ACER

European Union Agency for the Cooperation of Energy Regulators

Progress of EU electricity wholesale market integration

2023 Market Monitoring Report

November 2023

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Energy Community

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EXECUTIVE SUMMARY

1 2022 was marked by large price increases for all electricity markets, mostly driven by the Russian invasion of Ukraine. The crisis taught valuable lessons, the most important one being the resilience offered by interconnected electricity markets. Most developments currently happen in the balancing market, while ongoing legislative discussions focus on the long-term market, to better manage price risk and reduce price volatility.

2 This focus on the current functioning of electricity markets drives the content of this annual monitoring report. The European Green Deal calls for the transformation of the energy system, and the electricity system in particular, to deliver clean, affordable, and reliable electricity. Electricity markets should, through proper implementation of the recast Electricity Regulation, be the main source for delivering the necessary levels of efficiency and security of supply. Echoing this urge for transformation, the report delves into the evolution and current operation of day-ahead, intra-day, and balancing markets, while also shedding light on the state of play for long-term markets across Europe. Resulting indicators, metrics, and bellwethers, such as the surging costs for remedial actions and congestion incomes, point toward a certain need for change, intimately tied to the recent report on cross-zonal capacities and the 70% margin available for cross-zonal electricity trade.

The real challenge in market integration: ensuring cross-zonal capacity where and when needed.

3 In the past few years, important milestones have been reached. The internal electricity market is functioning. Day-ahead markets are now fully coupled, enabling efficient transmission capacity allocation, meaning available capacity is assigned to the electricity trades that create most welfare. All Member States are coupled through continuous intraday trading, and the introduction of intraday auctions is to follow. The remaining primary challenge for market integration is therefore not so much the allocation of capacity, but rather its availability, particularly in the intraday market. Improvements in the forward and balancing markets will drive future progress.

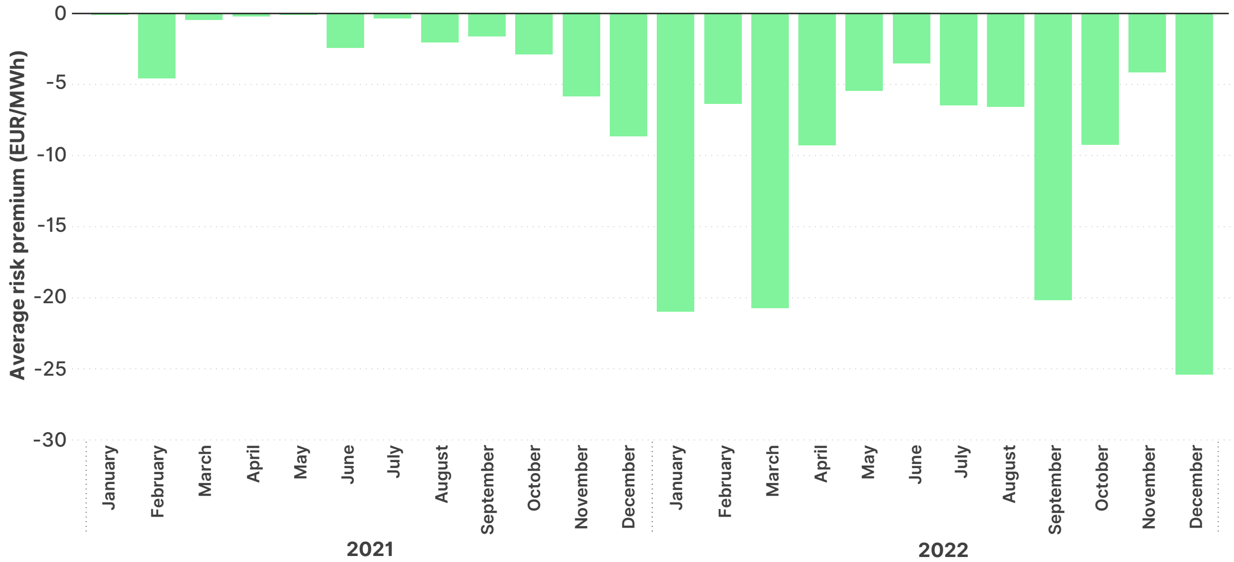
4 Stakeholders and policy makers in the energy sector have a clear mandate to fully implement the current EU rules, especially those outlined in the Clean Energy Package and to significantly enhance them where needed. This is crucial for the ongoing development of the EU's resilient electricity market, which demonstrated its strength during the recent turbulent events.

Powering progress with reliable forward markets

5 European forward markets exhibit limited liquidity with regional disparities. In 2022, liquidity further decreased, partly due to increased risk mitigation requirements, leading to reduced trading activity. Long-term transmission rights were often cheaper than forward trading spreads. This difference even intensified in 2022, particularly during the energy crisis, signifying heightened market uncertainty. Such uncertainty is further reflected in a shift from brokered to exchange trading of forward products, underscoring the evolving market dynamics. Prices of long-term transmission rights showed very limited risk premiums compared to day-ahead price spreads, indicating a cheap hedging opportunity. ACER and NRAs are exploring developments in European forward electricity markets, with discussions influenced by ACER's February 2023 policy paper, suggesting hub-to-zone trading.

ACER and NRAs are powering progress in European forward electricity markets.

Figure 1: Monthly evolution of the average risk premiums of long-term transmission rights in the EU – 2021-2022 (EUR/MWh)



Source ACER calculation based on REMIT and JAO data.

Note: Borders with low liquidity as per Figure 9 (BG-GR, HU-RO, AT-SI) have been excluded from this analysis, as no conclusive assessment can be made for them.

An increased use of spot markets during the crisis

6 Despite a decrease in forward trading, the liquidity of day-ahead and intraday markets remained stable. Spot trading likely thrived as the main option for traders to balance their portfolio faced with insufficient forward hedging. The coupling of spot markets played a crucial role in mitigating the risk of price spikes in certain Member States by facilitating imports from neighbours. The European day-ahead and single intraday market coupling showed a high level of concentration among market operators.

Scarce forward hedges fuelled spot market liquidity.

Balancing energy, balancing costs: a 'balancing act'

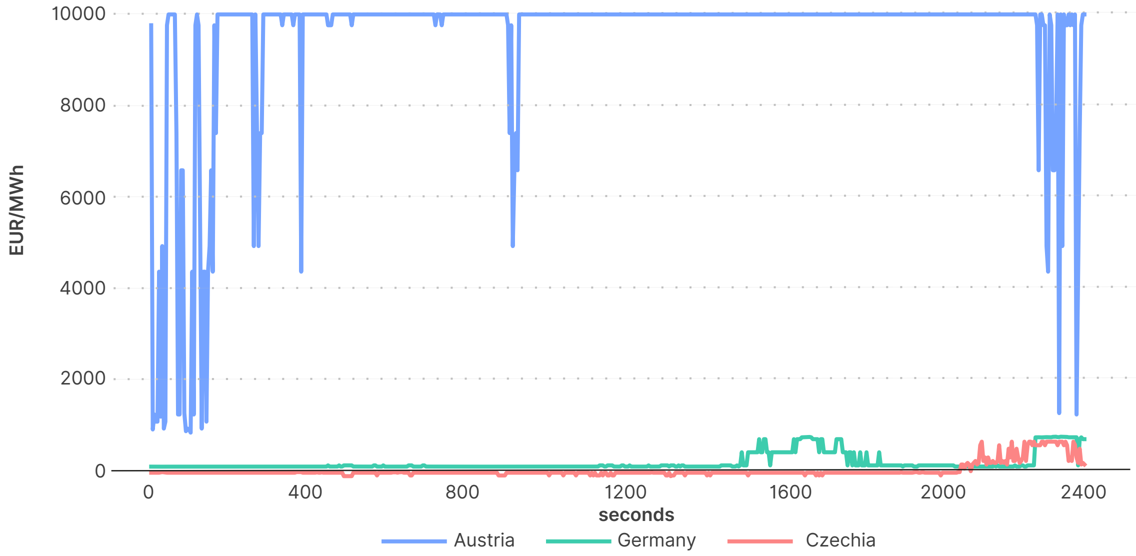
7 The importance of balancing is expected to increase with the surge of renewable energy sources. In 2017, the European Commission adopted the Electricity Balancing Regulation, which sets the guidelines for the standardisation of balancing products and the balancing platforms and thereby the foundation for the European market integration for balancing products. In 2022, the balancing markets saw large price increases for balancing services, which were primarily instigated by the Russian invasion of Ukraine. These price surges were particularly pronounced in services like frequency containment reserve (FCR) and automatically activated frequency restoration reserve (aFRR).

Low TSO engagement and data limitations cloud balancing platform success.

8 At the same time, 2022 marked the go-live of the balancing energy platforms for automatic frequency restoration reserves (aFRR), and manual frequency restoration reserves (mFRR). This concludes the go-live of all European platforms for balancing energy defined in the Electricity Balancing Regulation. The defined platforms will eventually enable Transmission System Operators (TSOs) to procure balancing products from all over Europe, allowing cheaper procurement of balancing products and dampening the effect of crises on prices.

9 However, despite the launch of both platforms in 2022, they saw limited engagement, with only a very small number of TSOs actively participating. Further, since the launch of the PICASSO platform, there have been repeated occurrences of price incidents. Strategies to address price incidents may involve more TSOs participating and increased availability of cross-zonal transmission capacity. The possible use of slower reserves, such as mFRR, following aFRR activations, should be studied.

Figure 2: Cross-border marginal prices in Austria, Czechia, and Germany on 18 August 2022 (EUR/MWh per second of optimisation)



Source: ACER calculation based on [Transnet](#) data.

Note: The incident occurred on 18 August 2022 between 19:20:36 and 20:00:00.

10 Balancing platforms are a crucial move for market integration. Yet ACER cannot confirm their effective implementation today, faced with low TSO participation and limited monitoring data.

Striving for efficiency in alleviating congestion

11 In 2022, congestion income increased significantly across Europe, reaching about 16 billion EUR. The level of congestion income is tied to cross-zonal capacity and price disparities. Price disparities, even if exacerbated by crises, may be temporary. Exchange pattern shifts may be periodic in the context of the Energy transition. Eventually, in a stable market, EU's congestion income should remain steady. Ideally, collected congestion incomes should be reinvested to alleviate congestion.

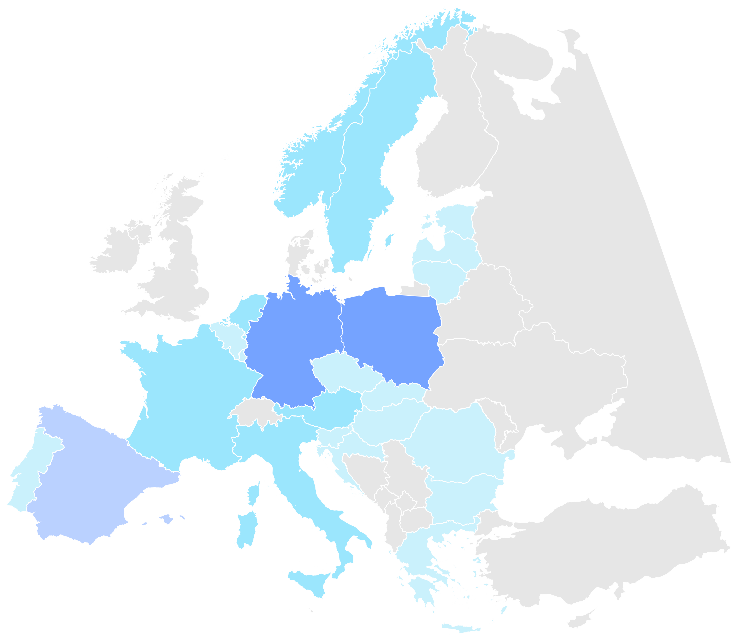
Congestion income soared due to price differences and changing energy exchange patterns.

Remedial actions:

Costs surged and curtailment of renewable energy increased.

12 The dire need for increased cross-zonal capacities to complete the integration of short-term power markets in the EU, in a context of poorly defined bidding zones, increased the demand for remedial actions. Expenses associated with remedial actions surged in 2022, exceeding 5 billion EUR, driven in part by elevated electricity prices and the increasing commitments towards the 70% cross-zonal capacity requirement. This increasing trend will only accrue in coming years, with the surge of renewable energy sources, unless more structural measures are implemented. Some remedial actions imply curtailment of the production of renewable energy sources. While currently no Member State curtails over the limit of 5% of renewable electricity generation, the increasing trend constitutes a risk since it often entails reducing clean energy sources to the detriment of more polluting generation.

Figure 3: Relative performance of the different EU Member States on the volume of remedial actions activated as a share of their total demand – 2022 (% of the total demand)



Source: ACER calculation based on NRA and ENTSO-E data.

Note: No complete dataset was available for the creation of this figure from Denmark, Finland and Ireland. Remedial actions may serve various purposes not exclusively tied to active power congestion or impacting trade with third countries.

Empowering the Energy Community for a brighter future

The Energy Community stands with Ukraine, supports synchronization and reforms.

13 The report covers for the second time energy market developments in the Energy Community, highlighting challenges in 2022 caused by the energy crisis and Russia's aggression against Ukraine. Steps were taken to support Ukraine's energy systems, including synchronization with Continental Europe. In 2022 the Energy Community Contracting Parties adopted the Clean Energy Package, including the Electricity Integration Package.

In conclusion, ACER recommends:

- **Enhancing cross-zonal trade to foster market integration, aligning with ACER's guidance on cross-zonal capacities and the 70% margin for electricity trade; mitigating loop flows through various means, including Remedial Actions;**
- **Continuing evolving the forward market, emphasising zone-to-hub trading as suggested in the ACER policy paper on the further development of the EU electricity forward market, and building on long-term transmission rights as a cost-effective hedging mechanism;**
- **Continuing to develop balancing markets in a way that attracts more TSOs to actively start using them;**
- **Studying the use of slower reserves such as mFRR following aFRR activations to manage price incidents effectively;**
- **Maintaining control over re-dispatching costs and minimising curtailing renewable energy sources, especially in areas with high concentrations of renewables such as large offshore wind farms, to stay well below the 5% curtailment limit, aligning with energy transition goals.**

List of acronyms

Acronym	Meaning
ACER	European Union Agency for the Cooperation of Energy Regulators
CACM	Capacity Allocation and Congestion Management
CNE	Critical Network Element
CNEC	Critical Network Element with Contingency
CWE	Central West Europe
DC	Direct Current
ENTSO-E	European Network of Transmission System Operators for Electricity
EU	European Union
HVDC	High Voltage Direct Current
IVA	Individual Validation Adjustment
JAO	Joint Allocation Office
NRA	National Regulatory Authority
NTC	Net Transfer Capacity
PTDF	Power Transfer Distribution Factor
SEE	South East Europe
SWE	South West Europe
TSO	Transmission System Operator

1. Introduction

14 The European energy sector is engaged into a profound energy transition, whose overall success highly depends on the efficiency and integration of the European electricity markets.

15 The Directive on common rules for the internal market in electricity (1996) was part of the ‘first energy package’ and marked the beginning of the liberalisation process at the European level. This first package was followed by a ‘second energy package’ (2003), including provisions on cross-border trade, a ‘third energy package’ (2009), focussing on further liberalising and integrating the internal energy markets, and a ’clean energy package’ (2019), paving the way for a green transition. Since the start of market integration, significant progress has been made towards establishing an efficient internal electricity market (IEM). Despite this progress, there are still numerous obstacles to overcome before achieving a truly integrated efficient market.

16 To better support the market integration process, ACER reports yearly on progresses and setbacks of the Internal Electricity Market. Specifically, ACER monitors evolution of electricity markets across market timeframes (Section 2).

17 Further, ACER monitors obstacles to use and access cross-zonal electricity capacity. The analysis of cross-zonal capacity is covered in a dedicated report: ACER’s Report on cross-zonal capacities and the 70% margin available for cross-zonal electricity trade. In the current report, ACER focuses on the availability and cost of solutions to maintain operational security (remedial actions) and the intensity of loop flows (Section 3).

18 Finally, following an initial joint report in 2021, ACER and the Energy community provide an updated look at the changes in the Energy community’s market in 2022 (Section 4).

19 For the first time, the report relies extensively on ACER REMIT data. The analysis uses the data reported by reporting parties under REMIT[1]. The change of data source implies that figures have been updated and may not be fully in line with previous reporting.

1 The REMIT data may not be complete, fully accurate and/or reported in a timely manner. ACER thus reserves the right to update the figures and outcomes of the analysis in the event of newly identified data quality issues.

2. The evolution of electricity markets over different timeframes

20 A well-functioning Internal Electricity Market relies on markets covering different timeframes, each with their own specific function. The interconnected markets apply capacity calculation and allocation principles. Capacity calculation refers to cross-zonal capacity being made available for commercial exchange. Capacity allocation means the attribution of cross-zonal capacity to the electricity trades.

21 Electricity markets need sufficient capacity for cross-zonal trade to truly operate as integrated European markets. The optimal calculation of commercial cross-zonal capacity is an essential prerequisite for the Internal Electricity Market to function well. The analysis of the cross-zonal capacity is covered in ACER's Report on cross-zonal capacities and the 70% margin available for cross-zonal electricity trade. Therefore, the availability of sufficient cross-zonal capacity falls out of scope of this chapter.

22 The current chapter focuses on how the different established markets evolve over time. The concerned markets are the forward market (Section 2.1)[2], the day-ahead market (Section 2.2), the intraday market (Section 2.3), and the balancing market (Section 2.5). The report's analyses revolve around the type of products offered in the different markets and their purpose, the market liquidity[3] and overall effectiveness of market integration.

23 Over the past few years, the day-ahead and intraday markets underwent significant progress in terms of market integration. Both markets now fully couple all European bidding zones, thereby ensuring that electricity exchanges always occur in the direction that maximises social welfare. To do so, capacity is implicitly allocated to the electricity trades that create most welfare to the coupled European bidding zones. Since all bidding zones are now part of a single coupled market in the day-ahead and intraday timeframe, the current monitoring does not include estimated social welfare gains to be obtained from further extending day-ahead or intraday market coupling to other bidding zones[4]. For the same reason, the more forward-looking analyses of potential efficiency gains is centred around the forward and balancing markets.

2.1. Forward markets

24 Forward markets are a major tool for hedging risks in electricity trading by fixing a price over a longer period in advance. Indeed, buying a forward product can mitigate a risk of paying a high price for electricity in spot markets. Similarly, selling electricity through a forward product guarantees a certain revenue for future electricity generation.

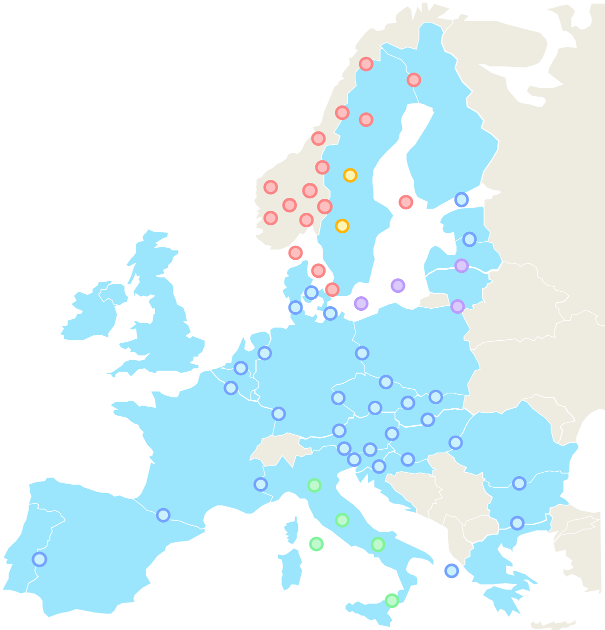
2 In this report, ACER refers to forward markets as the markets trading forward and future products, for delivery periods of over 2 days, on exchanges or via brokers.

3 Market liquidity is a crucial indicator of a well-operating electricity market. It reflects the capacity of multiple market participants to quickly buy and sell products in large amounts, without major price swings or substantial transaction costs. Assessing market liquidity can be approached through various methods. One prominent metric used in this report to update the perspective on liquidity across Europe is the 'churn factor'. The churn factor is defined as the overall volume traded through exchanges and brokers expressed as a multiple of physical consumption. The churn factor quantifies the market's relative size concerning its physical dimensions and pertains to all market timeframes.

4 The intraday market is still undergoing further development with the foreseen introduction of intraday auctions (IDA). Future editions of the market integration report will assess the welfare benefits expected from the introduction of intraday auctions. The current report will consider welfare associated with cross-border trade and increases in cross-border capacity.

2.1.1. Forward markets evolution

Figure 4: Forward capacity allocation – status of the implementation as of 1 September 2023



Source: ACER.

25 Market participants have access to hedging instruments related to forward markets at most EU borders. Financial instruments for hedging in the Nordic countries and Italy, for its inner borders, are based on the zone-to-hub design. All other countries offering hedging instruments rely on long-term transmission rights allocated via a single allocation platform. Most countries apply financial transmission rights, with a few countries in Central-East Europe still using physical transmission rights[5].

26 Forward liquidity in certain bidding zones remains limited for a large part of Europe (see Section 2.1.2). Nevertheless, long-term transmission rights provide market participants with additional hedging opportunities in each bidding zone and easier access to hedging contracts of neighbouring bidding zones. However, this eased access can further reduce the forward market liquidity in those bidding zones with a limited forward liquidity, for which the hedge is needed.

27 An assessment of hedging opportunities in a selection of bidding zones without long-term transmission rights concluded with the need to improve the situation at some borders. Following the observation that there were insufficient hedging opportunities on the border between Finland and Estonia, in 2022, long-term transmission rights were issued for the first time at this border. In 2022, ACER Decision 12-2022 suggests means to improve risk hedging opportunities on the bidding zone borders between Finland and Sweden. Implementation of the decision is still pending.

28 ACER and NRAs have investigated possible developments of European forward electricity markets. In February 2023, ACER issued a policy paper on how to improve the functioning of the electricity forward market in EU. ACER recommends pooling the liquidity of national forward markets into regional trading hubs, which need to be complemented with a liquid market for Financial Transmission Rights to hedge the remaining risk between the hub and each bidding zone. Regarding Financial Transmission Rights, ACER proposed several improvements, most notably to introduce Financial Transmission Right obligations[6] from each bidding zone towards a regional trading hub and to match the maturity of these Financial Transmission Rights with products in the forward market (monthly, quarterly, and yearly products with

5 A Physical Transmission Right allows the holder the option to either nominate energy on the concerned border or not nominate and thus receiving financial compensation. A Financial Transmission Right allows the holder to receive financial compensation.

6 ACER does not exclude the possibility of FTR options, which may be added only after careful evaluation of their impact on the efficient functioning of electricity forward market.

maturities up to three years ahead). These recommendations, which require further analysis regarding their feasibility and effectiveness, have been feeding into discussions on the electricity market design legislative reform published by the European Commission in March 2023[7] and the future amendment of the forward capacity allocation regulation.

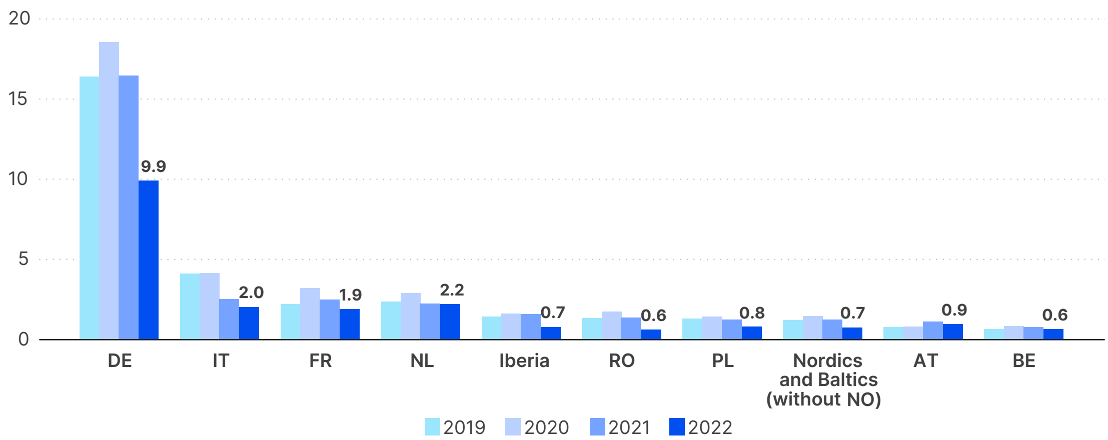
2.1.2. Forward markets liquidity

29 This section assesses the evolution of liquidity in major European forward markets in recent years.

30 To enable all market participants to hedge themselves efficiently, they need to have access to hedging products (or combination of such products) which themselves provide efficient hedge. The markets for these products need to be liquid to ensure these products can be accessed at competitive prices. When market participants cannot access liquid products, which provide efficient hedge, they can access products that provide an approximate (proxy) hedge (e.g. forwards or futures in the neighbouring market) and complement these products with other hedging products that can cover the remaining risk (e.g., long-term transmission rights).

31 Figure 5 displays the yearly churn factors of the largest European forward markets from 2019 to 2022. Forward markets' liquidity decreased significantly in most major European markets (37% overall decrease).

Figure 5: Churn factors in a selection of European forward markets – 2019-2022



Source: ACER calculation based on REMIT and ENTSO-E data.

Note: In the context of this exercise, ACER has transitioned from Prospex to REMIT data as the data source for trade volumes. Consequently, it is advisable to refrain from direct comparisons with similar data from prior editions of the report. European forward market showing the highest churn factors and sufficiently reliable underlying data were selected.

32 The evolution of forward markets volumes is unlikely due to a single factor, and some of those factors are Member State-specific. The price increases occurring in 2022 affected the forward markets, thereby significantly expanding the cost of collaterals[8]. This surge in costs of collaterals can explain the decrease in trading at organised market places[9], reflected in the lower churn rates for 2022[10]. Although hedging is the most straightforward way to address uncertainty during a crisis, the collateral requirements and high bank guarantees forced some market participants out of forward trading on organised market places, thereby having to rely on spot market trading or bilateral trading. Moreover, the expectations of market participants about Member States' interventions (i.e., price regulation, subsidies or other support) also reduced their incentives to hedge in forward market and thus increasingly rely on trading closer to real time.

7 Electricity Market Reform for consumers and annex (europa.eu).

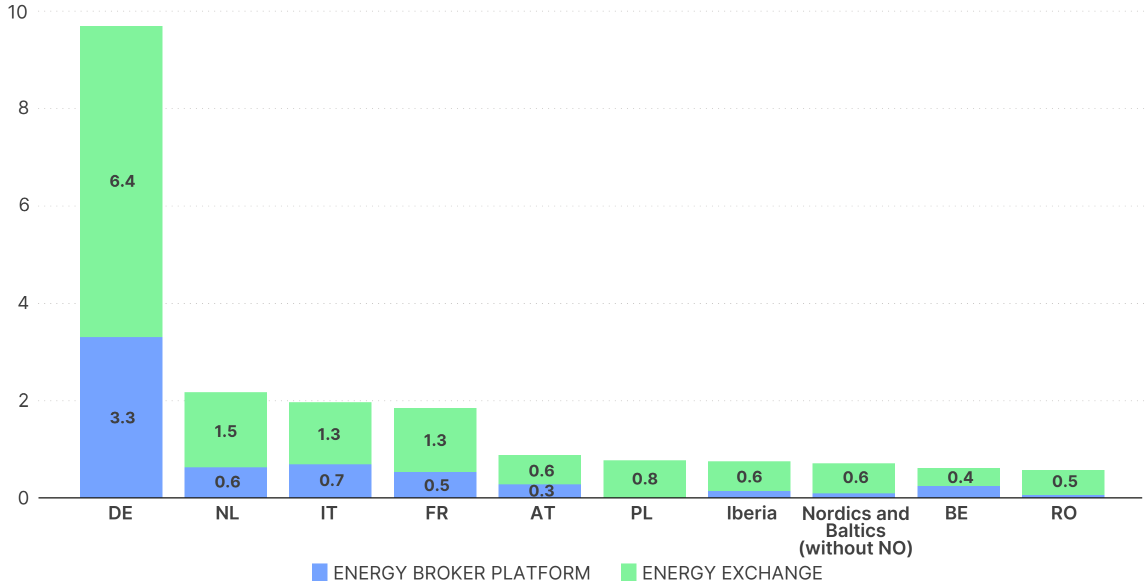
8 See also ACER's Final Assessment of the EU Wholesale Electricity Market Design.

9 See also Figure 7.

10 Demand in 2022 also dropped, which contributes to increasing churn factors. Nevertheless, the decrease in trading clearly outweighed the drop in demand in 2022.

33 Figure 6 shows the churn factors per type of organised marketplace across the major European forward markets, presenting their divergent structure. For example, in Poland, all organised forward market volumes are traded on power exchanges[11]. In other parts of Europe, market participants rely on both power exchanges and brokers.

Figure 6: Forward markets churn factor per type of trade in the largest European forward markets - 2022



Source: ACER calculations based on REMIT and ENTSO-E data.

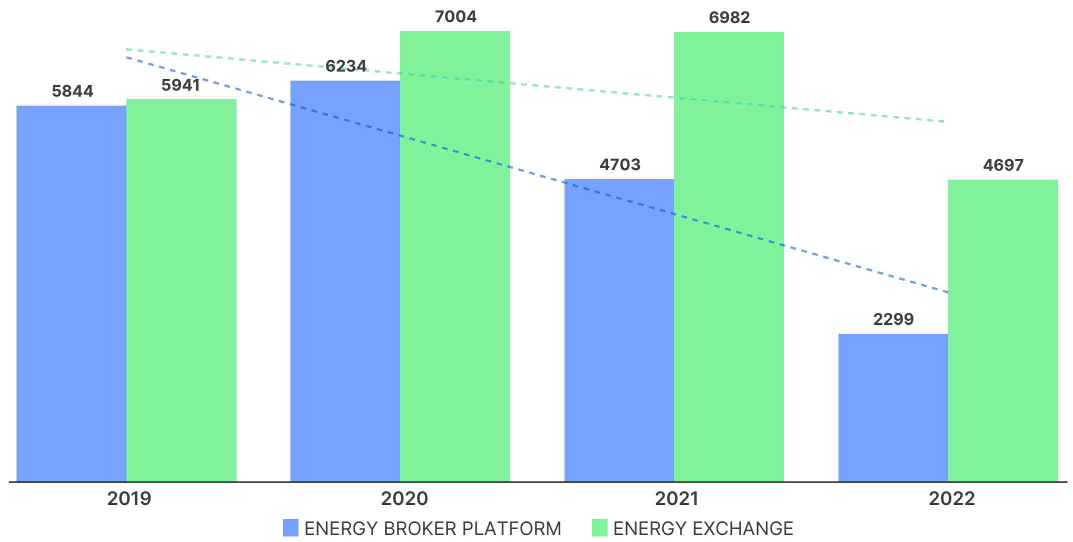
Note: In the context of this exercise, ACER has transitioned from Prospex to REMIT as the data source for trade volumes. Consequently, it is advisable to refrain from direct comparisons with similar data from prior editions of the report. European forward market showing the highest churn factors and sufficiently reliable underlying data were selected.

34 Over the last years, there was an overall shift in European forward markets from brokered trading to trading via power exchanges. Figure 7 confirms the shift continued in 2022. Part of the reason for the continued decline in brokered trading during 2022 can probably be found in the increased bank guarantees in Over-The-Counter trading (OTC), including brokered trading, compared to power exchange trading. Another reason could be found in the typically higher counterparty risk protection offered by power exchanges. This effect was exacerbated by the price surges in 2022[12].

11 In Poland as a principle all energy generated must be traded on power exchanges. There are, however, some exempted contracts for which Over-The-Counter trading is allowed.

12 Typically, brokered or bilateral trading has lower fees than trading via power exchanges. The fees can be zero for pure bilateral trades. However, with the surging prices, the impact of higher collaterals would become relatively more important than the impact of fees.

Figure 7: Evolution of brokered vs exchange trading in the EU – 2019-2022 (TWh)



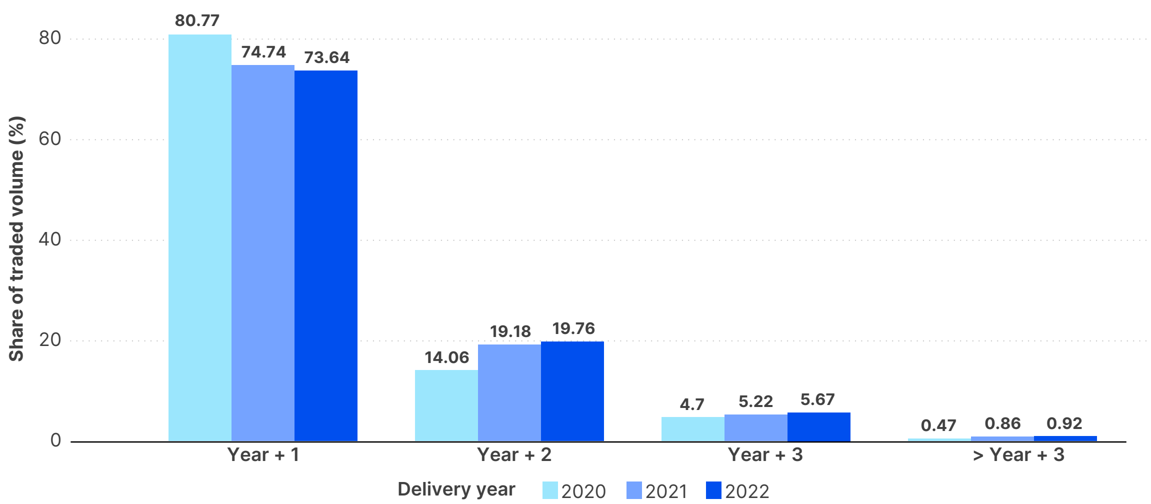
Source: ACER calculations based on REMIT data.

Note: The dashed lines mark the respective trends for brokered and exchange trading.

35 In 2022, higher electricity prices eroded counterparty credit limits which may have reduced liquidity on brokered forward markets. Moreover, the perceived risk of potential counterparty default may also have limited market participants willingness to hold bilateral positions. Initially, centrally cleared exchange trading was increasingly preferred by market participants. However, as higher price levels and volatility were incorporated in central clearing counterparties' margin calculations, financing requirements to enter into and hold power futures positions increased substantially, which may have had a negative impact on overall liquidity of exchange trading.

36 Figure 8 shows that most of the volume in the forward market in Germany is traded up to one year ahead. The liquidity of longer maturity contracts drops significantly after one year ahead and is almost non-existent beyond three years ahead. The analysed data suggests a slight trend of increasing trade with longer maturity contracts.

Figure 8: Relative shares of traded volume per year in the future for delivery in Germany – 2020-2022 (%)



Source: ACER calculations based on REMIT data.

2.1.3. Analysis of transmission rights' valuation

37 Long-term transmission rights constitute the main mechanism in the EU to hedge against price differences across bidding zones. TSOs play a major role in enabling market participants to hedge against the risk of short-term zonal price differentials, as they are responsible for calculating long-term capacities in a coordinated way and for allocating the (either physical or financial) transmission rights to market participants.

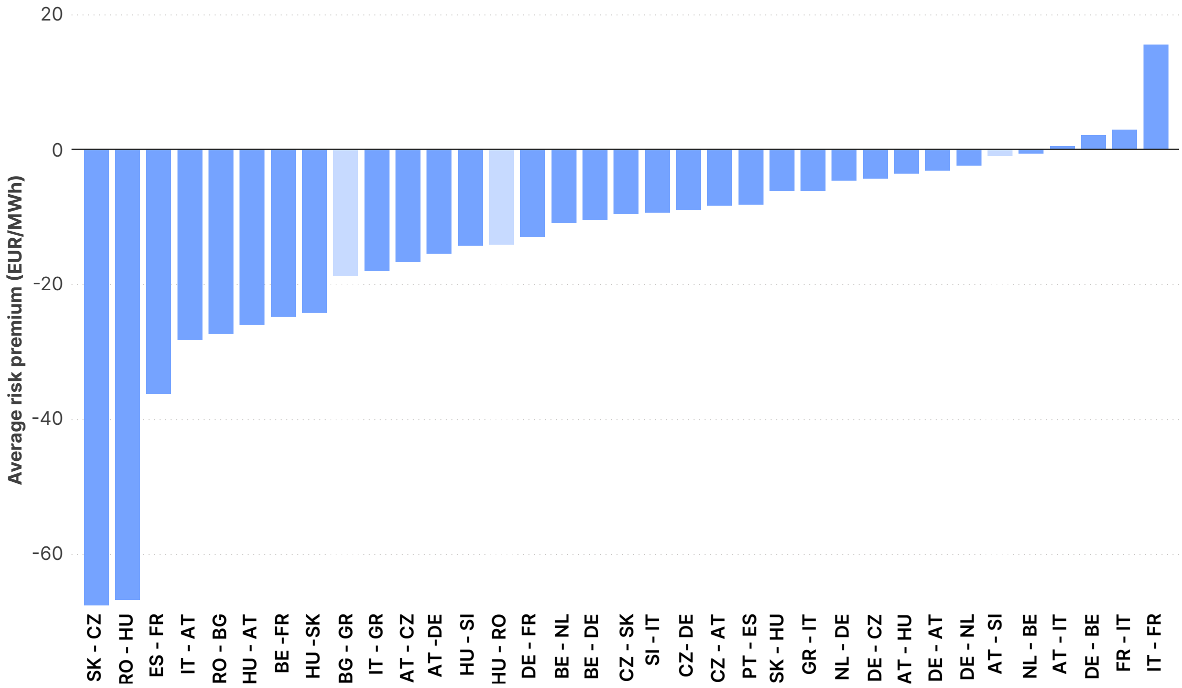
38 This section analyses the valuation of such transmission rights (i.e., the expected value or cash flow which a product can deliver to a buyer of the product, with regards to the purchase price). First by comparing the price of the long-term transmission rights against the price spread in the forward markets at the time of the auction of the transmission rights. Secondly through the ex-post risk premiums, defined as the difference between the price of the long-term-transmission right and the realised delivery-dated spot price differentials. This analysis will thus assess both how accurately market participants forecast the risk of short-term price differentials, and the efficiency of long-term transmission rights as a mechanism for risk mitigation.

39 When calculating risk premiums for transmission rights, the following aspects need to be considered. First, such calculation needs sufficient observations per product. Second, the products must feature similar times-to-maturity. In the analysis, both monthly and yearly products were considered. Borders without enough recorded observations (due to a non-liquid forward market) are highlighted. Third, the nature of the different products needs to be carefully considered. Transmission rights for a given border and direction are usually issued in the form of options. This implies that only the positive day-ahead price differentials are part of the expected and realised cash flows. The below analyses only consider observations where the price spread is positive for a given oriented border.

40 Figure 9 shows the price differential between the auction price of a long-term transmission right for a given border, and the corresponding price spread in the forward markets at the time of the auction and for the same delivery period. In order to calculate the price spread between bidding zones in the forward markets, the average closing price of all trades recorded within a specific range of days from the long-term transmission rights auction closure, and with the same delivery period as the transmission right, has been considered[13].

13 For monthly long-term transmission rights, trading on the month-ahead product between the 22nd and 24th of the previous month has been considered. For yearly long-term transmission rights, trading on the year-ahead between 30 November and 10 December of the previous year has been considered. This range may decrease the accuracy of the forward spread value, as opposed to considering only the trades that took place on the auction closure date itself, but it allows for a higher number of borders to be studied.

Figure 9: Average risk premium of long-term transmission rights in the forward markets for a selection of EU borders – 2022 (EUR/MWh)



Source ACER calculation based on REMIT and JAO data.

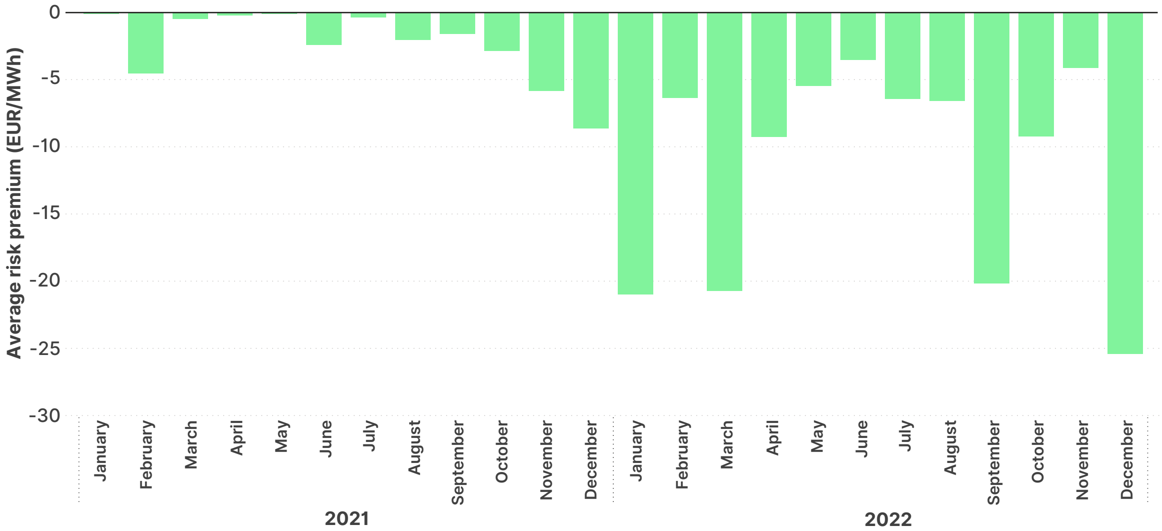
Note 1: Borders highlighted in a lighter blue colour show a limited number of observations due to a low level of liquidity in the forward markets. The risk premiums for such borders should be considered as indicative. Borders not displayed registered no trades in the forward market during the considered periods in at least one of the two hubs.

Note 2: The risk premium of a given directed border A>B is calculated as the difference of the LTTR price in both directions (LTTR A>B – LTTR B>A), minus the forward price spread in direction A>B. The border direction studied has been selected based on the direction of the forward spread for a given delivery period.

41 The analysis in Figure 9 shows that, for 2022, the long-term transmission rights were consistently underpriced compared to the trading in forward and futures of the involved bidding zones, with the main exception of the France-Italy borders. This shows that hedging against price differentials between bidding zones through buying long-term transmission rights is generally cheaper than doing so by trading spreads in the forward market directly, thus suggesting that the utilisation of long-term transmission rights as a risk mitigation measure could be improved. Between some bidding zones, the long-term transmission rights were over 20 EUR/MWh cheaper than the price spreads between the Member States, traded around the time of the long-term transmission rights auctions.

42 Figure 10 shows the monthly evolution of the average premiums in the EU over the last two years. The premium for long-term transmission rights was on average significantly lower in 2022 than in 2021. Moreover, the difference between price spreads on forward products and long-term transmission rights peaked during the height of the energy crisis, likely due to uncertainty on the outlook.

Figure 10: Monthly evolution of the average risk premiums of long-term transmission rights in the EU – 2021-2022 (EUR/MWh)



Source ACER calculation based on REMIT and JAO data.

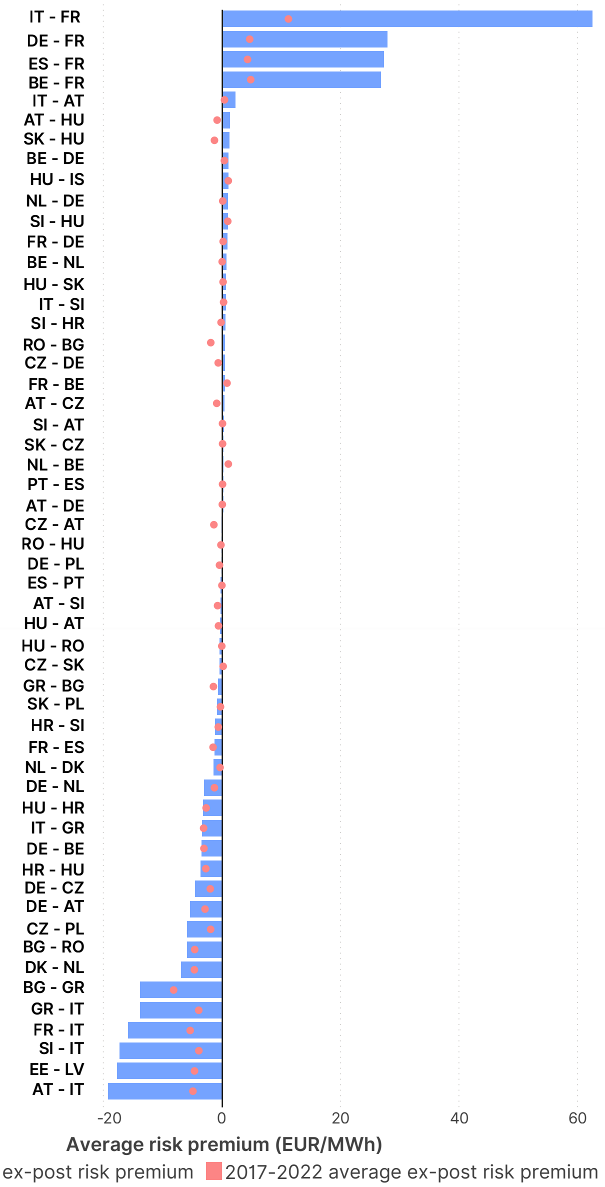
Note 1: Borders with low liquidity as per the previous figure (BG-GR, HU-RO, AT-SI) have been excluded from this analysis, as no conclusive assessment can be made for them.

Note 2: The risk premiums of the yearly LTTR products have been considered, for the purpose of this analysis, in the month of January of the corresponding delivery year.

43 Figure 11 shows the ex-post risk premiums of long-term transmission rights, calculated as the difference between the auction price of the long-term transmission right for a given border and delivery period, and the average realized value of the transmission right in the day-ahead market for that same border and delivery period[14].

14 The realized value of a long-term transmission right for a given market time unit and oriented border is calculated as the highest value between 0 and the day-ahead market spread of the given oriented border.

Figure 11: Average ex-post risk premium of long-term transmission rights for a selection of EU borders – 2022 (EUR/MWh)



Source ACER calculation based on ENTSO-E and JAO data.

44 The analysis shows that most borders present a good correlation between the long-term transmission right prices and the average day-ahead price spread. These cases even show relatively low risk premiums, suggesting the market only mildly appreciates the hedging value of the long-term transmission rights, or underestimates the day-ahead spread.

45 However, some specific cases, namely the French borders in import direction, show a significant deviation. Indeed, for a few borders and directions, long-term transmission rights prices were notably above or below day-ahead spreads. For those borders, the average risk premiums over a time horizon of several years shows that 2022 was an exceptional year, suggesting the extreme values can be attributed to the crisis[15].

46 On most of the French borders, where day-ahead price spreads were exceptionally high in 2022, transmission rights were more expensive than the difference of the average day ahead prices. A general explanation for the observed differences is that long-term transmission rights were bought under high uncertainty of how the day-ahead prices would evolve. For France, for example, during summer 2022, the market believed prices in autumn would skyrocket, where finally the prices were less severe.

15 A hedge is expected to be priced positively to account for the cost of the expected risk reduction; a closer look at significantly negative prices is necessary.

47 The low ex-post risk premiums detected in most borders suggest that long-term transmission rights are generally a cost-effective option for the hedging needs of market participant against short-term price differentials. Nonetheless, the market's valuation of this mechanism remains relatively low. Future policy developments on forward markets must build on the use of long-term transmission rights as a cost-effective hedging mechanism.

2.2. Day-ahead markets

48 This chapter's monitoring focuses on the coupled day-ahead market.

2.2.1. Day-ahead markets evolution

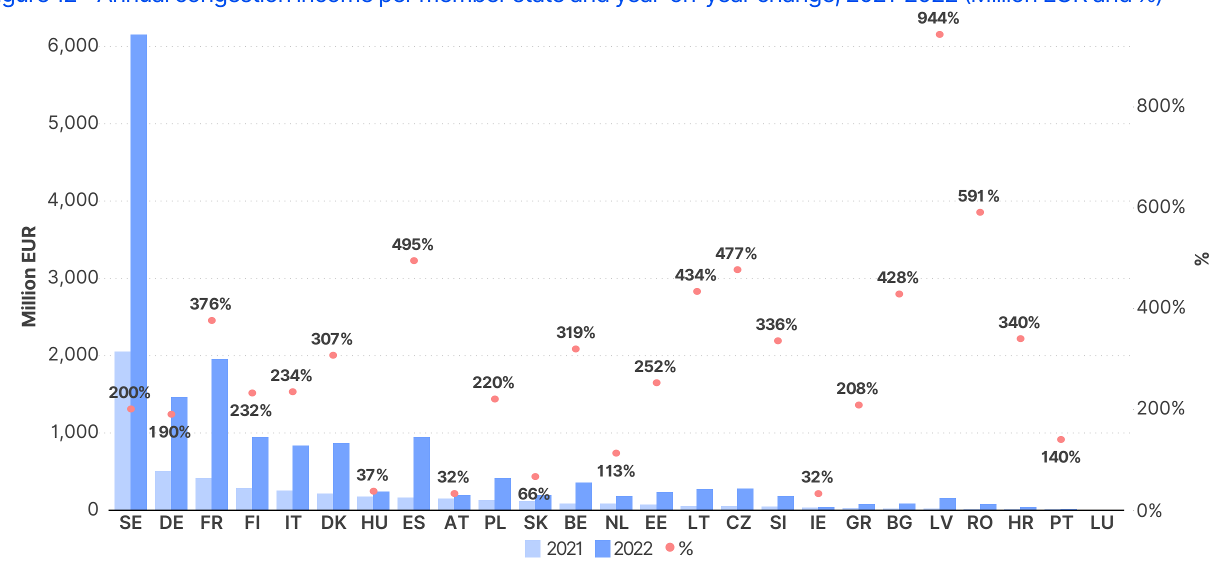
49 Over the years, ACER has monitored the evolution of potential welfare gains from extending day-ahead market coupling to further borders in the EU electricity market. Day-ahead market coupling has been achieved across Europe[16], which calls for a closer look at welfare components. Social welfare is the sum of producer surplus, consumer surplus, and congestion income[17]. The amount of congestion income correlates with the amount of cross-zonal capacity offered to the market and price differences between bidding zones, and occasionally by the allocation constraints imposed on cross-zonal exchanges.

50 In 2022, the amount of congestion income reported as collected overall increased by more than three times compared to the previous year, across Europe, reaching 16 billion EUR. Figure 12 details this evolution per Member State.

51 Congestion incomes are driven by price differentials across bidding zones. In 2022, differentials were exacerbated by the energy crisis, as it affected bidding zones to various extents depending on local fundamentals, such as the share of natural gas as a primary fuel for electricity generation. Sweden is a striking example of those discrepancies, with day-ahead prices remaining at 50 EUR/MWh on average in the most northern bidding zone while reaching 152 EUR/MWh on average in the southern bidding zone[18].

52 This illustrates the need to further maximise the available commercial cross-zonal capacity and optimise the use of the grid.

Figure 12: Annual congestion income per member state and year-on-year change, 2021-2022 (Million EUR and %)



Source: ACER.

Note: The underlying data is undergoing a quality check at the time of the publication. Due to a change in the reporting methodology, ACER assumes some errors that would not significantly affect the overall conclusions reached.

16 https://www.nemo-committee.eu/sdac

17 Producer surplus is the difference between the price a company is willing to sell and the actual price a consumer pays. Consumer surplus is the difference between the maximum price a consumer is willing to pay and the actual price they do pay. The congestion income payment is the difference between the market price of electricity in the congested area and the cost of generating and transmitting the electricity.

18 See the report on key developments in 2022 for EU wholesale electricity markets published by ACER in February 2023. Sweden is split into four bidding zones. The high congestion income indicates the significant congestion in the market.

Price spike event of 4 April 2022 leading to increased price cap for day-ahead markets

53 On 4 April 2022 the French day-ahead market had a price spike. For one hour, the price in France peaked at 2987 EUR/MWh, triggering a price cap increase in the day-ahead market from 3000 EUR/MWh to 4000 EUR/MWh.

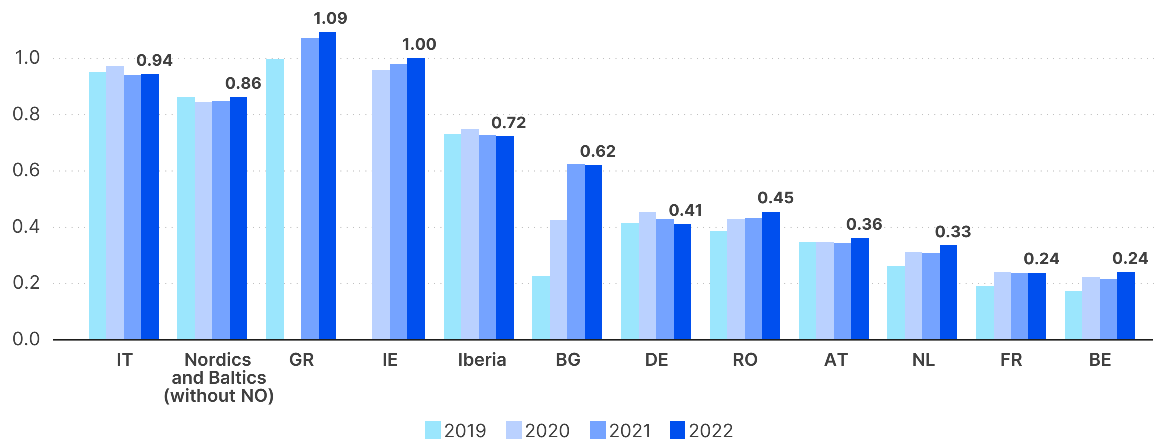
54 In a general market situation, the total gains for consumers or welfare gains represent the sum of the consumer's surpluses for all the buyers. The consumer surplus is the difference between the maximum price a consumer is willing to pay and the price a consumer pays. In the case of the day-ahead market, the maximum price a consumer is willing to pay is set by the price cap. A consequence of the increase in price cap is an increase in calculated social welfare. Consequently, welfare calculations before and after the price cap increase are relatively difficult to compare.

2.2.2. Day-ahead liquidity

55 Figure 13 shows the evolution of day-ahead markets churn factors across Europe in recent years. Levels of liquidity in Europe diverge significantly. Differences are often related to differences in market design and market structure. Churn factors are equal to one[19] in markets that are exclusive[20], such as in the Single Energy Market of Ireland and Northern Ireland and Greece. Churn factors are lower in markets where a significant share of the energy can be sourced through bilateral contracts or through specific national arrangements such as in France[21].

56 Moreover, Figure 13 shows that year-on-year changes in day-ahead market liquidity are in general modest. This suggests that day-ahead markets are mature for the largest part of Europe. Further, while forward trading dropped, day-ahead liquidity remained stable. In the absence of sufficient affordable hedging, spot trading likely remained the main option for traders to balance their portfolio.

Figure 13: Churn factors in major European day-ahead markets - 2019-2022



Source: Acer calculations based on REMIT and ENTSO-E data.

Note: In the context of this exercise, ACER has transitioned from Prospex to REMIT data as the data source for trade volumes. Consequently, it is advisable to refrain from direct comparisons with similar data from prior editions of the report.

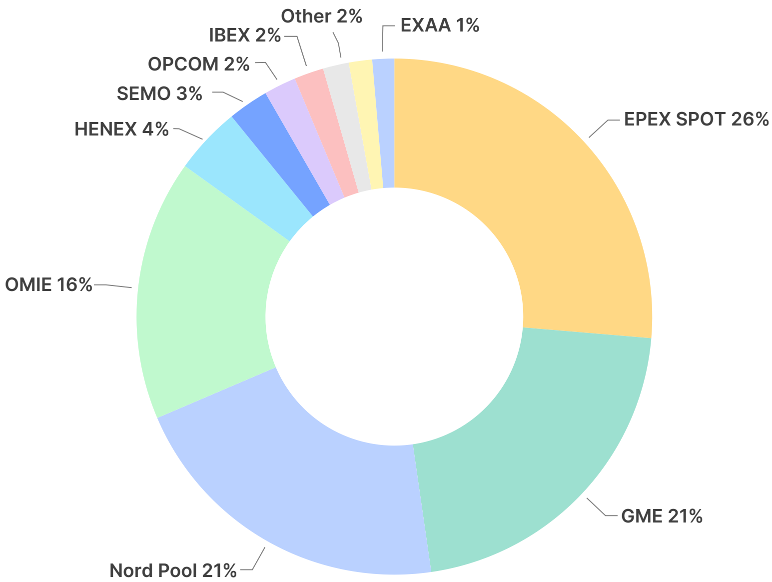
57 Most electricity traded in the day-ahead timeframe is done so through Nominated Electricity Market Operators (NEMOs). These NEMOs, also referred to as power exchanges, are designated in each Member State by the competent authority, in accordance with the Capacity Allocation and Congestion Management Regulation, to perform the single day-ahead and single intraday coupling. When analysing the market share of the different NEMOs based on the traded volume in the day-ahead market, Figure 14 shows a high level of concentration across the EU, with four power exchanges covering 84% of the traded volume.

19 Except deviations due to discrepancies in the data sources used or other aspects, such as the inclusion or exclusion of network losses and small producers in the statistics.

20 'Exclusive' refers to markets that represent the only route to trade ahead of delivery.

21 See ACER's report on Security of EU electricity supply, October 2023.

Figure 14: Market share per nominated electricity market operator in day-ahead market coupling in the EU – 2022 (% of traded volume)



Source: ACER calculations based on REMIT data.

Note 1: Traded volume for the purpose of this figure is calculated as the sum of all executed buy and sell orders for a given NEMO. This is necessary as within market coupling there can be a net transfer of electricity traded between two NEMOs.

Note 2: NEMOs with a traded volume below 1% of the total traded volume have been categorized as 'Other'.

2.3. Intraday markets

58 Currently, the coupled European intraday market relies on continuous trading. However, in 2024, intraday auctions will be introduced to price cross-zonal capacity, pursuant to ACER Decision 06-2022.

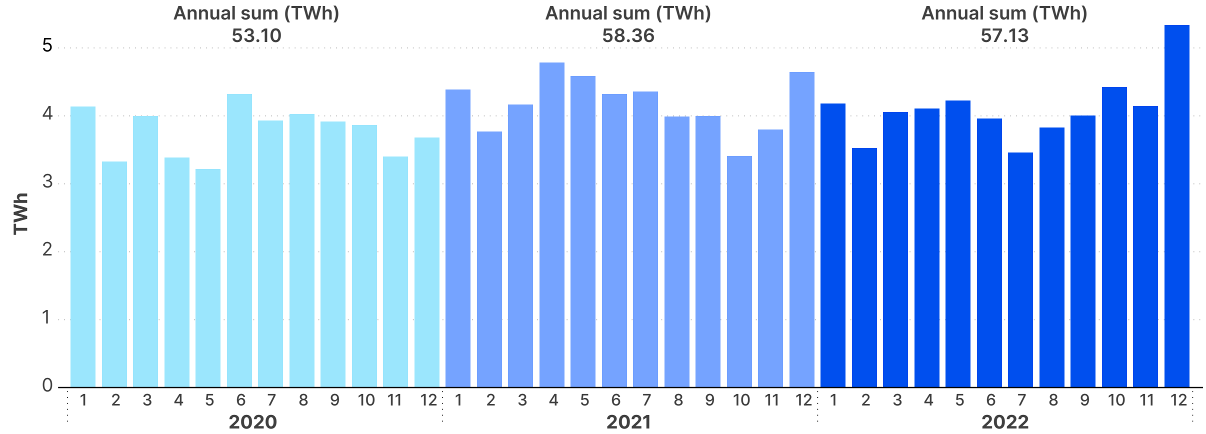
2.3.1. Intraday markets evolution

59 In line with the previous editions of the market monitoring report, this section assesses the level of economic efficiency in the use of available cross-zonal capacity in the intraday market timeframe[22]. It analyses the evolution of cross-zonal intraday exchanges and the level of utilisation of cross-zonal capacity in the intraday timeframe when it has an economic value (>1 EUR/MWh).

60 In absolute terms, Figure 15 reveals that aggregated cross-zonal volume nominated in the intraday market timeframe across the European network increased on average since 2020. Nevertheless, the figure also shows stagnation between 2021 and 2022, especially during the months when the prices in all markets were spiking. The overall upward trend in nominations is consistent with the increase in intraday-traded volumes observed in most Member States over the same period (see Figure 17).

22 The level of efficiency is defined as the absolute sum of net nominations and the level of utilisation of cross-zonal capacity in the intraday timeframe when it has an economic value (>1 EUR/MWh).

Figure 15: Absolute sum of net intraday nominations at all EU borders – 2020–2022 (TWh)



Source: ACER calculations based on REMIT data.

Note: This figure contains data for all European bidding zones with ID markets. No comparison should be made with the analysis performed in previous MMRs, where the list of borders analysed was shorter due to unavailability of the data.

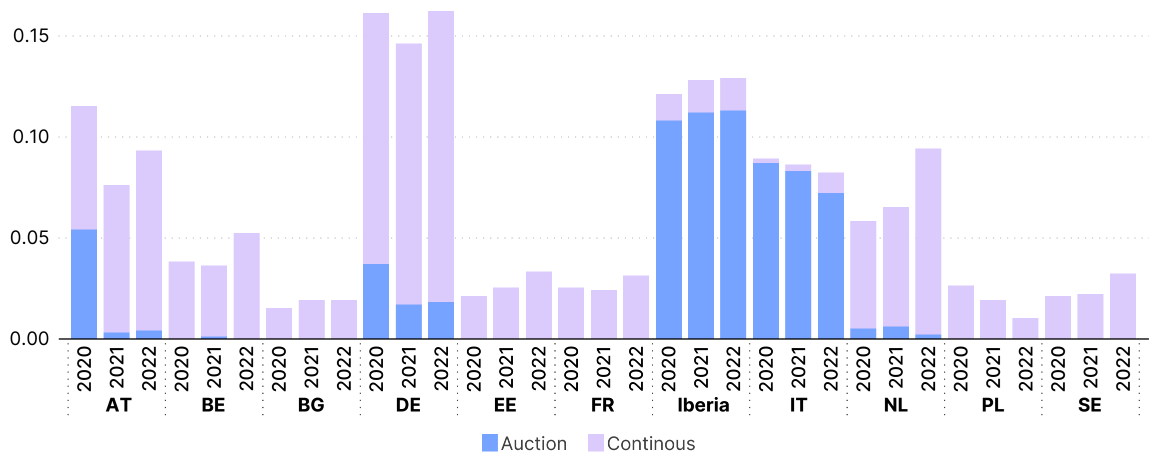
2.3.2. Intraday markets liquidity

61 This section provides an update on intraday markets liquidity in European intraday markets in 2022.

62 Figure 16 shows the evolution of yearly intraday churn factors in major European markets between 2020 and 2022. Overall, intraday churn factors increased since 2020, by 6% in 2021 and by 16% in 2022. Firstly, the figure indicates that in 2022 Austria, the Iberian Market, Germany, and Italy, continued to have the highest intraday-traded volumes expressed as a share of physical consumption.

63 Secondly, the figure shows that the upward trend in liquidity levels observed over the past years in most of the countries continued in 2022. Overall, while causes may be plural, the trend is consistent with the growing need for short-term adjustments due to the greater penetration of variable generation from renewables into the electricity system.

Figure 16: Yearly churn factors in major European intraday markets by type of trade – 2020–2022

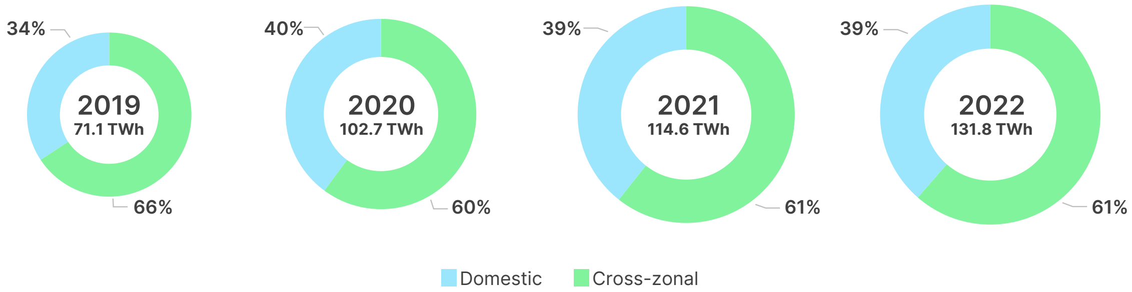


Source: ACER calculations based on REMIT and ENTSO-E data.

Note: In the context of this exercise, ACER has transitioned from Prospex to REMIT data as the data source for trade volumes. Consequently, it is advisable to refrain from direct comparisons with similar data from prior editions of the report.

64 Figure 17 illustrates the benefits of single intraday coupling (SIDC). The increasing share of cross-zonal intraday trade is expressed as a percentage of the overall continuous intraday trading volumes in Europe, following the go-live of SIDC in 2017. Overall, it confirms that SIDC allows market participants to access a larger portfolio of bids and offers to reduce their imbalances or support the system's balance in an efficient way.

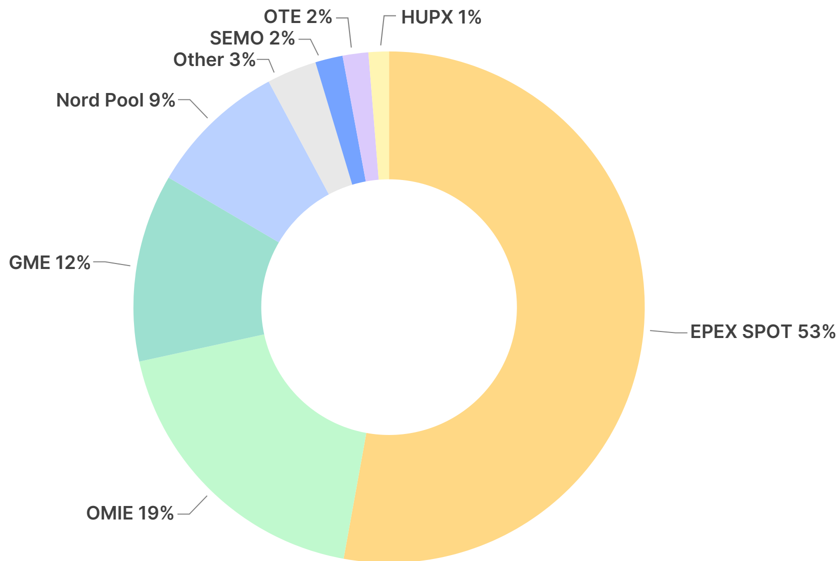
Figure 17: Share of continuous intraday-traded volumes according to intra-zonal vs. cross-zonal nature of trades in Europe and yearly continuous intraday-traded volumes – 2019–2022 (% and TWh)



Source: ACER calculation based on NEMOs data

65 Like day-ahead market coupling, a high level of concentration of nominated electricity market operators is seen in the single intraday coupling across the EU. In the case of the intraday markets, as shown in Figure 18, EPEX SPOT holds a predominant position covering over 50% of all traded volume.

Figure 18: Market share per nominated electricity market operator in the single intraday coupling in the EU – 2022 (% of traded volume)



Source: ACER calculations based on REMIT data.

Note 1: Traded volume for the purpose of this figure is calculated as the sum of all executed buy and sell orders for a given NEMO. This is necessary as within market coupling there can be a net transfer of electricity traded between two NEMOs.

Note 2: NEMOs with a traded volume below 1% of the total traded volume have been categorized as 'Other'.

2.4. Price correlation across timeframes

66 Figure 19 assesses the correlation of prices across timeframes in the EU in 2022. In theory, market prices in day-ahead and intraday timeframes share the same main driver: economic efficiency; security of supply is a strong fundamental in the balancing timeframe.

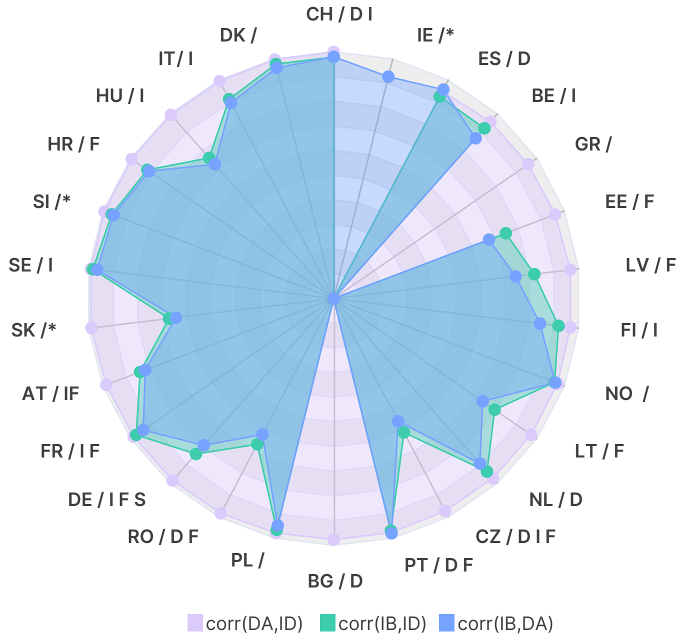
67 The analysis confirms the theory. On average, prices in the day-ahead and intraday timeframes correlate the best (0.97), followed by prices in the intraday and balancing timeframes (0.84). The correlation between prices in the day-ahead and balancing timeframes is the lowest (0.83).

68 Across Europe, correlations between day-ahead and intraday prices are homogenous, from 0.99 down to 0.94. The range broadens, from 0.97 in France down to 0.59 in Romania when assessing correlations between intraday and balancing timeframes. The range spans from 0.96 in Portugal down to 0.53 when assessing correlations between day-ahead and balancing timeframes.

69 A closer look at the structure of imbalance prices reveals that countries applying a single pricing with no additional component see higher price correlations across timeframes while countries showing a decorrelation of imbalance prices with prices in day-ahead and intraday timeframes apply dual prices with additional components.

70 Spain is the only country for which the correlation is the highest between balancing and day-ahead prices[23]. Portugal is the only country for which all correlations assessed are above 0.95.

Figure 19: Price correlations across timeframes in EU member states, Norway and Switzerland (day-ahead, intraday and imbalance prices) – 2022



Sources: ACER calculations based on NEMOs' data and ENTSO-E transparency platform, ENTSO-E Balancing report 2022.

*Note: The Pearson correlation coefficients range from zero (no correlation), at the centre of the figure, to one (full correlation), on the largest circle. ENTSO-E provided the data for day-ahead and imbalance prices. NEMOs provided the data for the intraday prices. Hourly intraday prices from continuous trading are averaged over the days of 2022. A Pearson correlation matrix has been calculated encompassing daily data of the day-ahead prices, the intraday prices, and the absolute values of the positive imbalance prices. Imbalance prices were not available for Bulgaria and Greece; no imbalance prices were available for Ireland, except from 24 March 2022 to 4 June 2022 and from 17 October 2022 to 5 December 2022. Intraday prices were not available for Ireland and only data from 29 November 2022 to 31 December 2022 were available for Greece. Following the acronym of a member state, letters and symbols refer to: D – dual imbalance pricing; I – Incentivising imbalance price component; F – imbalance price component related to financial neutrality of the TSO; S – scarcity imbalance price component. *For Ireland, Slovenia, and Slovakia no data was available regarding the structure of imbalance prices.*

2.5. Balancing markets

71 This chapter provides an update on the status of balancing markets integration considering the Electricity Balancing regulation[24]. The importance of balancing is expected to increase with the surge of renewable energy sources.

72 The Electricity Balancing Regulation, which entered into force in 2017, lays down detailed rules on electricity balancing. It harmonises the procurement, activation, and exchanges of balancing energy. It further allows TSOs to voluntarily engage in cooperations where they harmonise the procurement and exchange of balancing capacity and the sharing of reserves, including the allocation of cross-zonal capacity. Finally, it strives to implement an integrated balancing market, where TSOs will procure, exchange, and use both balancing energy and capacity in an economically efficient and market-based manner.

23 When the price differential between the Spanish and French bidding zones is significant, trades in intraday where the attacked bid is on the French side will be priced closer to the French day-ahead price. Therefore, on the Spanish side, the average price in continuous market and the day-ahead market price will diverge. In addition, the 'Iberian mechanism' covers all timeframes, bringing imbalance prices closer to the Spanish day-ahead prices.

24 Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing.

73 To analyse the status of market integration of balancing markets, firstly, Section 2.5.1 provides an overview of the recent developments achieved in the integration of balancing markets. Secondly, Section 2.5.2 elaborates on prices and costs of balancing services (energy and capacity) across Europe. Thirdly, Section 2.5.3 analyses the development of procurement timeframes for balancing capacity and finally, Section 2.5.4 includes an overview of the exchanges of balancing services (energy and capacity) across EU borders.

2.5.1. Developments in the integration of balancing markets

74 The main achievements accomplished in 2022 in the balancing timeframe undoubtedly relate to the go-live of two European balancing platforms, the automatic frequency restoration reserve (aFRR) platform and the manual frequency restoration reserve (mFRR) platforms (respectively in the context of the projects named PICASSO and MARI)[25]. The go-live of the aFRR platform took place in June 2022, whereas the mFRR platform went live in October 2022. With these platforms going live in 2022, all four European balancing platforms, including the imbalance-netting platform, developed in the context of the project IGCC, and the replacement reserves (RR) platform, developed in the context of TERRE, are now operational. While several TSOs are already part of IGCC and TERRE, the go-live of PICASSO and MARI in 2022 was followed by the accession of a very limited set of TSOs.

Table 1: TSOs operational on European balancing platforms – September 2023

Platform	PICASSO	MARI	TERRE	IGCC
Operational members (number of TSOs)	7	6	6	21
Operational members (Member states)	AT, CZ, DE, IT	AT, CZ, DE	CH, CZ, ES, FR, IT, PT	AT, BE, HR, CZ, DE, FR, DE, GR, HU, IT, NL, PL, PT, RO, SL, SI, ES, CH

Source: ACER and ENTSO-E.

Note: IGCC member Transmission System Operators (TSOs) fall into two categories: operational members, referred to as participating TSOs, who are active on a given the platform; and non-operational members, who contribute to decision-making but are not active on a given platform.

75 In the following paragraphs, each of the four balancing platforms is presented in more detail. Subsequently, the report provides a brief overview on existing cooperations for the exchange of balancing capacity.

2.5.1.1. IGCC

76 The International Grid Control Cooperation (IGCC) is the European platform for imbalance netting, as defined in Article 22 of the Electricity Balancing Regulation. Imbalance netting is the process agreed between TSOs of two or more Load Frequency Control (LFC) areas that allows avoiding the simultaneous activation of frequency restoration reserves (FRR) in opposite directions by considering the respective frequency restoration control errors. IGCC nets the imbalances, hence reducing the power imbalances that the TSOs must balance, effectively minimising the amount of automatic FRR needed. IGCC was launched in October 2010 as a regional project in Germany and has grown to cover 24 countries (27 TSOs) across continental Europe[26]. The latest countries to join the platform include Greece (June 2021), Romania (December 2021), Serbia (October 2022), and Bulgaria (March 2023).

2.5.1.2. PICASSO

77 The aFRR Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO) constitutes the European platform for the exchange of balancing energy from aFRR, in accordance with Article 21 of the Electricity Balancing Regulation. It also includes implicit imbalance netting of aFRR for participating countries, reducing the imbalance netting through the IGCC. PICASSO went live on 1 June 2022, even though the first active TSOs (APG, CEPS and the four German

25 MARI stands for "Manually Activated Reserves Initiative" and PICASSO stands for "Platform for the International Coordination of the Automatic frequency restoration process and Stable System Operation".

26 Some non-EU members are also members or observer to IGCC.

TSOs) effectively joined the platform only on 22 June 2022. Following this first wave of TSOs, no other TSO has joined the platform up until 19 July 2023, when TERNA successfully accessed PICASSO.

78 According to the aFRR implementation framework[27], TSOs must develop and update the platform's implementation timeline at least twice per year. Pursuant to Article 62 of the Electricity Balancing Regulation, NRAs may grant to their respective TSOs a derogation from the deadline by which they shall use the European balancing platforms. To date, based on such derogations, the number of TSOs in PICASSO is not expected to increase at least until the first quarter of 2024.

79 The main reason reported by NRAs for a delayed accession to PICASSO is technical, i.e., related to changes both in infrastructure and software, either on TSOs or market participants' side, to enable their connection and participation to the platforms. Other reasons concern the regulatory sphere and the market sphere. The regulatory sphere relates to amendments that need to be made in the national regulatory framework to comply with the European one. The market sphere relates to market issues either of the current national setup, or of the platforms, based on the current results of the platforms operation (occurrences of high prices).

80 As far as the market-related reasons for a delayed accession are concerned, high prices represent one of the main concerns for both TSOs and market participants. Section 2.5.4 includes a case study, which analyses the occurrence of price incidents in PICASSO since its go-live.

2.5.1.3. MARI

81 The Manually Activated Reserves Initiative (MARI) is the European platform for the exchange of balancing energy from mFRR, in accordance with Article 20 of the Electricity Balancing Regulation. The platform was launched on 15 September 2022 and brought into operation on 5 October 2022 with the accession of the Czech TSO and the four German TSOs. The Austrian TSO joined the platform on 20 June 2023. To date, based on the expiry date of the derogations granted by NRAs to their respective TSOs in accordance with Article 62 of the Electricity Balancing Regulation, the number of TSOs in MARI is not expected to increase until the first quarter of 2024.

82 As for PICASSO, the main reason reported by NRAs for a delayed accession to MARI is technical, i.e., related to changes both in infrastructure and software, either on TSOs or market participants' side, to enable their connection and participation to the platforms. Other reasons are either regulatory- or market-related.

2.5.1.4. TERRE

83 The Trans European Replacement Reserves Exchange (TERRE) represents the European platform for the exchange of balancing energy from Replacement Reserves (RR), pursuant to Article 19 of the EB Regulation. TERRE has been operational since January 2020, with the TSOs from Czechia, France, Italy, Portugal, Spain, and Switzerland connected to the platform as of January 2021. The Polish TSO is expected to join the platform in Q2 2024.

2.5.1.5. Cross-border balancing capacity cooperations

84 In addition to the European platforms for the exchange of balancing energy, there are three cooperations which allow for the exchange of balancing capacity:

85 **Nordic aFRR market**: Pursuant to Article 41 of the Electricity Balancing Regulation, the Nordic TSOs submitted to the Nordic NRAs a methodology for a market-based allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves. This methodology was referred to ACER, which approved it in August 2020. Following ACER's Decision, the Nordic TSOs implemented the Nordic aFRR capacity market, which began its operation on 7 December 2022[28]. Taking stock of this successful implementation project, a common Nordic capacity market also for mFRR is expected to follow in the coming years for mFRR as well.

27 See Annex I of ACER Decision 02-2020 on the Implementation Framework for the European Platform for Automatic Frequency Restoration Reserves.

28 See https://nordicbalancingmodel.net/the-nordic-afrr-capacity-market-went-live-7th-of-december-2022/.

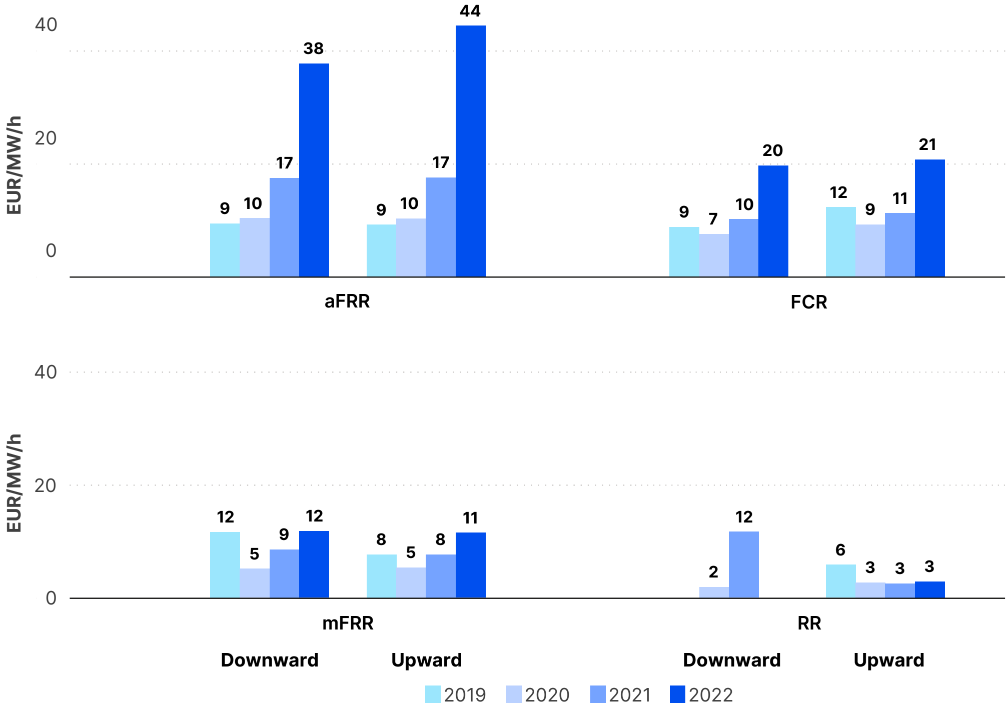
86 **German-Austrian aFRR balancing capacity cooperation**: Since the end of 2017, Austria and Germany have entered into a cooperation agreement for the allocation of up to 80 MW of cross-zonal capacity for the exchange of aFRR.

87 **FCR Cooperation**: The FCR Cooperation is a voluntary initiative comprising of twelve TSOs from nine countries (Austria, Belgium, Czechia, Denmark, France, Germany, the Netherlands, Slovenia, and Switzerland) to establish a common market for the procurement and exchange of FCR capacities[29]. The main goal of this platform is to procure FCR capacity through a common auction based on a common merit order list where the participating TSOs consider all the offers received from the BSPs connected to their respective grids. The procurement of the capacity involved in the project is conducted one day before delivery through daily auctions.

2.5.2. Overview of prices, volumes, and costs of balancing services (capacity and energy) across Europe

88 2022 was marked by large price increases for balancing services, mostly driven by the Russian invasion of Ukraine, especially for frequency containment reserve (FCR) and automatically activated frequency restoration reserve (aFRR). Figure 20 exemplarily shows a comparison of the average prices for balancing capacity per year and reserve type from 2019 to 2022. The prices for both FCR and aFRR more than doubled in comparison to the average of previous years.

Figure 20: Comparison of average prices for balancing capacity per year and reserve type in European markets for the period 2019 – 2022 (EUR/MW/h)



Source: ACER calculation based on NRA data.

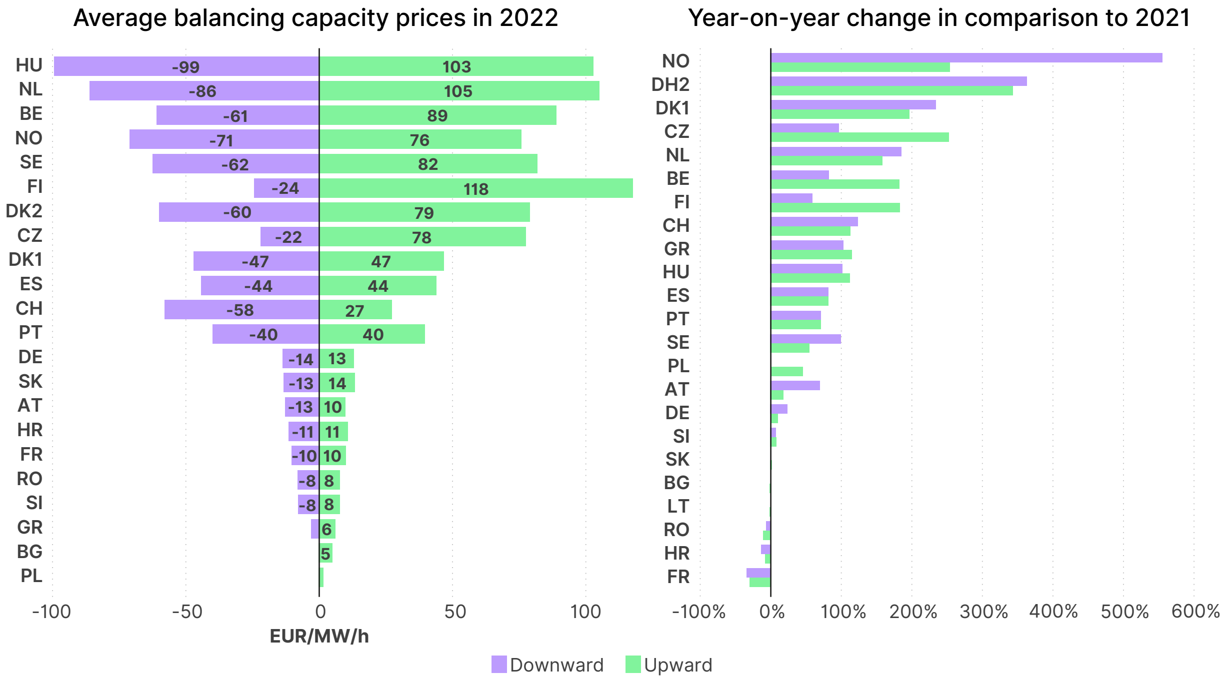
Note 1: The market areas considered represent all market areas for which data was received. No data was received from Malta, Cyprus and Ireland.

Note 2: In the Nordics, two FCR products exist, FCR-D and FCR-N. For this comparison, only FCR-D was considered as it is more comparable to the FCR product procured in other countries.

89 Figure 21 and Figure 22 show the prices for balancing capacity and balancing energy for aFRR per Member State and corresponding year-on-year changes in comparison to 2021. Significant disparities in balancing energy and balancing capacity prices between countries persisted in 2022. However, such differences are expected to be mitigated once major European projects and platforms initiated by the Electricity Balancing Regulation will be used more widely.

29 Since June 2020, units based in Luxembourg have the possibility to participate in German FCR via direct agreements with Amprion, and thus be part of this FCR cooperation.

Figure 21: Average prices of balancing capacity (upward and downward capacity from aFRR) and year- on-year change from 2021 in selected European markets – 2022 (EUR/MW/h, %)



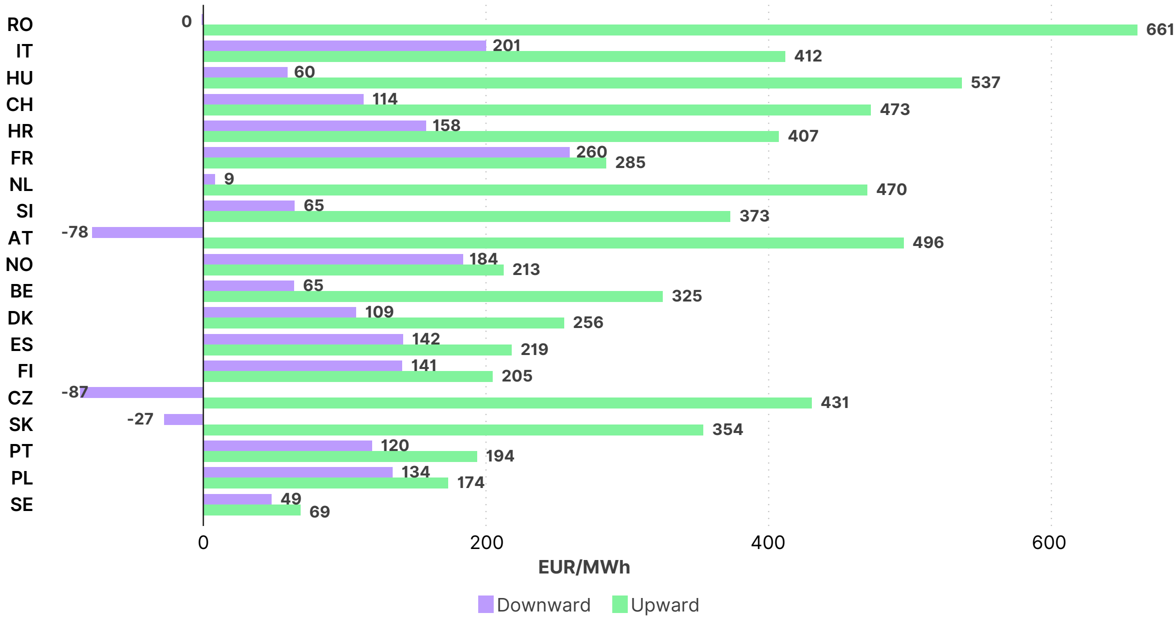
Source: ACER calculation based on NRA data.

Note 1: The values shown in the figure refer to the prices of activated balancing energy in each market area, irrespective of whether the activations aim to cover the needs for balancing in the same or in neighbouring market areas.

Note 2: No data was received from Malta, Cyprus, and Ireland. Luxemburg is included in the data for Germany as they pertain to the same bidding zone. Within the Baltic countries, Estonia, Latvia, and Lithuania, no aFRR is procured. Italy does not procure balancing capacity with explicit auctions.

90 In 2022, average prices for balancing capacity from aFRR upward and downward have increased in most Member States. The maximum price paid for upward and downward aFRR have increased by a factor of around 5 and 6, respectively, in comparison to 2021. The minimum prices have stayed in a similar range of a few EUR/MW/h.

Figure 22: Volume-weighted average prices of balancing energy activated from aFRR (upward and downward activations) in selected European markets – 2022 (EUR/MWh)



Source: ACER calculation based on ENTSO-E data.

Note 1: The values shown in the figure refer to the prices of activated balancing energy in each market area, irrespective of whether the activations aim to cover the needs for balancing in the same or in neighbouring market areas.

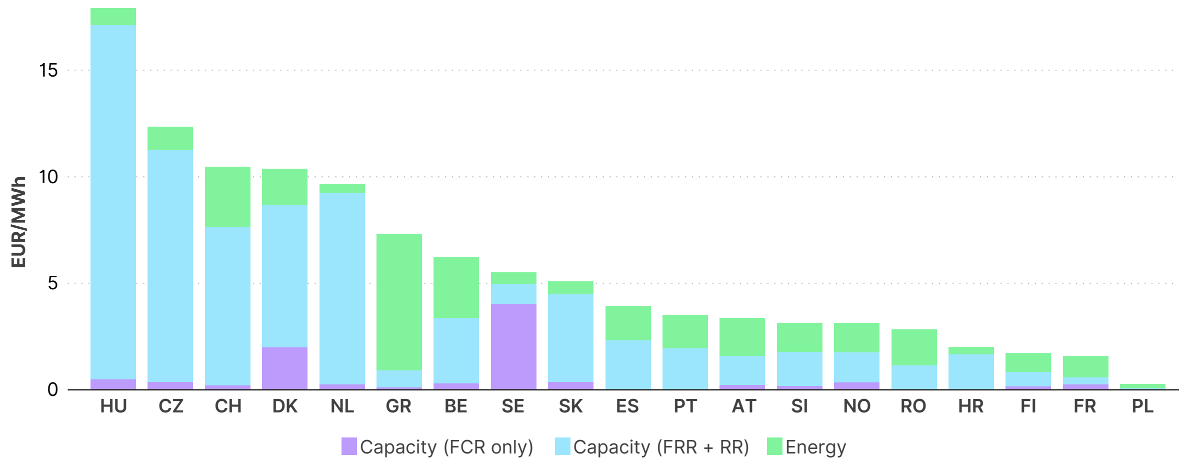
Note 2: The aFRR prices are shown for all countries for which data on ENTSO-E TP was available. Price data for Germany was incomplete at the time of publication and is therefore not shown.

91 Similarly, prices for balancing energy activated from aFRR have increased in most Member States. The average price for upward aFRR has increased from 74 EUR/MWh to 345 EUR/MWh in the analysed Member States, representing a more than fourfold surge. The average price for downward aFRR has increased by a factor of 12 from -7 EUR/MWh to -85 EUR/MWh. Figure 22 shows the prices per Member State. Like the prices for aFRR capacity, large disparities persist between Member States. Romania, which has had the highest price for several years, shows an increase by over a factor of 4 in comparison to 2021 for upward aFRR, resulting in the highest average of 661 EUR/MWh. The high prices may be a result of a highly concentrated market with few units qualified for aFRR. Section 6.1, in Annex I shows the corresponding figure with volume weighted prices for activated balancing energy from mFRR.

92 Figure 23 displays the overall costs of balancing for a selection of countries for which sufficient data was available. In comparison to previous years, the overall cost of balancing increased by a factor of 4 to 6 due to the overall increase in prices for balancing capacity and energy. The total volumes of contracted capacity over all Member States have stayed in a similar range with an annual average of about 38 GW. The activated volumes of balancing energy from FCR have slightly decreased by around 3%. The activated volumes of balancing energy from aFRR have increased by around 10% for both upward and downward activation in comparison to 2021. The activated volumes of balancing energy from mFRR downward have increased by around 10%. The activated energy from RR upward and downward increased by 26% and 14% respectively[30].

30 The given analysis of the volumes is based on NRA data for all Member States, Switzerland and Norway. The analysis excludes Finland (due to inconsistencies in the data) and Italy. In Italy the accounting rules changed, such that no direct comparison to data from previous years was feasible.

Figure 23: Overall costs of balancing (capacity and energy) over national electricity demand in selected European markets, Norway, and Switzerland – 2022 (EUR/MWh)



Source: ACER calculation based on NRA data and ENTSO-E data.

Note 1: The overall costs of balancing are calculated as the procurement costs of balancing capacity and the costs of activating balancing energy (based on national needs of energy volumes and the unit cost of activating balancing energy from the applicable type of reserve). For the purposes of this calculation, the unit cost of activating balancing energy is defined as the difference between the balancing energy price of the relevant product and the day-ahead market price. For better comparison between countries, the total cost is normalised with the total energy demand per country.

Note 2: In the Nordics, two FCR products exist, FCR-D and FCR-N. For this comparison, only FCR-D was considered as it is more comparable to the FCR product procured in other countries.

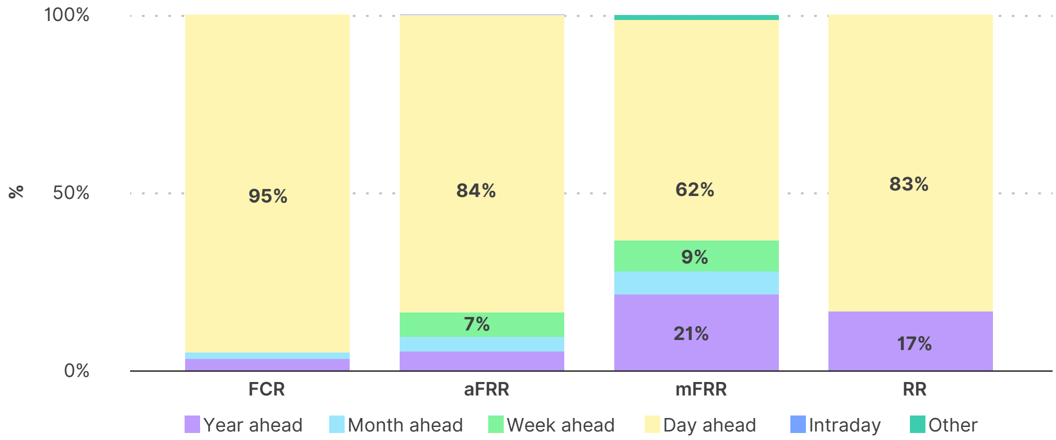
Note 3: For the following countries no complete data set, including both capacity and energy data, was available: Cyprus, Germany, Estonia, Ireland, Italy, Malta, Lithuania, and Latvia.

2.5.3. Procurement times for balancing capacity services

93 The recast Electricity Regulation reasserts the principle established in the Electricity Balancing Regulation, that balancing capacity procurement should be performed on a short-term basis. This principle aims to maximise the participation of flexible resources in short-term energy markets, to improve liquidity and competition. In particular, the day-ahead procurement of capacity advocated in the regulation allows for an efficient arbitrage between day-ahead and balancing capacity markets. The main benefit of this requirement is an ability to act in both markets and provide bids to both market around the same time, which better reflects the instantaneous needs of the system.

94 Following the implementation of the above-mentioned provisions, the share of balancing capacity contracted in the day-ahead timeframe has increased over the years. Figure 24 and Figure 25 show the procurement lead time for balancing capacity per type and per country and in 2022. Overall, day-ahead is the predominant contracting period. Figure 24 shows that over 80% of the capacity from FCR, aFRR and RR is already contracted on a day-ahead basis reaching 95% for FCR. For mFRR, 62% of the volume is contracted day-ahead, with one fifth still being contracted year-ahead.

Figure 24: Repartition of the procurement lead time of each type of reserve in selected European markets – 2022 (%)



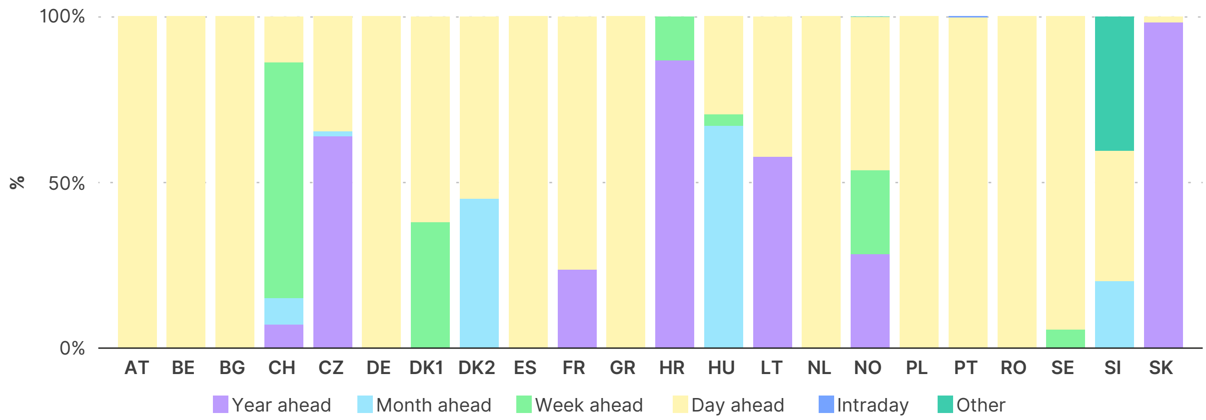
Source: ACER calculation based on NRA data and ENTSO-E data.

Note 1: This figure is based on the countries for which sufficient data was available, an overview is given in Figure 25.

Note 2: The category 'day-ahead' also includes the procurement of FCR in D-2 The category 'other' is related to long-term contracts in Slovenia for mFRR and for mFRR in Norway for a few special cases with expected low availability of balancing services resulting in procurement between D-7 and D-1.

95 Figure 25 shows the variation of dominant procurement lead times between countries. About half of the countries fully rely on day-ahead procurement, thereby presenting impressive shifts towards shorter procurement lead times in the previous years. Some countries rely on a mix of procurement lead times further away from real time. While Hungary, Lithuania[31], and Slovakia show limited changes to the share procured day-ahead in comparison to 2021, the share of day-ahead procurement in Croatia and Czechia has increased from 7% to 13% and from 28% to 35%, respectively. This is a positive trend, but significant efforts are still needed to align with the requirements of the recast Electricity Regulation.

Figure 25: Repartition of procurement lead time of each Member State, for all types of reserve (FCR, aFRR, mFRR, RR) – 2022 (%)



Source: ACER calculation based on NRA.

Note 1: Italy does not procure balancing capacity with explicit auctions prior to the day-ahead market but rebuilds and locks in "reserve margins" after the day-ahead and intraday market auctions, through market-based re-dispatching and the imposition of feasibility interval for subsequent continuous trading on the intraday market for the same delivery interval.

Note 2: No data was received for Cyprus, Malta, and Ireland. No information on procured capacity was provided by Latvia, and no information on procurement lead time was provided by Estonia. Data for Finland was not consistent at time of publication.

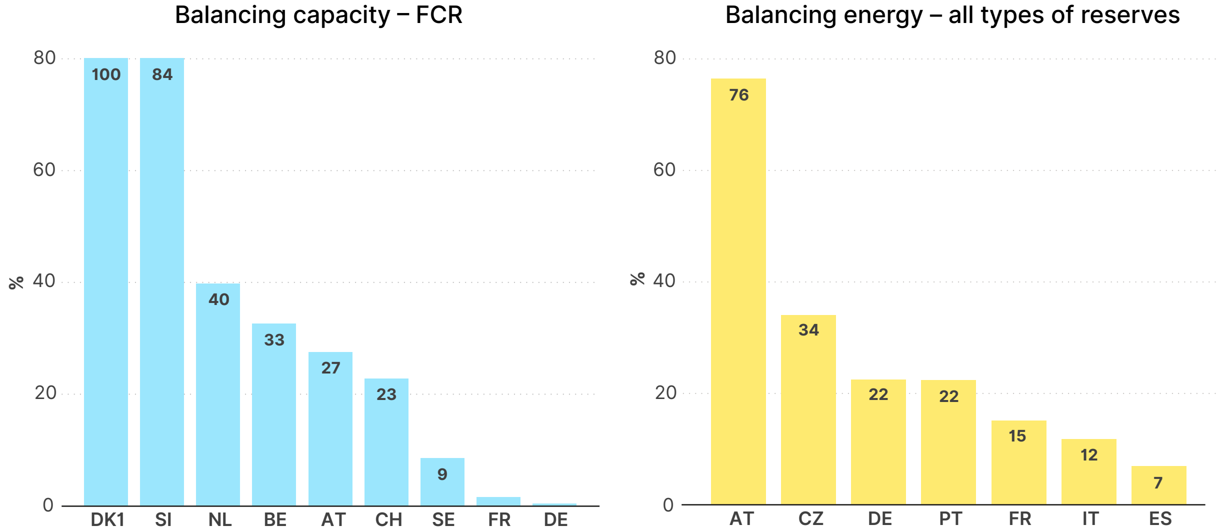
Note 3: The category 'day-ahead' also includes the procurement of FCR in D-2. The category 'other' is related to long-term contracts for mFRR in Slovenia and for mFRR in Norway for a few special cases with expected low availability of balancing services resulting in procurement between D-7 and D-1.

31 Both countries showed a large increase from 2020 to 2021.

2.5.4. Cross-zonal exchange of balancing services

96 This subsection consists of an overview of the exchanges of energy and capacity balancing services across EU borders. More specifically, Figure 26 shows the share of balancing capacity for FCR (on the left) and the share of balancing energy for all types of reserves (on the right) procured cross-border as a percentage of the national needs. The focus for balancing capacity is on FCR, which is exchanged through the FCR cooperation and in the Nordics. There was no significant exchange of other reserve types in 2022. Additionally, Figure 27 shows the application of imbalance netting as a percentage of the total needs for balancing energy.

Figure 26: Balancing capacity contracted cross-border as a percentage of the national requirements of reserve capacity for FCR (left) and balancing energy activated cross-border as a percentage of the total balancing energy activated to meet national needs (right) – 2022 (%)



Source: ACER calculation based on NRA data.

Note 1: These figures include only the Member States that reported some level of cross-zonal exchange. Special cases for the Baltic and Nordic countries are explained in the following notes.

Note 2: The Baltic countries are part of a cooperation project for the exchange of balancing services and activate balancing energy to balance the Baltic system by using a common mFRR balancing energy product. Hence, balancing energy activated cross-border cannot be reported per country and is therefore not represented.

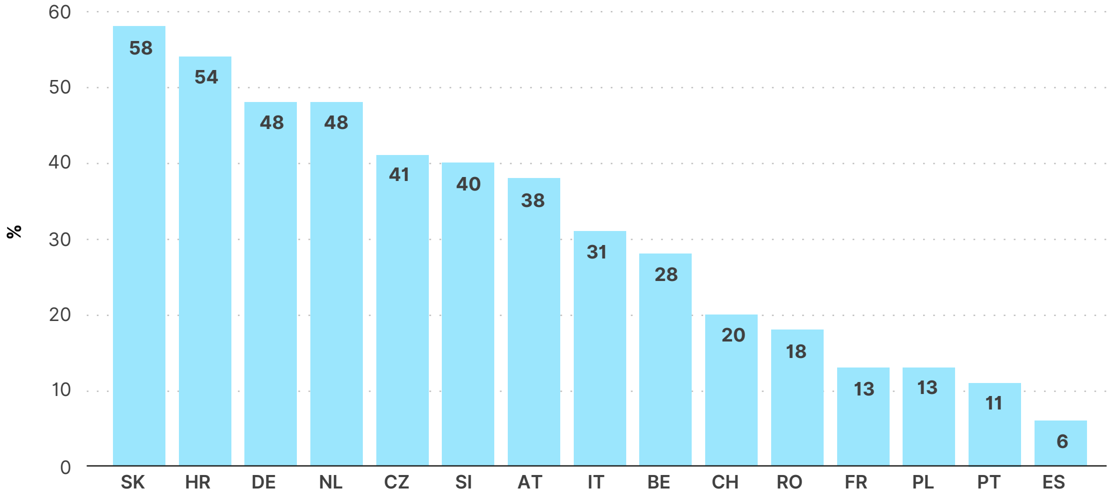
Note 3: The Nordic electricity systems are integrated and balanced as a single load frequency control (LFC) area. Therefore, the cross-zonal exchange of balancing energy cannot be disentangled from imbalance netting across borders and is therefore not represented.

Note 4: There is also cross-border procurement of balancing energy for DK1 and DK2. However, this data cannot be provided due to the existing IT system of Energinet. A system update is planned to update the system to be able to provide this data for future reports.

97 In 2022, the level of exchange of balancing capacity related to FCR increased significantly for Western Denmark and Slovenia in comparison to previous years, where they had not reported any cross-border procurement of FCR capacity. This is linked to them joining the FCR cooperation in 2021. They also portray the highest share of FCR capacity procured cross-border overall. For the Member States which had already been part of the FCR cooperation (i.e., Austria, Belgium, Germany, France and the Netherlands), the share of FCR capacity procured cross-border decreased significantly in 2022 in comparison to 2021, e.g., Belgium only contracted 33% instead of 66%, similarly in the Netherlands the share reduced from 52% to 40%. In Slovakia, the reduction was from 30% to 0%.

98 Contrary to the reduction in exchange of FCR capacity, there was an increase in the share of cross-border procurement of balancing energy, considering all types of reserves, when comparing 2021 to 2022 for all Member States, apart from France (which decreased its share from 22% to 15%). The highest increase can be observed for Czechia, which increased the share from slightly above 0% to 34%.

Figure 27: Imbalance netting as a percentage of the total need for balancing energy (explicitly activated or avoided by means of netting) from all types of reserves in national balancing markets – 2022 (%)



Source: ACER calculation based on NRA data.

Note 1: This figure includes only the countries that reported some level of cross-zonal exchange. Special cases for the Baltic and Nordic countries are explained in the following notes.

Note 2: The Baltic countries are part of a cooperation project for the exchange of balancing services and activate balancing energy to balance the Baltic system by using a common mFRR balancing energy product, imbalance netting is applied and only the non-netted imbalance is covered. Hence, imbalance netting cannot be reported per country and is therefore not represented.

Note 3: The Nordic electricity systems are integrated and balanced as a single load frequency control (LFC) area. Therefore, the cross-zonal exchange of balancing energy cannot be disentangled from imbalance netting across borders and is therefore not represented.

99 Compared to previous years, the percentage of imbalance netting in 2022, displayed in Figure 27, has stayed in a similar range or decreased for most countries. The highest decreases in comparison to 2021 are in Austria (-35%), Czechia (-27%), Spain (-24%), and Germany (-13%). The decrease of reported imbalance netting in Austria, Czechia and Germany is most likely due to these countries joining PICASSO in June 2022[32]. The highest increase of imbalance netting volume in comparison to 2021 can be seen for Romania (+67%), which joined the IGCC cooperation in December 2021. Smaller increases were also reported for Croatia (+8%), Slovenia (+7%), and Italy (+6%).

32 The algorithm of PICASSO includes implicit imbalance netting, such that these values cannot be reported as explicit imbalance netting anymore. With more countries joining PICASSO, the explicit imbalance netting values are expected to decrease.

Case study: Analysis of price incidents in the PICASSO platform

Disclaimer: This case study has been made possible through the transparency provided by German transmission system operators within the Picasso framework. The study does not assess compliance. While the findings and conclusions presented in this study pertain to the specific geographical area for which ACER collected sufficient information to conduct the analysis, it is important to note that these conclusions should not be assumed to be applicable exclusively to this geographic region. The results of this partial analysis should be interpreted with caution in any broader or similar settings.

100 PICASSO, the Platform for the International Coordination of Automated Frequency Restoration Reserves and Stable System Operation, was successfully launched on 1 June 2022. PICASSO's launch initiates the coupling of European national balancing markets for automatic activation of frequency restoration reserves (aFRR) with standard products, harmonized processes, central activation optimization, merit order activation, and consistent pricing. The platform enables TSOs to activate bids from across Europe to balance their systems and exchange balancing energy more flexibly with neighbouring TSOs.

101 Since the launch of the PICASSO platform, price incidents[33] have been observed regularly. To illustrate this, Table 2 shows the percentage of optimisation cycles that are part of price incidents.

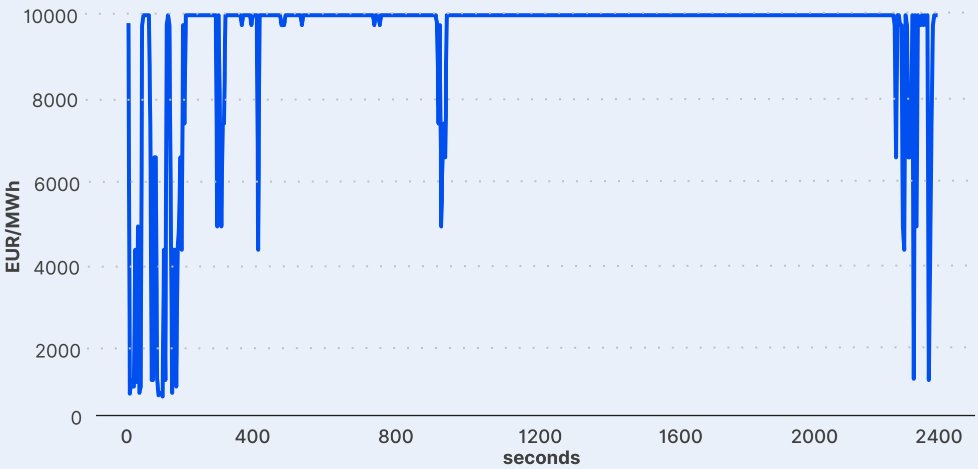
Table 2: Percentage of optimisation cycles that are part of price incidents for Austrian, Czech, and German bidding zones (last 6 months of 2022)

	Percentage of optimization cycles with price incidents
Austria	0.17%
Czech Republic	0.03%
Germany	0.02%

Source: ACER calculation based on Transnet data.

102 Some of these price incidents can last for a long time. For instance, Figure 28 presents a price incident in Austria where the prices stay around 10,000 EUR/MWh for almost 30 minutes. Though, many price incidents are very short (lasting a few optimisation cycles). Nevertheless, even short price incidents are part of a longer process of extreme prices. Indeed, short price incidents often follow each other. Figure 29 shows that the cross-border marginal price regularly oscillates around 7,500 EUR/MWh. This indicates that, even though most price incidents are short, activating a slower reserve such as the mFRR might be an interesting approach to mitigate price incidents.

Figure 28: Example of a long price incident in Austria on 18 August 2022 (EUR/MWh per second of optimisation)

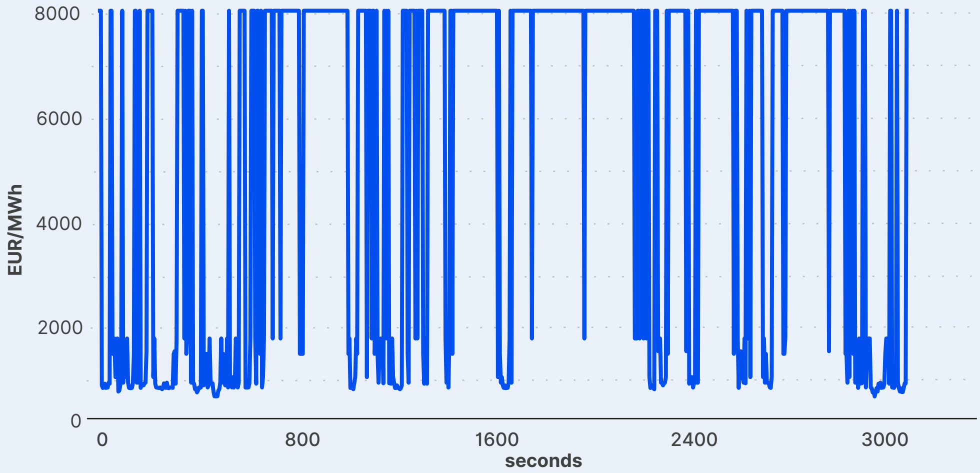


Source: ACER calculation based on Transnet data.

Note: The incident occurred on 18 August 2022 between 19:20:36 and 20:00:00.

33 Price incidents are defined as periods of time where the prices are above (resp. below) 7500 (-7500) EUR/MWh.

Figure 29: Example of a sequence of short price incidents in Austria on 20 August 2022 (EUR/MWh per second of optimisation)



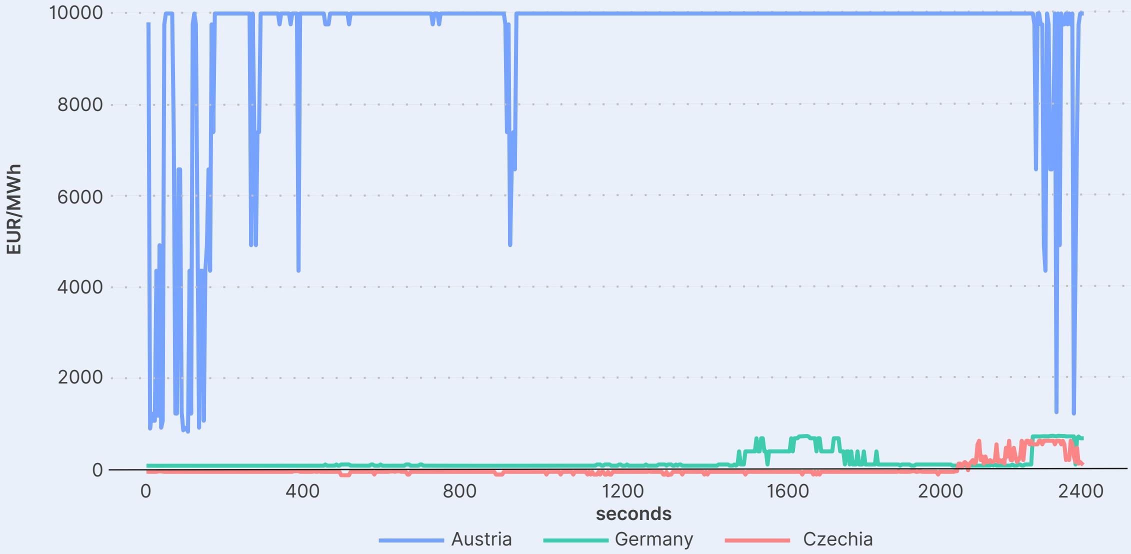
Source: ACER calculation based on Transnet data.

Note: The incident occurred on 20 August 2022 between 13:04:04 and 13:59:32.

Cross-border contribution during price incidents

103 The price convergence shows cross-border contributions during price incidents. Specifically, the following analysis shows the price difference between the bidding zone having the highest price during the price incident and the other bidding zones. During positive price incidents, the analysis shows that the median of the second highest price is equal to 640 EUR/MWh, while the median of the third highest price is equal to 71 EUR/MWh. During negative price incidents, the analysis shows that the median of the second lowest price is equal to 5 EUR/MWh, while the median of the third lowest price is equal to 73 EUR/MWh. This shows that, in general, there are assets with lower prices available in other LFC blocks that could help the bidding zone experiencing price incidents. Figure 30 illustrates the above by considering the three bidding zones during the price incidents of 18 August 2022.

Figure 30: Cross-border marginal prices in Austria, Czechia, and Germany on 18 August 2022 (EUR/MWh per second of optimisation)

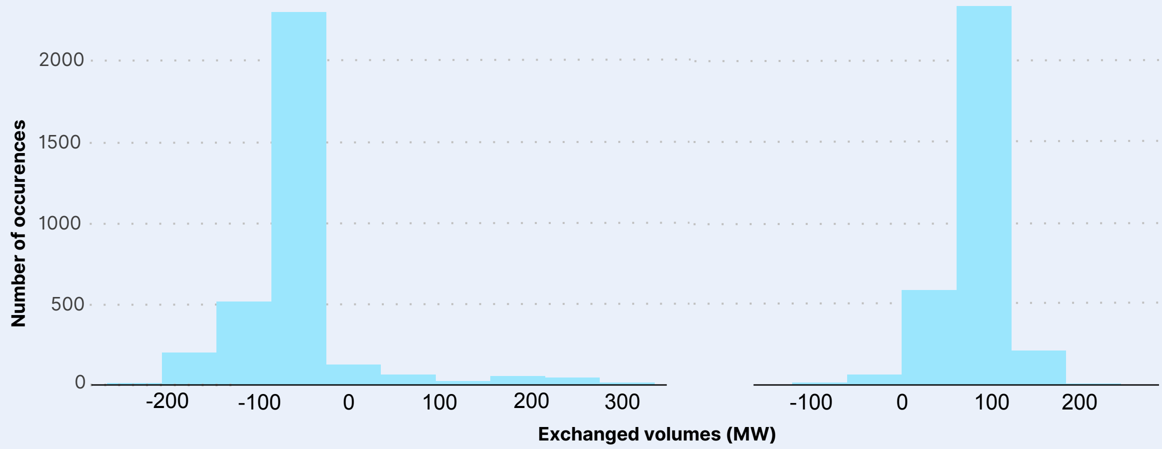


Source: ACER calculation based on Transnet data.

Note: the event occurred on 18 August 2022 between 19:20:36 and 20:00:00.

104 Another interesting indicator of cross-border contribution is the exchanged volumes during price incidents. To this aim, Figure 31 presents a histogram of the exchanged volumes of Austria during a price incident. These histograms confirm that there are few cross-border exchanges during price incidents. The peak of the histogram corresponds to an exchanged volume of -80MW (for positive price incident) and +80 MW (for negative price incident). This corresponds to an agreement for the allocation of cross-zonal capacity for the exchange of aFRR of 80 MW between Germany and Austria (German/Austrian aFRR cooperation)[34].

Figure 31: Exchanged volumes for Austria when it is facing a positive price incident (Left); and a negative price incident (Right) – 2022 (number of occurrences per MW)



Source: ACER calculation based on Transnet data.

105 Table 3 shows the percentile of the absolute value of the exchanged volumes for the different Load Frequency Control areas during price incidents. This table confirms that for 75% of the time during price incidents, the Austrian net position corresponds to the value of their agreement for the allocation of cross-zonal capacity for the exchange of aFRR. Table 3 also shows that, during price incidents, the Czech absolute exchanged volume is lower than or equal to 11.2 MW for 50% of the time. On the other hand, it can be observed that far higher exchanged volumes are achieved by German Load Frequency Control areas[35]. This is confirmed by Table 4, which shows the percentile of the exchanged volumes for the German Load Frequency Control area with the highest import and the highest export. It can be observed that 25% of the time (during price incidents) (i) the highest import German Load Frequency Control area imports more than 800 MW; and (ii) the highest export German Load Frequency Control area exports more than 895 MW. These exchanges confirm that physical transmission capacities are available to accommodate the impact of internal exchanges.

Table 3: Percentiles of the absolute value of the exchanged volumes in Picasso for each LFC area in MW

LFC area	APG	CEPS	50Hertz	Amprion	TenneT GER	TransnetBW
25th percentile	80	0	130	121	191	97
50th percentile	80	11.2	287	255	415	226
75th percentile	80	52	790	466	725	419
90th percentile	121	100	1113	744	1009	763
99th percentile	214	150	1522	2404	2137	1130

34 See Page 80 of the 2023 ENTSO-E Market Report.

35 German load frequency control areas exchange volumes regardless of the presence of cross-zonal congestions.

Table 4: Percentiles of the exchanged volumes for the German LFC area with the highest import and the highest export in MW

LFC area	Highest import	Highest export
25th percentile	306	274
50th percentile	547	545
75th percentile	800	895
90th percentile	1209	1112
99th percentile	2137	2404

Source: ACER calculation based on Transnet data.

106 During price incidents in the Austrian bidding zone:

- large price differences were observed with neighbouring bidding zones;
- access to balancing resources available at a lower price in the neighbouring bidding zones was scarce;
- at the same time, physical capacity was available for internal exchanges within the German bidding zone.

107 These observations, consistent with the current market design, may reveal inefficiencies: at times of price incidents, the Austrian bidding zone would have benefited from accessing the neighbouring bidding zones. This could have been achieved by optimising the availability and use of physical transmission capacity at the time of the incident to increase the amount of cross-border capacity for balancing purposes. ACER will deepen this analysis in future editions of the market integration report.

3. Remedial actions

108 This section provides an overview on the mechanisms implemented by the TSOs to address the congestion within the power grid. To this end, it analyses the costs and volumes of remedial actions[36] activated by Member States in 2022, providing a comparative overview among them, and investigates the reasons and technologies used to address the congestions.

109 Some remedial measures, such as changes in grid topology or the use of phase shifter transformers, do not lead to additional operating costs and thus are generally given priority over others, such as re-dispatching, countertrading, or curtailment of allocated capacities, which can come at a significant cost to the system.

110 The use of remedial measures to relieve physical congestions has become extensive across the European Union, and it is expected to increase further for several reasons:

- Firstly, considering the growing share of variable renewable electricity generation in the system, and the generalized delay in corresponding grid infrastructure development, the location of network congestion will continue to change more often with flow patterns, requiring TSOs' interventions in timeframes closer to real-time.

- Secondly, the minimum cross-zonal capacity requirements set out in Article 16(8) of Regulation 2019/493, foresee an increased application of both costly and non-costly remedial actions to ensure their fulfilment, as the reduction of cross-zonal capacities has been largely used by TSOs as a means to prevent internal congestion.

- Thirdly, bidding zones in the European Union are currently still mainly defined following political borders, and potential changes in their configuration are met with significant reluctance by Member States. Thus, they often cannot address efficiently structural, physical congestion in the network. As a result, locational price signals, via wholesale prices, are partly distorted and do not always reflect the cost of congestions.

3.1. Overview of the use of remedial actions across the EU

111 The costs of remedial actions activated in the EU in 2022 that have been reported to ACER by NRAs show a significant increase compared to previous years. The total cost of remedial actions in 2022 totalled 5.2 billion EUR. This constitutes a 45.75% increase compared to 2021, partly resulting from the overall higher prices of electricity in the different markets, but mainly triggered by the increased use of remedial actions[37]. The overall volumes of costly remedial actions activated in 2022 amount up to 49.91 TWh, which also constitutes a significant increase when compared to 2021.

112 Figure 32 shows a comparative overview between Member States in 2022 with respect to the use of remedial actions, measured as the total volume of costly remedial actions activated per unit of national demand.

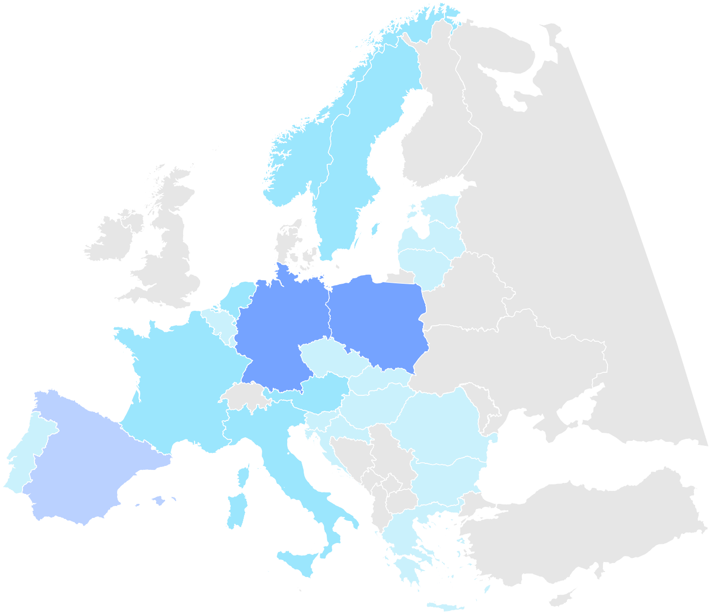
113 Germany shows the most extensive use of costly remedial actions in 2022 of all the analysed Member States, both in absolute terms, totalling 27.2 TWh of costly remedial actions activated, and relative to its electricity demand. This confirms the upwards trend detected over the last several years, where re-dispatching is generally relied upon to cope with structural congestion within the German bidding zone.

114 In 2022, Sweden showed the most significant increase in the activation of remedial actions, primarily employing countertrading between bidding zones to alleviate congestion. The reported usage of costly remedial actions in Sweden amounted to 363 GWh in 2022, which is a considerable increase from the 26 GWh reported in 2021.

36 Remedial actions constitute corrective measures to mitigate congestion.

37 This can be linked to an increased attention to the availability of cross-zonal capacities following the introduction of the minimum 70% requirement, which impedes the management of congestion through the reduction of cross-zonal capacities.

Figure 32: Relative performance of the different EU Member States on the volume of remedial actions activated as a share of their total demand – 2022 (% of total demand)



Source: ACER calculation based on NRA and ENTSO-E data.

Note: No complete dataset was available for the creation of this figure from Denmark, Finland and Ireland.

115 Table 5 presents the costs incurred by TSOs when activating costly remedial actions in 2022, both in absolute terms and per unit of demand, as reported by the NRAs. Moreover, it compares the total cost values of 2022 with those reported on previous years. The data shows a generalized increase in the costs of remedial actions across the EU, in line with the increases in day-ahead market prices motivated by the constrained supply curve of natural gas.

116 The data on costs show a similar trend as the volume, with Ireland (19.05 EUR/MWh) and Germany (5.82 EUR/MWh) having the most expensive procurement of congestion management measures. The total cost of congestion management in Germany in 2022 reached 2.8 billion EUR, constituting a 54% of all the congestion management cost across the analysed Member States.

Table 5: Evolution of the cost of remedial actions activated by the EU Member States – 2020–2022 (million euros)

Member State	Total Volumes 2022 (GWh)	Re-dispatching 2022 (MEUR)	Counter-trading 2022 (MEUR)	Other actions 2022 (MEUR)	Total Costs 2022 (MEUR)	Total Costs 2021 (MEUR)	Total Costs 2020 (MEUR)	Relative change 2022/2021 (%)	Cost per unit of demand 2022 (EUR/MWh)
AT	**102.82**	20.36	-	-	**20.36**	15.50	141.30	31	0.33
BE	**40.7**	3.42	3.86	0.00	**7.28**	8.16	1.69	-11	0.09
BG	**0.00**	0.00	0.00	0.00	**0.00**	-	0.00	-	0.00
CZ	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.06	-100	0.00
DE	**27209.15**	2437.22	370.35	0.17	**2807.74**	1849.69	1338.66	52	5.82
DK	**-**	-	0.59	0.00	**0.59**	0.00	-	-	0.02
EE	**7.99**	-	-1.95	-	**-1.95**	-0.14	0.06	-1332	-0.24
ES	**7218.99**	444.58	154.79	0.00	**599.37**		435.23		2.54
FI	**-**	1.75	5.54	0.00	**7.29**	2.50	0.69	192	0.09

Member State	Total Volumes 2022 (GWh)	Re-dispatching 2022 (MEUR)	Counter-trading 2022 (MEUR)	Other actions 2022 (MEUR)	Total Costs 2022 (MEUR)	Total Costs 2021 (MEUR)	Total Costs 2020 (MEUR)	Relative change 2022/2021 (%)	Cost per unit of demand 2022 (EUR/MWh)
FR	**1482.30**	24.01	146.89	0.00	**170.90**	34.16	7.61	400	0.39
GR	**4.07**	0.00	0.00	0.00	**0.00**	0.05	0.00	-100	0.00
HR	**5.53**	0.00	0.00	0.00	**0.00**	0.00	0.00	0	0.00
HU	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0	0.00
IE	**-**	564.59	47.46	-	**612.04**	-	-	-	19.05
IT	**306**	60.00	3.32	-	**63.32**	1055.37	1470.00	-94	0.22
LT	**4.56**	0.00	1.70	0.00	**1.70**	0.54	0.95	217	0.14
LU	**0.00**	0.00	0.00	0.00	**0.00**	-	-	-	0.00
LV	**1.15**	-	0.27	-	**0.27**	-	4.09	-	0.04
NL	**876.65**	168.02	-	220.88	**388.90**	336.62	78.74	16	3.87
NO	**1167**	50.89	-	-	**50.89**	20.78	9.54	145	0.39
PL	**11058**	396.10	0.57	0.00	**396.67**	212.85	75.78	86	2.30
PT	**0.08**	0.01	-	-	**0.01**	0.02	0.07	-15	0.00
RO	**1.62**	0.07	0.00	0.00	**0.07**	-	-	-	0.00
SE	**355.56**	5.97	32.73	0.00	**38.70**	6.92	1.14	459	0.29
SI	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
SK	**0.00**	0.00	0.00	0.00	**0.00**	-	-	-	0.00

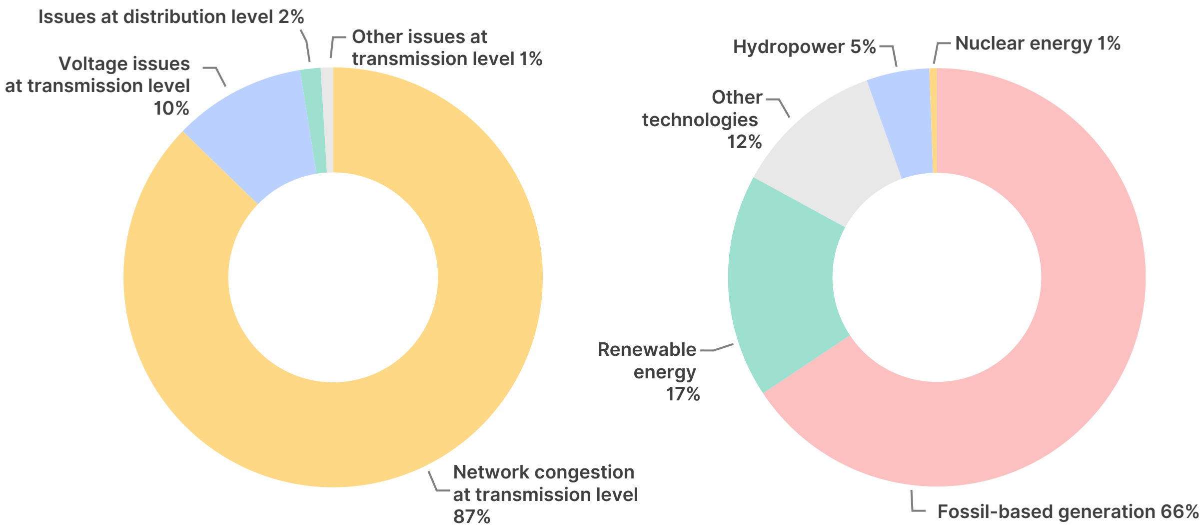
Source: ACER calculation based on NRA data.

Note 1: Fields filled with '-' indicate that the relevant NRA either could not provide the data requested, or could not provide it according to ACER's specifications.

Note 2: The volumes of remedial actions activated in a given country, and its associated costs, do not necessarily correspond to the TSO that is incurring such cost. This is mainly the case for countertrading, although cost-sharing of re-dispatching is also possible.

117 The data on the use of remedial actions reported by NRAs allows for a detailed breakdown of both the underlying cause of the activated re-dispatching, and by the technology involved both in upwards and downward regulation. As displayed in Figure 33, most re-dispatching activated in the Member States corresponds to managing grid congestions at transmission level (87% of the total volume) and uses fossil-based generation (66% of the total volume) for that purpose.

Figure 33: Distribution of total upward and downward re-dispatching volume by underlying cause (left) and by technology (right) in the EU – 2022 (% of MWh)



Source: ACER calculation based on NRA data.

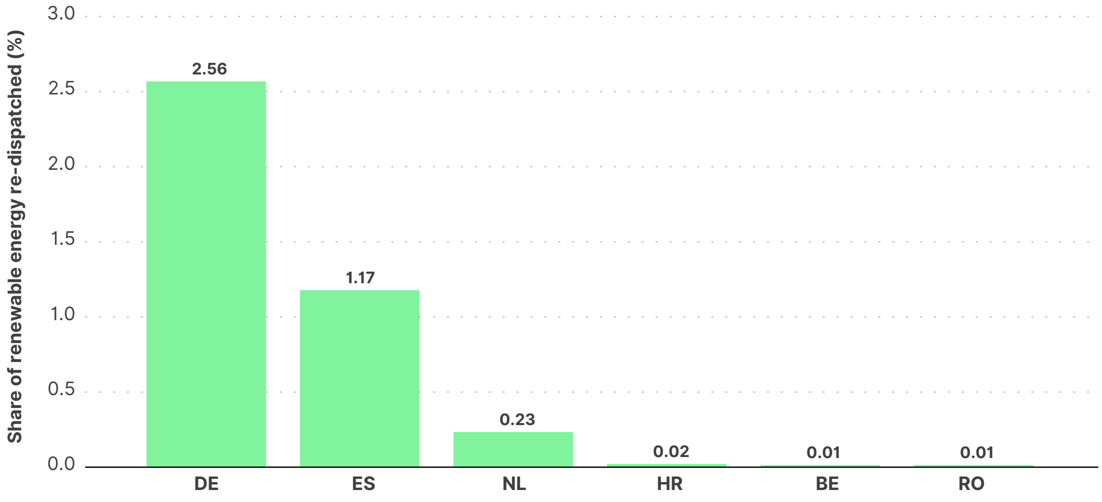
Note 1: No breakdown of re-dispatching volume by underlying cause has been provided from the following countries: Denmark, Ireland, and Latvia.

Note 2: No breakdown of re-dispatching volume by technology has been provided from the following countries: Denmark, Finland, France, Ireland, and Latvia.

118 The need for congestion management involving renewable energy technologies, mainly in the form of curtailment, is growing steadily. In comparison to previous years, activation of remedial actions involving renewable technologies has grown from 3.3% of the total volume in 2020, to 7.5% in 2021, and finally 17,1% in 2022.

119 As per Article 13(5)(a) of the Electricity Regulation, no more than 5% of the total renewable energy generation shall be curtailed for operational security reasons. The available data shows that some Member States are advancing steadily towards that mark. Figure 34 shows the percentage of volume of re-dispatching involving renewable energy technologies as a percentage of the total renewable energy generated in 2022 for several Member States. In the case of Germany, the increase over the last few years (0% in 2020, 0.64% in 2021 and 2.56% in 2022) and the ambitious targets set for offshore wind installations suggest that the 5% value may be breached in the coming years, unless measures to reduce the need for remedial actions follow the same pace. When remedial actions imply curtailment of the production of renewable energy sources, it generally entails reducing clean energy sources to the detriment of more polluting generation sources. Redispatching through curtailment of renewable energy sources therefore can be considered by itself a barrier for reaching energy transition goals.

Figure 34: Share of renewable energy technologies used in re-dispatching out of the total renewable energy generation per Member State – 2022 (%)



Source: ACER calculation based on NRA and ENTSO-E Transparency Platform data.

Note: No breakdown of re-dispatching volume by technology has been provided from the following countries: Denmark, Finland, France, Ireland, and Latvia.

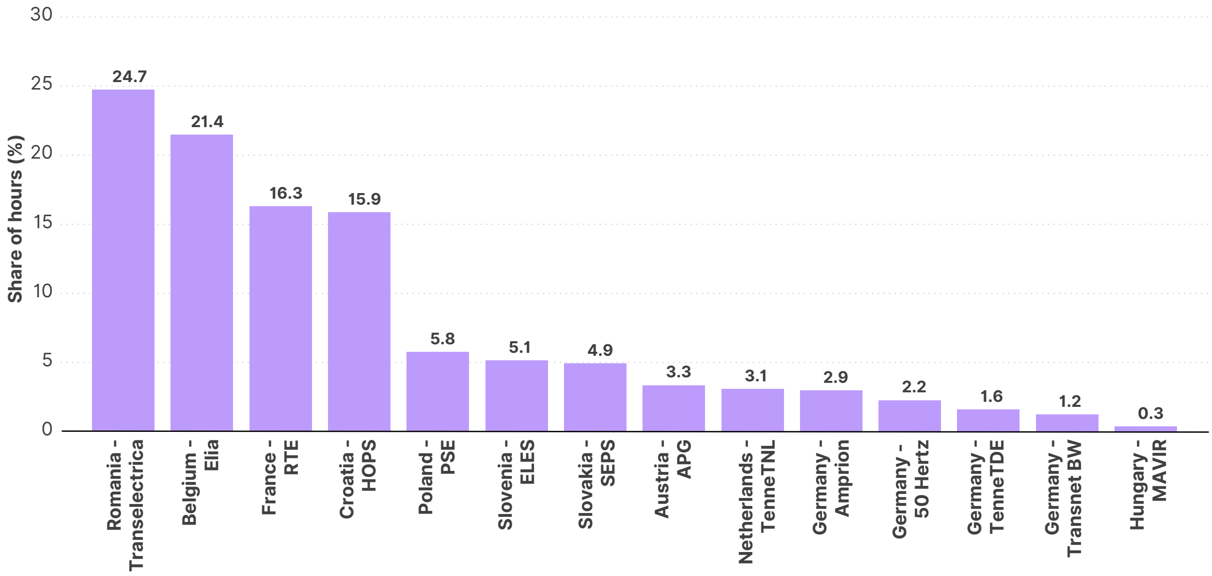
3.2. Use of remedial actions to guarantee cross-zonal capacity requirement

120 As described in ACER Report in cross-zonal capacities and the 70% margin available for cross-zonal electricity trade, guaranteeing the minimum cross-zonal capacity targets is a fundamental principle for the well-functioning of the European internal market, as it ensures the non-discrimination of cross-zonal trades with regards to internal ones. The current market design, where no limit to trades within a bidding zone is defined, relies on the extensive use of remedial actions to ensure that the minimum cross-zonal capacity requirements are maintained.

121 As mandated by Regulation 2019/943, TSOs are expected to use all available non-costly remedial actions to maximize cross-zonal capacities. In case that the minimum capacity targets set out in Article 16(8) of the Regulation cannot be achieved naturally within the capacity calculation, costly remedial actions are to be activated to ensure such minimum levels of cross-zonal transmission capacity can be offered to the market. Different provisions have been implemented in the regional capacity calculation methodologies to ensure this is so.

122 In the case of the Core capacity calculation region, which uses a flow-based approach in its capacity calculation and allocation processes, additional margin (or Adjustment for Minimum Remaining Available Margin) is added to the calculated cross-zonal capacity values on each critical network element with contingency to ensure that the legally binding targets are met. This additional capacity, if allocated, would require the activation of remedial actions to reduce the flow induced predominantly by internal transactions within a bidding zone in the relevant critical network element, in case of the loss of its associated contingency. In case that a given TSO considers that not enough remedial actions will be available to cope with the forecasted overload, the cross-zonal capacity to be offered can be reduced through a validation process. Figure 35 shows the frequency of application of such validation adjustments.

Figure 35: Frequency of application of validation adjustments in the Core capacity calculation region – 1 July 2022–31 December 2022 (% of hours)



Source: ACER calculation based on RCC data.

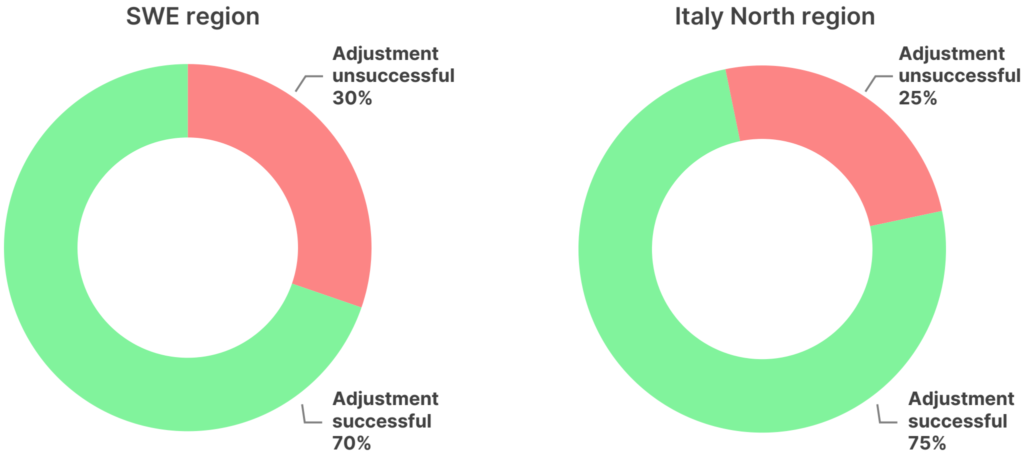
Note 1: Validation adjustments can be applied as a fallback, in case that the calculated capacities can't be assessed by the TSO, or whenever an error has been detected in the inputs of the capacity calculation. Those cases have been omitted for the purpose of this figure.

Note 2: The Austrian, Dutch and German TSOs apply a joint validation process known as DaVinCy, which pools the remedial action potential within the three bidding zones when assessing the application of validation adjustments. This in turn leads to a larger volume of remedial actions considered for guaranteeing the cross-zonal capacity requirements, when compared to other TSOs. For those Member States, the application of validation adjustments in one country correlates to a lack of remedial actions in the three Member States combined.

123 This assessment shows that there is a generalized lack of remedial action potential across the Core region to cope with the currently binding cross-zonal capacity requirements. This situation is expected to be aggravated in the future, as the integration of renewable energy technologies in the system will continue steadily, and the cross-zonal capacity targets will increase yearly across the EU until they are set at 70% by the end of 2025 in all Member States.

124 Capacity calculation regions which apply a coordinated Net Transfer Capacity (NTC) calculation approach, such as South-West Europe (SWE) and Italy North, have opted for an increase process within the capacity calculation that includes a set of remedial actions defined ex-ante by the TSOs. This adjustment process ends either when the minimum cross-zonal capacity level of 70% has been met, or whenever all the available remedial actions defined by the TSOs have been exhausted. Figure 36 shows the percentage of hours where the adjustment of capacity in both regions has resulted in either the fulfilment of the minimum cross-zonal capacity requirement or the exhaustion of remedial actions.

Figure 36: Rate of success of the cross-zonal capacity adjustment process in the SWE (left) and Italy North (right) capacity calculation regions – 1 July 2022–31 December 2022 (% of hours)



Source: ACER calculation based on RCC data.

125 Like the Core capacity calculation region, a lack of remedial action potential is also detected in both the SWE and Italy North capacity calculation regions, as the minimum cross-zonal capacity requirement of 70% cannot be met using remedial actions in 30% and 25% of the hours, respectively.

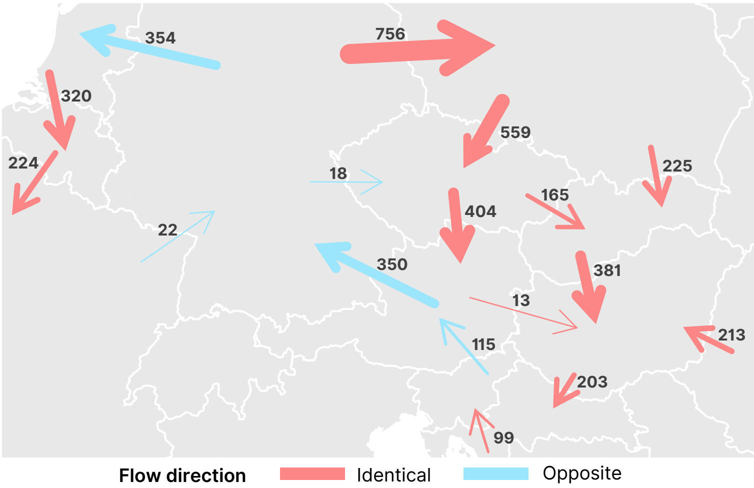
3.3. Loop flows

126 The processes described in the previous subsection show the limitations of relying exclusively on the activation of remedial actions to cope with the excessive presence of physical flows not deriving from any cross-zonal exchange. These are the so-called loop flows, which are exacerbated by the current configuration of bidding zones.

127 The Core day-ahead capacity calculation methodology introduces a way to accurately forecast the intensity of such flows in most of continental Europe. To calculate cross-zonal capacities, the grid model is brought to a zero-balance position, where no exchanges between the European bidding zones are active. In that scenario, the flows on the cross-zonal network elements correspond to loop flows.

128 Figure 37 corresponds to the average value of forecasted loop flows on the different bidding zone borders in the Core capacity calculation region since the implementation of the core day-ahead capacity calculation methodology. Moreover, it shows whether these flows go on average in the same direction as the total physical flows, and thus consuming cross-zonal capacities on that given border, or in opposite direction to the physical flows, and thus freeing up such capacity.

Figure 37: Average value of forecasted loop flows in the bidding zone borders of the Core capacity calculation region – 9 June 2022–31 December 2022 (MWh)



Source: ACER calculation based on JAO Publication Tool data.

Note: Loop flows are calculated based on parameters F0all and Fref of the critical network elements defined as tie-lines in the Core capacity calculation data. The accuracy of the calculated loop flow values depends on the quality of the data defined in the capacity calculation process. Inconsistencies have been detected in the data reported for the Austria-Germany border.

129 Figure 37 shows the significant presence of loop flows in some bidding zones borders of the Core capacity calculation region, consuming a significant portion of the physical interconnection capacity of the cross-border lines. The generalized lack of remedial action potential to cope with these loop flows, particularly visible in timeframes closer to real-time, puts at risk the fulfilment of the minimum cross-zonal capacity requirements, key to the finalization of the European internal market. As reported in ACER Report on cross-zonal capacities and the 70% margin available for cross-zonal electricity trade, reducing loop flows is a prerequisite for efficient cross-zonal trading. This emphasizes the need for more structural solutions to the mitigation of loop flows.

4. Energy Community outlook

130 The Energy Community[38] is an international organisation bringing together the EU and its neighbours to create an integrated pan-European energy market since 2006. The key objective of the Energy Community is to extend the EU internal energy market rules and principles to countries in Southeast Europe, the Black Sea region and beyond on the basis of a legally binding framework.

131 For the second time, the Electricity Wholesale volume includes an overview of the market developments in the Energy community. The first chapter reports on the progress among members of the Energy Community in implementing market reforms and the impact of the energy crisis on Energy Community Contracting Parties. The second chapter updates on the situation of specific countries.

4.1. Coordination of the market reforms in the Energy Community

132 This chapter presents the coordinated approach set by Contracting Parties[39] regarding the implementation of market reforms.

133 Wholesale electricity markets in the Energy Community Contracting Parties are generally less mature than EU electricity markets. While currently, the Third Energy Package is still in force, in December 2022, the incorporation of the Clean Energy Package (CEP) into the Energy Community *acquis* was completed. The process started in November 2021 with the adoption of part of the CEP and culminated in the adoption of the 2030 energy and climate targets and of the so-called Electricity Integration Package[40] in December 2022. The Electricity Integration Package encompasses adapted versions of nine legal acts, four of which are from CEP: Regulation 2019/941, Regulation 2019/942, Regulation 2019/943, Directive 2019/944; while the remaining five are network codes and guidelines, namely: Regulation 2016/1719, Regulation 2015/1222, Regulation 2017/2195, Regulation 2017/1485, and Regulation 2017/2196. This package sets the legal ground for the integration of the national electricity markets of Energy Community Contracting Parties into the single European market. The deadline for its transposition is the end of 2023.

134 The Energy Community Secretariat, based in Vienna, monitors and reports[41] on the level of implementation of the Energy Community acquis. It also enforces the acquis through infringement procedures against Contracting Parties in case of non-compliance. Further, in line with its mandate under the Energy Community Treaty, the Energy Community Regulatory Board (ECRB) monitors, reports and coordinates on certain aspects of regulatory and market developments. The ECRB developed a series of reports and recommendations to support the implementation of the Third Energy Package[42]. These documents cover the following areas: implementation of the Capacity Allocation and Congestion Management (including NEMO designation rules) and Forward Capacity Allocation Regulations, implementation of the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT), transparency requirements, cross-border capacity calculation and allocation process, and reports and recommendations on forward market, intraday and balancing. Additionally, ECRB gained new decision-making powers and competencies with the adoption of the Electricity Integration Package.

135 As of the second half of 2021, an unprecedented increase in electricity and gas prices, related to the natural gas price shock, has been recorded in the energy markets. Additionally, in February 2022, Russia's war of aggression against Ukraine exacerbated the situation in the electricity and natural gas market, leading to an additional increase in gas and electricity prices. The price surge in electricity and

38 https://www.energy-community.org/implementation/package/EL.html.

39 Presently, the Energy Community has nine Contracting Parties - Albania, Bosnia and Herzegovina, Kosovo*, North Macedonia, Georgia, Moldova, Montenegro, Serbia, and Ukraine. The Energy Community Secretariat clarifies that throughout this text the designation "Kosovo*" is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Advisory Opinion on the Kosovo declaration of independence.

40 See: https://www.energy-community.org/implementation/package.html#:~:text=The%20Ministerial%20Council%20adopts%20the,electricity%20security%20of%20supply%20rules.

41 Annual Implementation Reports produced by the Energy Community Secretariat can be found at: https://energy-community.org/aboutus/secretariat/reporting.html.

42 See: https://www.energy-community.org/documents/ECRB.html.

gas markets in the EU affected the electricity markets in the Energy Community Contracting Parties differently, depending on their reliance on imports and natural gas. However, no introduction of 'joint' measures in the electricity market at the Energy Community level has occurred, as it did in the EU, leaving Contracting Parties to rely on individual, national measures to tackle electricity price surges. Therefore, despite some level of correlation, Energy Community markets remained fragmented when it comes to utilisation of national resources for the purpose of supplying the end users. National electricity production is generally reserved for households and small commercial consumers. Unless electricity produced from coal or gas is imported, the price of such supply does not reflect the regional prices. In some cases, the price of such supply is even lower than individual country's internal total cost of service.

136 Russia's war of aggression against Ukraine brought new challenges in the energy markets, in addition to price surge. Among them are the drop in demand **combined** with significant drop-in rates of payments collection endangering financial liquidity of the sector, security and safety of critical energy infrastructure and resulting security of supply challenges. The Secretariat has reacted to the developments and supported Ukraine in facing the new challenges.

137 Important steps undertaken to support the functioning of the energy systems in Ukraine include the emergency synchronization of the control block of Ukraine and Moldova with Continental Europe and the gradual increase of commercial exchanges between the control block and the EU, which contributed to a stable and secure operation of the Ukrainian and Moldovan electricity systems during the last winter. Additionally, crucial laws, regulations and rules have been implemented in the gas sector. In electricity, bilateral market, day-ahead, intraday, and balancing market segments are functioning with certain protection measures in place.

138 The work programme of ECRB is updated on a yearly basis, keeping the activities of its working groups[43] consistent with the development of the Energy Community acquis. The role of the ECRB became even more important considering the recent extension of its competencies by the new Electricity Package. Simultaneously, the cooperation between ECRB and ACER is essential for carrying out new obligations and setting the basis for the integration into a pan-European electricity market.

4.2. Specific progress made by Contracting Parties

139 This chapter compiles the progress made by the Contracting Parties regarding their electricity market reforms. Detailed data regarding electricity markets of the Contracting Parties is available in Annex I.

4.2.1. Albania

140 Albania showed progress in the following areas:

- **Day-ahead market development:** The day ahead market started commercial operation on 12 April 2023. NRA approved the market rules and designated NEMO in August 2023.
- **Balancing mechanism development:** The NRA approved the balancing rules by the Regulator with decision n. 106 in 2020. Following a 9 month dry run period, the operation of the balancing Market started on 1 April 2021.
- **REMIT:** the NRA approved the Regulation by its Decision n. 126 dated 17 May 2021.
- **Connection Codes:** the NRA has approved the following Codes: Network Code on Demand Connection, Network Code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules, Network Code on requirements for grid connection of generators.
- **Renewable Energy Sources (RES) Auctions and RES Support:** the Ministry of Energy held two auctions for PV, of 100 MWp and 140 MWp respectively. Both projects are under construction and the first project is expected to be in operation since 2023. There is a feed-in tariff supporting scheme in place for RES projects of up to 15 MW installed capacity. These projects can have a PPA of 15 years under feed-in tariff support scheme.

43 ECRB working groups (WG): Electricity WG, Gas WG, Customers and Retail Market WG, REMIT WG

4.2.2. Bosnia and Hercegovina

141 Bosnia and Hercegovina showed progress in the following areas:

- **Balancing mechanism development:** the competitive market for balancing energy and ancillary services is in place since 2016. Cross-border balancing is implemented within the SHB control block shared with Slovenia and Croatia. The market rules were changed with the aim to implement system operation and electricity balancing guidelines. Bilateral exchanges of balancing energy with the operators of Serbia and Montenegro are applied.

- **REMIT:** the NRA successfully completed its activities on transposition and implementation of the REMIT Regulation adapted for the Energy Community legal framework in the electricity sector by the establishment of the Register of participants in the wholesale electricity market. In 2022, this Register was updated on a regular basis, and at the end of 2022, it included all the required data on 26 participants in the wholesale electricity market in Bosnia and Herzegovina.

- **Connection Codes:** in December 2021, with the approval of a new Grid Code, all requirements of the Connection Network Codes as adapted to the Energy Community legal framework were implemented.

- **Good practices in coordinated cross-border allocation:** interconnection capacity on the borders with Montenegro and Croatia is allocated annually, monthly and daily through regionally coordinated auctions at SEE CAO. The allocation of capacity for all timeframes on the border with Serbia and the intraday capacity auctions on all borders is bilaterally coordinated between the respective system operators.

- **RES Auctions and RES Support:** the country has registered a 39,84% share of renewables in 2020 and came very close to reaching its 40% target for 2020. The RES support scheme is based on administratively set feed-in tariffs in the entity 'Federation of Bosnia and Herzegovina', where renewable energy producers under feed-in tariffs remain fully released from balancing responsibility as the adoption of the methodology for allocating balancing costs is still pending. The entity 'Republika Srpska' adopted a new Renewables Law in February 2022, which enables market premiums and assumes full balancing responsibility for all projects above 500 kW.

4.2.3. Georgia

142 Georgia showed progress in the following areas:

- **Electricity market reform:** Electricity Wholesale Market Rules were approved by the NRA, for Day-ahead (DAM), Intra-day (IDM) and Balancing Markets. The draft of the new Electricity Transmission Network Rules was developed, incorporating cross-border capacity allocation, hourly metered data provision mechanisms and connection codes. Nevertheless, market opening has been postponed once again for one year.

- **Balancing mechanism development:** the responsible authorities for the operation of the organized markets were nominated: the Energy Exchange for operating DAM/IDM and the TSO is responsible for operating balancing market. Currently, organized markets are operating in a dry run regime.

- **REMIT:** In 2021 the NRA approved Energy Market Monitoring Rules for the purpose of REMIT transposition.

- **Connection codes:** Regulations: (EU) 2016/631, (EU) 2016/1388, and (EU) 2016/1447 were transposed in the Transmission Network Rules in 2019, and fully came into force in 2021.

- **RES Auctions and RES Support:** RES Auctions and RES Support: In 2022, the Government introduced a capacity auction for RES with an installed capacity of more than 0.5 MW. The scheme is a classic contract for difference ('CfD') mechanism, where the reference electricity price is the day-ahead market price. Within this scheme, support is provided for 15 years for any RES technology, with the following conditions: hydro and wind are supported for 9 and 8 months in a year respectively, and solar with the rest of RES technologies for the whole year. The existing feed-in premium scheme was suspended with the introduction of a capacity auction for RES. Besides capacity auctions, the

Government has the authority to promote RES technologies within the Public-Private Partnership Law, with the PPA mechanism.

4.2.4. Kosovo*[44]

143 Kosovo* showed progress in the following areas:

- **Market development:** in 2020, the Albanian Power Exchange was established. NRAs of Kosovo* and Albania together with the TSOs of both countries signed the agreement on the electricity markets coupling in October 2021. On December 2022, NRAs of Kosovo* and Albania held a joint meeting to approve trading rules and procedures. The development of the power exchange creates a common electricity market in Kosovo* and Albania where participants in the sector can buy and sell energy. Currently, the NRA is reviewing of the documents requested by the Albanian Power Exchange, including the request to nominate it as NEMO. In 2020, the Regulator has approved Rule on Designation of the Nominated Electricity Market Operator (NEMO) for carrying out activities related to market coupling and joint market operation. A NEMO was designated by the NRA in August 2023.

- **REMIT:** the NRA transposed the REMIT Regulation by in June 2020. According to the obligations arising from the REMIT rules, market participants must be registered in the national register which has been created. Subsequently, the Regulator collects registration data and publishes it in the national register. The national register is submitted to the Energy Community Regulatory Board Section.

- **Connection codes:** in 2018, the relevant provisions from the Demand Connection Code (Regulation 2016/1388) and Requirements for Grid Connection of Generators (Regulation 2016/631) were transposed into the Transmission System Operator's Network Code, and were approved by the NRA. Currently, the Network Code is being amended to comply with the Electricity Integration Package.

- **RES Auctions**: the first auction for the solar energy park with a capacity of 100 MW has been announced. Current RES support scheme is suspended until plans to move towards market-based mechanisms are put in place.

4.2.5. Moldova

144 Moldova showed progress in the following areas:

- **Market development:** on 7 June 2020 the NRA approved Power Market Rules approved with its Decision n. 283. On 1 June 2022 these rules entered into force. Only the bilateral market segment is operational for now, which is managed by the TSO due to the absence of an appointed power market operator. Since 11 June 2022 market participants are subject to financial responsibility for their imbalances. The TSO is responsible for the calculation and invoicing of imbalances. According to the Law on electricity n. 107 dated 27 May 2016, the market operator is being nominated by the Government.

- **REMIT:** public consultations are ongoing on the amendments to the Law on electricity n. 107 (transposition of REMIT in electricity).

- **Good practices on coordinated cross-border allocation:** starting from 12 October 2022 cros border capacity is allocated on a daily basis according to the Agreement between Moldavian and Romanian TSOs - Î.S. „Moldelectrica" and „Transelectrica" respectively. The agreement was approved by both NRAs. Monthly and annual allocation is not applied due to the actual constrains on MD/UKR control block. At the moment, on the Ukrainian and Moldovan border, the capacity allocation of capacity is made unilaterally by the Ukrainian side.

- **RES development and support schemes:** Public consultations on the amendments to the Law n. 10 dated 26 February 2016 regarding the promotion of the use of energy from renewable sources (transposition of Renewables Directive 2018/2001) are ongoing. According to the Law no. 10 there are 2 RES support mechanisms, namely:

44 The Energy Community Secretariat clarifies that throughout this text the designation "Kosovo*" "XK*" is without prejudice to positions on status and is in line with UNSCR 1244 and the ICJ Advisory Opinion on the Kosovo declaration of independence.

- Fixed price – for installations above (1 MW for PV and 4 MW for wind). The scheme is subject to the auction procedure managed by the Government;

- Fixed tariff – by confirmation of the status of eligible producer by the NRA, according to the „first come – first served" principle, and quotas approved for specific generation technologies.

- According to the Government Decision o. 401 dated 8 December 2021, the capacity limits and maximal quotas until 2025 are approved, 410 MW in total, 165 of the quotas (105 wind and 60 PV) allocated to auction procedures. It is important to underline that all 120 MW of PV capacity allocated for ground-mounted installations to receive fixed tariff was approved by the NRA, as this is confirmed to be of a high interest and an incentivizing tariff is set by the regulator.

4.2.6. Montenegro

145 Montenegro showed progress in the following areas:

- **Market development:** Montenegro officially opened the wholesale electricity market in 2009. In the meantime, TSO and DSO have been unbundled and a Market Operator and Power Exchange have been established. Day-ahead market started with its operation on 26 April 2023.

- On the national regulatory level, the Energy Law was amended in August 2020, where EU Regulation 2015/1222 on Capacity Allocation and Congestion Management (CACM) was partially transposed and the main provisions for the designation of the nominated electricity market operator (NEMO) are prescribed. Transposition of CACM is important for the Montenegrin market in order to provide legal certainty for market coupling, especially taking into account that in 2019 a HVDC cable Italy-Montenegro has been put into operation. Full transposition of CACM is expected to occur through the adoption of a regulation which is currently under preparation.

- In parallel with the creation of the legal framework for market coupling, activities related to the implementation of the 'AIMS market coupling' project are carried out. This project involves TSOs, PXs and NRAs of Albania, Montenegro, Italy, and Serbia. NRAs are observers in this process.

- **Cross-border capacity allocation:** Long-term and short-term cross-border capacity allocation auctions (except the border with Serbia) have been organized by South East Europe Coordinated Auction Office (SEE CAO) since 2015.

- **REMIT:** the Law on Surveillance of Wholesale Electricity and Gas Market, transposing REMIT Regulation (EU) No 1227/2011 on wholesale energy market integrity and transparency (REMIT), entered into force in January 2022. This law prescribes new obligations of wholesale market participants and the powers of the NRA, as an institution that monitors the wholesale electricity and natural gas market. According to this law, the NRA adopted the Decision which defines a list of transparency and Inside Information platforms for publishing inside information, as well as a set of forms that can be used to apply for registration of wholesale market participants, to delay the publication of inside information in cases prescribed by law, for the use of exemptions from prohibition of insider trading, as well as for reporting suspicions of violations of the Law on Surveillance of the Wholesale Electricity and Natural Gas Market. The national register of wholesale market participants has been established. By the end of 2022, 50 market participants were registered. In the reporting period, data on transactions of wholesale energy products were collected on a monthly basis.

- **Connection codes:** EU Commission Regulations establishing network codes on demand connection, on requirements for grid connection of generators and on requirements for grid connection of HVDC systems and DC connected power park modules were transposed into Montenegrin legislation by adopting regulations by Government. The Regulation on requirements for grid connection of generators entered into force on 1 January 2022, while other two regulations entered into force on 1 January 2021.

- **RES support:** support for privileged producers who produce electricity from renewable energy sources and high-efficiency cogeneration, exists and is based on feed-in tariff scheme. In 2023 several privileged producers left the support scheme and started entering the wholesale market.

4.2.7. North Macedonia

146 North Macedonia showed progress in the following areas:

- **Day-ahead market development:** on 9 September 2020 the Electricity Market Operator, upon the previous proposal of the Regulator and positive opinion of the TSO, was appointed by the Government as an power exchange which will be responsible for market coupling, that is, was designated as NEMO. In 2022, a trading and clearing platform for DAM was procured. After necessary preparations, go-live of the power exchange for DA segment began on 10th of May 2023. Market coupling between North Macedonia and Bulgaria is at the stage of preparation. North Macedonia is part of the USAID initiative for market coupling between Greece, North Macedonia, Albania, and Kosovo.

- **Balancing mechanism development:** TSO implements Rules for balancing the power system and procures the ancillary services in a transparent and market-based manner. Also, when determining the price of imbalances, a transparent, objective and market-oriented methodology is applied.

- **REMIT:** REMIT was transposed into the Amendments in the Energy Law from November 2022 and further implemented through the Rulebook on manner and procedure for monitoring the functioning of the energy markets adopted by the Regulator on 27 of April 2023. On 25 May 2023, the Regulator issued a Guidance on application of the obligation to publicly disclose inside information, in order for the participants in the wholesale energy market to correctly apply and fulfil the obligation to disclose internal information. The Guidance is based on the Guidance of the ACER for the application of the REMIT. The NRA has established the REMIT register and published it on its website based on submitted applications by market participants. The Regulator has created a special section for REMIT on its website in the Monitoring section.

- **Connection codes:** Energy Law regulates that Network Codes shall be deemed to have been accepted and applied directly by the TSO in accordance with the obligations undertaken with the ratified international agreements, as well as the obligations of the TSO arising from the membership in ENTSO-E. The connection codes are transposed in the national transmission grid code as of 2021.

- **Good practices in coordinated cross-border allocation:** on two borders, with Greece and Kosovo*, coordinated auction rules apply. The Macedonian TSO has good experience with coordinated allocation of cross-border capacity and would like to implement it on the remaining two borders with Serbia and Bulgaria.

- **RES auctions:** starting from 2019, the Government launches auctions for granting premiums for RES generation. Actions were for the PVs and since 2019 up to 2021 three actions were performed. In 2022 there was no action.

- **RES support:** the preferential tariff as a measure to support electricity production from renewable energy sources was introduced in 2007. In addition to the preferential tariff, since 2018, the Premium tariff is also introduced as a measure of support and is granted with competitive auctions.

4.2.8. Serbia

147 Serbia showed progress in the following areas:

- **Day-ahead market development:**
  - The Regulation 2015/1222 on capacity allocation and congestion management has been adapted and adopted for application in the Energy Community;
  - The regulation was partially transposed into national laws through amendments to the Energy Law and the national Regulation on day-ahead and intraday electricity market coupling;
  - SEEPEX has been officially appointed as the nominated electricity market operator (NEMO) for day-ahead and intraday electricity market in Serbia;
  - Alpine-Adriatic Danube Power Exchange (ADEX) was established through a corporate merging

    between BSP SouthPool and SEEPEX, offering spot power trading services in Slovenia and Serbia;

  - Market coupling initiatives in the Western Balkans are lagging, but there are plans for coupling the Serbian market with Bulgaria and Croatia, as well as coupling between Albania, Italy, Montenegro, and Serbia.

- **Balancing mechanism development:** Two imbalance netting projects were implemented, first one at the regional level between Serbia and Montenegro and the second one at the European level as part of the IGCC cooperation.

- **REMIT:** on 28 October 2021, the NRA has adopted Rules on Prevention of Abuse in Electricity and Natural Gas Markets. In accordance with these Rules, the TSO is obliged to publish privileged information that is available on the transparency platform and on the EMS website.

- **Connection codes:**

  - EU Commission Regulations on long-term forward capacity allocation, operation of the electricity transmission system, and electricity balancing have not been transposed into national legislation yet but are expected to be in the near future;

  - EU Regulation on electricity emergency and restoration has been partially transposed into the Law on Amendments to the Energy Law, mandating transmission system operators to establish Rules for suspension and re-establishment of market activities, subject to approval by the Energy Agency of the Republic of Serbia.

  - **RES auctions:** from 2023 Government has launched auctions for the allocation of market premiums for RES (for wind power plants 400 MW - maximum purchase price is 105 EUR/MWh and for solar power plants 50 MW maximum purchase price 90 EUR/MWh).

  - **RES support:** RES support (feed-in tariff) existed until 2020. From 2023, the Government has launched auctions for the allocation of market premiums for RES (for wind power plants 400 MW - maximum purchase price is 105 EUR/MWh and for solar power plants 50 MW maximum purchase price 90 EUR/MWh).

4.2.9. Ukraine

148 Ukraine showed progress in the following areas:

- **Market developments:**

  - All market segments – forward, DAM, IDM, Balancing, and ancillary services markets remain operational, despite the invasion of the Russian Federation.

  - The NRA made a decision regarding the special functioning of the electricity market in cases of system emergency. The decision, in particular, stipulates that in case of an emergency situation all market segments will suspend operation and bids will be cancelled. Market participants, whose accepted bids were cancelled will be refunded. Electricity trading is to be carried out only on Balancing market at the average market price of DAM for the last month.

  - The NRA approved the methodology for determining significant price fluctuations and setting price caps on the day-ahead market, intraday market and balancing market.

    - Electricity storage activity was introduced into regulatory framework in order to enable proper balancing of energy system operation and increase stability of electricity supply to consumers

- **TSO:**
  - TSO was certified and obtained Observer status at ENTSO-E.
  - Following emergency synchronization of Ukraine/Moldova control block with the Continental European Power System, TSO was included into the FSkar mechanism of settlements for unintended exchanges.

    Regulation EU 543/2013 was fully implemented by amending the NRA decision no. 459 that made it possible for TSO to publish data on ENTSO-e Transparency Platform
- **Cross-border capacity allocation:** Joint cross-border capacity allocation procedures are yet to be implemented. Unilateral auctions are applied at borders with adjacent EU Member States and Moldova. The NRA approved the Rules for joint cross-border capacity allocation between Ukraine and Romania in compliance with the provisions of the harmonized allocation rules for long-term transmission rights in accordance with Article 51 of the Commission Regulation (EU) 2016/1719.
- **REMIT:** On 2 July 2023, the Law transposing into the Ukrainian legislation the provisions of the REMIT Regulation entered into force. NRA has approved certain regulatory acts to fulfil the requirements of the Law: the Procedure of wholesale electricity market participants' registration; the Investigation procedure of abuses on the wholesale energy market; the Procedure (methodology) for determination of fines.
- **RES support:**
  - Support scheme is based on feed-in tariff ("green" tariff), legal provisions for RES auctions were adopted but actual implementation is still pending.

    The NRA adopted changes that regulate the Procedure for entry into and exit from the balancing group of the Guaranteed Buyer[45] by business entities, including electricity entities with a 'green' tariff.
- **New legislation:** the Law on the Restoration and Green Transformation of the Energy System of Ukraine was adopted on 30 June 2023. The Law provides for:
  - The establishment of a system for issuing guarantees of origin for electricity generated from RES. NRA has been designated as Guarantees of Origin for issuing body.
  - The implementation of a market premium mechanism (Feed-in-premium), as required by EU Directive 2018/2001.
  - The procedure of exit by economic entities from the balancing group of the Guaranteed Buyer. In particular, the Law designates that the suspension/termination of participation agreements in the Guaranteed Buyer's balancing group shall not constitute grounds for the cessation of the green tariff.
  - Possibility of exporting electricity by renewable energy producers and the Guaranteed Buyer.

45 Special entity created under Ukrainian legislation for ensuring performance of public service obligations for RES development.

5. Conclusions and recommendations

149 2022 was marked by large price increases for all electricity markets, mostly driven by the Russian invasion of Ukraine. Market integration progressed in some areas, broadly in line with the principles of the applicable legislation, the main hurdle for effective integration remaining the available cross-zonal capacity.

150 Day-ahead and intraday market coupling are crucial elements in the integration of European electricity markets. Coupling in those timeframes has already been achieved throughout the entire European Union. As a result, the efficient day-ahead and intraday use of interconnectors remained stable in recent years. Next steps in market integration in those markets relate to improved cross-zonal capacity calculation and allocation methods, such as the application of flow-based market coupling in meshed grids, or the introduction of auctions in the intraday market.

151 When it comes to improving market integration, further efficiency gains can be achieved through enhancements in both the forward and balancing markets.

152 Concerning the forward market, especially the low liquidity is of concern in a situation where hedging is an important element in the electricity trading. Ongoing discussions on improving the way forward markets operate, and the role of long-term transmission rights therein should lead to further integration of the forward market. The current report finds that in 2022 forward market prices encompass a premium, stemming from liquidity deficiencies or imperfect forecasts. The analyses suggest that for most borders, contracting long-term transmission rights was a cheaper option to hedge against price differences between two neighbouring bidding zones than to trade forward spreads between these zones. However, the prices of long-term transmission rights were overall in line with the spread ultimately observed on the day-ahead market for most borders.

153 Balancing markets saw the largest evolution in 2022 with the launch of the PICASSO and MARI platforms, respectively for Automated Frequency Restoration Reserve and Manual Frequency Restoration Reserve for the exchange of balancing energy. Due to the energy crisis, balancing prices were high. However, thanks to imbalance netting in the balancing market, the volumes and capacities that needed to be acquired were reduced. Moreover, balancing market integration increased cross-border access to balancing energy and capacity, which offers more options for acquiring balancing services. Further analysis will define whether such acquisition outperforms local sourcing of balancing services.

154 Another noteworthy evolution in the balancing market is that many Member States have now evolved to procuring balancing services closer to real time, mostly in the day-ahead timeframe. This allows to maximise the participation of flexible resources in short-term energy markets. This should improve liquidity and competition, partly through allowing for an efficient arbitrage between day-ahead and balancing capacity markets.

155 In 2022, the costs of remedial actions surged. This can be explained by the energy crisis and related price increase on the one hand, and the increasing volumes needed for remedial actions on the other hand. The report also finds that on multiple occasions, not enough remedial actions were available to guarantee sufficient cross-zonal capacity. With the increasing needs for sufficient cross-zonal capacity being offered to the market (the minimum 70% threshold) and the surge of certain renewable energy sources, the need for remedial actions will only accrue.

156 Since the primary hurdle to market integration lies not in capacity allocation but in ensuring its availability, advances in market integration relate more to the actual calculation of cross-zonal capacity. Sufficient capacity for cross-zonal trading is crucial for a well-functioning European Integrated Electricity Market. The availability of cross-zonal capacity is covered in detail in ACER's Report on cross-zonal capacities and the 70% margin available for cross-zonal electricity trade. A significant obstacle to markets integration remains: addressing issues related to loop flows is a costly effort, and remedial actions alone may prove insufficient. This predicament may demand drastic measures, particularly in the pursuit of reaching the 70% requirement.

157 In 2022, the Energy Community faced price surge challenges amid the energy crisis and Russia's war on Ukraine. The impact of the crisis on Contracting Parties was different depending on individual market's reliance on imports of electricity and gas. In Ukraine, the Russian aggression caused reduced demand and payment issues, risking energy sector stability. However, parties responded with emergency measures, targeted to ensure stable operations during the winter. The Electricity Integration Package adoption in 2022 paved the way for a unified European electricity market.

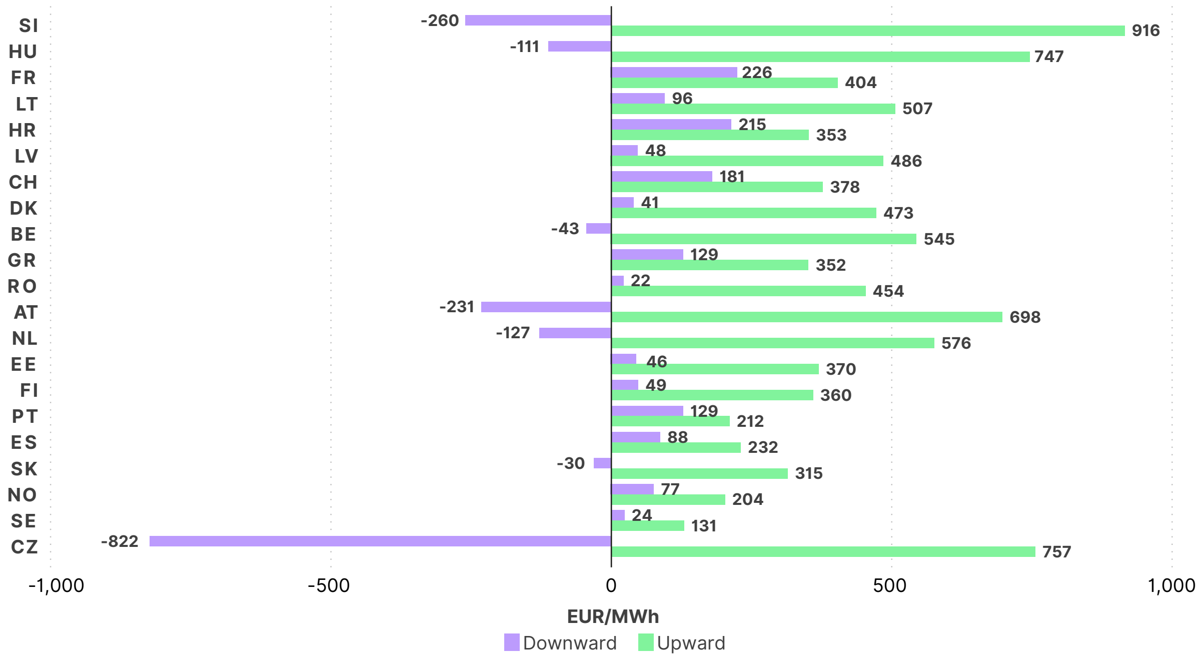
5.1. Recommendations:

- Continue with the forward market's evolution, with a focus on zone-to-hub trading, following ACER's February 2023 policy paper.
- On the aFRR activations in PICASSO: even though most price incidents are short, activating a slower reserve such as the mFRR might be an approach worth studying to mitigate price incidents.
- ACER suggests that the derogations allowing TSOs to trade in intraday are limited to the extent that TSOs are not further required to intervene in the intraday markets.
- Since market integration hinges on the availability of capacity for cross-border trade, a maximisation of such capacity, in line with in ACER's Report on cross-zonal capacities and the 70% margin available for cross-zonal electricity trade is recommended. In the same respect, loop flows should be reduced by all means available, including but not limited to Remedial Actions.
- Keep re-dispatching costs under control and avoid curtailing large amounts of renewable energy sources, since this goes against the principles of the energy transformation. With a view of increasing amounts of renewables in concentrated locations, such as large offshore wind capacities, staying well below the 5% curtailment limit will be important.

6. Annex I: Additional figures and tables

6.1. Volume-weighted average prices of balancing energy activated from mFRR

Figure 38: Volume-weighted average prices of balancing energy activated from mFRR (upward and downward activations) in selected European markets – 2022 (EUR/MWh)



Source: ACER calculation based on ENTSO-E data.

Note 1: The values shown in the figure refer to the prices of activated balancing energy in each market area, irrespective of whether the activations aim to cover the needs for balancing in the same or in neighbouring market areas.

Note 2: The mFRR prices are shown for all countries for which data was available on ENTSO-E TP.

6.2. Energy Community outlook

Table 6: Main market characteristics of the Contracting Parties of the Energy Community – 2022 (TW)

Contracting Parties	Installed Capacity [GW]		Peak Demand [GW]		Peak Date		Electricity Production [GWh]		Electricity Demand [GWh]	
Year	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Albania	2.61	2.61	1.54	1.63	22-Dec	26-Jan	8,962.70	7,002.65	8,415.00	7,924.00
Bosnia and Hercegovina	4.61	4.66	1.91	1.89	23-Dec	25-Jan	17,055.44	15,035.96	11,232.00	11,147.00
Georgia	4.48	4.51	2.34	2.38	25-Dec	21-Jan	12,431.36	13,988.02	14,244.00	14,808.70
Kosovo*[46]	1.71	1.75	1.40	1.43	21-Dec	24-Jan	6,349.37	5,077.56	6,885.28	6,547.32
Moldova	0.42	0.48	1.28	1.30	19-Feb	03-Feb	984.71	851.10	4,155.82	4,050.48
Montenegro	1.05	1.05	0.59	0.55	29-Jul	08-Aug	3,656.00	3,235.00	2,982.26	2,623.54
North Macedonia	2.12	2.27	1.42	1.39	13-Feb	25-Jan	5,284.43	5,634.86	7,906.00	7,105.00
Serbia	8.52	8.52	5.62	5.94	23-Dec	25-Jan	35,656.00	33,112.00	35,217.00	34,789.00
Ukraine	55.22	55.96	24.97	24.17	24-Dec	25-Jan	155,266.18	113,016.53	153,093.20	109,997.42

46 The Energy Community Secretariat clarifies that throughout this text the designation "Kosovo*" "XK*" is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Advisory Opinion on the Kosovo declaration of independence.

Table 7: Main market characteristics of the Contracting Parties of the Energy Community – 2022 (%)

Electricity Production mix [GWh]	Nuclear		Coal/lignite		Gas		HPP		PV		Wind		Sources labelled as "Other"	
Contracting Parties	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Albania							8,921.94	6,952.55	40.76	50.09				
Bosnia and Hercegovina			9,840.96	9,650.13			6,756.18	4,865.30	65.129	117.05	383.00	390.42	10.17	13.06
Georgia [GWh]					2,284.21	3,248.73	10,063.88	10,651.96			83.27	87.32		
Kosovo*			5,947.16	4,510.55			279.05	203.24	13.10	13.79	110.06	349.98		
Moldova					800.62	612.93	67.77	41.28	7.76	30.30	76.31	143.02	32.24	23.57
Montenegro			1,333.00	1,454.00			2,000.00	1,454.00	3.00	4.00	320.00	323.00		
North Macedonia			2,078.30	2,621.64	1,517.10	967.32	1,453.69	1,397.40	51.46	76.84	103.30	107.66	81.08	464.00
Serbia			21,534.00	21,413.00	630.00	1,058.00	11,587.00	8,893.00			1,004.00	876.00	898.00	872.00
Ukraine[47]	86,199.00	n/a	37,240.45	n/a	8,705.26	n/a	10,162.38	n/a	7,746.17	n/a	3,865.44	n/a	1,347.48	n/a

47 For Ukraine, information labelled as «n/a» for 2022 is not subject to disclosure due to the martial law in Ukraine, and in accordance with the resolution of the NEURC No. 349/2022 "On the protection of information that, in conditions of a state of war, may be classified as restricted access information, including regarding critical infrastructure objects." The decision to withhold the disclosure of this information is rooted in the intention to safeguard the interests of the state, particularly in light of potential threats such as Russian missile attacks targeting Ukrainian energy infrastructure. It is essential to emphasize that this precautionary measure is temporary and directly aligned with the ongoing martial law circumstances. After the conclusion of the martial law period, the NEURC will revisit the data and update the report accordingly. For 2021 data on coal/lignite and gas production is assumed to equal production at thermal power plants and combined heat & power plants respectively.

Table 8: Market share in generation for the Contracting Parties of the Energy Community– 2022 (%)

Market share in generation	AL		BIH		GE		XK*		MD		ME		MK		RS		UA	
	GW	%	GW	%	GW	%	GW	%	GW	%	GW	%	GW	%	GW	%	GW	%
Company 1	1.45	55.4	1.73	37.2	1.30	28.8	1.48	84.6	0.24	50.2	0.88	83.0	1.48	65.3	7.74	90.81	14.31	25.6
Company 2	0.26	10.5	1.36	29.2	0.49	10.8			0.05	11.3			0.23	10.0			7.70	13.8
Company 3	0.10	4.0	0.89	19.2	0.23	5.1			0.02	5.0			0.21	9.3			6.15	11.0
Company 4			0.30	6.4	0.23	5.1											6.03	10.8
Company 5					0.18	4.1											4.75	8.5
Company 6																		
All other with <5% share	0.81	30.9	0.37	8.0	2.08	46.1	0.27	15.4	0.16	33.4	0.18	17.0	0.35	15.5	0.78	9.19	17.03	30.4

Table 9: Market share in DAM for the Contracting Parties of the Energy Community – 2022

Market share in generation	AL		BIH		GE		XK*		MD		ME		MK		RS		UA	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
Company 1	3,859.73	48.7	5,849.20	39%	3,719.55	27%	4,510.55	88.8	505.95	59.4	2,727.50	84.3	3,754.99	66.64	31,130.00	94.01	62,394.73	55.2
Company 2	490.42	6.2	4,975.95	33%	1,702.65	12%			22.06	2.6			926.81	16.45			3,098.94	2.7
Company 3	344.90	4.1	1,451.45	10%	1,121.35	8%			83.56	9.8			412.62	7.32			10,415.16	9.2
Company 4			2,128.21	14%	1,116.63	8%											4,020.96	3.6
Company 5					816.11	6%											11,731.79	10.4
Company 6																		
All other with <5% share	2,307.59	41.0	631.15	4%	5,511.74	39.2%	567.01	11.2	239.53	28.1	506.50	15.7	540.44	9.59	1,982.00	5.99	21,354.96	18.9

Table 10: Main market characteristics for the Contracting Parties of the Energy Community – 2022

Market share in generation	AL		BIH		GE		XK*		MD		ME		MK		RS		UA	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
Company 1															823.45	12.8	4,429.57	24.3%
Company 2																	1,330.82	7.3%
Company 3																	2,140.54	11.8%
Company 4																	307.27	1.7%
Company 5																	1,494.76	8.2%
All other with <5% share															5,598.39	87.2	3,001.09	16.5%
All other with <5% share	2,307.59	41.0	631.15	4%	5,511.74	39.2%	567.01	11.2	239.53	28.1	506.50	15.7	540.44	9.59	1,982.00	5.99	21,354.96	18.9

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