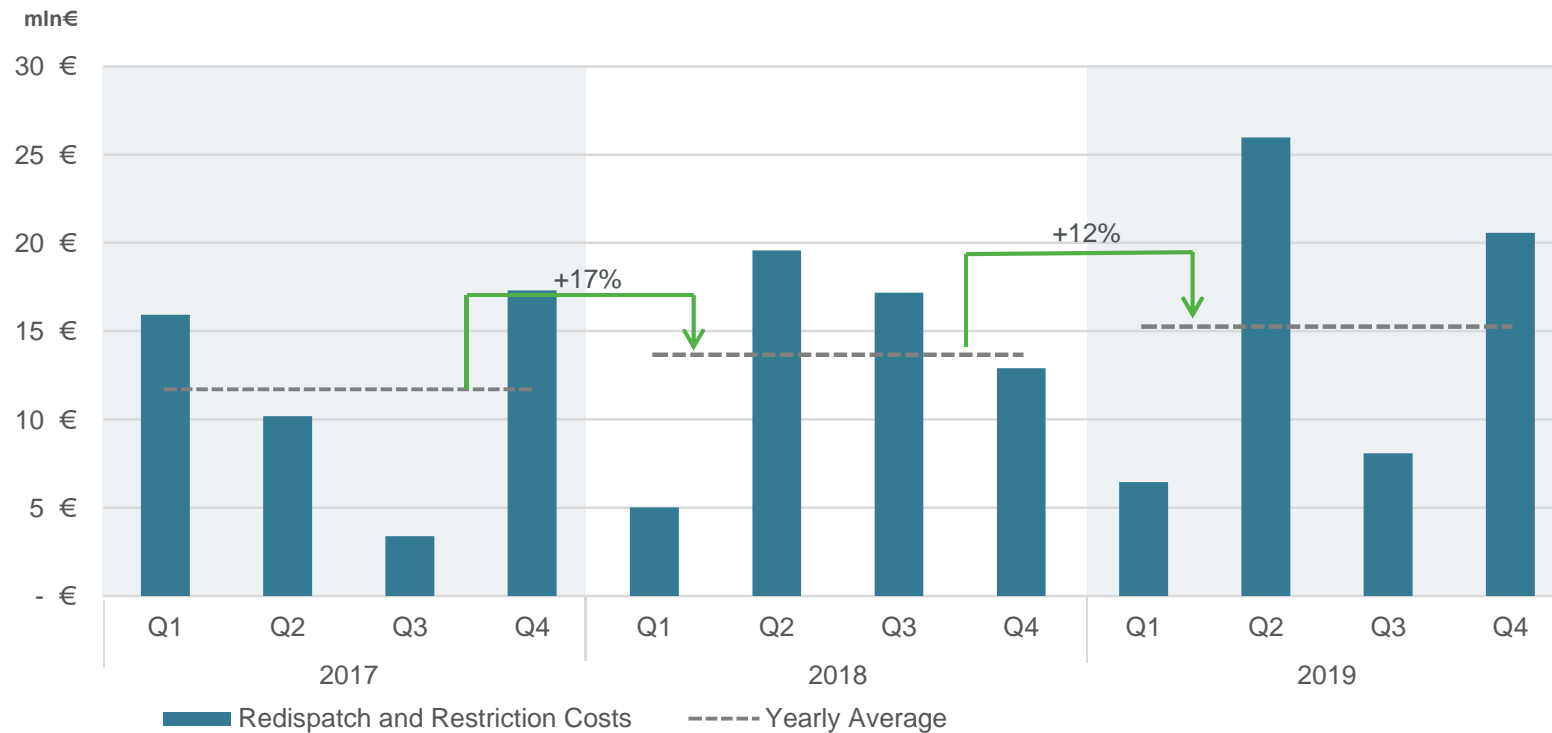
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Redispatch Costs NL

Costs for congestion management increased by 12% in 2019

Redispatch and Restriction Costs in the Netherlands



- This figure shows redispatch and restriction costs in the Netherlands. Restriction concerns contracts with market parties to withhold a share of production for a certain period. Total costs increased from €54.6 million in 2018 to 61.0 million in 2019 despite the decrease of redispatch volume activated. A significant part of the cost increase is related to restriction contracts.

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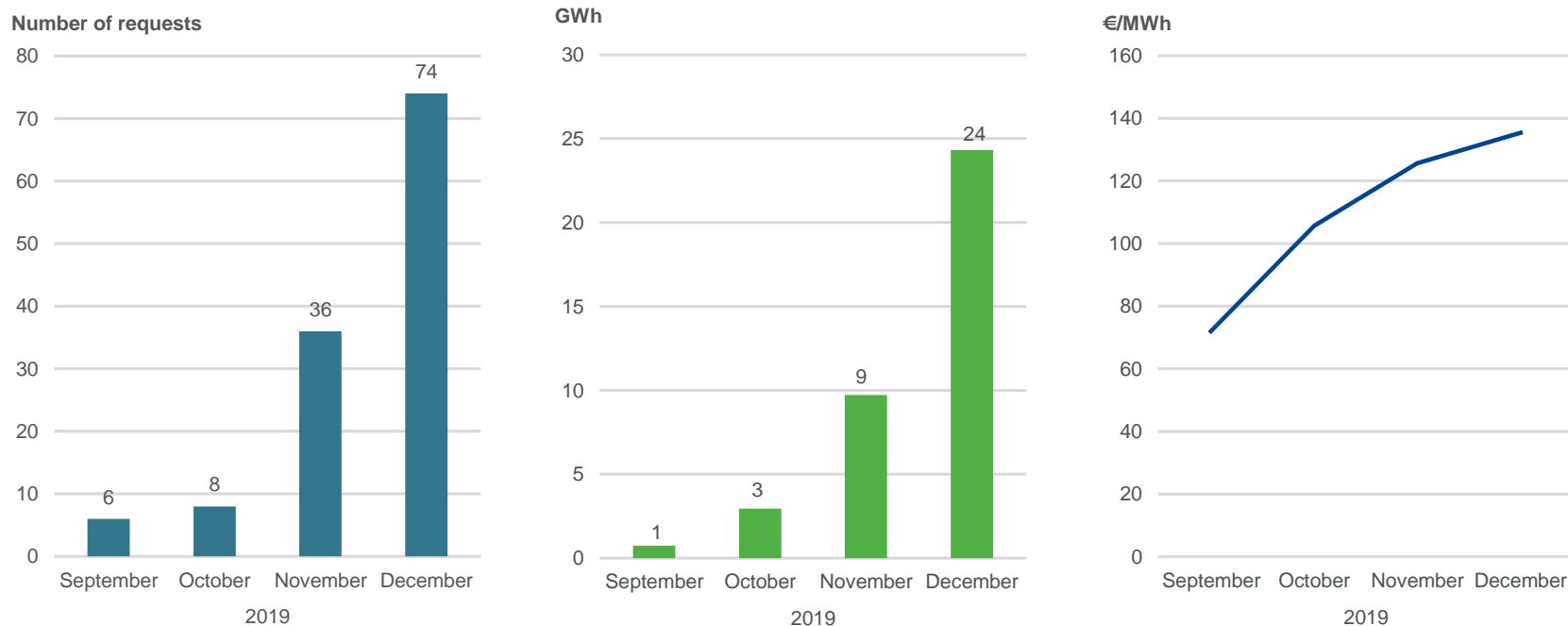
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First IDCONS activated on GOPACS in September 2019

Number of congestion management request, cleared volume of IDCONS, and weighted average prices of cleared IDCONS



- In September the first Intraday Congestion Spreads (IDCONS) were activated via the Grid Operators Platform for Congestion Solutions (GOPACS). GOPACS is a Dutch TSO-DSO coordinated market-based congestion management platform that enables intraday bids with a geo-tag to be used for congestion management as well. An IDCONS is the spread the Grid Operator pays in order for a buy and sell bid to be cleared. For a more detailed explanation visit: www.GOPACS.eu.
- Between September and December the amount of IDCONS activated, the volume of cleared IDCONS and the weighted average prices all increased.

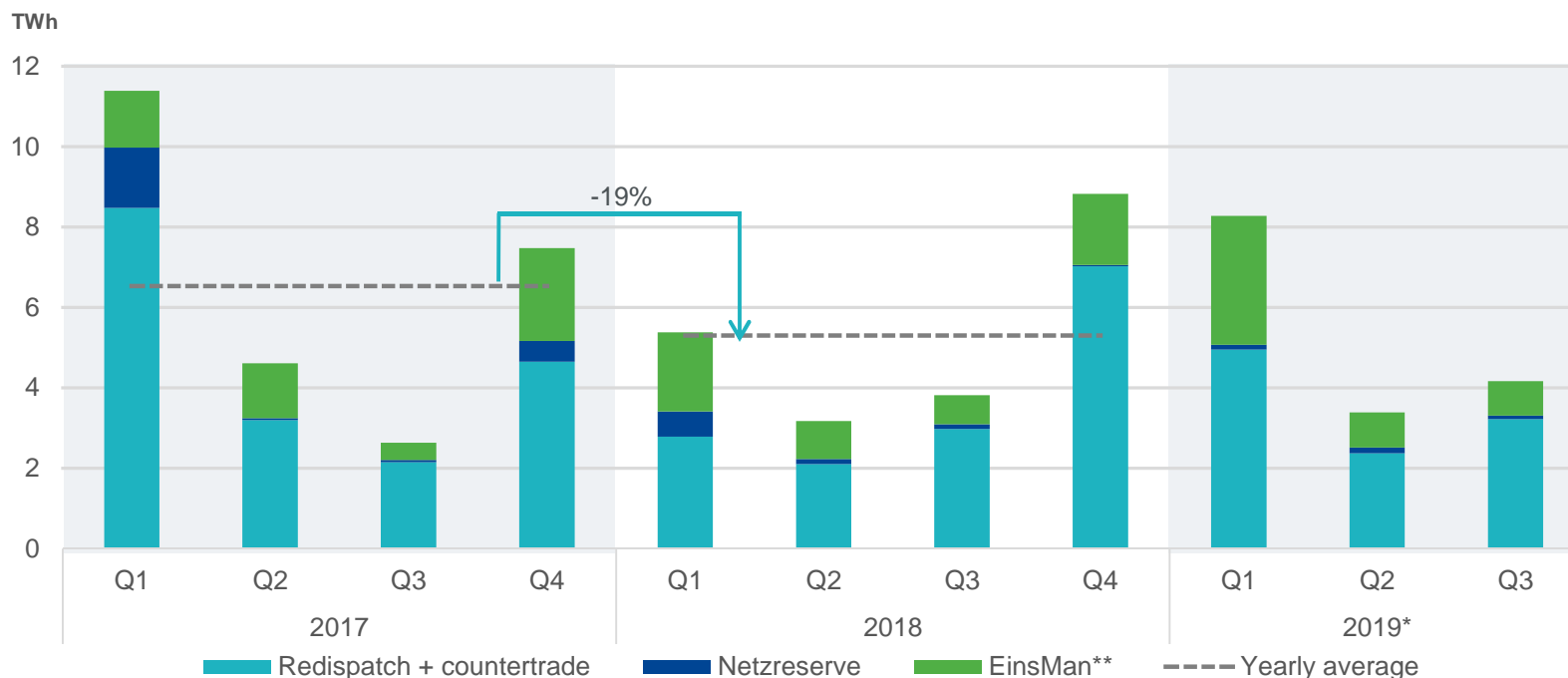
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Redispatch Volumes DE

Increased EinsMan related Redispatch

Redispatch Volumes in Germany



* For 2019 only costs for the first three quarters were available. ** EinsMan volumes exist only of downward adjustments.

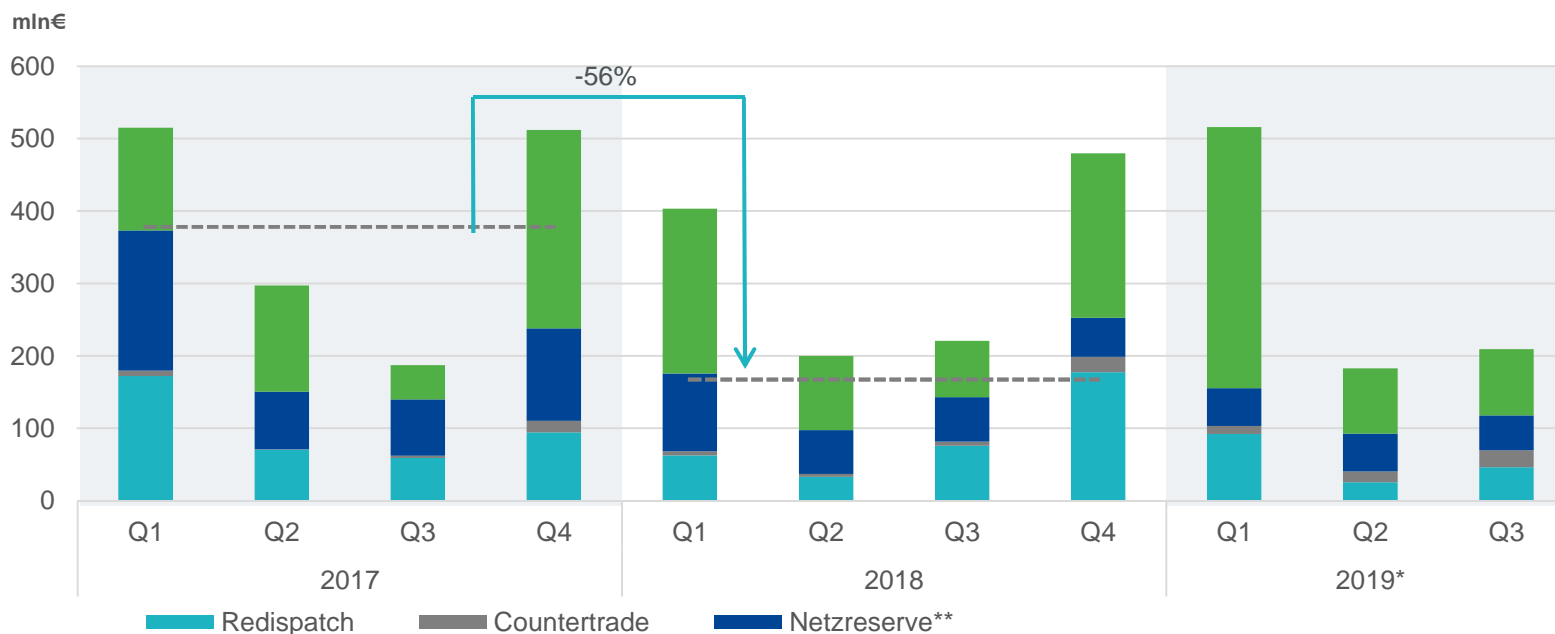
- RES curtailment (EinsMan) related redispatch increased in the first three quarters of 2019, especially in Q1. Conventional redispatch (conventional power plants > 10 MW in combination with countertrade remained the most common process used for solving congestion in the German grid.
- The contracted Netzreserve plants are called upon when redispatch availability is insufficient. For the first three quarters of the 2019, the use of Netzreserve decreased significantly compared with the first three quarters of 2017. This can be explained by the DE-AT bidding zone split that resulted in less DE-AT cross-border flows as well as Austrian power plants, with German contracts leaving the German Netzreserve, became Austrian market power plants.



Redispatch Costs DE

Increased Redispatch costs mainly in Q1

Redispatch Costs in Germany



* For 2019 only costs for the first three quarters were available. ** Netzreserve costs for all years were given as yearly aggregated values. Therefore, costs were equally divided over the four quarters.

- Costs for congestion management increased the first three quarters of 2019 compared to 2018, mainly due to Q1. Biggest contribution to increasing costs due to EinsMan (high wind energy production). Netzreserve costs decreased.
- Congestion management costs are generally higher in winter months, due to more stressed grid conditions. Due to different weather conditions in Q4, the overall costs in 2019 might have reached the level of 2018.
- When compared to the previous slide, redispatch measures show the lowest costs per GWh, and EinsMan the highest.

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	Day-ahead average price 2018	Day-ahead average price 2019	Day-ahead median price 2018	Day-ahead median price 2019	Physical import 2018	Physical import 2019	Physical export 2018	Physical export 2019	Net export position 2018	Net export position 2019
	€/MWh	€/MWh	€/MWh	€/MWh	TWh/year	TWh/year	TWh/year	TWh/year	TWh/year	TWh/year
AT	46.2	40.1	46.5	39.4	29.4	21.1	19.0	18.0	-10.4	-3.1
BE	58.8	39.8	52.6	39.0	21.6	11.7	4.3	13.4	-17.4	1.6
CH	52.2	40.9	51.3	40.0	30.3	25.1	31.6	27.4	1.3	2.3
CZ	46.02	40.2	46.1	39.7	11.6	8.6	25.5	21.3	13.9	12.7
DE	44.5	37.9	45.1	38.1	31.5	27.5	82.6	61.3	51.1	33.8
DE-AT	41.7	NA	42.4	NA	NA	NA	NA	NA	NA	NA
DK1	44.5	38.6	44.2	38.8	15.6	15.0	10.4	9.3	-5.2	-5.7
DK2	46.2	39.9	45.5	39.6						
EE	47.1	45.9	46.2	43.5	3.4	3.9	5.2	3.2	1.7	-0.7
ES	57.3	47.7	60.0	48.9	24.0	15.8	12.9	9.7	-11.1	-6.1
FI	46.8	44.1	46.1	42.0	23.4	16.0	3.4	3.9	-20.0	-12.1
FR	50.2	39.5	49.9	38.7	13.4	10.5	76.0	67.9	62.6	57.4
GB	64.9	48.9	63.0	47.5	22.7	24.9	2.2	2.2	-20.5	-22.6
HR	52.0	49.3	51.8	46.8	12.7	6.4	6.5	2.3	-6.2	-4.1
HU	51.0	50.4	50.1	48.2	18.6	15.0	4.2	6.8	-14.3	-8.2
IE	61.9	50.3	58.9	47.0	1.6	1.0	1.6	1.2	0.02	0.2
IT-CNOR	61.1	52.2	60.8	51.3	47.1	42.7	3.2	4.1	-43.9	-38.6
IT-CSUD	61.0	52.3	61.0	52.0						
IT-NOR	60.7	51.3	60.4	50.1						
IT-SARD	60.7	51.8	60.9	51.8						
IT-SICI	69.5	62.7	63.8	55.8						
IT-SUD	59.4	50.9	60.1	50.9						
LT	50.0	46.3	47.9	44.2	12.8	6.8	3.2	2.9	-9.6	-3.9
LV	49.9	46.2	48.0	44.1	5.1	2.8	4.3	2.8	-0.8	-0.02
NL	52.5	41.2	50.9	39.7	26.8	16.9	18.6	16.7	-8.2	-0.3
NO1	43.7	39.4	43.9	38.9	8.1	11.3	18.0	11.1	9.9	-0.2
NO2	43.3	39.3	43.6	38.8						
NO3	44.1	38.6	44.9	38.4						
NO4	43.7	38.4	44.7	38.2						
NO5	43.0	39.3	43.7	38.9						

Annex (2/3)



	Day-ahead average price 2018	Day-ahead average price 2019	Day-ahead median price 2018	Day-ahead median price 2019	Physical import 2018	Physical import 2019	Physical export 2018	Physical export 2019	Net export position 2018	Net export position 2019
	€/MWh	€/MWh	€/MWh	€/MWh	TWh/year	TWh/year	TWh/year	TWh/year	TWh/year	TWh/year
PL	52.0	53.2	48.9	53.4	13.8	15.7	8.1	6.8	-5.7	-8.9
PT	57.5	47.9	60.0	49.0	5.7	6.9	8.3	3.5	2.7	-3.4
SE1	44.2	38.0	44.8	38.1	14.2	9.0	31.6	35.0	17.3	26.0
SE2	44.2	38.0	44.8	38.1						
SE3	44.5	38.4	44.9	38.2						
SE4	46.4	39.8	45.4	39.3						
SI	51.2	48.8	50.6	46.7	8.9	7.0	9.3	7.5	0.4	0.4
SK	48.5	41.5	47.4	40.5	12.5	13.4	8.7	11.7	-3.8	-1.6

Annex (3/3)



	Unit	2017		2018		2019		Source
		NL	DE	NL	DE	NL	DE	
Yearly average weighted intraday price	€/MWh	40.6		53.0		41.8		[1,2]
Intraday volumes CrossBorder	GWh/year	901.9		1213.0		1,703.5		[1,2]
Intraday volumes Spot	GWh/year	593.8		1047.6		1,559.0		[1,2]
Yearly average hard coal price (API#2 OTC)	€/MWh.th	10.7		11.2		8.0		[3]
Yearly average natural gas price (TTF OTC monthly)	€/MWh.th	17.4		22.0		14.1		[3]
Yearly average carbon price (EEX futures)	€/tCO2	5.8		15.4		24.9		[3]
Yearly average Clean Dark Spread base	€/MWh	9.8	6.8	13.4	6.8	2.8	0.9	[3,4]
Yearly average Clean Dark Spread new	€/MWh	13.2	10.3	17.9	11.3	7.2	5.4	[3,4]
Yearly average Clean Spark Spread base	€/MWh	6.9	4.5	8.6	2.0	8.7	6.8	[3,4]
Yearly average Clean Spark Spread peak	€/MWh	12.5	9.5	14.3	6.7	12.4	10.6	[3,4]
Average imbalance price delta long system	€/MWh	24.2		21.0		16.4		[4,5]
Average imbalance price delta short system	€/MWh	17.4		22.9		16.4		[4,5]
Yearly average FCR price Dutch auction weekly (symmetrical)	€/MW/h	14.9		19.1		14.8		[6]
Yearly average FCR price Dutch auction daily (symmetrical)	€/MW/h					14.4		[6]
Yearly average FCR price Joint auction weekly (symmetrical)	€/MW/h	14.6		12.8		8.8		[6]
Yearly average FCR price Joint auction daily (symmetrical)	€/MW/h					8.7		[6]
Yearly average aFRR price (asymmetrical)	€/MW/h	5.1		9.8		6.5		[5]
Yearly average mFRRda upward price (asymmetrical)	€/MW/h	1.1		4.8		4.1		[5]
Yearly average mFRRda downward price (asymmetrical)	€/MW/h	2.3		7.1		2.5		[5]
Redispatch volumes	GWh/year	664.0	26,101	696.3	21,181	575.7		[5,7]
Redispatch costs	mln.€/year	46.8	1,512	53.9	1,304	61.0		[5,7]

Sources

1) APX 2) ETPA 3) energate 4) MRC Market Coupling 5) TenneT NL 6) regelleistung.net 7) Bundesnetzagentur

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