ENTSO-E Bidding Zone Configuration Technical Report 2025

Regular Reporting on Bidding Zone Configuration

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ENTSO-E Mission Statement

Who we are

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the **association for the cooperation of the European transmission system operators (TSOs)**. The **40 member TSOs**, representing 36 countries, are responsible for the **secure and coordinated operation** of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

ENTSO-E **brings together the unique expertise of TSOs for the benefit of European citizens** by keeping the lights on, enabling the energy transition, and promoting the completion and optimal functioning of the internal electricity market, including via the fulfilment of the mandates given to ENTSO-E based on EU legislation.

Our mission

ENTSO-E and its members, as the European TSO community, fulfil a common mission: Ensuring the **security of the interconnected power system in all time frames at pan-European level** and the **optimal functioning and development of the European interconnected electricity markets**, while enabling the integration of electricity generated from renewable energy sources and of emerging technologies.

Our vision

ENTSO-E plays a central role in enabling Europe to become the first **climate-neutral continent by 2050** by creating a system that is secure, sustainable and affordable, and that integrates the expected amount of renewable energy, thereby offering an essential contribution to the European Green Deal. This endeavour requires **sector integration** and close cooperation among all actors.

Europe is moving towards a sustainable, digitalised, integrated and electrified energy system with a combination of centralised and distributed resources.

ENTSO-E acts to ensure that this energy system **keeps consumers at its centre** and is operated and developed with **climate objectives** and **social welfare** in mind.

ENTSO-E is committed to using its unique expertise and system-wide view – supported by a responsibility to maintain the system's security – to deliver a comprehensive roadmap of how a climate-neutral Europe looks.

Our values

ENTSO-E acts in **solidarity** as a community of TSOs united by a shared **responsibility**.

As the professional association of independent and neutral regulated entities acting under a clear legal mandate, ENTSO-E serves the interests of society by **optimising social welfare** in its dimensions of safety, economy, environment and performance.

ENTSO-E is committed to working with the highest technical rigour as well as developing sustainable and **innovative responses to prepare for the future** and overcoming the challenges of keeping the power system secure in a climate-neutral Europe. In all its activities, ENTSO-E acts with **transparency** and in a trustworthy dialogue with legislative and regulatory decision makers and stakeholders.

Our contributions

ENTSO-E supports the cooperation among its members at European and regional levels. Over the past decades, TSOs have undertaken initiatives to increase their cooperation in network planning, operation and market integration, thereby successfully contributing to meeting EU climate and energy targets.

To carry out its **legally mandated tasks**, ENTSO-E's key responsibilities include the following:

- Development and implementation of standards, Network Codes, platforms and tools to ensure secure system and market operation as well as integration of renewable energy;
- Assessment of the adequacy of the system in different timeframes;
- Coordination of the planning and development of infrastructures at the European level (**Ten-Year Network Development Plans, TYNDPs**);
- Coordination of research, development and innovation activities of TSOs;
- Development of platforms to enable the transparent sharing of data with market participants.

ENTSO-E supports its members in the **implementation and monitoring** of the agreed common rules.

ENTSO-E is the common voice of European TSOs and provides expert contributions and a constructive view to energy debates to support policymakers in making informed decisions.

Contents

Executive summary

According to Commission Regulation (EU) 2015/1222 (CACM), bidding zones (BZs) should be defined in such a manner as to ensure efficient congestion management and overall market efficiency. In addition, according to the Commission Regulation (EU) 2019/943 (Electricity Regulation under the Clean Energy Package (CEP)), BZ borders shall be based on long-term, structural congestions in the transmission network. BZs shall not contain such structural congestions unless they have no impact on neighbouring BZs or unless – as a temporary exemption – their impact on neighbouring BZs is mitigated with remedial actions and those structural congestions do not lead to reductions in cross-zonal trading capacity in accordance with the requirements of Article 16 of the Electricity Regulation. The configuration of BZs in the Union shall be designed in such a way as to maximise economic efficiency and cross-zonal trading, while maintaining security of supply.

In order to monitor the implementation of these requirements, the Agency of the Cooperation of Energy regulators (ACER) is tasked with periodically (every three years) assessing the efficiency of the current BZ configuration. ENTSO-E prepared this Technical Report for the 2021–2023 period upon the request of ACER, received on 22 May 2024. Since assessing the efficiency of BZ configurations is the task of ACER, this Technical Report serves only for fact-collection purposes and provides no recommendations in this regard.

The Technical Report comprises four main sections. The first three sections correspond to major CACM requirements, whereby Chapter 2 deals with congestions, Chapter 3 deals with flows not resulting from capacity allocation, and Chapter 4 deals with congestion income and firmness costs. Finally, Chapter 5 corresponds to Article 14.2 of the Electricity Regulation and deals with the implementation of the CEP's 70 % margin available for cross-zonal trade.

Chapter 2 provides an overview of congestions for the following time stages: capacity calculation for the purpose of day-ahead (DA) capacity allocation, D-1 (operational planning after DA market closure) and (close to) real-time, including the location and frequency of congestions. In the 'capacity calculation for the purpose of DA capacity allocation' timeframe, reported congestions are generally on BZ borders or in their direct vicinity. Relatively few grid elements show congestions at a relatively high frequency. In the D-1 and close-to-real-time timeframes, reported congestions are either on tie lines or internal lines. In D-1, a relatively high number of grid elements show congestions, most of them at relatively low frequencies compared to those for the 'capacity calculation for the purpose of DA capacity allocation'. In the close-to-real-time timeframe, the number and frequency of congestions is generally lower than in the D-1 timeframe because remedial actions have been applied to solve previously detected congestions. For specific information on congestions on Critical Network Elements (CNEs), please refer to the expert assessments in Chapter 2 and Appendix 1.

Chapter 3 illustrates the Power Transfer Distribution Factor (PTDF) flow deviation indicator, based on hourly PTDF data, measured cross-border physical flows, and calculated flows. The PTDF indicator used to quantify power flows not resulting from capacity allocation is the same as the one used by ACER for the Market Monitoring Report.

Calculated PTDF indicators are available for 2021, 2022, and 2023, with the results showing changing flow directions during the energy crisis in the Core region. Maximum values were obtained at the border between Italy and France, representing a change from the previous reporting period.

Chapter 4 provides an in-depth analysis of congestion income, congestion management measures, and related costs to ensure the firmness of cross-border capacities. Over the three years analysed, France, Germany, Italy, Spain, and Sweden received high congestion income, with a surge in 2022 due to high electricity prices. By 2023, congestion income levels had decreased but remained higher than in 2021. Financial firmness costs – mainly due to emergency grid security curtailments – were highest in Italy and France. Germany and Poland incurred the highest costs for physical firmness measures, with Germany's costs largely due to renewable energy curtailment compensation. Country-specific factors such as renewable energy capacities and country size are crucial for understanding these trends.

Chapter 5 provides an overview of the results of the national compliance monitoring methodologies of the CEP70 provisions for 2021–2023. For 2023, these results are compared to those of the ACER market monitoring. Where feasible, this involves considering the intermediate targets as well as the 70 % value. While a direct comparison of these monitoring results is highly limited due to the different underlying methodologies, it is in the interest of transmission system operators (TSOs) to provide the best possible transparency. Therefore, all differences in the national methodologies are explained in a comprehensible manner. The national monitoring figures have been drafted as close as possible to the ACER figures from a visual perspective to ensure a certain level of comparability. In summary, the figures show the considerable progress made towards a more integrated and efficient European electricity market, with member states having been able to comply with the (temporary) targets applicable at the national level. For the example of the Core capacity calculation region (CCR), the national assessment and ACER's market monitoring show similar results when monitoring fulfilment with the currently binding minimum capacities per border (resulting from derogations, action plans, or already 70 %).

1 Introduction

Figure 1: Bidding zone configuration[1,2,3]

1 According to Annex 1 to ACER Decision No 06/2016 from 17 November 2016, the BZ border between Germany and Austria is defined for Core CCR; however, capacity allocation on this border is introduced in line with an implementation calendar agreed upon by the relevant regulatory authorities. Following the decision from BNetzA and E-Control, the allocation on the DE-AT border started as of October 2018.

2 For Italy, virtual BZs are not represented on the map.

3 Due to the data source used in the process of the Technical Report preparation, the control block of Slovenia, Croatia and Bosnia and Herzegovina (CB SHB) is presented as one BZ. In practice, CB SHB comprises three separate BZs, namely one for each aforementioned country.

1.1 Background and current bidding zone configuration

The current and target model for the European Electricity Market is based on a zonal approach. In accordance with Article 2 of the Commission Regulation (EU) No 543/2013,[4] a bidding zone (BZ) is the largest geographical area within which market participants can exchange energy without capacity allocation. Cross-zonal electricity trades and exchanges are organised between these zones based on available transfer capacities calculated by transmission system operators (TSOs). According to Commission Regulation (EU) 2015/1222 (CACM), BZs reflecting supply and demand distribution are a cornerstone of market-based electricity trading and a prerequisite for reaching the full potential of capacity allocation methods, including the flow-based method. Therefore, BZs should be defined to ensure efficient congestion management and overall market efficiency. In the current configuration, there are multiple BZs in Italy and the Nordic countries, one BZ covering two countries (DE/LU) following the DE/AT/LU split, and BZs based on a historical context corresponding to Member States (see Figure 1). CACM details how the efficiency of the current BZ configuration should be assessed.

1.2 CACM requirements and CEP Article 14.2 of the Electricity Regulation

Article 34 of CACM requires that ACER conduct a triennial efficiency assessment of the current BZ configuration, comprising:

- the Technical Report, prepared every three years by ENTSO-E according to Article 34 of CACM and sent to ACER; and
- a market report evaluating the impact of the current BZ configuration on market efficiency, prepared by ACER.

Article 34 of CACM requires that the Technical Report shall include at least:

- a list of structural and other major physical congestions, including their location and frequency;
- an analysis of the expected evolution or removal of physical congestions resulting from investment in networks or from significant changes in generation or in consumption patterns;
- an analysis of the share of power flows that do not result from the capacity allocation mechanism for each capacity calculation region (CCR), where appropriate;
- congestion income and firmness costs; and
- a scenario encompassing a ten-year timeframe.

Article 14.2 of the Electricity Regulation (CEP70) requires that the Technical Report shall contain an assessment of whether the cross-zonal trade capacity reached the linear trajectory pursuant to Article 15 or the minimum capacity pursuant to Article 16 of this Regulation.

In addition, ACER's letter dating from 22 May 2024 includes the following requests:

- In order to provide also valuable insights for policymakers and other stakeholders, it would be most useful if ENTSO-E continues its efforts in increasing the relevance and quality of the information from the previous report and in presenting more accurately the constraints in the European power grid.
- In its assessment of congestions, the report should apply a single methodology across all TSOs and CCRs, in order to ensure a coherent reporting process.

4 Commission Regulation (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council.

1.3 Structure of the Technical Report

The present Technical Report is subdivided into four main sections:

- Executive summary and introduction (Chapter 1)
- Present congestions and their future evolution (Chapter 2)
- Power flows not resulting from capacity allocation (Chapter 3)
- Congestion income and firmness costs and volumes (Chapter 4)
- Implementation of the CEP's 70 % minimum capacity to be available for cross-zonal trade (Chapter 5)

In addition, three appendices contain the following:

- Detailed expert assessments on major congestions
- A full list of congestions for all CNEs
- Overview fulfilment of minimum capacity targets (considering derogations and action plans) for 2021–2023 by region/border

2 Present congestions and their future evolution

CACM requires the publication of structural congestions and major physical congestions, including their location and frequency. It also envisages an analysis of the expected evolution of these congestions due to investments or changes in generation or consumption patterns. This chapter seeks to address these requirements by first providing general background information on methodological descriptions before presenting congestions in 2021, 2022, and 2023 and their future evolution patterns.

2.1 Methodology and general descriptions

The following have been investigated and analysed for this Technical Report:

- Grid elements limiting cross-zonal capacity that appeared as active market constraints in the DA capacity calculation.
- Grid elements that appeared to be congested during the short-term operational planning based on congestion forecasts in D-1 after the DA market but before the application of any remedial actions at this stage.
- Alleviated and unalleviated congestions from up to one hour before the time of operation.

All three processes are briefly described in the following chapters, followed by an explanation of the methodology used to define which congested CNEs were further analysed through expert assessments.

As explained in Chapter 1.2 above and in accordance with CACM Regulation and Regulation 2019/943, only structural congestions and major physical congestions are relevant to assess the BZ configuration. Hence, although this Technical Report includes an exhaustive list of all historical congestions in the different timeframes during the 2021–2023 period as required by CACM Regulation and Regulation 2019/943, only those congestions that were structural should be considered when assessing the BZ configuration, as also recognised by both CACM Regulation and Regulation 2019/943. Given that the definition of structural congestion in Article 2 of CACM does not yet provide clear technical criteria to identify such congestions, this report incorporates information about the frequency of occurrence of the different types of congestions over the study period and indicates the causes of the identified congestions and expected future developments of the currently congested areas.

Congestions in Bulgaria, Norway, Slovakia, Spain, Sweden, and Switzerland are considered ‘sensitive critical infrastructure protection-related information’ according to CACM and the national laws of the respective countries. For Spain, the data of CNEs is anonymised. For Bulgaria, Slovakia, and Switzerland, the data is anonymised, and the lines are presented instead as bubbles. For Norway and Sweden, there is no data on congestions in the report.

2.1.1 Capacity calculation for day-ahead allocation

Within the capacity calculation process, TSOs calculate cross-zonal capacities that will be made available to the DA market so that market participants can realise their cross-border transactions. Capacity calculation aims to compute the maximum available cross-zonal capacity while complying with underlying grid security standards (N-1 criterion) and respecting the operational security limits of each TSO, such as thermal limits, voltage limits, short-circuit current limits, frequency, and dynamic stability limits. This is undertaken for a given timeframe and BZ borders, including the so-called technical profiles, which encompass several BZ borders. Operational security limits cover the permissible loading of grid elements,[1] with their finite capabilities defined by their design and construction, as well as the voltage and angular stability of the power system, which are defined by the local structure and characteristics of the grid, where applicable. These aspects represent the limiting factors (constraints) when assessing cross-zonal transmission capacity. Grid elements that constrain cross-zonal capacity are called **CNEs**. The CNEs limiting cross-zonal exchanges appear not only on BZ borders but also within the grid of a BZ. Such elements are then recognised as internal lines with cross-border relevance since they are also affected by cross-border trading. In anticipation of potential congestions affecting CNEs, TSOs include remedial actions in the capacity calculation process to provide maximum cross-zonal capacity to market participants and ensure the system's secure operation. Together with reliability margin and risk policies applied, this ensures that cross-zonal capacities are offered to the market while ensuring operational security.

Before available capacities are provided to the market, they are also subject to mutual coordination between neighbouring TSOs. The TSO manages other congestions – fully internal to the BZ – via remedial actions, e.g., redispatching, topological changes, etcetera.

The two approaches currently applied in Europe for cross-zonal capacity calculations are NTC approaches with different levels of TSO coordination across Europe and the flow-based (FB) approach, which has currently only been implemented in the Core CCR. In the NTC approach, the TSOs determine the capacity to be provided to the market for each BZ border and direction. In the FB approach, TSOs determine flow-based parameters (comprising available margins on CNECs associated with PTDF factors) that capture the interrelation between BZ borders in highly meshed and interdependent systems and the market 'decides' how the available cross-zonal capacity is to be used within the allocation process. In regions with existing interrelations and an application of the coordinated NTC approach, the TSOs of the region apply splitting rules for distributing the available capacity among BZ borders.

For the purposes of this Technical Report, only active market constraints are considered in this timeframe. For regions using the FB approach, the active constraints are available from the FB computation, while for regions using the NTC approach, the active constraints have been computed ex-post for this report.

The active constraints are determined after the application of remedial actions in line with the agreed methodologies for capacity calculation.

2.1.2 Day-ahead operational planning (D-1)

Day-ahead congestion forecasts (DACFs) – which comprise the results of the DA allocation – represent the basis for the short-term operational planning process, e.g., DACFs and intra-day congestion forecast (IDCFs). In particular, DACFs take into account information resulting from the previous processes (cross-border as well as internal transactions), updated information about renewable energy sources (RES), updated load forecasts, and unforeseen events. In the case of network elements with cross-border relevance, deviations from forecasts such as unexpected changes in the grid topology or the generation or load pattern mainly cause congestions that occur during these D-1 processes.

The deviations might also be a consequence of inefficiencies in the current market configuration – e.g., uncoordinated capacity calculation – resulting in unscheduled transit flows, loop flows, etcetera. During this phase, congested network elements that pose physical risks to system security are identified and costly and/or non-costly remedial actions for preventing or mitigating the forecasted security violations are determined.

In this Technical Report, congested network elements are identified based on congestion forecasts in D-1 after the DA market (in the TSO-internal DA operational security assessment or the regional DACF process) but before the application of any remedial actions at this stage. However, the effect of remedial actions applied before the D-1 timeframe is taken into account.

1 Lines, transformers, breakers etc.

2.1.3 Close-to-real-time system operation

The aim of congestion management procedures addressing congestions identified in earlier timeframes is to avoid congestions appearing close to real-time operation. Thus, these congestions should be less frequent compared to the previous timeframes, such as DACF. However, in contrast to the previous stages, congestions that appear close to real-time system operation represent an immanent physical risk with a reduced scope of available remedial actions. They are generally caused by forecast errors, unscheduled flows, and unexpected (unplanned) events.

For this Technical Report, it was envisaged to collect alleviated and unalleviated congestions from the period as close to the time of operation as possible, defined as up to one hour before real time. The effect of any remedial actions applied in previous timeframes is inherently considered. During the data collection phase, it became apparent that some TSOs could not collect inclusive data up to one hour before real time or could not extract this data from their systems. These TSOs provided data on incidents that had been recorded as incident classification scale (ICS) data. This means that for these TSOs, congestions seen within one hour of real time that were resolved by control room actions – e. g., redispatch without a real-time security breach – are not recorded.

The data collected by these two approaches is significantly different and therefore considered as not comparable. Consequently, for this report, two sets of real-time maps are provided to visualise the data, one for ICS data and the second for data up to one hour before real time.

2.1.4 Defining major congestions for detailed expert analysis

A detailed expert assessment of the major congestions has been conducted for each member state and is included in Appendix 1. Major congestions were identified based on criteria concerning their frequency of occurrence. Furthermore, a focus was placed on elements located at BZ borders. Overall, over 100 critical network elements (CNEs) out of approximately 2,300 have been analysed, representing approximately the top 5 % of the highest congestions.

The detailed expert assessment for the major congestions identified covers the historical evolution and severity of congestions of each single CNE or group of CNEs during 2021, 2022, and 2023, as well as the three timeframes (CC for DA, D-1, and close to real-time). Details on the main types of flows contributing to the congestion are also included where available.

Additionally, the projected future evolution of these congestions is presented, taking into account factors such as grid developments and other relevant considerations. This projection includes a ten-year scenario to provide a comprehensive view of how these congestions might evolve over the next decade. Furthermore, this analysis includes a country map to facilitate identifying congested elements.

For network elements situated in the Core CCR, an indicator measuring the type of flow is reported for 2022 and 2023 based on the Core FB capacity calculation (described in detail in Section 3.1.2).

Appendix 1 provides a complete expert assessment of each major congestion by TSOs, along with non-allocated flows for the Core CCR.

2.2 Congested area overviews in years and timeframes

In this section, congestions reported by TSOs are presented on maps for the different years and timeframes under investigation. Appendix 2 provides a list of all congestions. In compliance with CACM, in the current Technical Report congestions are reflected only by their frequency, i.e., the percentage of hours per year during which the congestion appeared. However, as this is only one indicator of congestions, evaluation of congestions should always be complemented by further indicators – such as the overload volume and the simultaneity of congested lines – and contextualised by expert assessments.

The frequency differences between the countries not only depend on the general grid topology (e.g., highly meshed, slightly meshed) but also differences in capacity calculation or allocation, demand behaviour, or ongoing grid maintenance works in the respective year.

It is worth noting that not all congestions appear at the same time, with the maps showing full years. Furthermore, the frequency does not provide any information about the extent to which this congestion affects the volume of cross-zonal capacity.

The maps and scale below should be understood as follows:

- The colour scale represents the percentage of total hours of the year, reflecting the range of congestion frequency for most reported lines.
  - Congestions with frequency below 0.5 % are not represented (see Appendix 2 for a full list of congestions).
  - Congestions with a frequency above 35 % are represented in dark red.
- A dot represents a transformer, substation, or transmission line with a length of less than 10 km.
- Coloured lines/dots/transparent bubbles represent the congestion reported with a frequency corresponding to the number of hours per year according to the colour scale.
- Grey lines/dots/bubbles represent reported congestions with no frequency available.
- If a country is shown in yellow, the data is not available.
- For countries in blue, the data available uses a different standard than shown in the map (this only refers to ICS or close-to-real-time maps).

For double-circuit lines, only the circuit with a higher frequency is displayed on the maps, while Appendix 2 provides a full list of congestions. The shape of the grid elements on the maps (straight lines) does not correspond to their real geographical layout, whereby only the coordinates of the substations at both extremities are used.

2.2.1 Capacity calculation for capacity allocation

2021 – Capacity calculation for DA allocation

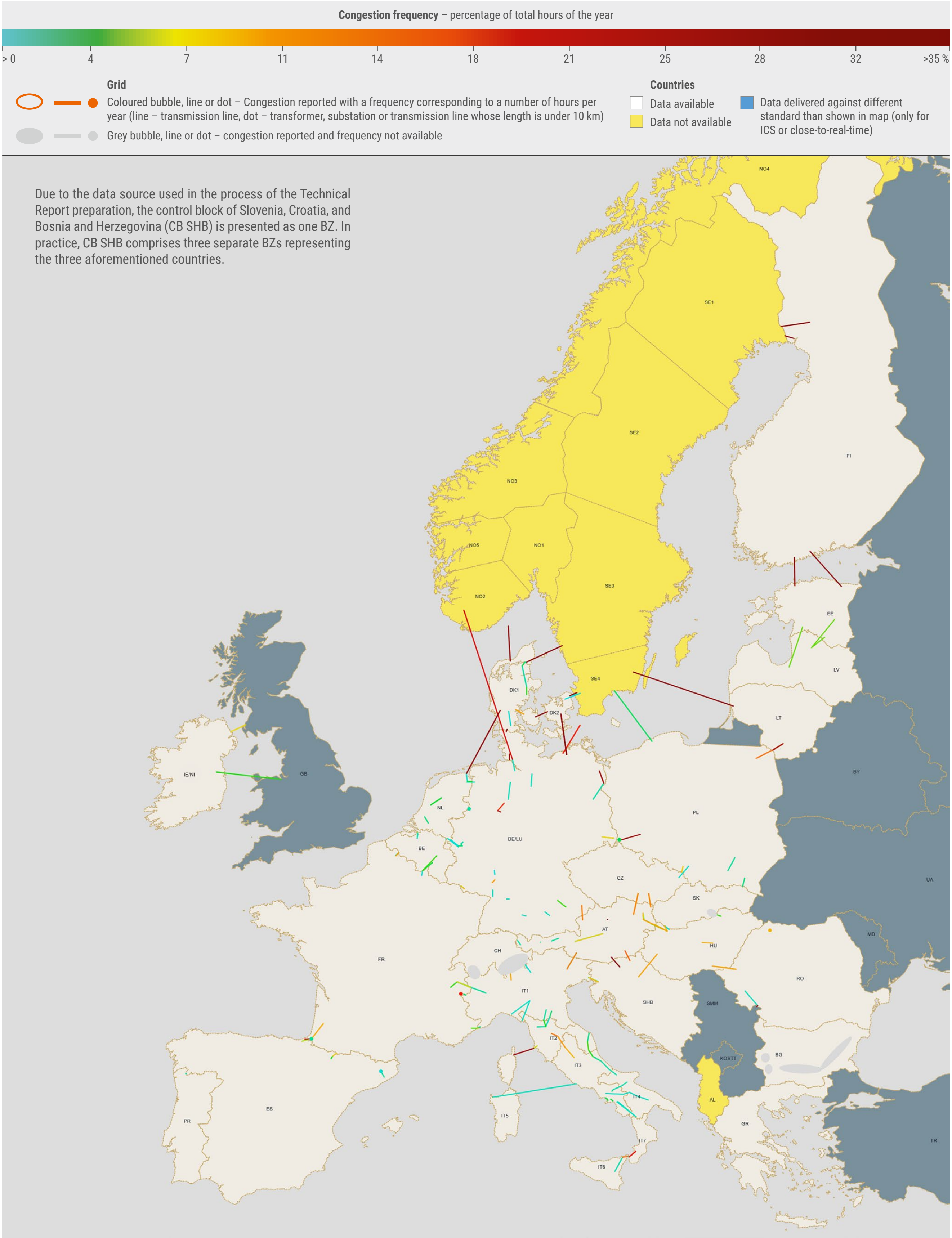


Figure 2: CCDA for 2021

2022 – Capacity calculation for DA allocation

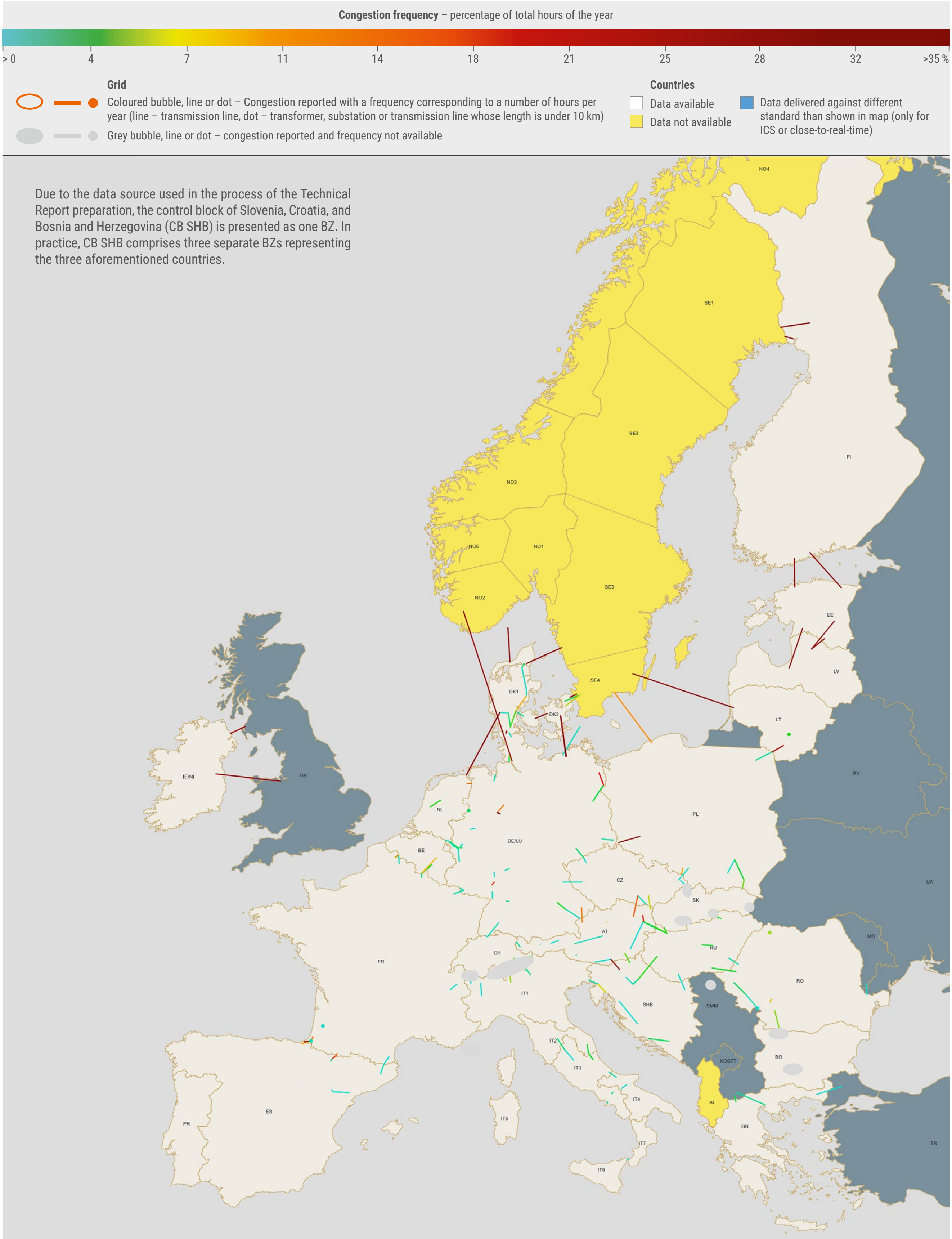


Figure 3: CCDA for 2022

2023 – Capacity calculation for DA allocation

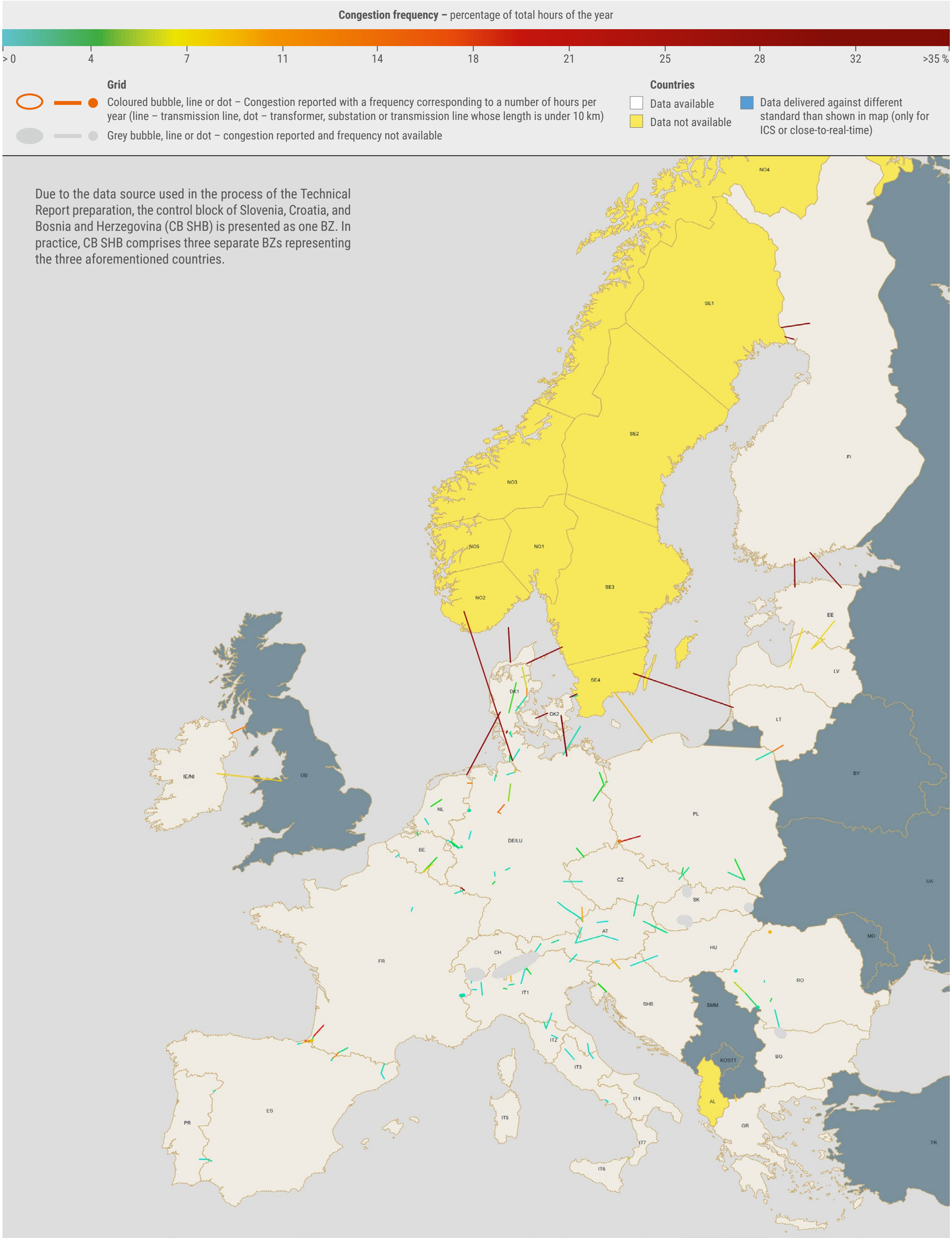


Figure 4: CCDA for 2023

2.2.2 D-1 timeframe

2021 – D-1

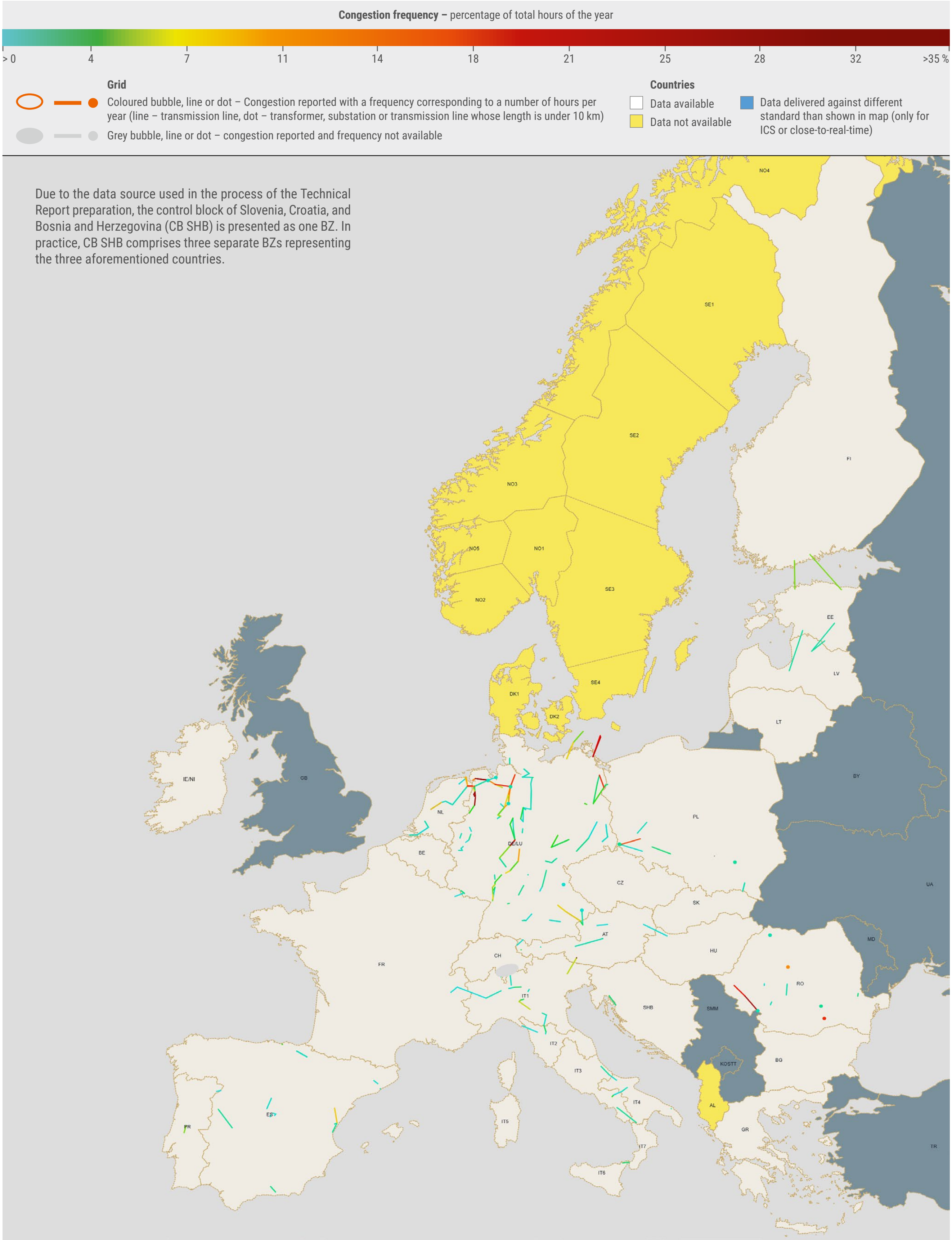


Figure 5: D-1 for 2021

2022 – D-1

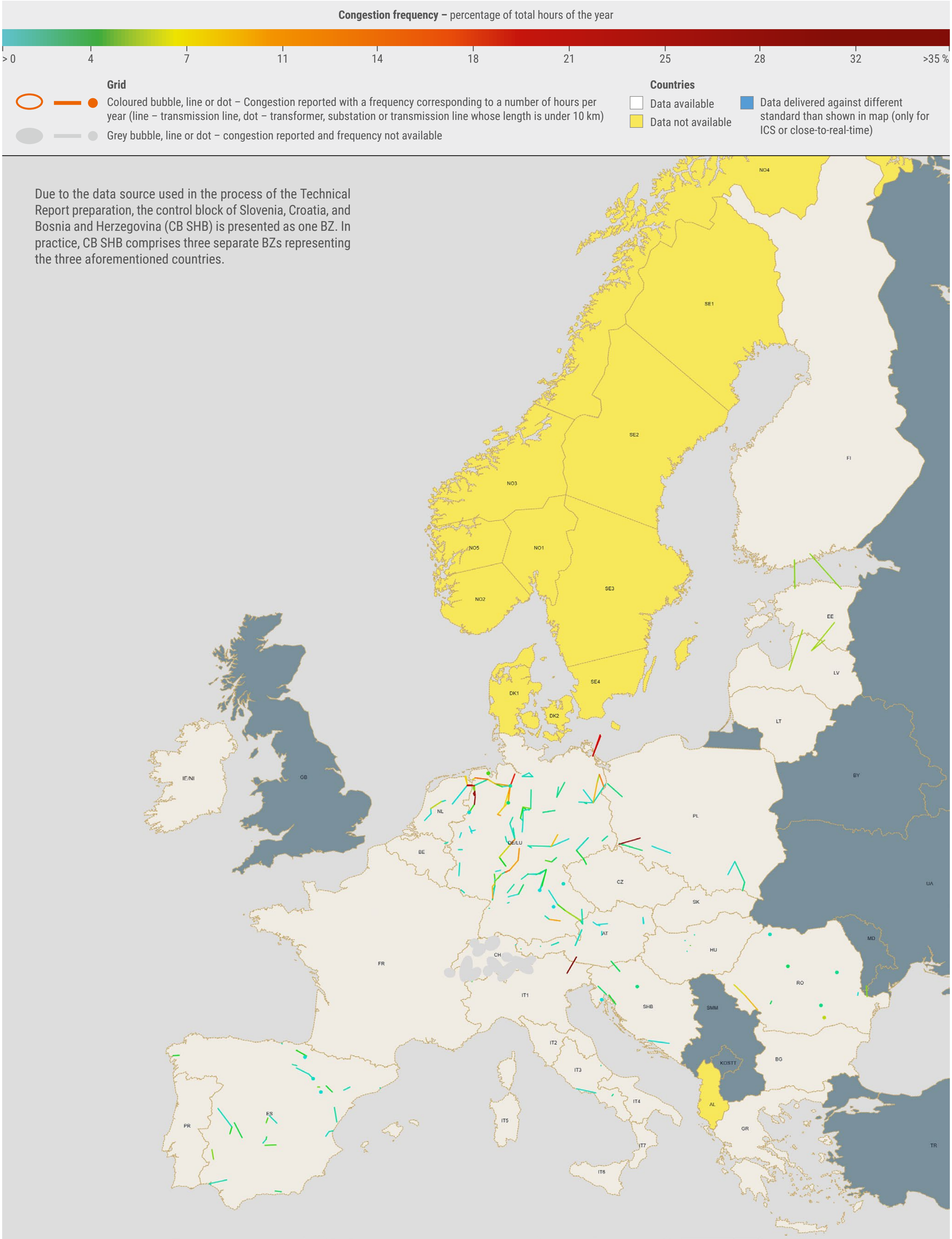


Figure 6: D-1 for 2022

2023 – D-1

Congestion frequency – percentage of total hours of the year

> 0 | 4 | 7 | 11 | 14 | 18 | 21 | 25 | 28 | 32 | >35 %

Grid

Coloured bubble, line or dot – Congestion reported with a frequency corresponding to a number of hours per year (line – transmission line, dot – transformer, substation or transmission line whose length is under 10 km)

Grey bubble, line or dot – congestion reported and frequency not available

Countries

Data available

Data not available

Data delivered against different standard than shown in map (only for ICS or close-to-real-time)

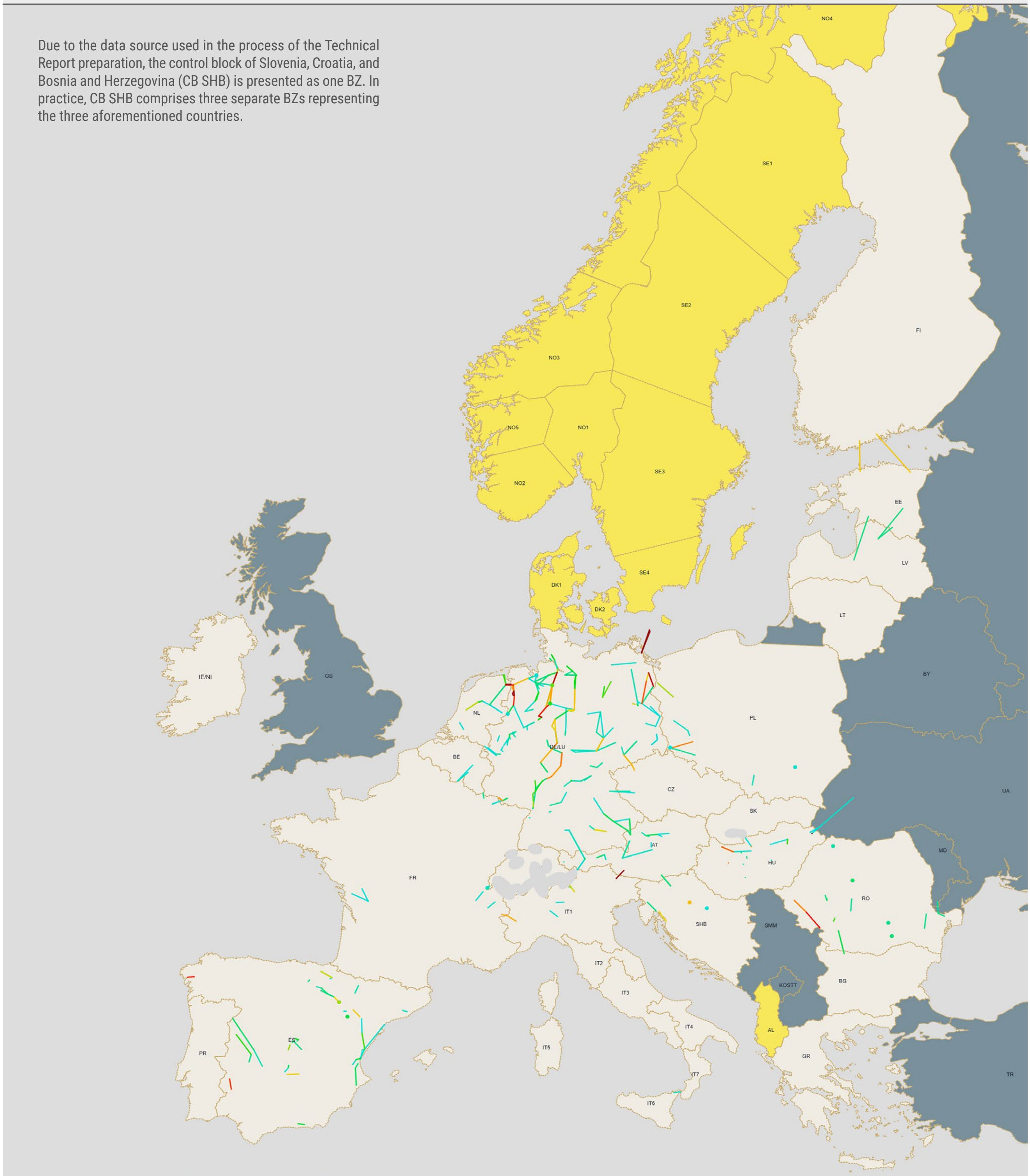


Figure 7: D-1 for 2023

2.2.3 Close-to-real-time

It is especially challenging to provide comparable data for the close-to-real-time stage since congestion management approaches and data processing and reporting differ among TSOs. Therefore, two different sets of maps are shown for this stage.

2.2.3.1 Close-to-real-time maps of the TSOs that used up to one hour real-time data

The following set of maps includes the close-to-real time congestions that are reported up until one hour of real time. However, sources differ even for these TSOs, meaning that the resulting reported congestions are not necessarily comparable. Further details can be found in the individual TSO descriptions in the expert assessment.

It is important to highlight that only Switzerland reported congestions in a close-to-real-time timeframe over a five-minute time interval, whereas all other countries reported over a one-hour time interval.

2021 – Real time, one hour

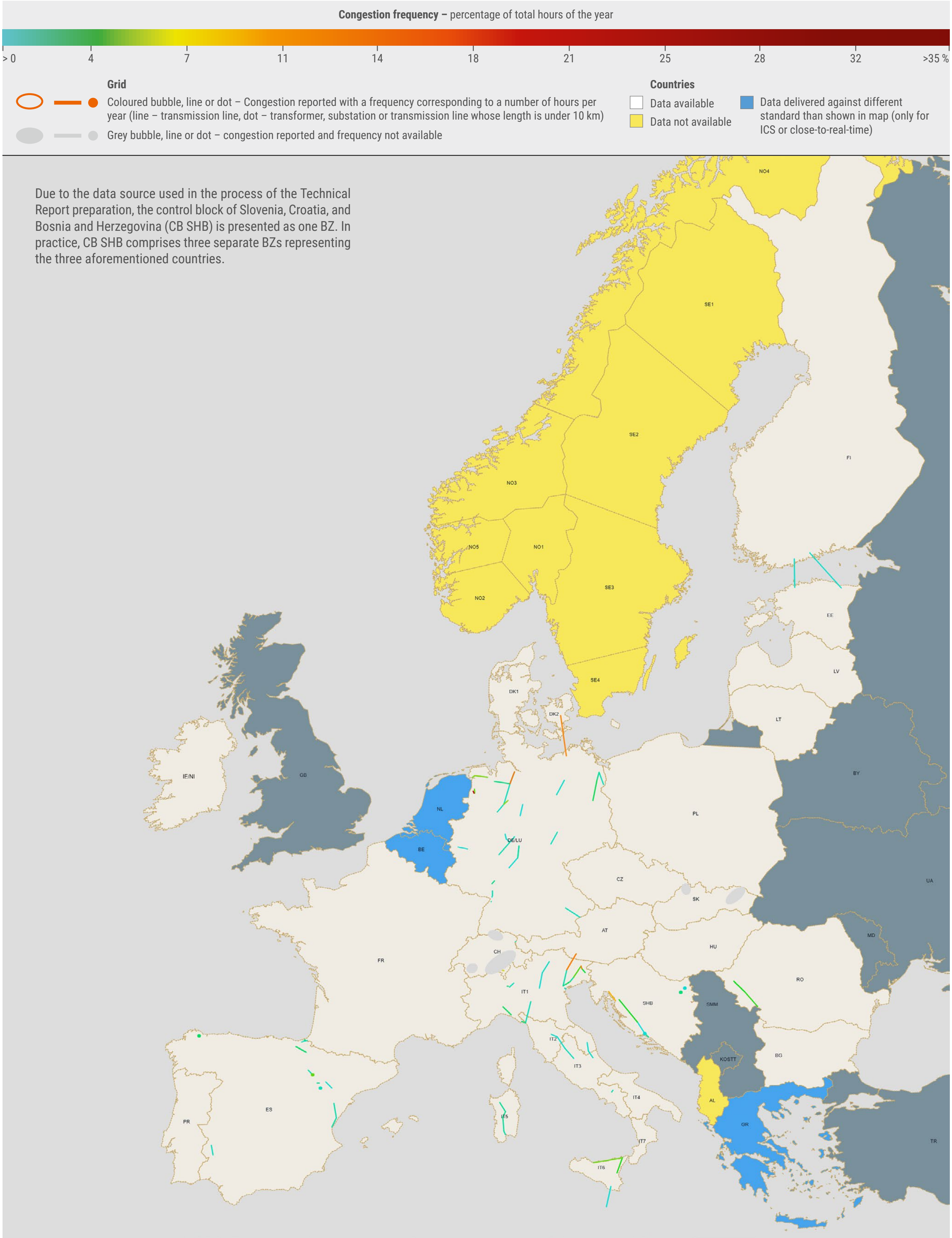


Figure 8: Real time for 2021

2022 – Real time, one hour

Congestion frequency – percentage of total hours of the year

> 0 | 4 | 7 | 11 | 14 | 18 | 21 | 25 | 28 | 32 | >35 %

Grid

Coloured bubble, line or dot – Congestion reported with a frequency corresponding to a number of hours per year (line – transmission line, dot – transformer, substation or transmission line whose length is under 10 km)

Grey bubble, line or dot – congestion reported and frequency not available

Countries

Data available

Data not available

Data delivered against different standard than shown in map (only for ICS or close-to-real-time)

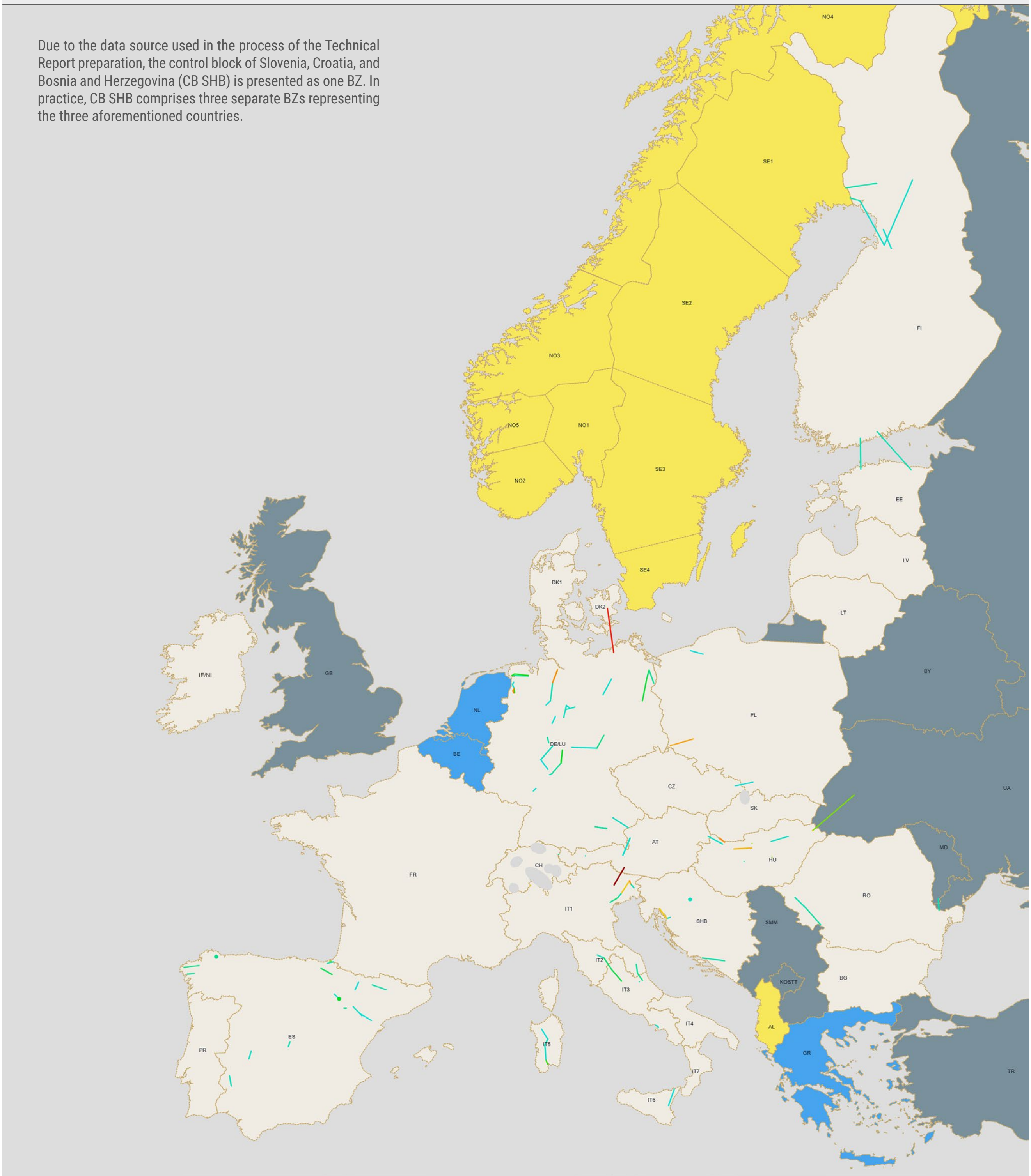


Figure 9: Real time for 2022

2023 – Real time, one hour

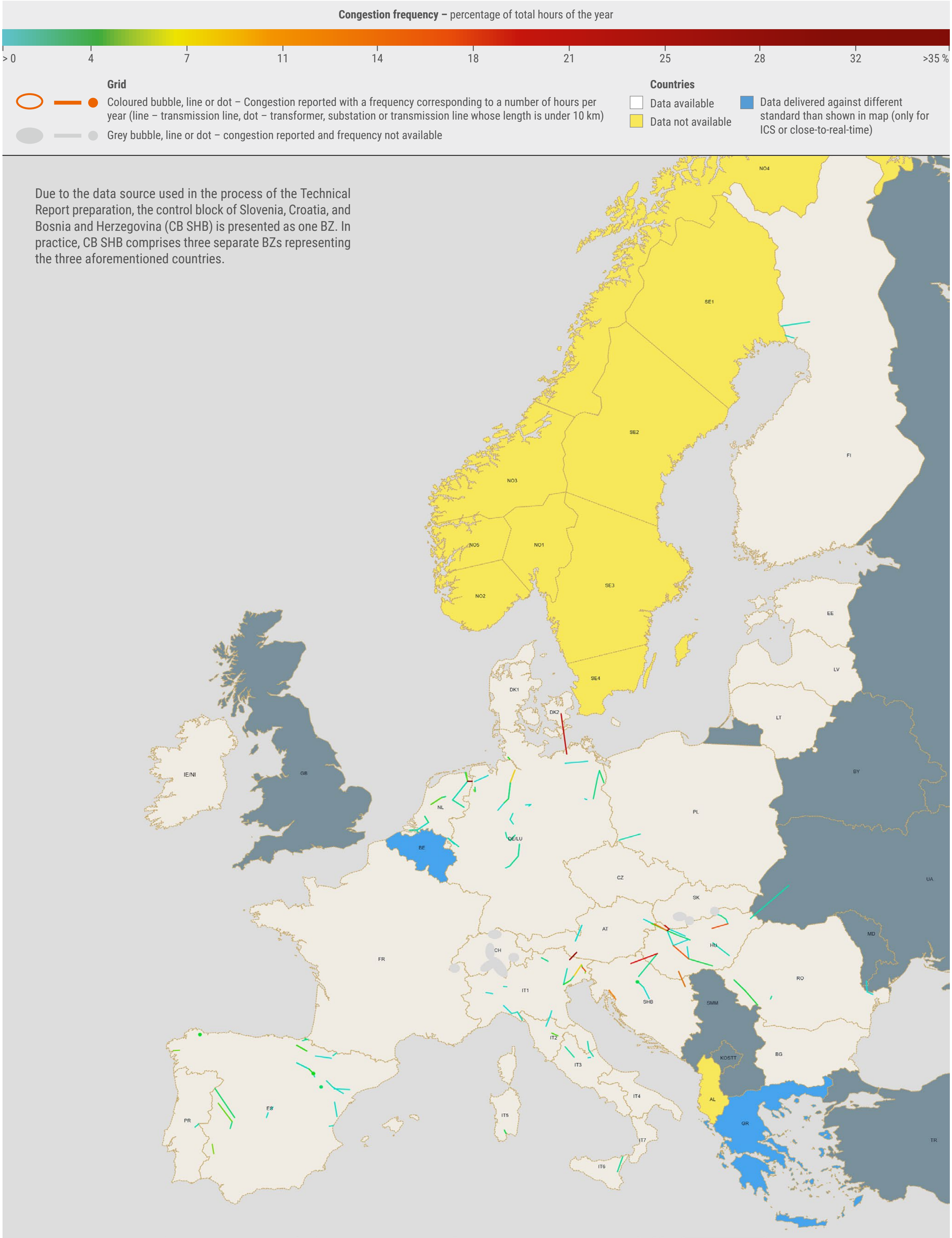


Figure 10: Real time for 2023

2.2.3.2 Incident classification scale

This set of maps includes the TSOs that used ICS reports as their source. The close-to-real-time congestions reported in the ICS are by Belgium, Greece, and until 2022 by the Netherlands. These TSOs typically have very few congestions in this timeframe since ICS reports only include (N-1) grid violations appearing in real time.

For 2021 and 2023, the reported congestions based on the ICS standard delivered by Belgium, Greece, and the Netherlands (2021 only) have a frequency lower than 0.5 % per year and therefore no maps are included here. The expert assessments for the reported congestions can be found in Section 2.3 and Appendix 1. Appendix 2 provides a full list of congestions for all three years.

2022 – ICS

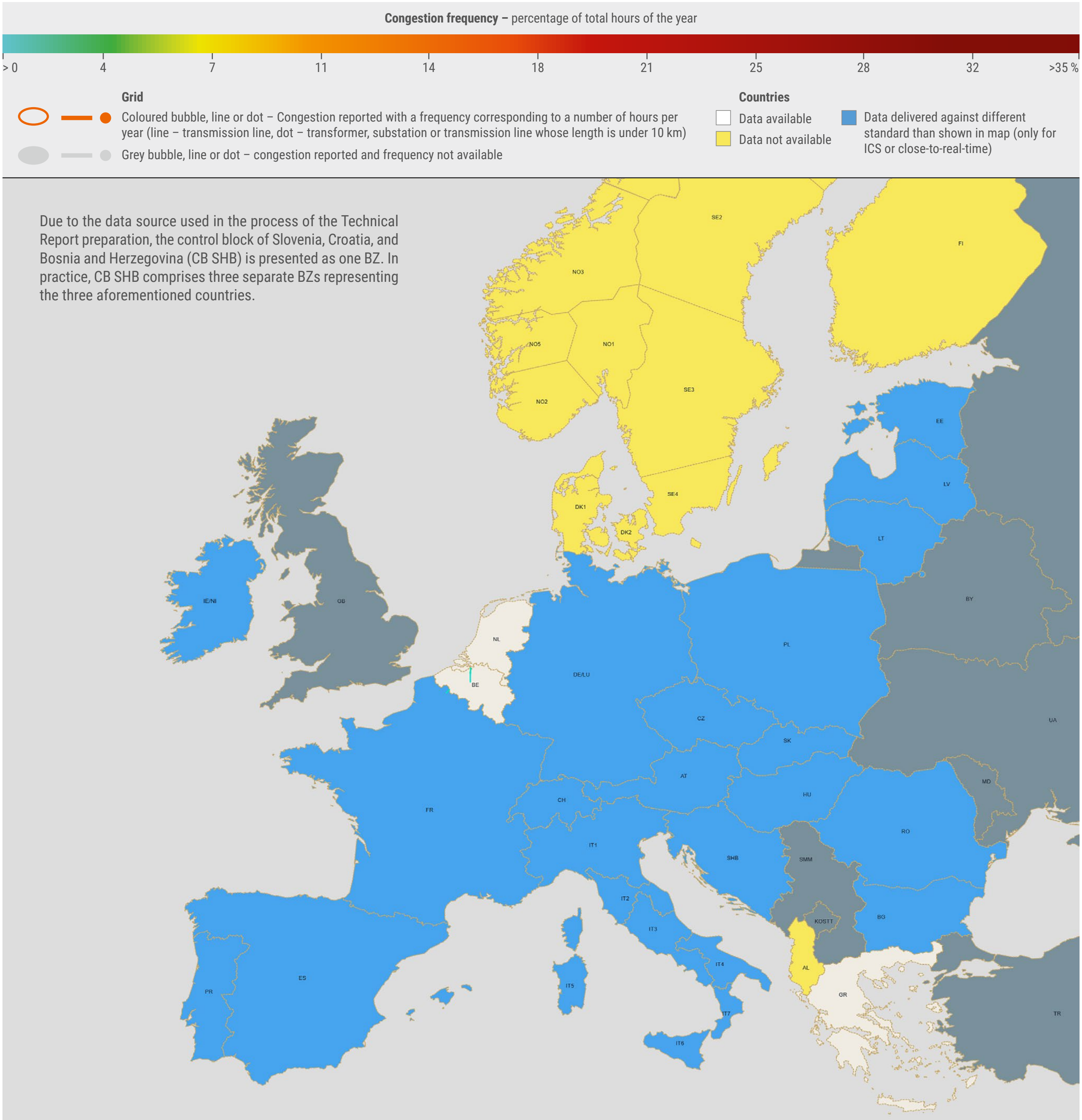


Figure 11: ICS for 2022

2.3 High-level expert assessment per country

In this chapter, each TSO provides a high-level expert assessment of the major congestions, including interdependencies of congested lines and an explanation of their causes, as well as how expected future changes affect the identified congestions. These future changes might be due to changes in generation and demand patterns or grid development based on the TSOs' investment plans.

Congestion evolution for the future horizon is subject to uncertainties and assumptions. Furthermore, congestions can move at an hourly resolution, which cannot be easily reflected in the assessments.

The detailed expert assessments as described in Section 2.1.4 can be found in Appendix 1.

2.3.1 Austria

Austria is significantly influenced by diverse export and import patterns due to its central location within continental Europe. Historically, the primary load flow directions have been north–south and west–east, with a new emerging pattern from east to west observed since 2022.

The transmission elements experiencing the highest rates of congestion are primarily cross-border lines. The high rankings are mostly due to frequent constraints identified during the DACC process in 2021 and 2022. Additionally, some of these elements are strongly affected by non-allocated flows. Notable exceptions include the Lienz–Auronzo cross-border line and the phase-shifting transformer in Lienz, which experience higher congestion rates during the DACF and close to real-time periods. Generally, the shift in the number of constraints in the DACC process can be attributed to the transition from the NTC approach to FB market coupling in June 2022 and the implementation of a new procedure in the CCR Italy North region following the CEP and the 70 % criterion in October 2021. These changes have notably reduced congestion rates in the DACC process. Congestions in the DACF timeframe are primarily attributed to a more challenging network situation since 2022 and – specifically for the Obersielach–Podlog line – increased exports to southeast Europe.

Close to real time, fewer network elements in the Austrian control area appear congested. This improvement is largely due to the effective application of remedial actions in the D-1 timeframe (DACF process). Most congestions predicted one hour before real-time occur on the Lienz–Auronzo cross-border line and the phase shift transformers (PST) in Lienz. Forecasted overloads on these elements are generally disregarded due to the real-time relief provided by the Lienz PST.

Various grid expansion projects are already being implemented or planned to further reduce current and future congestions. Appendix 1 provides a detailed expert assessment with the assignment of the projects to the congestions.

2.3.2 Belgium

Capacity calculation

Concerning DA capacity allocation, Elia looks at all 380 kV lines in the corridors that pass through Belgium with respect to both critical grid elements and critical outages. Elia provides as much capacity as possible while considering operational security. Given that the grid does not have structural congestions,any capacity limitation is usually related to required maintenance work that reduces the available capacity.

In DA security assessments, Elia considers all 380 kV lines in the corridors that pass through Belgium regarding both critical grid elements and critical outages. Given the market result of the DA capacity allocation, Elia will prepare all remedial actions required to ensure operational security in collaboration with Coreso and TSCNet.

Close to real time

As foreseen by its operational rules, Elia will manage any congestions that occur in or close to real time as soon as possible to avoid any N-1 violations in the whole Elia grid. N-1 violations are managed partly with preventive and partly with curative measures, namely thosethat can be put into operation sufficiently quickly after the occurrence of an N-1 to reduce the loading of the line to below the permanent limit.

Future development

A principal area of congestion is on the FR–BE border, resulting from higher power flows within the CWE area in the process of transporting energy through and to Belgium. The 380 kV France–Avelgem–Horta–Mercator axis is occasionally a bottleneck in DA FB market coupling. The 380 kV Lonny (FR)–Achêne (BE)–Gramme axis will be affected by the closing of the Tihange power plant – connected at Gramme – by 2025.

The 225 kV axis between Moulaine (FR) and Aubange (BE) is strongly influenced by both the FR–BE and FR–DE cross-border flows. Given the expected increase in power flows, these axes would become structural bottlenecks. Increasing the interconnection capacity between France and Belgium creates synergies between France's export position during favourable meteorological conditions and Belgium's import position, with higher flows from south (France) to north (Belgium) appearing more frequently at the FR–BE border. In particular, the Horta–Mercator part of the 380 kV France–Avelgem–Horta–Mercator axis is linked with the integration of new offshore production capacity, the potential connection of new large power plants west of Mercator, and the integration of a second interconnector with Great Britain (Nautilus). This will require developing approximately 6 GW of transport capacity from the coast to the centre of Belgium. It is envisioned that this corridor will be implemented with AC technology based on the example of the Stevin project. Timing, routing, scope, and other elements are subject to feasibility studies and subsequent spatial planning procedures.

TheZandvliet 380 kV PST is an active constraint for DA allocation, very likely due to lower minRAM targets than 70 % caused by the loop flow derogation, although high market flows can also cause constraints if the market perspective aims to exceed 70 %. Elia holds a derogation for excessive loop flows and has installed PSTs on its borders to control active power flows on internal and cross-border network elements, thereby reducing loop flows. Elia uses this capability in the Core DACCM to limit excessive loop flows with PSTs. According to the(F)2802 study carried out by the CREG in 2024, the use of PSTs reduced loop flows on Elia's CNECs to a lower absolute level in 94.4 % of all hours in 2023, with an average reduction of 342 MW. These PSTs do not lead to overloads in other timeframes due to several factors, including forecast effects where flows are lower in DACF/close-to-real-time models than initially forecasted in D2CF models. Operational procedures such as agreements with international partners allow for flow redistribution using extra tap ranges on PSTs, employing other remedial actions with cross-border impact, and cross-border redispatches that cannot be individually validated in DACC.

Congestion is also visible on the 380 kV Gramme–Achêne axis, particularly after DA market coupling. According to the same (F)2802 study, the capacity available on this CNEC was above 70 % for more than 75 % of the hours in 2023 and above 50 % for more than 95 % of the hours. The large amount of nuclear generation at the Gramme substation contributes to internal trade within Belgium, meaning that a significant portion of the active power flow on this CNE is attributed to internal flows.

2027

FR–BE: Installation of a PST at Achêne (planned in the Belgium NDP) to secure the current transfer capacity due to the nuclear shutdown in Belgium that could directly affect the flow from Lonny (FR) to Achêne and Gramme.

NL–BE: Construction of a new 380 kV corridor between Zandvliet and Mercator comprising a double-circuit AC overhead line, including a new 380 kV substation in Lillo. This will sustain the development of interconnection capacity on the Belgian north border (NL–BE) with a view towards a broader scenario framework, thereby securing the supply of electricity around the Antwerp harbour area in light of increasing industrial demand, as well as developing capacity for the potential integration of new production in the Antwerp area.

Internal: The implementation of the internal backbone upgrade started with the upgrade of the Massenhoven–VanEyck section by 2024 since this is the weakest link with only one conductor. A second upgrade along the Mercator–Bruegel section is planned to be built by 2025/2026.

2030–2033

Internal: Development of a ~6 GW corridor from the coast to the centre of the country, in parallel with the Stevin axis at the coast and Horta–Mercator (2028). The HTLS reinforcement of the internal backbone will continue with the rest of the 380 kV Massenhoven–VanEyck–Gramme–Courcelles–Bruegel–Mercator–Massenhoven ring, whichis projected to run up to 2035. Phasing is subject to optimisation as a function of outage constraints (operational security) and the evolution of the production park.

2.3.3 Bulgaria

Capacity calculation

ESO EAD does its utmost to provide full capacity during all normal operational conditions, and market coupling allocates all given capacity. CNE is a double-circuit interconnection line between bordering substations in Bulgaria and Romania. 400 kV-BG_L1 is a double-circuit line, and usually one of the two circuits is kept as reserve, which means open/disconnected due to high voltages. In cases with topology like this – which is the usual state for these interconnection lines – and when the circuit of BG_L1 that is in operation appears to be a limiting critical network element during the DA and ID CC, a topology remedial action could be applied, whereby the other circuit that is in reserve/disconnected is put into operation. Based on our expect assessment, the aforementioned BG_L1 could not be classed as an active market constraint under normal operating conditions. Considering this and according to our expertise based on historical data and our future expectations, such a CNE could not be classed as frequently occurring under normal power system conditions. It could not be assessed as a congestion point and active market constraint on the BG–RO border.

Given that this element is a cross-border line,it is assumed that a large portion of the active flow on this network element is cross-border flows, transit flows, and loop flows.

Regarding the BG–GR border, the 220-kV-BG_L2 line was a limiting element in our control area, although it was only observed as a limiting one in 2021. Moreover, it appeared only in maintenance operating conditions in our transmission network, and it is not an active market constraint. 220-kV-BG_L2 is an internal network element, and it is assumed that the main portion of the active flow on this network element is internal flows. Due to major investments in the Bulgarian transmission network in the last two years, this limiting element had disappeared by 2023 and is not expected to be present in the future.

Day ahead

ESO EAD does its utmost to provide maximum capacity to the market. Full capacity is allocated during all normal operational conditions and market coupling allocates all given capacity. During the 2021, 2022, and 2023 target years, no congestions were identified in the D-1 timeframe. If there was a security violation identified, it was eliminated by applying non-costly RA.

Close to real time

ESO EAD does its utmost to provide maximum capacity to the market. Full capacity is allocated during all normal operational conditions and market coupling allocates all given capacity. During the 2021, 2022, and 2023 target years, there were no congestions identified in the close-to-real-time timeframe. If there was a security violation identified, it was eliminated by applying non-costly RA.

Future development

Given that there were no congestions identified during the D-1 and close-to-real-time security assessment for 2021, 2022, and 2023, and there are no real active market constraints and no structural congestions for the capacity calculation in our control area for 2021, 2022, and 2023, we are not planning any new major investments in our network related to solving congestion issues. Moreover, it should be noted that major investments have been made in our network in the last two years, which can be found in the ENTSO-E TYNDP and on our **TSO website** and thus the internal limiting elements had disappeared by 2023.

2.3.4 Croatia

The NTC values used during the current uncoordinated bilateral calculation of NTC capacities are not a fully relevant reflection of the cross-zonal capacity for HOPS since the since the minimum values calculated by the TSOs within the bilateral area (HR–SI, HR–HU, HR–BA, HR–RS) have been selected in accordance with the operation handbook. This means that certain NTC values might reflect the network constraints of the neighbouring TSOs (limiting elements are present outside the HOPS transmission network). The capacity calculation on the HR–SI and HR–HU borders has been switched switching to the coordinated capacity calculator in the Core CCR from the middle of 2022.

D-2 and D-1 timeframe

D-2 and D-1 congestions are mainly due to the unplanned unavailability of transmission elements, and high hydrological and changeable weather conditions in the region with accompanying unplanned trading/transitional flows in the grid, influenced by cross-border energy exchange between the Balkan region and central Europe.

This has a significant effect on the congestion frequency identified in the D-1 timeframe before the application of any remedial actions for the following elements:

- 400 kV and 220 kV transmission line from the south to north of Croatia, exactly on the BA–HR–SI route towards central Europe (active constraints: 220-kV-Pehlin – xnode Divača, 220-kV-Senj – Melina, 220-kV-Zakučac – xnode Mostar, 400-kV-Zerjavinec – Tumbri).

Close to real time

In general, some congestions have already been recognised during the D-2 and D-1 timeframe (almost the same elements appear for the same reasons explained for the D-2 and D-1 timeframe) and according to the operational rules all possible violations are reduced by measures as soon as possible to avoid any N-1 violations. Congestions are mainly solved by applying preventive topological remedial action. It can be noticed that the situations of high unscheduled flows in the region are increasing, resulting in local preparation of curative remedial actions in case of need.

2.3.5 Czech Republic

Appendix 1 provides a comprehensive expert assessment for Czech Republic, including a map to identify the major congestions.

2.3.6 Denmark

Capacity calculation

In Denmark, there are generally no significant congestions internally in the BZs, as is also evident from the maps presented in Chapter 2. Energinet has historically been proactive in ensuring that the transmission grid internally has been continuously developed, along with the commissioning of new interconnectors and the introduction of the significant amounts of renewable generation found in Denmark.

Day ahead

In Denmark, there is no structured congestion management process for the D-1 timeframe after market allocation but before the use of remedial actions. The market result from the allocation phase is directly useable if there are no unplanned outages in the grid between the time when capacity is given to the market and real time. The use of BZs to handle significant congestions ensures that the market outcome can be directly applied regardless of the schedules that market participants submit to the TSO.

Close to real time

In general, as with the CCDA stage, there are no internal congestions in the Danish BZs when all grid elements are in operation. This means that most congestion management during real time involves handling faults in the grid.

Future development

Denmark will initiate and complete the following projects before 2027. These are just a few of the most important ones since there are over 100 projects in the pipeline to ensure a smooth addition of extra RE in the grid alongside the increased electrification:

- Upgrade of Endrup–Idomlund 400 kV (2026 + upgrade in 2028)
- New 400 kV cable between Landerupgaard and Revsing (2029)
- Improve grid in DK2 to accommodate more RE (two phases ongoing over several years)

2030

The Danish grid is generally dimensioned to ensure that no internal congestions occur during normal operation. Energinet does not have a detailed plan of projects that will be realised from 2030 onwards (see under 2027 for projects), although system development needs will continuously be addressed as they are identified with a reasonable degree of certainty.

2033

The Danish grid is generally dimensioned to ensure that no internal congestions occur during normal operation. Energinet does not have a detailed plan of which projects will be realised from 2030 onwards aside from reinvestment, although system development needs will continuously be addressed as they are identified with a reasonable degree of certainty. The political system in Denmark is strongly focused on increasing the wind infeed into the Danish transmission system, and thus it is expected that significant investments will be needed over the coming years.

2.3.7 Estonia

Capacity calculation

During normal operations, full capacity of Estlinks is offered to the market. The connections between Estonia and Finland have been limited due to scheduled maintenance work and unplanned outages, with cross-border capacity between Estonia and Latvia from 2021 to 2023 limited due to significant renovation of cross-border lines for CESA synchronisation.

Day ahead

The higher percentage of cross-zonal congestions during the D-1 timeframe was caused by the Baltic countries' dependency on cheaper electricity produced in the Nordic countries, which caused the north–south flow in Estonian BZ.

Close to real time

A minimal number of cross-zonal congestions were noticed close to real time.

Future development

2027

Given that investments planned for synchronisation in 2025 have been completed, the number of congestions on the EE–LT cross-border is expected to decrease. Further initial planning processes for Estlink 3 and a fourth EE–LT power line are ongoing, with final investment decisions for the projects expected to be confirmed by 2027. To allow new interconnectors to the grid and fulfil the Estonian "Taastuvenergia 100" (TE100) renewable energy target, additional investments for transmission lines must be completed, which might reduce available short-term capacity due to disconnections needed for renovation or the connection of new substations or lines, although this shall increase the total capacity in the long term.

2030

Investments in TE100 are planned to be completed by the start of 2030. Continuous grid planning is anticipated to adapt to the system demand and generation needs.

2033

The construction works on the fourth EE–LT power line are expected to be finished by the end of this year. The construction works for Estlink 3 are ongoing and are expected to be finished by 2035.

2.3.8 Finland

Capacity calculation

Full capacity has been given during all normal operational conditions, and market coupling allocates nearly all given capacity. Internal congestions are rare, and congestions mostly occur on the border interconnectors in very high or low net positions. Cross-zonal congestions in 2020–2022 were mostly due to the Finnish BZ dependence on import electricity from SE1 and SE3. From 2023 onwards, dependence on imports has shifted, and congestions are more common due to transit flows towards SE3 and EE.

Generally, transmission within the Finnish BZ is adequate, with no internal congestions noticed before the DA allocation. Fingrid has made investments for internal cuts between the northern and southern part of Finland. The latest line from north to south is the fourth and has been in operation for a few years. The fifth line was commissioned in 2022 to reduce the possibility of bottlenecks in central Finland that could affect border capacities.

Day ahead

There is only a small number of congestions observed during the D-1 timeframe since the congestions are acknowledged in the D-2 timeframe. All D-1 congestions are due to unplanned outages that took place for several hours within a day before the next day's D-2 capacity allocation. Typically, planned remedial actions are rare and used in a few planned outages. Unexpected congestions are managed by remedial actions close to real time. Generally, capacity within the Finnish BZ is adequate and there are no internal congestions noticed in D-1 timeframe.

Close to real time

There are only a few congestions noticed close to real time since the congestions are already acknowledged during the D-2 and D-1 timeframes. These few congestions are due to higher transmission allowed under certain operational conditions. Sudden congestions due to unplanned outages are managed in some cases by remedial actions, which has led to no congestions at the borders or within the Finnish BZ.

At the FI –EE border, congestions close to real time are more slightly common due to how capacity is set and flow is not measured at the node at Finland or Estonia but rather a perceived mid-point flow. Due to this, slight changes in network flows around interconnector nodes might cause congestion in real time. Furthermore, the interconnector was operating at a reduced capacity for most of 2023 due to thermal issues.

Future development

The transmission needs within the Finnish BZ are expected to significantly increase, although grid reinforcements are planned to answer these needs.

2025

A new transmission line – known as the Aurora line – shall be commissioned in 2025 between the Finnish and SE1 areas. The commissioning of this transmission line increases the capacity between the two areas and will add more reinforcements to the internal Finnish network.

The direction of congestion has changed and might do so more significantly in the future since an increasing amount of wind power is being added to the Finnish network. As such, on windy days congestion might increasingly occur in the export direction and even in the internal network, especially for individual CNEs.

2030

The cross-border capacity between Finland and Sweden is not expected to change between 2026 and 2030 after the commissioning of the Aurora line. Fenno-Skan 1 HVDC (FI–SE3) was previously expected to reach the end of its service life by the end of 2020, although after investigations by Fingrid and Svenska kraftnät, it has been decided that the link's service time shall be extended until 2040. It is not anticipated that there will be any need to strengthen the links between Finland and Estonia until 2030. The expectations are dependent on the operational environment of the electricity markets and will be investigated in greater depth in different international grid planning platforms. From a long-term perspective, Fingrid sees a need to reinforce connections to both Sweden and Estonia, most likely during the 2030s. Fingrid plans to further investigate its options in the ENTSO-E TYNDP process.

2.3.9 France

Capacity calculation

Exceptional power system conditions and situations of planned outages are not removed from the frequency levels.

The FR–ES area can be qualified as congested. RTE and Red Eléctrica have committed themselves to a high level of grid investments, with projects such as the PST of Arkale in 2017. The Biscay Gulf project – whose commissioning is planned in 2028 – should almost double the cross-zonal capacity between France and Spain. Argia–Hernani new cables will have a higher transit capacity, making it possible to increase exchange capacity.

Furthermore, the go-live of the coordinated capacity calculation has maximised the exchanges between France and Spain since the beginning of 2020.

On the FR–IT border, a few active constraints can be noted, created by the PST optimisation. A new high voltage direct current (HVDC) line between France and Italy ('Savoie-Piémont') was commissioned in November 2022 and has increased the cross-zonal capacity of the North Italian border.

On the FR–BE border, two active constraints can be noted in 2022 due to works on neighbouring elements.

The occurrence of all the other active constraints in France is very low (under 0.69 %), meaning that they cannot be qualified as structural or major. Nevertheless, RTE maintains its investment in the whole territory in anticipation of potential future congestions.

RTE is using mainly preventive and curative topological remedial actions to maximise cross-border capacities and solve congestions, enabling:

- Flexibility: In particular, the curative topological remedial actions are only used in real time and only if the congestion actually occurs (integrated and identified in D-2 and D-1/ID processes). For instance, the use of redispatching requires activating generation units several hours before the occurrence of the congestion.
- Cost-effectiveness for France and neighbouring countries, which is therefore also beneficial for the European end consumers since the topological remedial actions reduce the use of costly remedial actions, whose costs are shared with France's neighbouring countries.

In order to use preventive and curative topological remedial actions, RTE has invested in substations (busbars, couplers) and developed operational rules that allow its operators to manage the congestions efficiently and close to the limits.

Day ahead

Network congestion data during the short-term operational planning (or D-1 congestion) are partial data and correspond to the constraints detected in D-1, for which costly preventive measures have been implemented to manage the constraints in real time.

Other D-1 congestions are significantly reduced by the application of topological measures and preventive remedial actions.

For the rare grid elements for which a constraint required a costly preventive measure, the frequency never exceeds 0.78 % and is rather low over the years. Therefore, they cannot be considered as structural or major physical congestions.

Close to real time

RTE reported the N violations close to real time. The frequency of such violations is very low (below 0.8 %) and they are solved in a few minutes with topological modifications as remedial actions (costly remedial actions with generation redispatching are almost impossible to solve this kind of violations in less than around fifteen minutes). Therefore, they cannot be considered as either structural or major physical congestions.

Future development

2027

Reconductoring of the existing 400 kV OHL Argia–Cantegrit and Argia–Hernani for maintenance reasons. As the new cables have a higher transit capacity, they will make it possible to increase exchange capacity when these lines are critical branches.

2030

Creation of a new 400 kV line between Chaingy and Dambron and reconductoring of existing 400 kV lines between Marmagne and Tabarderie to face increasing flows between the west of France (development of onshore and offshore RES, increase of exchange capacity with Spain) and the Paris region (increased load).

Reconductoring the existing 400 kV line between Breuil and Marmagne for maintenance reasons and to face increasing flows between the south and north of the Massif central (development of RES in the south, increase of exchange capacity with Spain, increase of hydropower and pump storage capacity in the Massif central area).

Reconductoring one of the existing 400 kV lines between Cantegrit and Saucats (solar integration in the south-west of France, increase of exchange capacity with Spain).

Connection of the existing 400 kV line between Plessis Gassot and Villevaudé to the substation of Sausset to balance the flows on the lines in the area (development of nuclear and offshore production along the Normandy coast, increase of load in the Paris region, increase of exchanges with Germany).

2033

In the most recent network development plan published in 2019, four "areas of fragility" that could require structural reinforcement were identified. In these four areas, certain reinforcement needs have been confirmed and projects have been launched. These are the reinforcements cited for the 2030 time horizon. Studies are currently being carried out as part of a new network development plan, which should be published by the end of 2024, identifying the areas of fragility that could require structural reinforcement beyond 2030.

2.3.10 Germany

Being centrally located at the heart of Europe's power grid, Germany plays an integral role in the continent's electricity transit, facilitating significant east–west and north–south power flows. The period from 2021 to 2023 has been marked by notable changes in Germany's electricity exchanges with its neighbouring countries, driven by evolving load patterns, shifts in generation capacities, and the impacts of the 2022 energy crisis, which underscored the need for a robust and adaptable grid.

The power generation sector in Germany is facing a substantial transformation. There has been a marked reduction in nuclear, lignite, and hard coal generation as the country has increasingly shifted towards RES. This transition has been accelerated by the 2022 energy crisis, highlighting the urgent need for a more resilient and flexible energy system. The majority of congestions within the German power grid occur when there is high renewable energy generation in the northern regions and when Germany exports electricity southwards to countries such as France (especially when the availability of French nuclear generation is low, as seen in 2022), Switzerland, and Austria. These scenarios often result in congestions along crucial north–south and northeast–southwest corridors. A further reason for congestions is outages of elements due to grid construction in the area.

In northern Germany – particularly in regions such as Emsland – high capacities of offshore wind farms lead to network congestion. This congestion is highly weather-dependent, varying with the annual wind profile. Besides several AC projects in this region, the national grid development plan includes many DC projects that will transport electricity generated by wind farms to the load centres in the future and thus reduce the pressure of the electricity grid in northern Germany.

Central Germany faces congestion challenges due to power flows from north to south and east to west, largely driven by the high production of wind energy in the northern regions. In particular, 2022 saw an increase in congestion – notably in the Rhine–Main area – as higher exports to France during the energy crisis exacerbated the strain on the grid. Multiple grid expansion projects are in the pipeline to address such issues, aiming to enhance the system's capacity and alleviate congestion, ensuring a more reliable and efficient power supply.

Southern Germany faces congestion due to high solar feed-in, high electrification of demand, and cross-border energy flows, particularly with France, Switzerland, and Austria.

To tackle these challenges, German TSOs are continually reviewing and optimising grid expansion projects as part of the national grid development plan (Netzentwicklungsplan). Innovative measures such as dynamic line rating are being implemented to enhance grid utilisation efficiency, aiming to address congestion and improve the overall efficiency of the power grid. Active constraints in Germany regarding DA capacity allocation have significantly evolved from 2021 to 2023. These changes have been influenced by targeted grid expansion projects and the implementation of minimum capacities as per Regulation (EU) 2019/943 and the German Action Plan initiated in early 2020.

Despite some challenges, overall congestion in Germany close to the real-time phase has decreased over the observed period, thanks to targeted grid expansion projects and more efficient grid utilisation. The introduction of minimum capacities has shifted some congestion but also driven the need for continuous optimisation of grid management strategies.

Looking forward, German TSOs are committed to reviewing and optimising planned grid expansion projects to tackle both current and forecasted congestion. Major investments – approved by the German regulatory authority and often anchored in German law – include various internal and cross-border projects such as new lines and reinforcements. These projects aim to significantly resolve internal congestion. Notably, several internal HVDC links are planned or under construction to transport wind energy generated in the North and Baltic Seas to major consumption centres in western and southern Germany. These efforts are crucial in addressing the primary causes of historically observed congestion. In addition, several further PSTs will be put into operation in the near future.

Figure 12 shows the most congested grid elements and interconnectors in Germany, as well as the onshore HVDC projects that will go live within the next ten years according to the national grid development plan. Each of these HVDC links has a transmission capacity of 2 GW, making it possible to transmit wind energy from northern to western and southern parts and thus relieve the stress from the congested elements shown. Additionally, the national grid development plan includes several offshore HVDC (directly connecting demand regions to offshore wind energy) and AC lines to be built in the next ten years, which will also have positive effects on grid congestion. These are not included in the figure for readability reasons.

Appendix 1 provides a detailed assessment of the most congested grid elements, including the future year in which they are expected to be solved. Please note that the F-value provided indicating the type of flows should be treated with caution as it only refers to time intervals with active constraints, which can be as low as one or two hours.

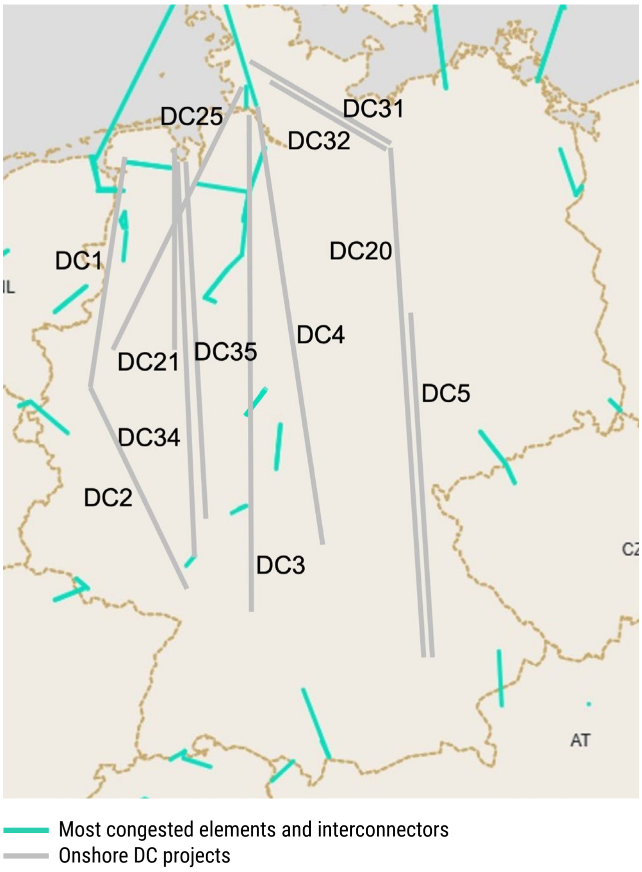


Figure 12: Map of Germany's most congested elements and interconnectors (see Appendix 1) and onshore DC projects going live within the next ten years according to the national grid development plan

2.3.11 Greece

The frequency of congestion on the reported interconnection lines has varied over the reported period. Notably, the second line between Bulgaria and Greece – in operation since mid-2023 – led to a significant decrease in active constraints by the end of 2023.

On the 400-kV Bitola (MK)–Meliti (GR) tie line – which is also a BZ border – commercial congestion predominantly affected Greek imports during the DA timeframe in both 2022 and 2023. These congestions were more intense in periods from April to May 2022 and December 2022 to June 2023. The additional capacity brought by the new BG–GR connection has alleviated many of these constraints.

The 400-kV Dubrovo (MK)–Thessaloniki (GR) tie line – which is also a BZ border – experienced low levels of commercial congestion in both 2022 and 2023, primarily during maintenance outages on the Bitola–Meliti line. While relatively infrequent, these constraints also affected Greek import capacity, highlighting the importance of coordinated infrastructure and maintenance strategies to minimise bottlenecks in the regional grid.

Similarly, the 400-kV Babaeski (TR)–Nea Santa (GR) tie line – which is also a BZ border – was commercially congested for limited hours in 2022, with such occurrences related to Greek imports. A second GR–TR line is planned and expected to significantly enhance cross-border trade between the two countries and further reduce congestions.

Future evolution

2027

The operation of the line Bitola (MK)–Elbasan (Albania) could reduce the loading of the line Bitola–Meliti line, which is a frequent critical network element determining the amount of Greek imports/exports.

2030

A new DC connection of 1,000 MW among Cyprus, Greece, and Israel shall be developed.

2033

A second line between Greece and Albania will be developed, which will release the currently existing high flow between Greece and Albania due to the existence of one line and further increase cross-border trading between the two countries.

A second line between Greece and Turkey will be developed, which will further increase cross-border trading between the two countries.

A second line between Greece and Italy will be developed, which will further increase cross-border trading between the two countries.

A new DC connection of 1,000 MW among Cyprus, Greece, and Israel shall be developed.

A new line between Greece and Egypt shall be developed, as well as new lines with Germany and Saudi Arabia.

For all years, the investments are approved by the Greek regulator in the framework of the ten-year national grid development plan. Information on the already planned projects is included in the most recent ENTSO-E TYNDP regional investment plan for the Southeast Europe (SEE) region.

2.3.12 Hungary

Capacity calculation

The congestions in the Hungarian system during this timeframe are concentrated in the northern part of the network. This congestion area comprises cross-border lines and those directly connected internal lines at the Austrian, Slovak and Ukrainian borders. In a broader sense, this area is part of the so-called Central Eastern European (CEE) profile, which is a structural bottleneck between the northern and central parts of Central Eastern Europe. This profile comprises the tie lines between Czech Republic and Austria, Slovakia and Hungary, and Slovakia and Ukraine. In Hungary, constraints of this profile limit market exchanges mainly on the AT–HU and SK–HU borders, thus representing the main active market constraints in the country. When the market exchanges are limited, mostly the two cross-border lines to Slovakia and the 220 kV circuits in the western part of Hungary (one line, a partly double-circuit running over several substations from the centre of the country over the border towards Austria) set the limits. Other lines limit less frequently, usually in maintenance situations when one or several lines are not available in the area. The constraints have been relatively stable (very similar to the previous period) and no constraints have gained or lost importance in a significant manner.

Day ahead

Based on the capacity calculation timeframe situation, congestions can be expected in the northern part of the Hungarian power system. As the market reaches the limits set by network constraints in the region, unscheduled flows and loop flows can cause overloads. These flows cause overloads in various situations in the northwestern part of the Hungarian network, where the tie lines to Austria and Slovakia are concentrated and interdependent. Overloads in this region have been relatively stable.

Other internal overloads are concentrated in the 220 kV network in the western region due to the effect of the higher transit flows on these elements in case of maintenance.

In the aforementioned cases, there were topological measures available to reduce the loading of the affected lines.

Close to real time

The real-time congestions presented for the Hungarian network cover violations of the 100 % thermal limit in the real-time contingency analysis of the SCADA system, corresponding to the permanent admissible thermal limit of the network elements. According to the security policy laid down in the grid code, overloads in the N-1 case do not necessarily imply the violation of the system security as long as the temporary admissible thermal limit is not exceeded, and topological measures are available to reduce the loading of the overloaded lines. These measures are considered curative actions, which means that they are only activated if the contingency situation actually occurs. The temporary limits for the transmission network were not exceeded in real time, and curative measures were always available to mitigate violations of the permanent limit.

Real-time violations correlate with the congestions identified in the D-1 timeframe, which means that forecasts are generally in line with the real-time experience. There were several violations that only appeared in real time, although they had a very limited frequency of only a few hours per year.

Future development

2025

Based on the Hungarian NDP and the TYNDP, the congestions related to AT–HU and SK–HU cross-border lines are expected to remain in the mid-term time horizon. These results from congestions in the Austrian 220 kV and SK grids.

2030

The congestions related to AT–HU and SK–HU cross-border lines are expected to remain in the mid-term time horizon, resulting from congestions in the AT 220 kV and SK grids. Looking over a longer horizon, it can be concluded that only partial remaining congestions are expected on the AT–HU cross-border lines. HU–SK congestions are expected to improve due to Slovakian internal investments and the new Sajóivánka-R. Sobotá second circuit cross-border line (by the end of 2027).

2033

No remaining congestions are expected after the commissioning of new internal 400 kV investments in the Austrian grid, although significant changes are foreseen in the generation portfolio after the commission of Paks2 NPP and a very significant increase in installed PV capacities, leading to high export flows on several borders for a large number of hours.

2.3.13 Ireland and Northern Ireland

Capacity calculation

The single electricity market (SEM) on the island of Ireland and the BETTA market arrangement in Great Britain are not coupled at the DA stage. Scheduled flows on the HVDC interconnectors are set by the intra-day market gate closures. The scheduled flows do not change from IDA schedules to different flows at real time unless the TSOs countertrade for security or priority dispatch on market firm schedules.

Net transfer capacity can be reduced at times for adequacy reasons to prevent interconnector flows that are likely to cause either or both Ireland and Northern Ireland to enter a system alert (amber) state or mitigate the severity of a probable system alert (amber) or system emergency (red) state in either jurisdiction. This is the driving cause for the level of NTC reduction observed in 2022.

The cause of congestion after market allocation is the price differential between the SEM and the BETTA market arrangement in Great Britain to 'fill up' the two HVDC interconnectors, usually Moyle first as it has fewer losses.

Day ahead

No structural congestions on the grid were identified in this timeframe.

Close to real time

No structural congestions on the grid were identified in this timeframe.

Future development

For the Moyle interconnector (500 MW capacity), maximum export from Northern Ireland to Scotland is 400 MW due to SONI constraints. For 1 April to 31 October, import from Scotland to Northern Ireland is 450 MW but might be reduced to 410 MW under certain system outage conditions. For 1 November to 31 March, import from Scotland to Northern Ireland is 450 MW.

For the Greenlink interconnector (500 MW capacity), a new HVDC interconnector is planned from Ireland to Great Britain and is expected to be completed by 2024/2025.

For the Celtic interconnector (700 MW capacity), a new HVDC interconnector is planned from Ireland to France, expected to be completed by 2026

2.3.14 Italy

Italy is divided into seven BZs, five on the continent and one each for the islands of Sardinia and Sicily. Sardinia is connected to the continent by two different BZs, via two HVDC connections.

Almost all congested elements identified (CNECs) belong to cross-border sections. This configuration based on several BZs allows congestions to be already intercepted in the D-2 phase, meaning that the percentage values for the D-1 and real-time phases are typically lower. The values in D2CC correspond to the limiting CNECs in the DA capacity calculation frame.

A declining tendency in the congestion values is typically observed between 2021 and 2023, usually due to improvements made to the conductors.

Development works are planned for almost every section over the next ten years.

Capacity calculation

Active critical branches in the Italian power system are presented for all existing BZ borders, including internal Italian BZs.

The frequencies of critical branch activations are stable over the aforementioned periods:

- The main limiting sections are between Sicily and Sardinia (IT5 and IT6) and continental Italy.
- At the continental level, the most binding section is between IT2 (Italy Central North) and IT3 (Italy Central South), where there are congestions for some 220 kV link elements, as well as voltage constraints in N and N-1 (about 10 %, not represented in the maps).
- Various elements limit the section between IT3 (Italy Central South) and IT4 (Italy South) due to outages of grid elements.

Day ahead

The congestion level in the Italian power system is stable during the D-1 timeframe, with a significant reduction relative to the CCDA.

Most of the congestions detected at the D-1 stage are linked to:

- Cross-border flows between internal BZs, which are expected to exceed the NTC value due to the application of improved load and RES infeed forecasts in the D-1 stage from the Terna side.
- Local congestions within BZs and close to metropolitan areas.
- Different load and generation distribution compared to the capacity calculation process.

Close to real time

The real-time congestion level for elements in the Italian power system is derived from an online system security assessment (considering the N-1 security criterion) performed on state estimation results.

The main congested areas in the last three years (with at least one element with a frequency higher than 10 %) are as follows:

- Congestions close to the AT–IT and SI–IT borders that appear when high import flows are observed from the eastern countries. These congestions can be solved by managing the PSTs' tap positions and they are also mitigated by special protection schemes at the border.
- Congestions on the 220 kV grid close to the IT1–IT2 border, which are observed when high flows on this border appear simultaneously with high load conditions in this area. They are solved by applying proper topological schemes.

Future development

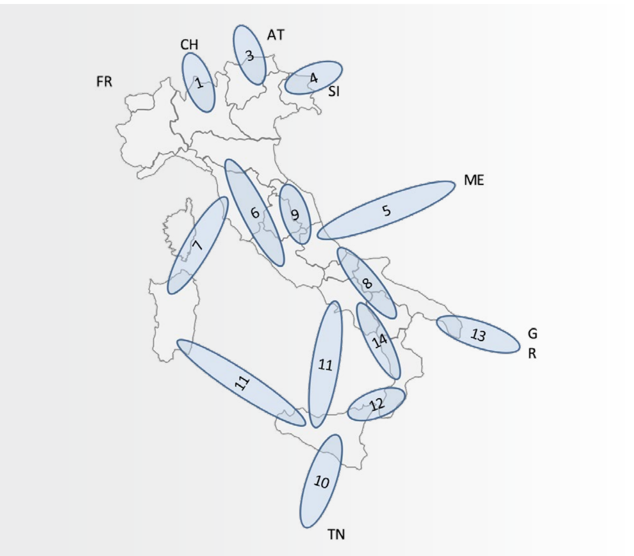


Figure 13: Future grid improvements areas

2027

A new 400 kV OHL line from Calenzano to Colunga (Area 6, replacing the existing 220 kV line) will increase transmission capacity between Italy North (IT1) and Italy Central North (IT2), also relieving the congestions observed in recent years.

- Adriatic link: the measures to remove the limitations envisaged along the 220 kV power lines on the central-south and central-north sections and the creation of the HVDC Adriatic link will allow an increase in the exchange limit on the central-north/central-south section and the central-north/north section (Areas 6 and 9).
- Basilicata–Campania reinforcement + southern Italy + Aliano-Tito-Montecorvino: The construction of the Foggia–Villanova, Montecorvino–Benevento III, and Aliano–Montecorvino 380 kV lines in the area north of Benevento will make it possible to increase the exchange limit on the south/centre-south section (Area 8). Furthermore, developments in Area 14 will increase the exchange limit between IT7 (Calabria) and IT4 (south) and therefore the transit of energy produced by the plants located in Calabria towards the centres of consumption located in Campania and central Italy.
- The repowering of the existing HVDC link between the Italian mainland, Corsica, and Sardinia (SACOI3) will also enhance the interconnection between Sardinia and Continental Italy (Area 11).
- The Tyrrenhian link project will create new interconnections between Sicily and Sardinia islands (IT5–IT6) and between Sicily and centre–southern Italy (IT5–IT3). The new interconnections allow containing the congestions in those market areas as the new cable connections represent a further possibility for the transit of energy from the south to the north of the country, with notable benefits in the ancillary services market and RES integration.
- A new interconnection between the Valchiavenna area (Italy North) and Switzerland is planned.

2030–33

- A further increase in the available transmission capacity at the northern Italian border is expected due to the new Salgareda–Divača (Area 4) HVDC link.
- Two new HVDC links are also planned between Italy and Tunisia (Area 10).
- The implementation of the HyperGrid project will make it possible to increase the exchange limits between the internal areas of Italy's continental area as the new HVDC connections represent a further possibility for the transit of energy from the south to the north of the country, with notable benefits in the ancillary services market and RES integration.

2.3.15 Latvia

Latvia does not have major congestions.

2.3.16 Lithuania

Appendix 1 provides a comprehensive expert assessment for Lithuania, including a map to identify the major congestions.

2.3.17 Luxembourg

Appendix 1 provides a comprehensive expert assessment for Luxembourg, including a map to identify the major congestions.

2.3.18 Netherlands

The most critical congestions are observed on the Meeden–Diele network element, which is an interconnector between the Netherlands and Germany. Congestions have been observed as often as 25 % of all market time units (MTUs) in 2023. Furthermore, about 60–78 % of this network element's physical capacity is occupied by loop flows from Germany (for MTUs where congestions were active during the capacity calculation, based on 2023 data). In the next ten years, there are no plans to expand the physical capacities of this network element.

The congestions on Meeden–Diele first appear during the capacity calculation and are carried over to market coupling during DA, thus often limiting the operational efficiency of market coupling. Although the overloads are solved with the application of (costly) remedial action, the interconnectors consequently remain fully loaded, thereby continuing to limit the cross-border intra-day market. For market participants in the Netherlands, this directly limits cross-border trading opportunities during the intra-day market. Close to real time, congestions appear on a frequent basis, which means that the remedial actions applied to solve the overload are insufficient and/or loop flows have become worse as a result of trades occurring during the intra-day market that do not consider cross-zonal capacity, e.g. trades taking place within another BZ.

Congestions on CNEs other than Meeden–Diele have less impact on market functioning. For more details, please see the full expert assessment in Appendix 1.

2.3.19 Norway

Before going live with the FB approach, Statnett does not have the necessary data on the requested timeframes. FB market coupling went live in the Nordics on 29 October 2024, and Statnett's goal is to provide more data for the subsequent technical reports.

2.3.20 Poland

The most frequently congested elements are as follows:

- DC-LINK-Słupsk–Starno: Connection from Słupsk to Starno substations
- 400-kV-Wielopole–Nosovice: Interconnector to Czech Republic
- BtB-Elk–Alytus: Connection from Elk to Alytus substations

Capacity calculation and close to real time

The Wielopole–Nosovice interconnector is strongly influenced by loop flows from Germany and further towards Czech Republic. Congestion is most prominent in the DA timeframe. In the intra-day timeframe, congestion remains noticeable, albeit less so than in DA. However, in real-time operations, it is often possible to resolve the congestion using topological remedial actions.

The PL–SE and PL–LT DC connections have no data for the D-1 and real-time timeframes. For the D-2 timeframe, it should be emphasised that energy prices in the Nordic region are often lower than in Poland. This has led to considerable interest from market participants in the SE–PL direction, as well as transit from Sweden via Lithuania to Poland or further to other Polish neighbours.

Future development

All investments reduce the number of limiting internal lines active constraints in DA capacity allocation, as well as the frequency of internal line congestions in and close to real time timeframes.

The following are planned after 2030:

- Upgrade of the AC/DC Słupsk converter station.
- Construction of new 220 kV lines from Podborze substation towards the Kopanina–Liskovec line, from Podborze substation towards the Bujaków–Liskovec line, from Podborze substation towards the Bieruń–Komorowice line, and from Podborze substation towards the Czeczott–Moszczenica line, and 400 kV lines from Podborze substation towards the Nosovice–Wielopole line and from Podborze substation towards the Dobrzeń–Detmarovice line, together with construction of the 400/220/110 kV Podborze substation.
- The planned Harmony link between Poland and Lithuania will reduce congestion on this border and boost overall transfer capacity.

2.3.21 Portugal

Capacity calculation

REN does its utmost to provide maximum capacity to the market and the main congestions of the Portuguese system in this timeframe are associated with outages.

There are no relevant active market constraints on the REN network elements monitored in the ES–PT DA capacity calculation. The rate of price convergence between the Spanish and Portuguese BZs is 94.7 %, meaning that the Spanish and Portuguese BZs only presented different DA prices in 5.3 % of the total hours in 2023. The commissioning of the new ES–PT interconnection line will solve the detected congestion.

Day ahead

In the Portuguese system, the D-1 congestions in this timeframe were mainly due to grid outages.

Close to real time

In the Portuguese system, the real-time congestions in this timeframe were mainly due to outages combined with forecast errors in meteorological conditions and forecast generation.

Future development

2027

It is expected that the future new interconnection between Portugal and Spain in the northwest part of Portugal – foreseen for 2025 – will solve the current angle deviation restrictions that occur in that area. This reinforcement will increase the NTC with Spain to higher values in both directions (ES–PT and PT–ES).

In the northern region of Portugal, a high volume of hydropower plants have already been installed. Therefore, in wet conditions, some constraints could occur in the internal Portuguese network and in the northeast PT–ES interconnection, although these constraints should not significantly affect market operations.

2030–2033

With the foreseen massive increase in solar power plants in the south of the Iberia peninsula, some constraints can appear in the south interconnection lines between both countries and/or in the internal network of each country. This situation must be accompanied by both TSOs taking into account the actual installation of those solar power plants to minimise and find measures to overcome possible current and voltage restrictions.

2.3.22 Romania

Appendix 1 provides a comprehensive expert assessment for Romania, including a map to identify the major congestions.

2.3.23 Slovakia

Capacity calculation

The most limiting elements for the capacity calculation based on the FB approach are located on the CZ–SK, SK–HU, and SK–UA borders, as well as the internal grid. The reasons for congestions are mainly related to the following two factors:

- Internal flows that are loading the lines, especially those located in the vicinity of the nuclear power plants, which can lead to a reduction of the MACZT.
- The transit flows from the northern part of Europe towards southern Europe (specifically Hungary and Balkan countries).

The most frequently presolved elements are:

- Nosovice–Varin/N-1 Krizovany–Sokolnice
- Levice–God/N-1 R.Sobota–Sajóivánka
- V.Kapusany–Mukachevo (WPS)/N-1 R.Sobota–Sajóivánka
- V.Dur–Levice 1/N-1 V.Dur–Levice 2

Day ahead

Congestion is heavily dependent on the market outcome based on the capacity calculation process. As for the capacity calculation, we have listed four elements that are presolved (limiting the FB domain), although it does not mean that their remaining available margin will be fully allocated by the market parties during the market coupling session. The element that has most frequently assigned the shadow price is V.Dur–Levice 1/N-1 V.Dur–Levice 2, as this element is loaded by both internal and transit flows, which can lead to the price in the Core region.

Close to real time

Real-time congestions are considered those that violate the permanent admissible thermal limit defined in our SCADA system. In the case of violation, SEPS usually activates the topological measures at its disposal based on the topology. The most severe congestion is on the V.Dur–Levice 1/N-1 V. Dur–Levice 2 element, which is the result of the allocation mentioned above.

Future development

The following information is in accordance with the 2024–2033 TYNDP.

2027

Planned doubling of the existing 400 kV cross-border line to Mukachevo (Ukraine), whereby the most optimistic realisation is by 2027.

2030

Internal congestion problems around the Levice substation should be solved by planned changes by 2029. There is a discussion on the possible doubling of the 400 kV cross-border Rimavská Sobotá (SK)–Sajóivánka (HU) line after 2030.

2033

There is a discussion on the possible doubling of the 400 kV cross-border Rimavská Sobotá (SK) –Sajóivánka (HU) line after 2030.

2.3.24 Slovenia

Appendix 1 provides a comprehensive expert assessment for Slovenia, including a map to identify the major congestions.

2.3.25 Spain

Congestions in Spain are anonymised due to their classification as sensitive critical infrastructure protection-related information as per the CACM and national legislation.

Capacity calculation

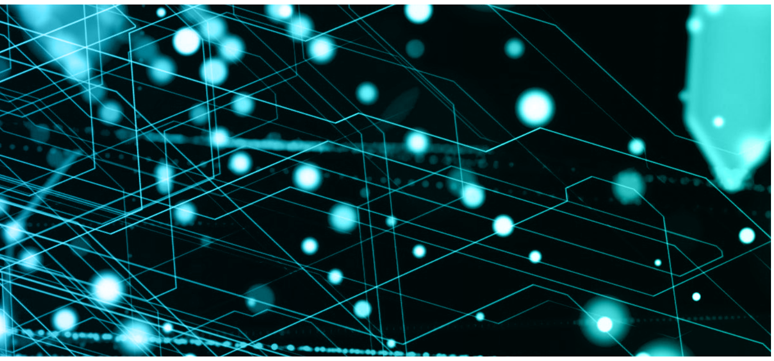
There are no relevant active market constraints on the Red Eléctrica network elements monitored in the ES–PT CCDA, as demonstrated by the high rate of price convergence between the two BZs in the DA timeframe (e.g. the Spanish and Portuguese BZs only presented different DA prices in 5.3 % of the total hours in 2023). For 2023, Red Eléctrica observed only two active market constraints on the ES–PT border, the first one located on the Duero interconnection line with a frequency of less than 1 % (400-kV – ES_L47) and the second one on the southern interconnection line with a frequency of 1.7 % (400-kV – ES_L46).

There are more active market constraints on the network elements monitored in the ES–FR CCDA, limiting cross-zonal trade through the ES–FR BZ border. Therefore, the western interconnection lines on the ES–FR border can be qualified as the only congested area within the Spanish BZ.

These active market constraints on the western interconnection lines reached frequency values of 8.7 % (400-kV – ES_L1), 12 % (220-kV – ES_L3) and 16.8 % (220-kV – ES_L2) for 2023. Since early 2022, the SWE coordinated capacity calculation has maximised the exchanges between France and Spain to comply with the objective of 70 % set forth by Regulation 2019/943, increasing congestion in the interconnection. It is planned that the relevant congestion in the western zone of the ES–FR BZ border shall be solved with the commissioning of the new HVDC link between Spain and France through the Bay of Biscay, which will increase the cross-border capacity between these countries.

Day ahead

Many congestions observed in D-1 do not appear at the CCDA stage since they are not included in the critical elements monitored in the CCDA, because they do not present any relevant sensitivity to cross-border exchanges.



From 2021 to 2023, most relevant congestions observed by Red Eléctrica in D-1 showed an upward trend in frequency over the years due to the gradual increase in renewable energy – especially solar photovoltaic – in central and south-west Spain. The key CNEs under this assumption are 220-kV – ES_L5, 220-kV – ES_L9, 220-kV – ES_L11, and 400-kV – ES_L16, as noted in the most congested grid elements (see Appendix 1).

The possible non-costly measures applied are topology measures and advanced tools to maximise grid use by applying swift remedial actions (run-back automatism) to avoid initiating redispatching and redispatch as a last resort. Thus, this large portion of the active power flow on these CNEs is internal flow to evacuate the large amount of photovoltaic generation installed in that area.

Furthermore, this congestion is highly seasonal and mainly occurs in the summer months, when the photovoltaic production is higher and the capacity values of the electric lines is lower. In this aspect, Red Eléctrica started using monthly capacity values instead of a seasonal approach in 2024, optimising the use of the grid.

A similar situation of high penetration and associated increased congestions during 2021–2023 can be observed with wind power in northern and northeastern Spain. The majority of the active power flow on these CNEs is internal, facilitating the evacuation of the significant wind generation capacity installed in the region. The current measures to address these issues include topology measures and advanced tools designed to maximise grid use by implementing swift remedial actions (run-back automatism) to prevent the need for redispatching and redispatch as a last resort. The key CNEs under this assumption are 220-kV – ES_L10, 220-kV – ES_L12, 220-kV – ES_L13, 220-kV – ES_L14, and 400/220-kV – ES_L15, as noted in the most congested grid elements.

Close to real time

There are no relevant congestions in real-time operation. In general, the frequency of congestions – typically caused by unexpected events or operational situations – has remained below 6 %. Additionally, some congestions are influenced by the variability in the forecast of wind generation.

These congestions are managed using topological measures and either counter-trading or redispatching measures, depending on the affected elements. Since 2022, the implementation of advanced tools has enabled Red Eléctrica to maximise grid use by applying swift remedial actions (run-back automatism) to prevent the need for redispatching.

Future development

2027

Most current congestion will be solved by the commissioning of the new reinforcements included in the current 2021–2026 national network development plan for the transmission grid and will relieve overloads thanks to uprate of lines mostly in the northeast and south of Spain by 2026. Delays in the commissioning of reinforcements in other areas will cause some identified congestions to remain.

The commissioning of a new ES–PT interconnection increases the NTC at the border and will relieve congestions at the ES–PT border.

2030

New reinforcements linked to the development of future new solar and wind installations will require reinforcements that are not included in the current national network development plan. However, a new version of the plan is being developed, which will solve these congestions.

The commissioning of the new ES–FR Gulf of Biscay interconnection (in 2028) increases the NTC at the border and will relieve congestions at the ES–FR border. Nevertheless, some new developments in north region of Spain will be necessary to solve congestions associated with the ES–FR border and strengthen the grid before the commissioning of this new interconnection.

2033

Commissioning of the new HVDC interconnections with France, Navarra–Landes, and Aragón–Atlantic Pyrenees will increase the capacity and change flow patterns at the ES–FR border up to 8 GW. These interconnections are considered a measure to achieve the NECP in Spain. Potential further internal reinforcements in line with future scenarios will be studied and included in future network development plans to achieve the 8 GW of ES–FR interconnection capacity. However, due to the rapid development of new RES facilities in the Iberian peninsula, studies already show that price differences at the ES–FR border will still be substantial even after the commissioning of the above mentioned projects to achieve the energy and climate goals set for Spain and Portugal.

2.3.26 Sweden

Capacity calculation

Due to national legislation, data on congestions for the respective timeframes cannot be provided for Swedish network elements, and consequently no expert assessment is provided.

Future development

2027

A third AC line providing an additional 800 MW will be built between SE1 and FI to increase transmission capacity and robustness and is expected commission in 2025–2026.

Renewal and upgrading on multiple lines between SE2 and SE3 to increase the capacity between SE2 and SE3 primarily due to the need to relieve existing and increasing congestions and connect land-based wind power is planned to be carried out between 2024 and 2028.

A new power line will be built between SE3 and SE4 to ensure the operation of the NordBalt line and meet regional demand, and is currently in the planning stage.

Reinforcement with a power line in SE3 is planned to relieve internal congestions (West Coast corridor) and meet increasing demand in the region of Gothenburg.

A new power line will be built in SE4 to increase transmission capacity and enable the connection of offshore wind power.

A new power line will be built in SE1 to meet the increasing demand for electricity.

2030

Due to increasing electricity demand in the Stockholm area, 220 kV lines are being replaced with 400 kV lines, with a commission date from 2023 to 2030.

New 400 kV lines will be built between SE2 and SE3 due to the need to relieve existing and increasing congestions and connect land-based wind power.

New lines will be built in SE2 and SE3 to relieve internal congestions and increase long-term capacity between SE2 and SE3.

A new power line is under consideration to meet the increasing demand for electricity in western SE3.

2033

Reinforcement with a power line in SE3 is planned to relieve internal congestions (West Coast corridor) and meet increasing demand in the region of Gothenburg.

Old power lines and new connections call for the reinforcement and renewal of multiple lines at 220 kV and 400 kV in SE2.

2.3.27 Switzerland

Capacity calculation

Swissgrid has concluded an agreement with the Italy North capacity region and participates in IN DACC and IN IDCC as a technical counterparty. The IT–CH border is the only northern Italian border that has no PST installed. Therefore, the possibility of controlling the power flows on the Swiss border is lower compared to the other borders, which makes it a frequently congested border.

There are currently no coordinated CC processes in place for the DE/AT–CH borders, so the cross-zonal capacities are determined in a bilateral way between the affected TSOs. The grid in northern Switzerland is highly meshed and the appearance of congestions is dependent on maintenance activities around the BZ border. Maintenance activities can lead to a decrease in the available cross-zonal capacity, especially in the planning phase. The occurrence of congestions in this area is influenced by national and regional characteristics. During the winter period, cross-zonal capacity is mainly limited by the PSTs in the northern Swiss grid or the 380 kV transit lines.

There are currently no coordinated CC processes in place for the FR–CH border, so the cross-zonal capacities are determined in a bilateral way between the affected TSOs. Congestions on the CH–FR border are highly dependent on the French import and export situation, which change based on the season and weather conditions.

Day ahead

The constraints on the IT–CH border are mainly the same in D-1 as in the CCDA timeframe.

Apart from the lack of PSTs, the high production capacity installed in the Swiss Alps – close to the Italian border – is also a worsening factor. Therefore, PST coordinates with the FR–IT and SI–IT borders, and pentalateral redispatches are very frequent. However, looking to the future, the commissioning of the FR–IT HVDC Grande-Ile Piossassco line and the change in the German production schemes (more often importing than exporting) should make it less problematic from 2024 onwards.

The installation of PSTs in the 220 kV Riddes line and the future 380 kV Chippis–Lavorgo line might also act as game changers in the area.

The flows at the DE/AT–CH border are still highly dependent on the French and German net positions, as well as the production/pumping scenario in Switzerland. The congestions on internal 220 kV lines are frequently worsened by high unscheduled FR–DE flows, especially when maintenance works are planned on these strategic axes (Mosses, Sanetsch, Gemmi). Depending on the scenario, the main congested elements are the 380 kV/220 kV PSTs or 380 kV transit lines.

The constraints on the FR–CH border are the same in the D-1 as in the CCDA timeframe. Despite the relatively lower frequency of occurrence over the observed period, the main cause of congestions on the FR–CH border remains the high export position of France, together with the pumping scenario in the Swiss Unterwallis region or German/Italian imports (unscheduled flows in this case). Planned outages close to the FR–CH and FR–IT borders also play a very important role. Good coordination with CORESO(RTE/Terna) is key but still takes considerable resources due to the numerous actors involved and the number of possible remedial actions, not all depending on Swissgrid (FR–IT PST coordinations, French 380/220 kV topologies).

Close to real time

The constraints at all Swiss borders are mainly the same in the real time as in the D-1 timeframe.

Future development

The realisation of the 2025 strategic grid should enable eliminating current congestions and accommodating large new pump storage devices (Nant de Drance and Linth–Limmern). The following list of investments should eliminate current and future congestions and is included (either implicitly in the grid model or explicitly in the projects) in the various TYNDP packages:

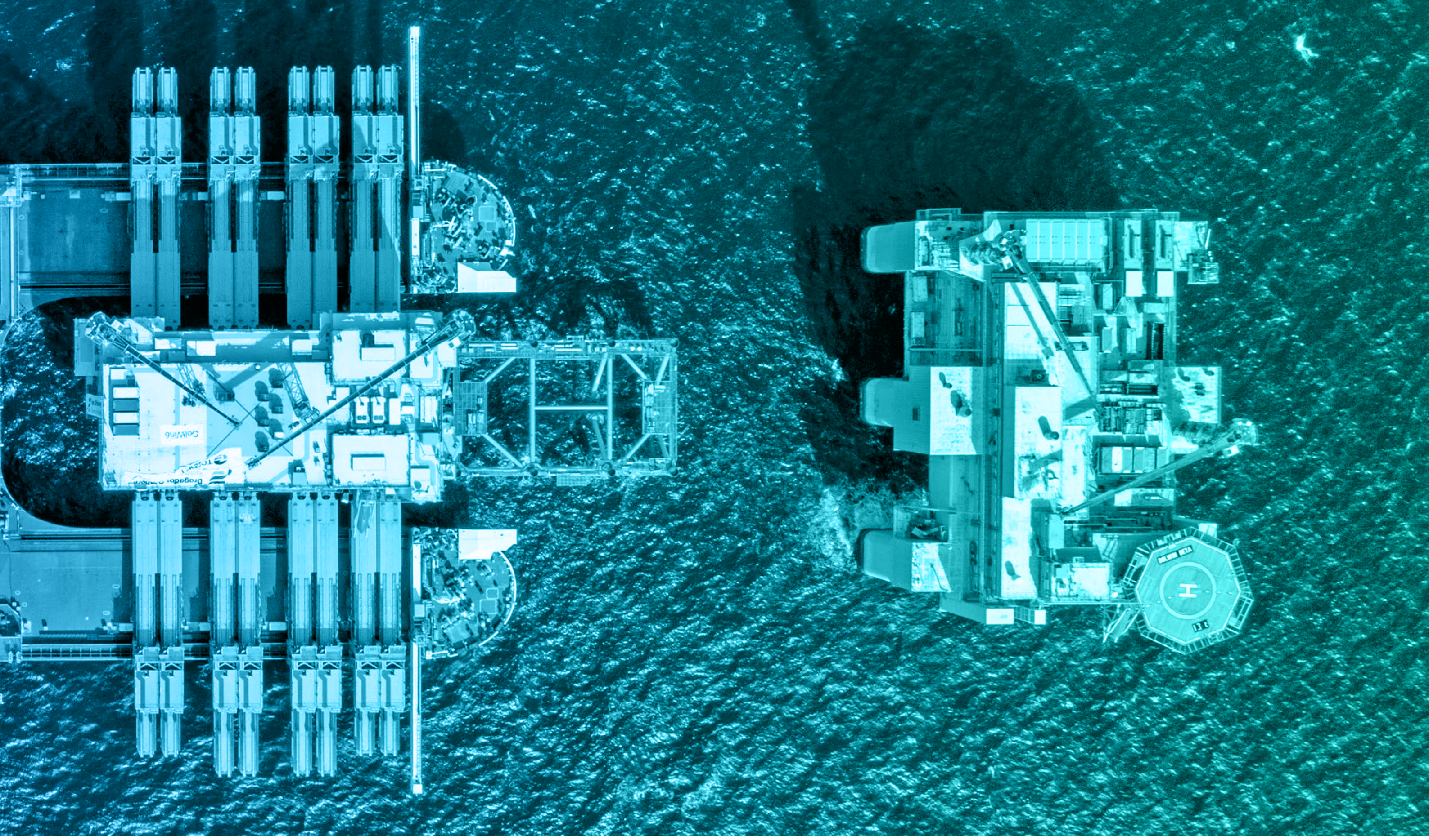
2030

Bickigen–Chippis: Optimisation of the existing route by voltage conversion to 380 kV.

2033

Beznau–Mettlen: Reinforcement of the existing lines between Beznau and Mettlen with 2 × 380 kV throughout and a minor grid extension.

Chippis–Lavorgo: Reinforcement by construction of a new 380 kV route including a new 380/220 kV transformer in Mörel.



2.4 Conclusions

This chapter provides an overview of congestions for the 'capacity calculation for capacity allocation', D-1 timeframe (operational planning after DA market closure), and Close-to-real-time stages, as well as the location and frequency of congestions.

In the 'Capacity calculation for capacity allocation', reported congestions with a relative high frequency are generally at BZ borders or in their direct vicinity. This is the case because only the grid elements with relevant sensitivity to cross-border exchanges are considered in the capacity calculation timeframe.

In the 'D-1 timeframe', the report identifies congested lines detected during the operational planning process, where TSOs check the DA market outcome for feasibility against the technical capability of the grid. In this timeframe, all grid elements are considered, irrespective of their cross-zonal relevance. Many lines with low congestion frequency are reported, while high-frequency congestions are reported for a relatively limited number of grid elements.

As far as the 'Close-to-real-time timeframe' is concerned, the collection of consistent data was challenging due to differences in TSO approaches to collecting and processing real-time operational data. Some TSOs provided incident data from real-time systems, while others reported all congestions identified up to one hour before real time.

Since these two types of data refer to different situations, two sets of real-time maps have been provided. Independent of the data reported for the real-time timeframe, the number and frequency of congestions is generally lower than in the D-1 timeframe because remedial actions have been applied to solve previously detected congestions.

With respect to the future evolution of reported congestions, TSOs' high-level expert assessments have been provided in this section (the detailed expert assessments can be found in Appendix 1). It should be emphasised that TSOs have extensive investment plans in place to address the congestions identified in the short- to medium-term timeframe, and that the changing congestions illustrate that the energy transition is well underway.

Finally, it is important to highlight that those congestions – even with a high frequency – do not automatically cause a loss of social welfare if the congestions are resolved by non-costly remedial actions, such as topological changes, flow-control devices, etcetera. Congestions that cannot be resolved using non-costly measures can potentially affect social welfare due to their impact on cross-border capacities (congestion on relevant cross-border lines identified during cross-border capacity calculation process and active during the allocation phase) or the need to apply costly remedial measures that are paid for in transmission tariffs by all grid users (congestion identified during D-1 and real-time stages).

3 Power flows not resulting from capacity allocation

This chapter assesses flows not resulting from capacity allocation based on the PTDF flow indicator. Section 3.1 details the calculation methodologies and general descriptions, before Section 3.2 provides an overview of the data used, Section 3.3 presents and comments upon the results.

3.1 Methodology

In addition to the PTDF indicator, a description is also provided for $F_{0,all}$ (and $F_{0,core}$), which are used to assess flows not resulting from capacity allocation in further detail.

3.1.1 PTDF flow indicator

This section describes the PTDF flow indicator. The consideration of power flows not resulting from capacity allocation is complex, and different indicators are possible. For this report, the same PTDF indicator calculated for the Market Monitoring Report (MMR) is used and described in this section. This PTDF indicator is widely accepted as an approximation of power flows that do not result from capacity calculation.

This indicator is based on the capacity allocation model of the internal zonal electricity market in Europe, assuming that:

Market transactions within each BZ are not limited (the zone is considered to operate as a 'copper plate').

- Market transactions between all BZs are limited through cross-zonal capacity calculation and allocation procedures.
- Flows not resulting from capacity allocation are computed as the difference between the physical flow measured and the flows computed at the BZs borders. In most cases, the BZ and member state borders are the same.

The equation is as follows:

$$PTDF\ flow\ deviation_b\ (h) = PF_b\ (h) - CF_b\ (h)$$

- PF_b ***(h):*** Cross-border physical flow measured over a given BZ border ***(b)***.
- CF_b ***(h):*** Calculated flow induced by all cross-border exchanges between all European BZs, i.e., estimation of export/import and transit flows.

To compare the measured cross-border physical flows $PF_b(h)$ and calculated flows $CF_b(h)$, it is necessary to transform the net position per BZ (via PTDF) into cross-border flows resulting from capacity allocation. This transformation considers the electric properties of the transmission grid from a common grid model.

The indicator calculates average PTDF flow deviations per border, providing a comparison between cross-border flows that are the result of the capacity allocation process and the physical flows measured on cross-border tie lines.

Hence, the indicator focuses on power flows not resulting from the capacity calculation (which are a subset of unscheduled flows) and it does not evaluate who is responsible for the PTDF flow deviations nor whether the PTDF flow deviations identified induce security issues.

$$CF_h = \left(\sum_{l=1}^{L=\text{number of BZ borders}} \begin{bmatrix} 1 & \cdots & k \\ \vdots & \ddots & \vdots \\ L & \cdots & . \end{bmatrix} \cdot \begin{bmatrix} 1 \\ \vdots \\ k \end{bmatrix} \right)$$

Sum of the flows created by all exchanges between BZs in the synchronous area at all BZ borders

PTDF matrix (resolution) per bidding zone)

Net positions of the relevant BZs

For each hour, the flows resulting from capacity allocation are computed using a PTDF matrix and the net positions of the relevant BZs from the synchronous area. The hourly physical flow measured minus the above vector $CF_b(h)$ is the indicator for each hour. The PTDF indicator is not computed for some areas of continental Europe that are radially structured (e.g., internal Italian BZ borders).

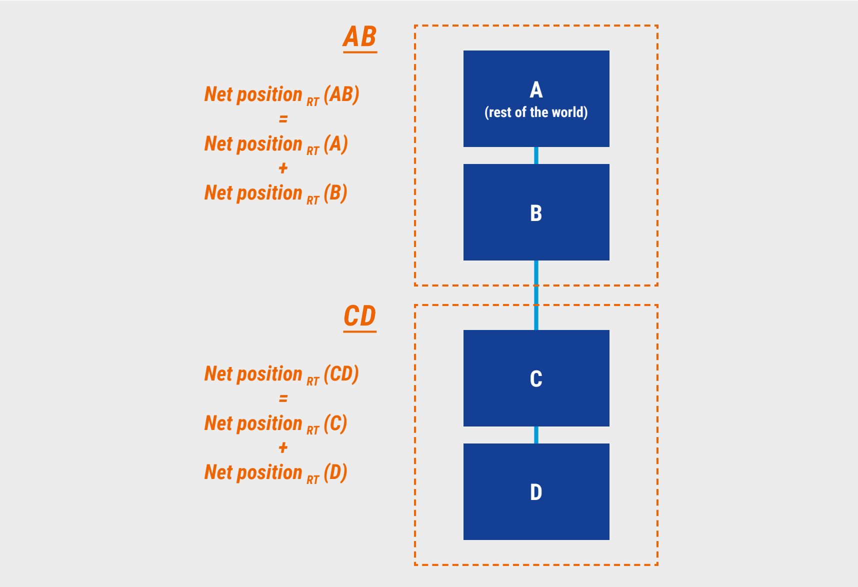


Figure 14: Radially structured network

In a radially structured network as shown in Figure 14:

› Physical measured flow on a given border can be computed from an energy balance of the radial part:

$$PF_{C\to B}(h) = NP_{RT,C}(h) + NP_{RT,D}(h)\ \forall h$$

Where:

› $PF_{i\to j}(h)$ is the measured physical flow from BZ i to BZ j
› $NP_{RT,z}$ is the net position (in real time) of the BZ z
› PTDF coefficients are equal to −1, 0 or 1:
  – $PTDF_A^{(C\to B)} = 0$
  – $PTDF_B^{(C\to B)} = 0$
  – $PTDF_C^{(C\to B)} = 1$
  – $PTDF_D^{(C\to B)} = 1$

Where:

› $PTDF_b^l$ is the sensitivity of link l to a variation of the net position of the BZ b

Consequently, the calculated flow induced by all cross-border commercial exchanges between all European BZs $(CF_{(C\to B)}(h))$ is equal to:

$$CF_{C\to B}(h) = PTDF_C^{C\to B}\cdot NP_C(h) + PTDF_D^{C\to B}\cdot NP_D(h) = NP_C(h) + NP_D(h)\ \ \forall h$$

Hence:

$$\begin{aligned} PTDF\ Flow\ Deviation_{C\to B}(h) &= PF_{C\to B}(h)\ -\ CF_{C\to B}(h) \\ &= \left[NP_{RT,C}(h) + NP_{RT,D}(h)\right] - \left[NP_C(h) + NP_D(h)\right] \\ &= \left[NP_{RT,C}(h) - NP_C(h)\right] + \left[NP_{RT,D}(h) - NP_D(h)\right] \end{aligned}$$

The difference between the hourly real-time net position and the hourly realised net position (control programme) is equal to the hourly BZ imbalance $(IMB_D\,(h))$:

$$PTDF\ Flow\ Deviation_{C\to B}(h) = IMB_C(h) + IMB_C(h)$$

Since it lies beyond the scope of this report to assess system imbalances and it is also reasonable to assume that the average yearly value of the system imbalance is equal to zero for each BZ, the PTDF indicator can be assumed negligible for the BZ borders in a radially structured part of the system.

3.1.2 F indicator for critical network elements

In order to provide proxy information about the type of flows on the congested elements, the F indicator is calculated based on data available from the Core CCR's FB market coupling. For Core, $F_{0,\,all}$ is calculated on an MTU basis during DA market coupling, indicating power flows that arise on network elements without any commercial exchange between BZs.

For CNEs that limited the DA market ("active constraints"), the **F indicator** is calculated as:

$$F = Mean\left(\frac{F_{0,all}}{F_{max}}\right)$$

F represents the average share of maximum feasible physical capacity that is used up by flows not caused by commercial cross-border exchanges. For cross-border elements, this includes loop flows, while for internal lines, this includes internal flows and loop flows. Negative $F_{0,all}$ values are set to 0, as they are in fact relieving the CNEC. CNECs are aggregated to the CNEs.

Compared to the PTDF indicator, the F indicator represents another state of the system. While the PTDF indicator considers realised physical flows and includes all short-term exchanges (such as intra-day trades), the F indicator solely considers the results of the DA market, whereas all flows realised after the clearing of the DA market are not considered. Given that the grid situation can considerably change after DA market clearing, due to – for example – plant outages or erroneous forecasts., the F indicator can only be considered a rough estimation of the real physical grid situation.

Appendix 1 reports the data for the Core CCR from mid-2022, alongside the expert assessment of congestions.

3.2 Data sources

This chapter describes the data used for calculating the PTDF indicator used in this Technical Report. For each relevant category of input data (actual versus computed information), the data source is detailed for the three main synchronous areas (SAs) considered in this report (continental Europe, Baltic and Nordic SAs).

3.2.1 Actual data

As described in Section 3.1, the computation of the PTDF indicator requires the following hourly series of raw data:

Measured physical flow

- These values represent the aggregated metered load flows at the border between two control blocks. They are uploaded approximately at the end of the following week.

Control programmes (net position)

- Realised control programmes (net positions) are the sum of the realised scheduled exchanges of each block. The realised control programme considers long-term nominations, DA exchanges, ID exchanges, and potential remedial actions and might include balancing exchanges.

For 2022, it should be noted that due to some issues regarding the data from the Vulcanus Verification Platform, the quality of the PTDF flow deviation from 30 June 2022 until the end of the year cannot be guaranteed. This behaviour is due to unbalanced realised control programmes for some regions in the scope of this analysis, which can be observed in the aggregation of these programmes in the hourly results.

$F_{0,\,all}$ values for the Core CCR

- Following the Core CCM Art. 17 (3), $F_{0,\,all}$ "is the flow on each CNEC in a situation without any commercial exchange between bidding zones within Continental Europe, and between bidding zones within Continental Europe and bidding zones from other synchronous areas". Data is available since the go-live of the Core FB capacity calculation in mid-2022 from JAO's publication platform. Data is provided for active constraints in the Core, linked to the data reported in Chapter 2. Data is reported alongside the detailed expert assessments in Chapter 2 and Appendix 1.

The following data sources were used for the three SAs:

Continental Europe

The data source for calculating the PTDF indicator for continental Europe is the ENTSO-E verification platform. Data provision is provided by each TSO separately and via any intermediaries. Data is stored primarily at an hourly resolution; however, for some TSOs, data is also available at a quarter-hourly resolution.

Baltic area

Since a structured process for common PTDF computation has not yet been implemented in the Baltic area, data for the PTDF indicator is not available for the relevant period and therefore is not included in the report.

Nordic area

Since a structured process for common PTDF computation has not been available in the timeframe of this report in the Nordic area, data for the PTDF indicator is not available for the relevant period and is therefore not included in the report. The Nordic area is divided into several bidding zones and many of these are connected with HVDC links. These factors ensures that the majority of power flows are allocated by the markets. The use of HVDC technology at many of its bidding zone borders effectively prevents loop flows from occurring at these borders, which diminishes the significance of this particular indicator for the Nordic region.

3.2.2 Computation of the PTDF matrix

A power transfer distribution factor (PTDF) is an influence (sensitivity) factor in modifying the generation or load on the active power flow of a given element of the grid (or a zone). The PTDF matrix is based on a DC load flow approach.

The PTDF matrix (resolution per BZ) was computed separately for each of the three main SAs from a common reference grid model (CGM) and a generation shift key (GSK), according to the consulting agreement between ENTSO-E and Amprion GmbH for the 2021–2023 period.

The PTDF flow indicator is based on FB capacity allocation models of the European electricity market. The indicator calculates PTDF flow deviations by comparing cross-border flows resulting from the capacity allocation process and measured physical flows on cross-border tie lines. The DACF common grid models were used for the PTDF calculations.

Different rules are used in Europe for determining GSK (e.g., merit order, linear GSK). For the indicator, the computation of the GSK must be standardised to ensure the comparability of the PTDFs. For this Technical Report, a GSK with a pro-rata of all generation units connected to the grid model has been chosen. Non-linear phenomena – e.g., constraints on maximal generation unit power infeed – are not considered. For example, when a BZ produces 2,000 MW and a power plant in the BZ produces 100 MW, if the BZ production is increased by 30 MW, the power plant production will be increased by 1.5 MW since 100 / 2,000 × 30 = 1.5.

Now, assume that the generation of a BZ is increased by 100 MW. If the load of a line in the grid model considering the GSKs increases by 5 MW, the PTDF of the BZs on the given line will be 0.05. This computation is carried out for each tie line and BZ. However, the results are not given per tie line but aggregated for each border between BZ.

The shape of the PTDF matrix for ***k*** BZ and ***n*** borders is as follows:

$$\begin{array}{c} \\ Border\ AB \\ Border\ AC \\ \dots \\ \dots \\ Border\ n \end{array} \begin{array}{c} \begin{array}{ccc} BZ\ A & BZ\ B & BZ\ k \end{array} \\ \begin{bmatrix} PTDF_{BZ\ A\ on\ border AB} & & PTDF_{BZ\ k\ on\ border AB} \\ PTDF_{BZ\ A\ on\ border AC} & & PTDF_{BZ\ k\ on\ border AC} \\ & & \\ & & \\ PTDF_{BZ\ A\ on\ border\ n} & & PTDF_{BZ\ k\ on\ border\ n} \end{bmatrix} \end{array}$$

3.3 Analysis of the indicators

Schedules are a TSO tool for planning system operation after market closure and before real time. Schedules include agreed-upon plans from generation and consumption units, as well as internal and external commercial exchanges and exchanges between TSOs. Schedules provide the necessary information for the TSO to operate and balance the system and carry out security analysis. All schedules in a scheduling area should sum up to zero within a given period to keep the system in balance. If no faults occur, both consumption and production will be equal to the prognosis. This enables the TSO to balance its system in real time with a minimum level of reserves for balancing, compared to the extensive level of reserves necessary if no schedules are available.[1]

In this sense, **load frequency control (LFC) ensures that the sum of all differences between commercial and physical flows over all borders of a BZ and the respective control area is very close to zero**. From the BZ perspective, control system differences between schedules and physical flow at one border net off differences at other borders (netting effect).

In the ideal case of two isolated systems with a single AC interconnection, the physical flow will also always be equal to the schedule. However, in a meshed network, when looking at individual borders of a BZ, differences between schedules and physical flows can be observed.

3.3.1 Results of the PTDF flow indicator for 2021, 2022, and 2023

Table 1 details the advantages and limitations of the PTDF flow indicator, followed by a graphical representation of the indicator for 2021, 2022, and 2023.

Advantages	Limitations
The physics of the flows are considered by translating commercial exchanges into physical flows between BZs.	Errors between forecasted flows and realised flows are included in the values.
Linkage with the enduring capacity allocation process in Europe (FB market coupling) is ensured by using allocated flow (sum of export, import and transit) as an input to the calculation.	Assumptions on pro-rata GSK do not consider merit order or cross-border portfolio optimisation; maximum generation per generator is considered when applying pro-rata GSK.
	Measured physical flows include both market and non-market transactions (internal, bilateral, multilateral redispatch, primary and secondary reserve power), with some transactions not being scheduled (e.g., primary and secondary reserves).

Table 1: Advantages and limitations of the PTDF flow indicator

Based on the given input data set and the necessary assumptions and limitations, the PTDF indicator estimates the size of flows that do not result from capacity allocation but also includes uncertainties related to the PTDF matrixes adopted for the computation. Its average value naturally cannot provide the (total) absolute value of flows not resulting from capacity allocation.

1 Source: Supporting Document for the Network Code on Operational Planning and Scheduling, Chapter 5.7, Page: 44

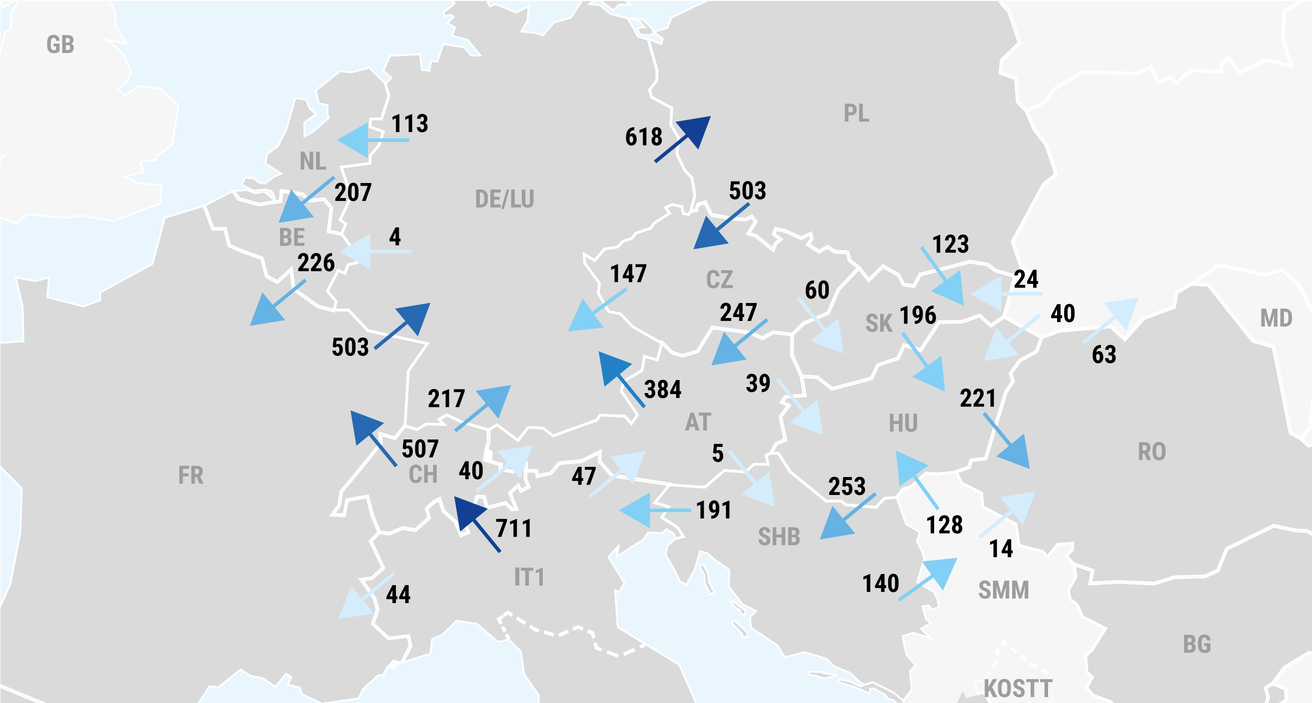


Figure 15: Average PTDF flow indicator for 2021 (in MW). CCR: Core and Italy North[2]

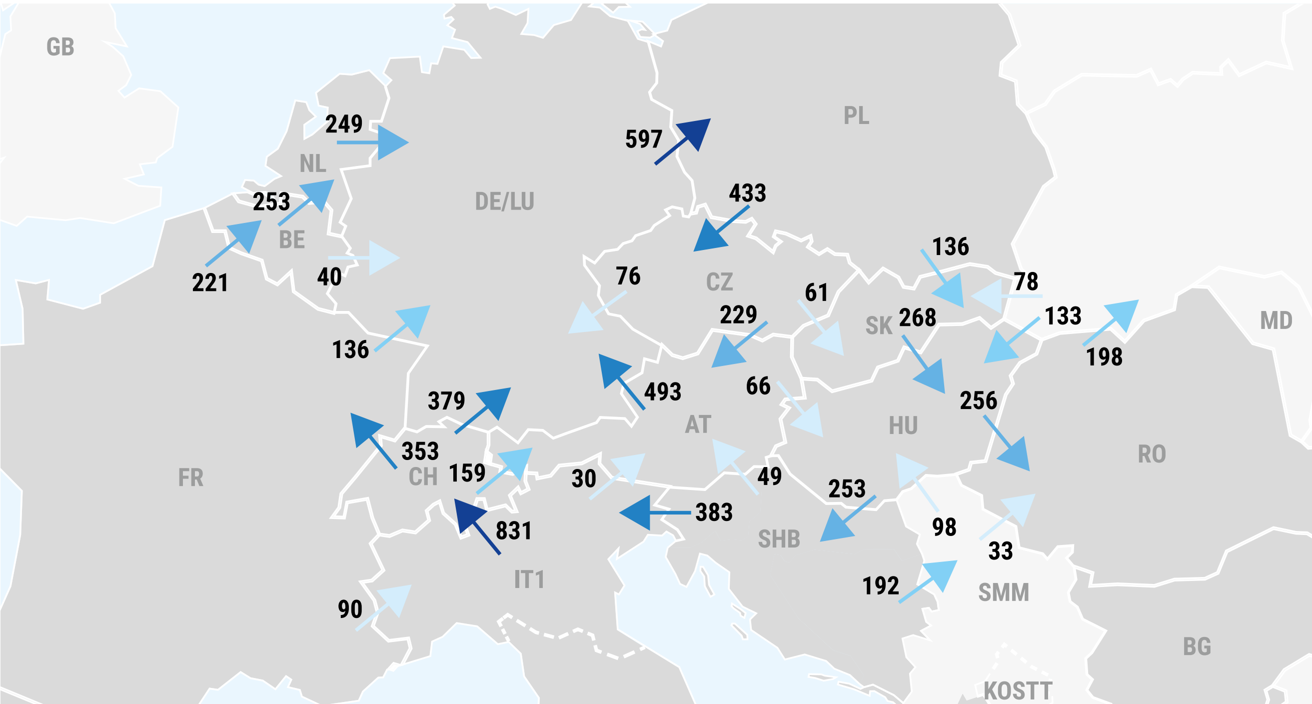


Figure 16: Average PTDF flow indicator for 2022[3] (in MW). CCR: Core and Italy North[4]

2 Due to the data source used in the process of the Technical Report preparation, the control block of Slovenia, Croatia and Bosnia and Herzegovina (CB SHB) is presented as one BZ. In practice, CB SHB comprises three separate BZs namely one for each aforementioned country.

3 For 2022, due to some issues regarding the data from the Vulcanus Verification Platform, the quality of the PTDF flow deviation from 30 June 2022 until the end of the year cannot be guaranteed. This behaviour is due to unbalanced realised control programs for some regions in the scope of this analysis, which can be observed in the aggregation of these programs in the hourly results.

4 Due to the data source used in the process of the Technical Report preparation, the control block of Slovenia, Croatia and Bosnia and Herzegovina (CB SHB) is presented as one BZ. In practice, CB SHB comprises three separate BZs namely one for each aforementioned country.

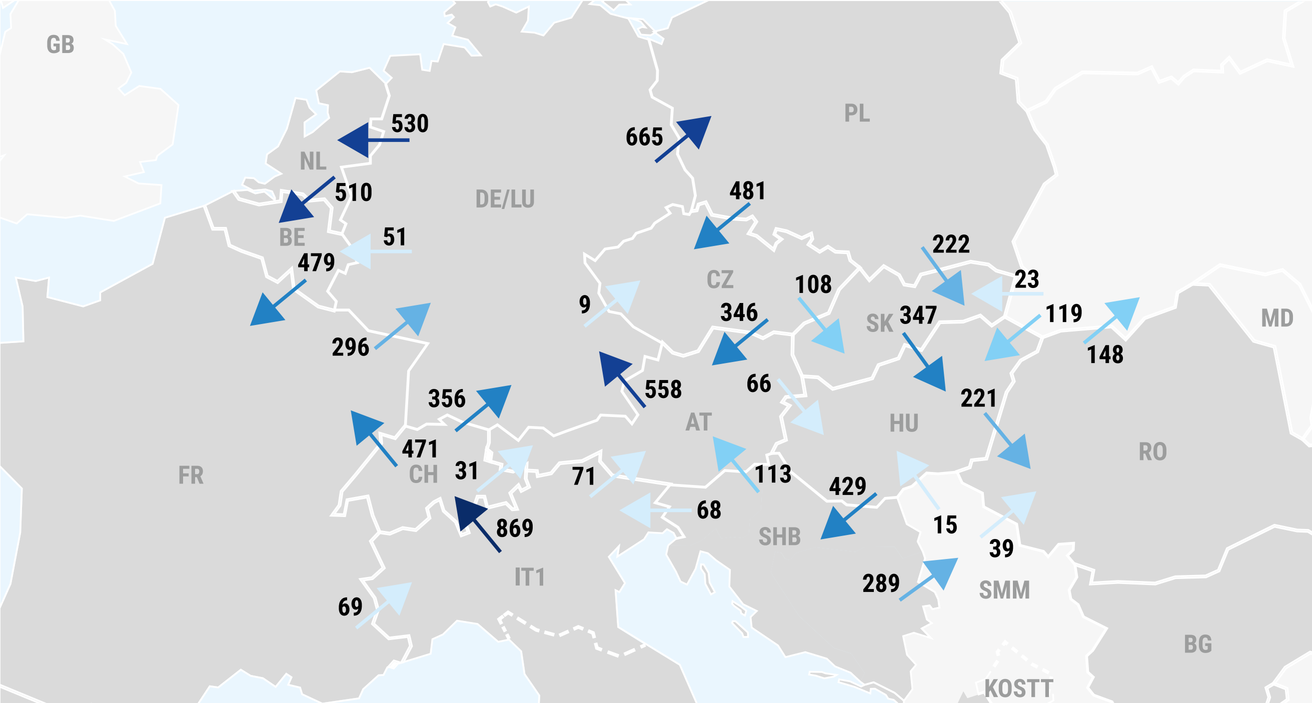


Figure 17: Average PTDF flow indicator for 2023 (in MW). CCR: Core and Italy North[5]

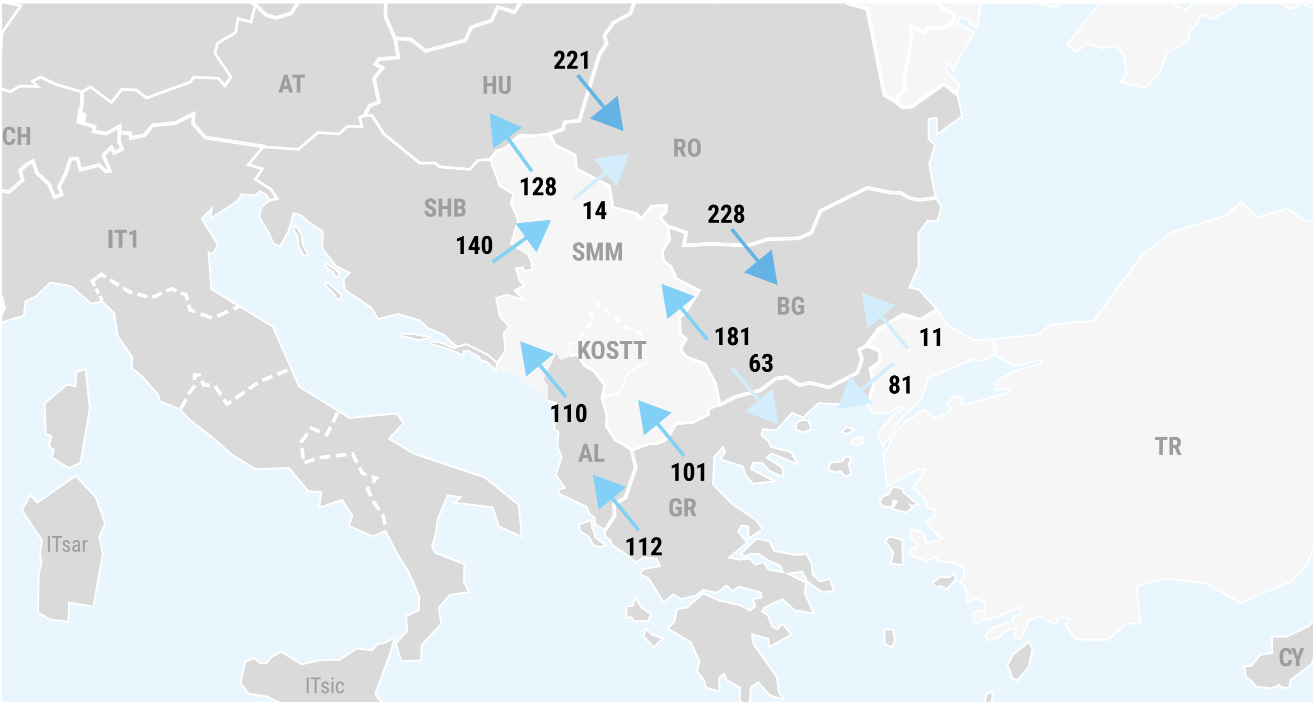


Figure 18: Average PTDF flow indicator for 2021 (in MW). CCR: Southeast Europe (SEE)

5 Due to the data source used in the process of the Technical Report preparation, the control block of Slovenia, Croatia and Bosnia and Herzegovina (CB SHB) is presented as one BZ. In practice, CB SHB comprises three separate BZs namely one for each aforementioned country.

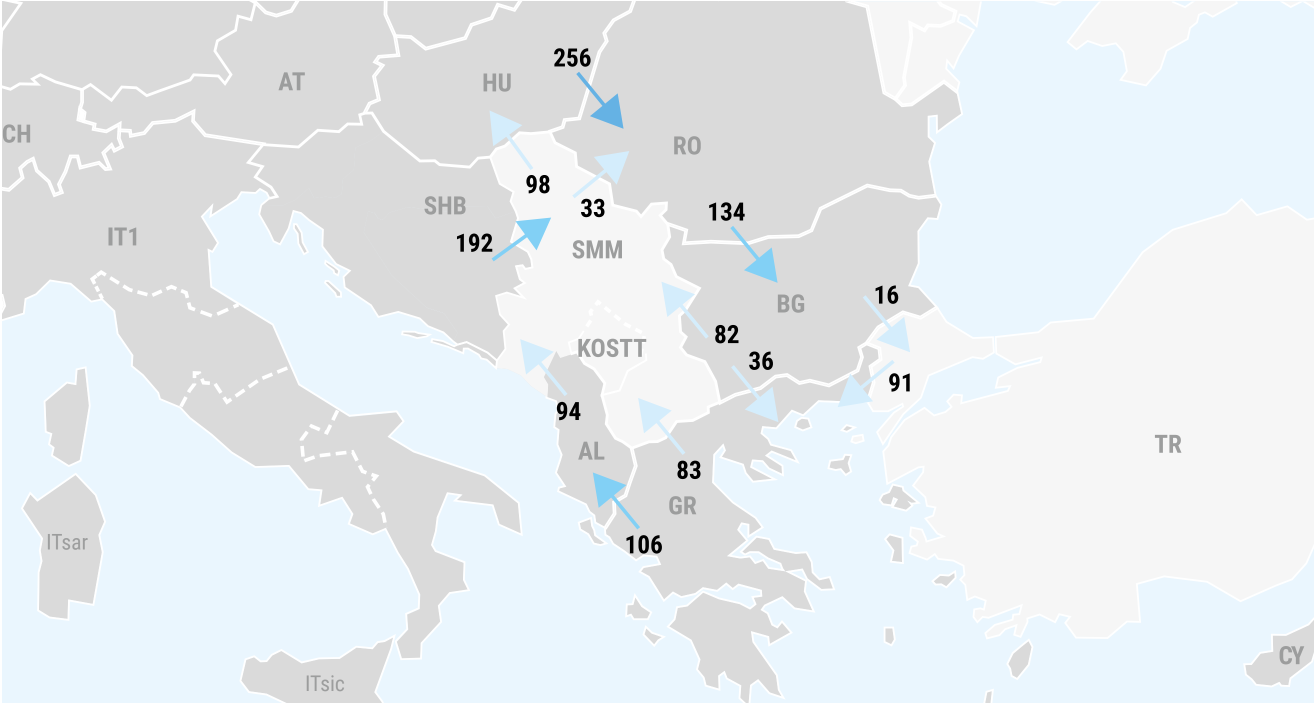


Figure 19: Average PTDF flow indicator for 2022 (in MW). CCR: Southeast Europe (SEE)

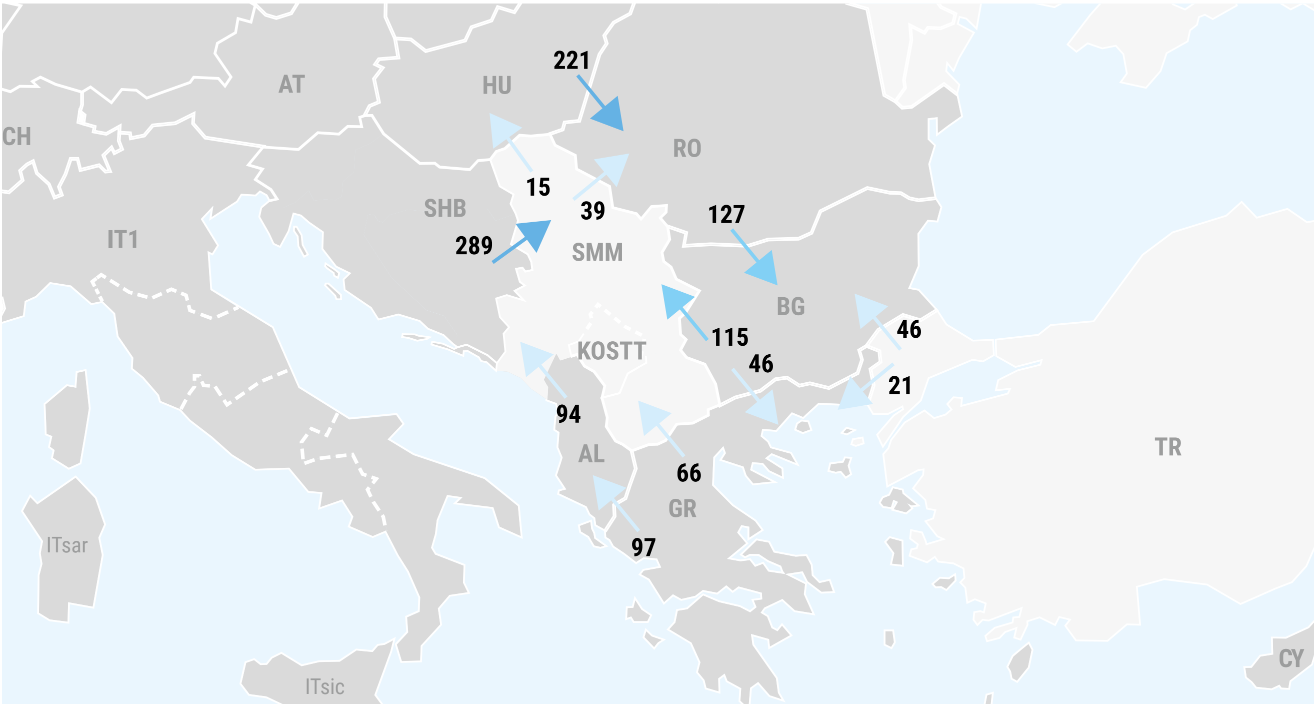


Figure 20: Average PTDF flow indicator for 2023 (in MW). CCR: Southeast Europe (SEE)

3.4 Conclusions

This chapter has provided information on flows not resulting from capacity allocation. The PTDF indicator used to quantify power flows not resulting from capacity allocation is the same as the one used by ACER for the MMR. However, the current methodology used to compute these indicators has some limitations, as described in Section 3.3.1. Calculated PTDFs are available for 2021, 2022, and 2023.

The development of the PTDF indicator showcases a mixed development from 2021 to 2023. Figure 21 provides an overview of these flows across all relevant BZ borders for 2021, 2022, and 2023. Average values are shown for the PTDF indicator, considering their respective direction based on the positive/negative sign.

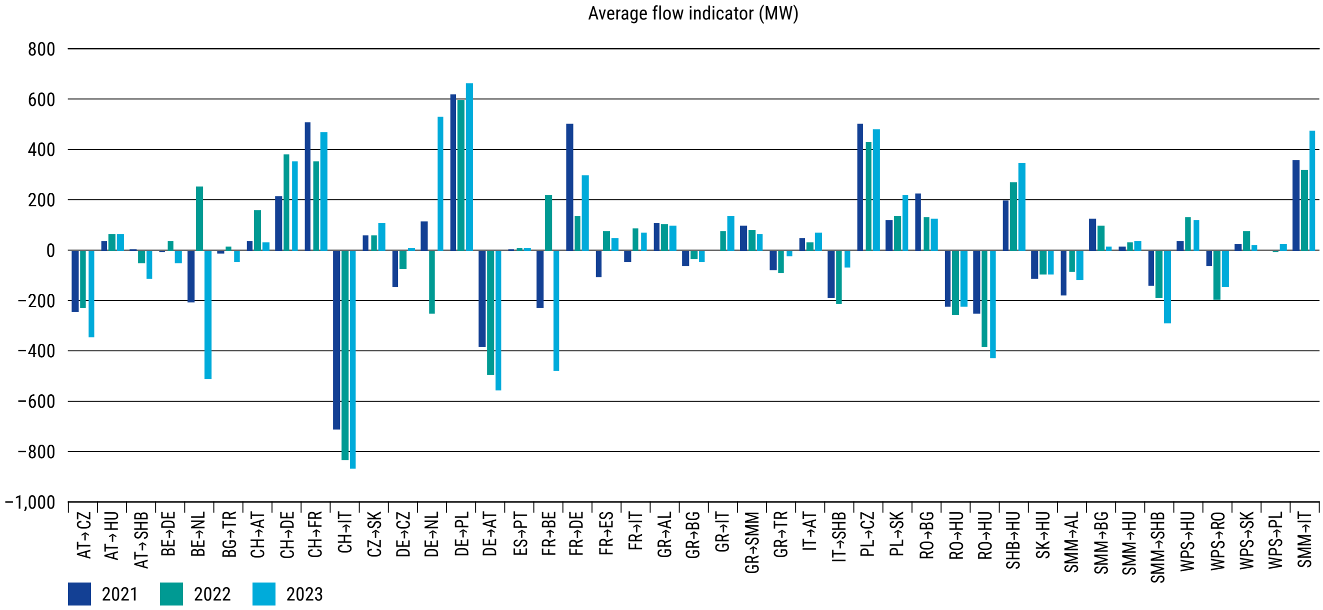


Figure 21: Three-year comparison of the PTDF flow indicator per border

In all years, the highest value of the PTDF indicator has been observed on the CH–IT border. The highest value of 869 MW was reached in 2023, with an increasing trend from 2018 onwards. This represents a change compared to the previous report, where the most charged border was DE–FR. Flows not resulting from capacity allocation across the DE–FR border showcase a decreasing trend.

Notably, the PTDF indicator changed directions from 2021 to 2022 in the FR–BE–NL–DE region, and back again from 2022 to 2023. Several noteworthy events during 2022 contributed to the changing flow patterns. The energy crisis with increased gas prices hit Europe in 2022, affecting electricity prices throughout Europe.

Additionally, nuclear power plant outages combined with extended heat periods caused France to become a net importer of electricity in 2022. Furthermore, FB capacity allocation was implemented in the Core region in June 2022, extending the previous CWE market coupling.

The SEE region map above presents the natural distribution of power flows determined by the demand zones, namely from north to south.

4 Congestion income and firmness costs and volumes

Congestion income indicates the degree to which market participants value the possibility of cross-border trade, how interconnections are used, and where capacity might be increased. For firmness costs, a distinction is made between financial and physical firmness costs. Congestion income and firmness costs generally indicate cross-border congestions and in some cases can also reflect the existence of internal congestions.

4.1 Congestion income

Congestion income is defined in Article 2.16 of the Regulation (EU) 2015/1222 (CACM) as "the revenues received as a result of capacity allocation". The capacity allocation could be long-term, day-ahead and/or intra-day, as well as either explicit or implicit. These revenues are shared between TSOs involved according to the CID (congestion income distribution) methodology, which must facilitate the efficient long-term operation and development of the electricity transmission system and the efficient operation of the electricity market of the union. The methodology should also comply with the general principles of congestion management provided in Article 16 of Regulation 2019/943 ("General principles of capacity allocation and congestion management"), allow for reasonable financial planning, be compatible across timeframes, and establish arrangements to share congestion income deriving from transmission assets owned by parties other than TSOs.

For congestion income, reporting at the border level utilises gross congestion income (CI), whereas reporting at the country level uses net congestion income. Gross CI represents the total congestion income without any deductions for expenses, while net CI is derived from gross CI by subtracting long-term transmission rights remuneration and curtailment costs.

Total yearly income data was gathered at a country level for 2021, 2022, and 2023, and the revenues are presented in the graphs below. The income data was gathered at country and border levels for those borders where capacity allocation mechanisms exist.

The CI received at a specific border does not explicitly describe the congestion situation on that border. Indeed, the income depends on many factors:

- Price development in individual countries, which is dependent on load/demand/RES infeed/generation park/weather conditions and can change from year to year.
- Price differences between countries (is it more or less interesting to trade with country A than with country B?).
- The amount of capacity made available to the market, which affects prices but also determines the volume that can be traded (while there might be a lower volume, due to reduced capacity there might also exist an increased willingness among traders to pay high prices).
- Grid investments, which might lead to more cross-zonal capacity on a specific border to be offered to the market and might lead to lower prices.
- The capacity allocation method (implicit vs explicit, where implicit allocation leads to higher price convergence and thus a lower price difference).
- The number of borders that a country shares with other countries (the more borders one has, the more CI one might receive, so high income does not automatically mean that a country is more congested than another country).
- New interconnectors (still-inexistent borders, such as new HVDC lines) might lead to new CI and thus more total CI (so more cross-zonal capacity does not automatically lead to reduced CI).

A brief analysis accompanies each graph, complemented by an assessment by the TSOs at the end of the section.

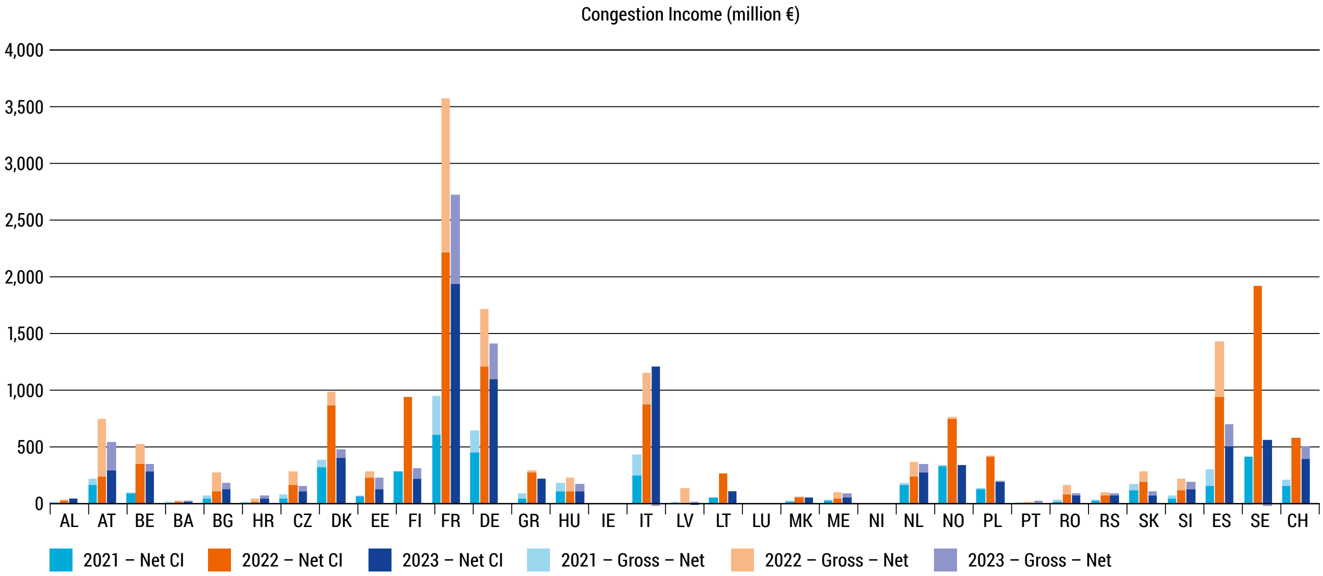


Figure 22: Congestion income 2021–2023

From the graph above, it is evident that France, Germany, Italy, Spain, and Sweden received very high congestion revenues. CI had a very high increase in 2022 for almost every country due to the similarly high electricity prices, whereby the average CI quintupled.

For most countries, 2023 saw a decline back to a level similar to 2021, although the average remained 2–3 times higher than in 2021.

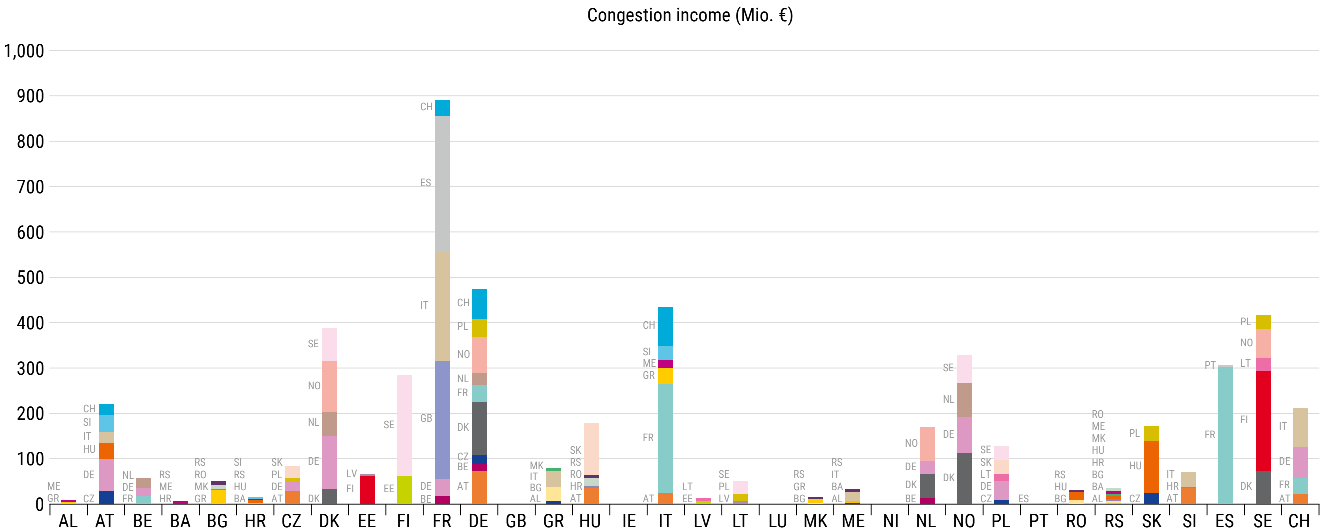


Figure 23: Congestion income 2021

As can be seen from the graph above, France, Germany, and Italy had the highest CI from the capacity allocation process in 2021, closely followed by Denmark and Sweden.

Here, the French borders are substantial, as well as the Finnish and Danish borders for Sweden.

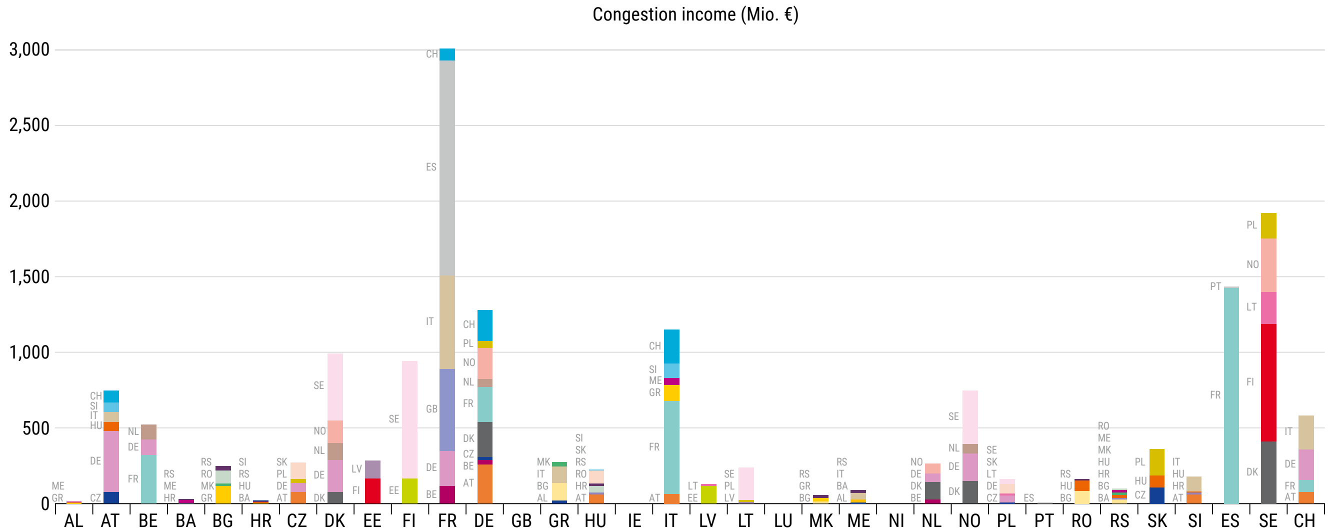


Figure 24: Congestion income 2022

As can be seen from the graph, France, Spain, and Sweden had the highest CI from the capacity allocation process in 2022, closely followed by Germany and Italy. Here, again the French borders are substantial, as well as the Finnish and Danish borders for Sweden.

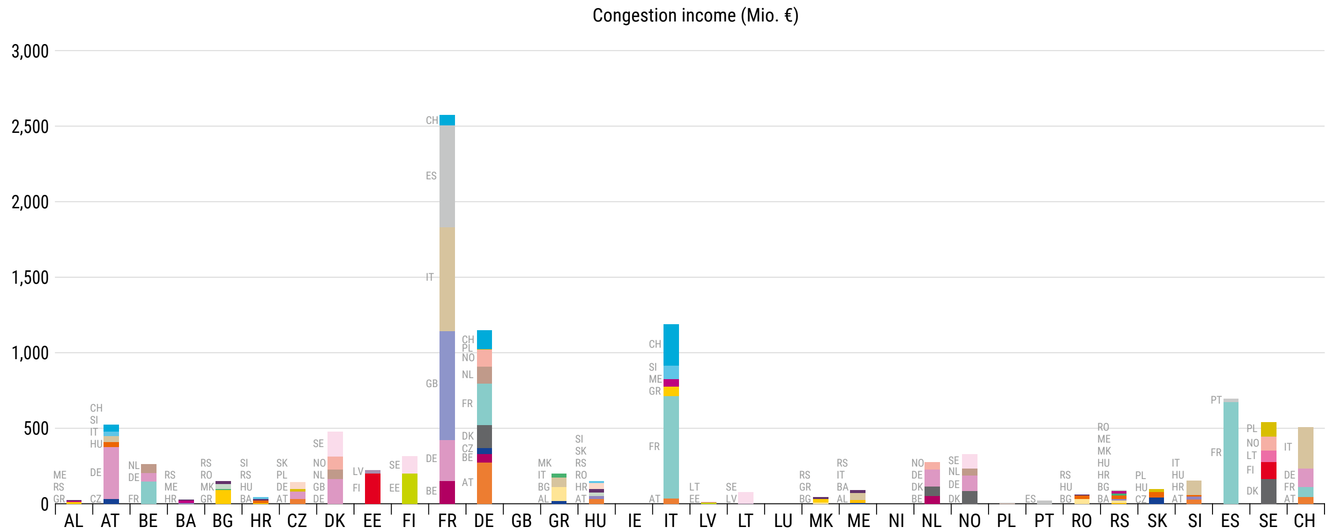


Figure 25: Congestion income 2023

As can be seen from the graph above, France, Germany, and Italy had the highest CI from the capacity allocation process in 2023. The French borders for Germany, Italy, and Spain are among the highest for each country.

4.1.1 Summary and comments from TSOs for congestion income

The CI subsection is prepared according to the requirements stated in the Article 34 of CACM and Article 16 of Regulation 2019/943 ("General principles of capacity allocation and congestion management"). The CI revenues part presents the total yearly incomes at a country level for three different years and at a border level for those borders where capacity allocation mechanisms exist.

The impacting factors could be different in each case and it is not possible to highlight specific ones. The particular comments about CI for some countries are briefly provided below.

Austria

The main influence on the CI generated is generally the market prices and especially the market price spreads, which typically increased with the absolute prices. Starting from September 2021, prices increased and therefore already for that year the net CI for Austria was around € 164 million. For 2022, this trend continued until May. However, with the go-live of Core FB market coupling, especially for Austria, there was a dramatic change as the so-called socialisation principle was no longer valid for Core CCR (as it was for CWE DA-MC) and due to the large amount of DE–AT long-term capacities high amounts for long-term remuneration also have to be paid back to market participants. For example, in August 2022 the total net CI for Austria was negative by more than € 12 million. For the rest of 2022, Austria's net CI was very volatile (including due to strong differences of M-auction results, again most relevant at the DE→AT border). However, based on the very high CI in the first few months, Austria's overall net CI for 2022 was again high at around € 246 million. In 2023, prices and market spreads generally remained relatively high and therefore the net CI for Austria was again high, at about € 295 million. Overall, the situation on the DE–AT border was so dominant for the Austrian CI for 2021 to 2023 that other effects on the borders are not relevant in comparison.

Belgium

For Elia Transmission Belgium, the three Core borders are considered, namely BE–NL, BE–DE, and BE–FR. The numbers include long-term congestion income (LT CI) from yearly and monthly auctions, net DA congestion income (net DA CI) and redistribution due to the Polish allocation constraint (PL AC). From 2021 to 2022, ETB saw a significant rise in CI, from € 87 million in 2021 to more than € 365 million in 2022. A positive effect was expected by moving to the FB marked in 2022 because the socialisation step is no longer applied since then. However, the effects of the increased prices and market spreads in 2022 outweigh any other possible effects. In 2021, the price increase played a role, with roughly half of the total revenues realised in the last two months of 2021.

Further, 2022 is characterised by high monthly LT CI compared to yearly, and high net DA CI because the high prices were not yet anticipated in the yearly LT auctions. In 2023, the opposite is observed, with the major part of total CI coming from yearly LT CI, and significantly lower monthly CI and net DA CI revenues compared to 2022. Revenues for 2023 amounted to € 290 million.

Bulgaria

Bulgarian CI varies in the range of € 46 million to € 142 million in the 2021–2023 period for both EU and non-EU borders. In 2022, the CI peaked at € 142 million due to extremely high energy prices on the electricity markets in comparison with 2021. After that, a normalisation and decrease in CI is observed.

Croatia

In 2021, Croatia's CI was similar to previous years, as it was only coupled with Slovenia, and congestion occurred infrequently. However, after the launch of Core FB market coupling in June 2022, Croatia began to experience regular congestion income on its borders with Slovenia and Hungary. In 2022 DA congestion income was approximately € 2,5 million, while the revenues for 2023 amounted to € 7 million.

Czech Republic

Since 2022, the CI for ČEPS has experienced a significant increase, driven by the energy crisis and the go-live of the FB market. The energy crisis led to a sharp rise in electricity prices and wider market spreads, both of which contributed to the higher CI during this period. By 2023, the CI had began to stabilise across all time frames.

Denmark

As a transporting country between the Nordics and central Europe, Denmark has a unique TSO position. When the price levels in the two regions diverge at a large scale for an extended period – as was the case in 2022 – CI rapidly increases, as can be seen in the figures for the same year. The largest fraction of the CI comes from the DK–SE border in 2022 and the DK–DE border in 2021 and 2023.

Estonia

No extra information provided.

Finland

There are only a small number of observed congestions during the D-1 timeframe since the congestions are acknowledged at a minimum in the D-2 timeframe. All D-1 congestions are due to unplanned outages that took place for several hours within a day before the next day's D-2 capacity allocation. Typically, planned remedial actions are rare and used in a few planned outages. Unexpected congestions are managed by remedial actions close to real time.

During the D-1 timeframe, intra-day trade generally relieves D-2 congestions in the reverse direction, providing a market-based congestion management method.

Generally, capacity within the Finnish BZ is adequate and there are no internal congestions that affect border capacities in the D-1 timeframe.

France

The French congestions income shows a spike in 2022, reaching almost € 3,600 million, due to higher power prices and imports to France than usual. It is balanced among all borders, except with Switzerland, due to the historical long-term contracts that give priority and free access to capacity.

Germany

Due to many interconnectors and thus high capacities on German borders, the CI for Germany is higher than for most other countries. The energy crisis in 2022 led to higher electricity prices and higher spreads, which resulted in increasing CI in general.

Hungary

No extra information provided.

Italy

CI was mainly associated with the borders with France and Switzerland. Values were quite stable in 2022 and 2023, while they were lower in 2021, reflecting a general trend among most countries.

Latvia

No extra information provided.

Lithuania

No extra information provided.

Luxembourg

Luxembourg did not receive any congestion revenue during the 2021–2023 period under the congestion distribution methodology currently applied in the Core region.

Netherlands

CI over 2021–2023 was volatile, ranging from around € 180 million to € 400 million. This volatility was caused by diverging electricity prices between the Netherlands and its neighbouring BZs. This divergence of prices was predominantly driven by circumstances in the market, including the energy crisis and the fall-out of French nuclear generation). As such, the information on CI should not be interpreted as a proxy for the severity of congestions on the border of the Netherlands BZ.

Norway

No extra information provided.

Poland

No extra information provided.

Slovakia

The CI for SEPS has changed since 2022, as the principles of the CI redistribution have changed with the go-live of the FB market coupling. Whereas the congestion calculation was previously made per border, the congestion redistribution is calculated at the regional level (Core). This has affected the CI for SEPS, with reduced income after 2022. This is not solely caused by the new congestion calculation, although the prices also contributed to this decrease.

Slovenia

No extra information provided.

Spain

More than 98 % of CI collected is generated at the FR–ES interconnection, which presents by far the highest utilisation ratio (67.2 % of hours presented congestion after the DA market in 2023 compared to 5.3 % in the case of the PT–ES interconnection) and DA market spread (€ 26.32/MWh in 2023 compared to € 1.34/MWh in PT–ES).

The utilisation ratio and the DA market spread indicate the need for reinforcing the FR–ES interconnection to allow proper integration of the Iberian peninsula in the internal electricity market.

Sweden

In 2021, internal CI constituted the majority of the total CI. Increasing prices of gas, coal, oil and emission rights in Europe together with congestions between BZs resulted in high price differences, which contributed to the CI.

The CI was significantly higher during 2022 compared to 2021. High gas prices, low nuclear power production in France, scarce water reservoir levels in southern Norway, and a delay of nuclear power expansion and repair work in Finland and Sweden resulted in high electricity prices in areas close to the continent and lower prices in northern Scandinavia. Similar to 2021, the transmission between Sweden's internal BZs made up the majority of the CI. The highest level of CI was generated on the border between SE2 and SE3 due to high price differences and the large transmission between these BZs.

During 2023, the CI significantly decreased compared to 2022. Similar to the previous years, the majority of CI was generated by electricity price differences within Sweden, particularly between SE2 and SE3. Compared to 2022, price differences between the Swedish BZs were generally lower, which resulted in lower CI in 2023.

4.2 Firmness costs and volumes

According to CACM, 'firmness' refers to a guarantee that cross-zonal capacity rights will remain unchanged and that compensation will be paid if they are nevertheless changed. For the purpose of this report, it was assumed that firmness costs are related not only to cross-zonal aspects but also to internal redispatch actions taken by TSOs. Furthermore, the report distinguishes between financial and physical firmness costs as follows:

- Financial firmness costs: If there is a curtailment of assigned cross-zonal capacity rights, compensation is paid. Different compensation cases and rules are defined in the European regions.
- Physical firmness costs: Since congestion management measures are taken to accommodate a secure flow resulting from all transactions in a BZ, it is not always possible to make a clear distinction between measures taken for the firmness of cross-border capacity or internal capacity. When it is not possible, all costs and volumes for congestion management measures are included in the figures for physical firmness. Possible types include internal redispatch, cross-border redispatch, counter-trading, or others defined by TSOs.

4.2.1 Financial firmness costs

The comparability of financial firmness costs is affected by differences in detailed auction rules by country. The detailed auction rules for EU member states have been set forth in harmonised allocation rules for LTTR in accordance with Article 51 of Commission Regulation (EU) 2016/1719 establishing a guideline on forwards capacity allocation in 2016 (hereafter referred to as 'HAR')[1]. The HAR considers the general principles, goals, and other methodologies set out in Regulation (EU) 2016/1719 and these allocation rules, as well as including the related regional and/or border-specific appendices, and it contains the terms and conditions for the allocation of LTTR on BZ borders in the EU.

HAR contains:

- At a minimum, harmonised definitions and scopes of application.
- A description of the allocation process or procedure for LTTR, including the minimum requirements for participation, financial matters, type of products offered in explicit auctions, nomination rules, curtailment and compensation rules, rules for market participants in the case of transferring their LTTR, the use-it-or-sell-it principle, and rules regarding force majeure and liability.
- Regional- or BZ border-specific requirements regarding – but not limited to – the description of the type of LTTR offered on each BZ border within the CCR.
- The type of LTTR remuneration regime to be applied on each BZ border within the CCR according to the allocation in the DA timeframe.
- The implementation of alternative coordinated regional fallback solutions.
- Regional compensation rules defining regional firmness regimes.

HAR contributes to the efficient long-term operation and development of the electricity transmission system and electricity sector in the EU since it optimises the allocation of long-term capacity, reflecting congestion on all EU borders in an efficient way.

The different compensation cases and the associated compensation rules differentiate – for example – between 'force majeure', emergency situations/safety of power systems, or other costs for financial firmness. The related financial firmness costs were delivered at a TSO level for 2021, 2022, and 2023, and they are represented as total financial firmness costs by country and type, and firmness costs per border.

Please note that financial firmness costs are usually shared between the TSOs involved, albeit not always equally. It is necessary to add the costs that country A had to pay for border A/B to the costs that country B had to pay for border A/B in case of curtailment. Costs are reported on a TSO basis.

1 https://www.acer.europa.eu/sites/default/files/documents/Individual Decisions_annex/ACER_Decision_18-2023_HAR-AnnexI.pdf

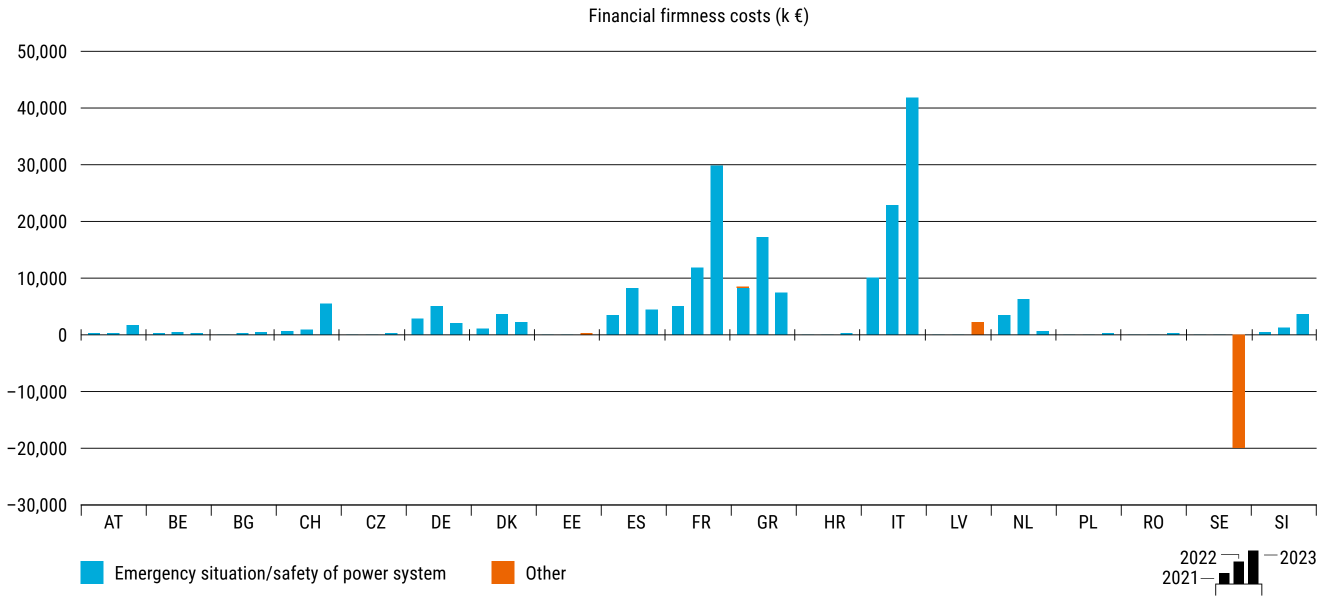


Figure 26: Financial firmness costs per country, type and year in k€

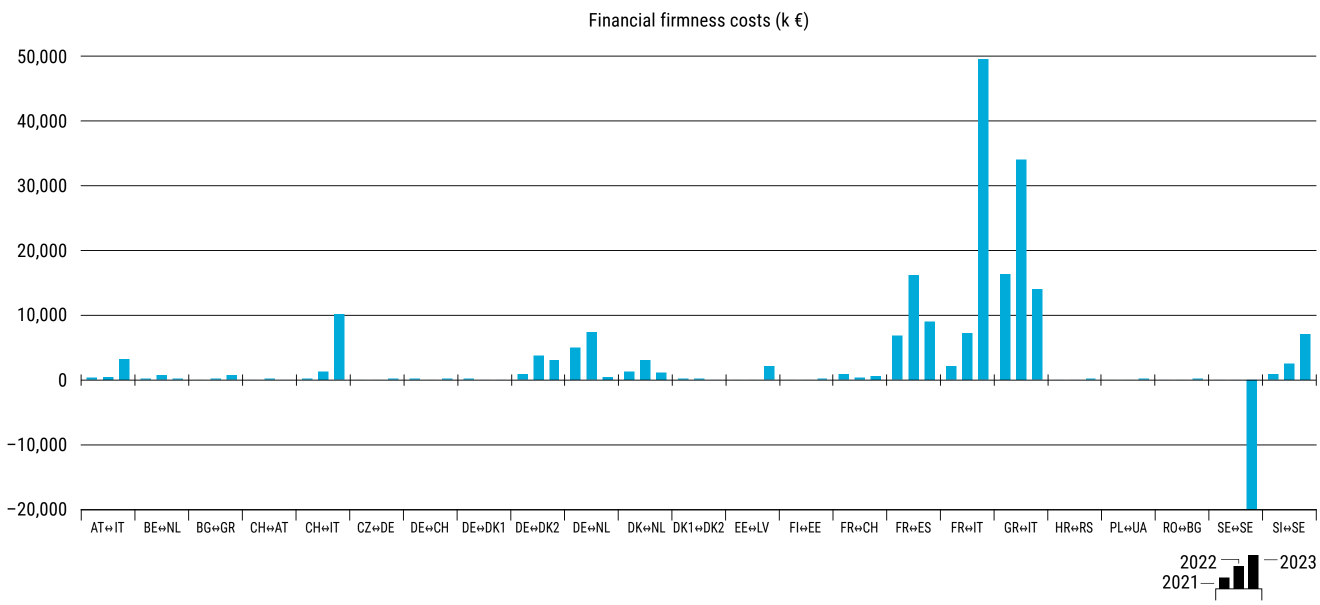


Figure 27: Total financial firmness costs per border and year in k€

As can be seen in the figures above, most of the costs paid to ensure the financial firmness of cross-border capacity in 2021–2023 are due to curtailments caused by emergency grid security or safety issues, with other unspecified reasons following. The highest costs in all considered years are observed in Italy, France and Greece, mostly driven by the high costs on the FR–IT, GR–IT, and FR–ES borders. A significant rise in costs can be observed at most Italian external borders from 2022 to 2023 (IT–CH +693 %, IT–FR +588 %, IT–AT +561 %).

For detailed explanations, see the country-specific comments in Section 4.2.1.1.

Please note that the detailed representation of total financial firmness costs only shows countries and borders that have applied financial firmness, whereas countries and borders with zero values are not included. This is the case because either the costs were actually zero (Hungary, Ireland/Northern Ireland, and Slovenia) or no data was available (Finland, Lithuania, Luxembourg, Norway, and Portugal).

4.2.1.1 Summary and comments from TSOs for financial firmness costs

Austria

For 2021 and 2022, APG observed similar curtailment costs as in the previous years, with around € 200,000 on its borders, mainly the AT–IT BZ border. However, a significant increase of curtailments up to almost € 1.6 million can be observed for 2023. The main reason for this is the failure of the merchant line interconnector operated by ENECO at the end of March 2023, which is still not operational.

Belgium

Financial firmness costs in Belgium represent small amounts in comparison with the high amounts of CI. At the Netherlands border, the spike in costs in 2022 is linked to higher price spreads.

Bulgaria

In 2022 and 2023, curtailment was only applied in exceptional cases of extremely low demand, which leads to a lack of reserve capacity, low system stability, and inertia, and consequently requires a minimum number of power plants on the grid. Financial firmness cost represents small amounts in comparison to the CI.

Croatia

As in the previous Technical Report, in exceptional cases of high power flows during high hydrological conditions in the region, it was necessary to limit ID capacities with Bosnia and Herzegovina and Slovenia to ensure operational security in the transmission network. No financial firmness costs occurred in those situations.

In July 2023, an exceptional curtailment had to be performed on the HR–RS and RS–HR border due to unplanned outages that took longer than foreseen. In line with HAR, full compensation of € 87,000 and € 137,000, respectively, has been granted.

Denmark

The large congestion income on most Danish borders outweights the relatively low financial firmness costs found on the borders where LTTRs are offered.

Estonia

No extra information provided.

Finland

No extra information provided.

France

Financial firmness costs in France represent small amounts in comparison with the high amounts of CI. On the Italian border, financial firmness costs increased between 2021 and 2022, due to higher price spreads. The spike in volumes and costs in 2023 is linked to important capacity reductions. On the Spanish border, the spike in costs in 2022 is linked to higher price spreads.

Greece

For 2021, 2022, and 2023, significant financial firmness costs and volumes occurred on the IT–GR border. Since the interconnection between Italy and Greece comprises only one HVDC cable, planned and unplanned outages of the link required the application of curtailment measures to ensure system security. For 2022 and 2023, a much smaller amount of financial firmness costs and volumes occurred on the BG–GR border.

Hungary

In the context of financial and physical firmness costs, the currency conversion for countries that do not use the Euro as their official currency becomes relevant. The cost data shown for MAVIR is the summed result for the previous given year. The sum components are converted to Euros as the average daily mid-price exchange rate of the last day of the month in which the quantity was activated, using data provided by the Central Bank of Hungary.[2]

2 https://www.mnb.hu/en/arfolyamok

Italy

For 2021 and 2022, the highest financial firmness costs and volumes occurred on the IT–GR border. Since the interconnection between Italy and Greece comprises a single HVDC cable, planned and unplanned outages of the link required the application of curtailment measures to ensure system security.

For 2022 financial firmness costs and volumes between Italy and Greece declined thanks to the reduction of outages. For 2023, the highest values are represented by the interconnection with the France border.

Except for the IT–GR border, there was an increase in the financial firmness costs in 2023 compared to 2022 on the FR–IT, AT–IT, CH–IT and SI–IT border directions. This increase in costs is not associated with an increase in the curtailment price (the average price has remained in line with those of previous years) but rather an increase in the reduced long-term volumes following the results of the D-2 capacity calculation.

Ireland

There are no assigned capacity rights for the interconnectors, and hence the costs are zero.

Latvia

No extra information provided.

Lithuania

No extra information provided.

Luxembourg

No extra information provided.

Netherlands

For the Netherlands, financial firmness costs are incurred when LTTRs are cancelled, which occurs in the event of a cable outage or maintenance. Therefore, these costs should not be interpreted in the context of congestions and/or identification of structural congestion.

Norway

No extra information provided.

Poland

No extra information provided.

Portugal

No extra information provided.

Slovakia

Due to the ongoing war in Ukraine, transmission capacity and nominations were cut to zero on 11 October 2022. The request for curtailment was initiated by Ukrenergo.

Slovenia

No extra information provided.

Spain

In the three-year study period, curtailments were only applied at the FR–ES border. The spike in firmness compensation costs was reached in 2022.

Sweden

During 2023, Svenska kraftnät started auctioning financial contracts for electricity price area differential (EPAD) contracts. EPAD is a standardised future that is exchange-traded and cleared by a central counterparty clearinghouse (CCP). Therefore, there is full firmness and no possibilities of curtailment.

Svenska kraftnät offers (via auctions) to both buy and sell EPADs in SE2, SE3, and SE4 BZs. EPAD auctions aim to provide market support, i.e., supporting hedging opportunities and thereby increasing liquidity in the Swedish continuous forward market and acting as an example of an alternative to the measures currently described in the FCA regulation.

Svenska kraftnät's hedging activities during 2023 also positively contributed to total CI. Svenska kraftnät measures and follows up on hedge effectiveness, which shows a strong negative correlation with CI. The hedge effectiveness is within the span permitted by accounting principles. Note that EPAD is registered as an income and hence the value is negative in the figures above.

4.2.2 Physical firmness costs and volumes

Physical firmness volumes and costs are related to measures carried out by TSOs that guarantee unchanged cross-zonal capacity rights by managing congestions. This can be achieved through remedial actions such as topological changes or by changing the generation and/or load pattern (redispatch current and voltage-triggered, countertrade, or a variety of other measures/products).

In addition to guaranteeing unchanged cross-zonal capacity rights, measures might also be necessary to solve internal congestions within a BZ. For this report, such measures are considered part of physical firmness volumes and costs.

TSOs delivered the costs and respective volumes for 2021, 2022, and 2023 for all measures to manage congestions, regardless of the product design or activation process. The measures are classified as 'classic' congestion management measures such as countertrade, redispatch, or grid reserves. Cross-border redispatch refers to redispatch measures activated across BZ borders, including multilateral redispatch. Internal redispatch means redispatch measures activated within the BZ. For most TSOs, these classic measures are not filtered to separate them into cross-border- and non-cross-border-relevant or current- and voltage-related measures but contain all measures of each TSO.

The 'renewable curtailment' measures and 'other measures' are not used in all countries and are therefore presented separately for the relevant countries. Renewable curtailment volumes are highly dependent on installed RES production capacities and must be considered due to fluctuating RES production.

In the 'other' category, TSOs included values such as:

- Preventive restriction agreements (NL)
- Fuel change test from gas to oil (HU)
- Costs related to distribution system bottlenecks (in normal situations or during special maintenance situations; ES)
- Planned and unplanned outages (ES)
- Special network-related equipment (German instrument for grid stability and congestion management: besondere netztechnische Betriebsmittel (bnBm))

It must be noted that any comparison of these data can only be indicative since there are substantial differences between the different countries (see the TSO comments).

Lithuania did not supply any physical firmness data. For further details, please refer to the country-specific comments. Only the volumes of the measures have been reported for Switzerland, as the associated costs are exclusively available for the NRA.

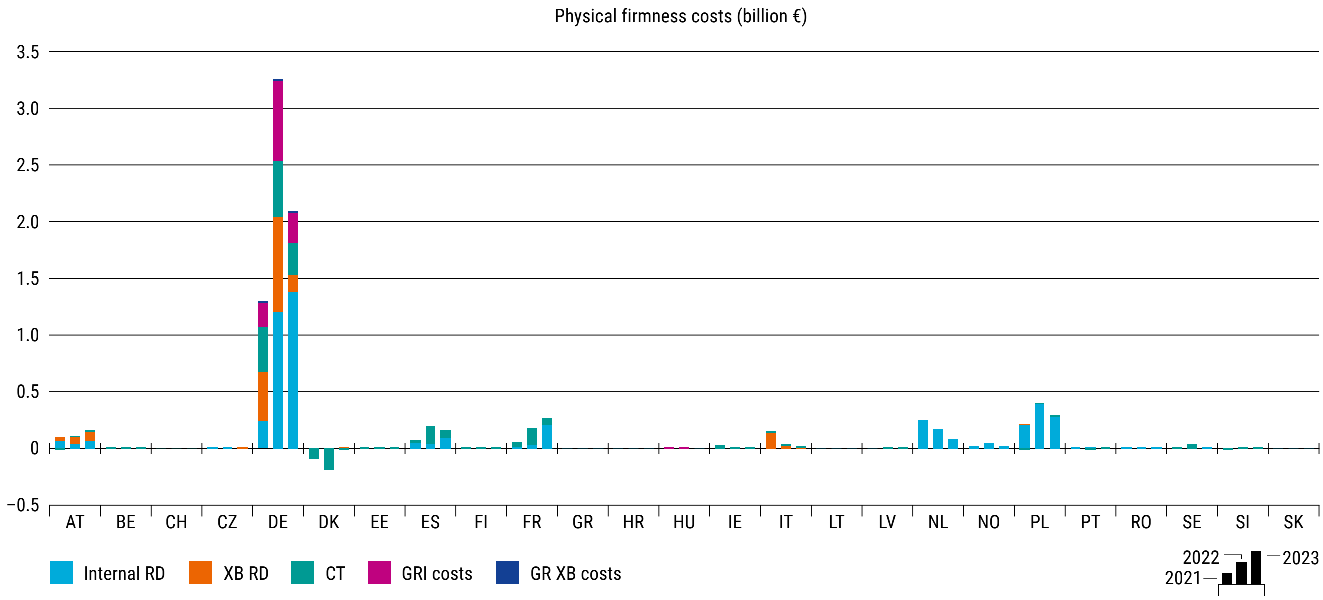


Figure 28: Physical firmness costs per bidding zone for 2021 to 2023. Note: Since PSE applies an integrated scheduling process (ISP), the cost and volume reported by PSE cover the whole ISP – i. e. not only congestion management – and thus the reported cost and volume should be deemed to be strongly overestimated. For a more detailed explanation, see Section 4.2.2.1.

For better readability, the following diagram includes the same data on physical firmness costs without Germany and Poland with a different scaling.

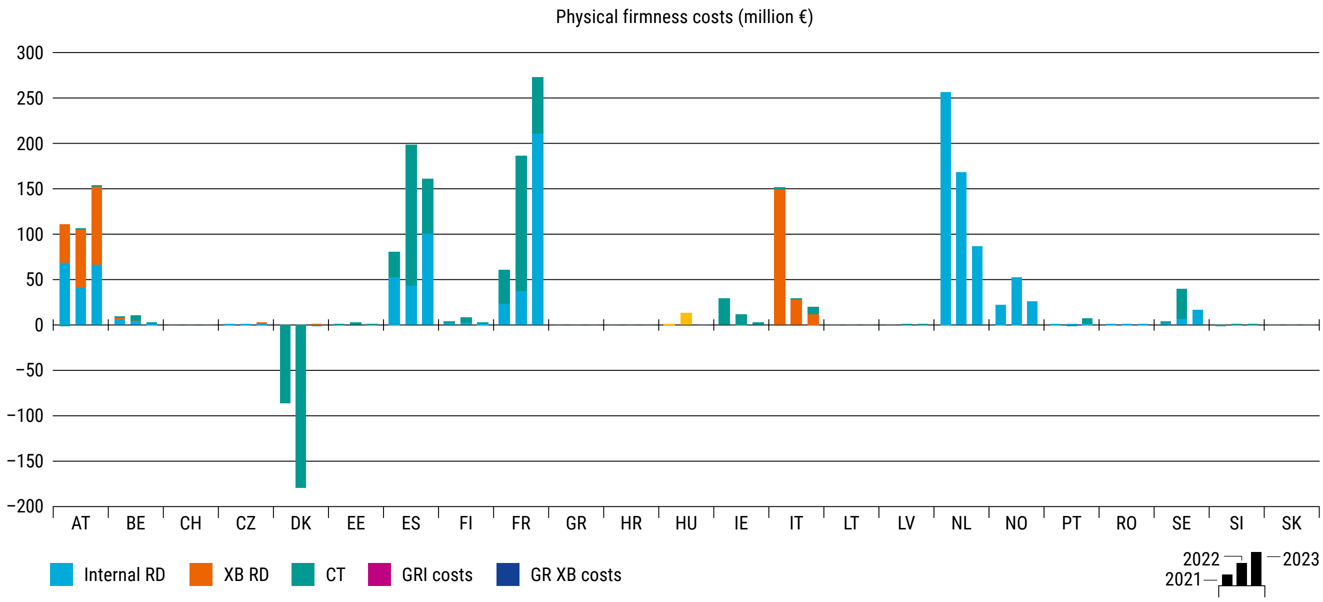


Figure 29: Physical firmness costs per bidding zone for 2021 to 2023 (zoomed in)

The graphs show costs related to countertrade (CT), internal redispatch (internal RD), cross-border redispatch (XB-RD), internal grid reserves (GRI), and cross-border grid reserves (GR XB) for 2021, 2022, and 2023. The cost values have to be analysed in conjunction with volumes (see Figure 32). Data on physical firmness costs for Switzerland are not provided since these are only available for the NRA.

Congestion management measures are induced and influenced by a variety of factors. One possible factor to determine the size of a BZ is the overall volume of contracted electricity that the grids have to transfer from generation to load.

The magnitude of transit flows, loop flows, and PST flows passing through the grid of a BZ and the location of generation and load are among other relevant factors that have a significant influence on volume and the costs of congestion management measures. The annual electricity consumption represents the electricity that the grids had to transfer from generation to load after the application of TSO measures for congestion management and balancing.

Thus, the following maps in Figure 30 present the total costs of congestion management measures related to the annual electricity consumption [GWh] per country.

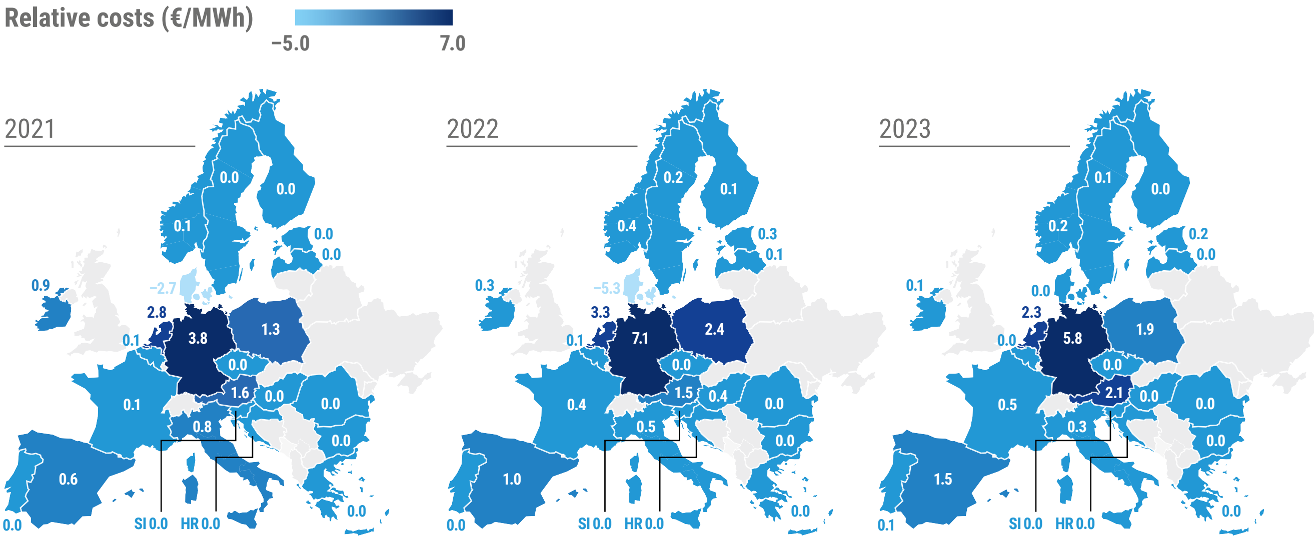


Figure 30: Physical firmness costs per country relative to annual electricity consumption for 2021 to 2023

The relative maps indicate that the differences between the countries are smaller if the absolute physical firmness cost values are placed into relation to the electricity consumption in each country. Nonetheless, these maps should be read carefully. In particular, it must be noted that these contain the total costs of all congestion management measures, while also incorporating congestion management measures that are not directly linked to congestions in transmission networks, such as congestions in distribution networks, voltage-related RD measures, or compensation costs for curtailing renewable energy resources.

Some countries have reported costs for other measures such as renewable curtailment (RC) and other costs related to congestion management that are not part of the physical firmness types shown above. The costs of these other physical firmness types are presented in Figure 31.

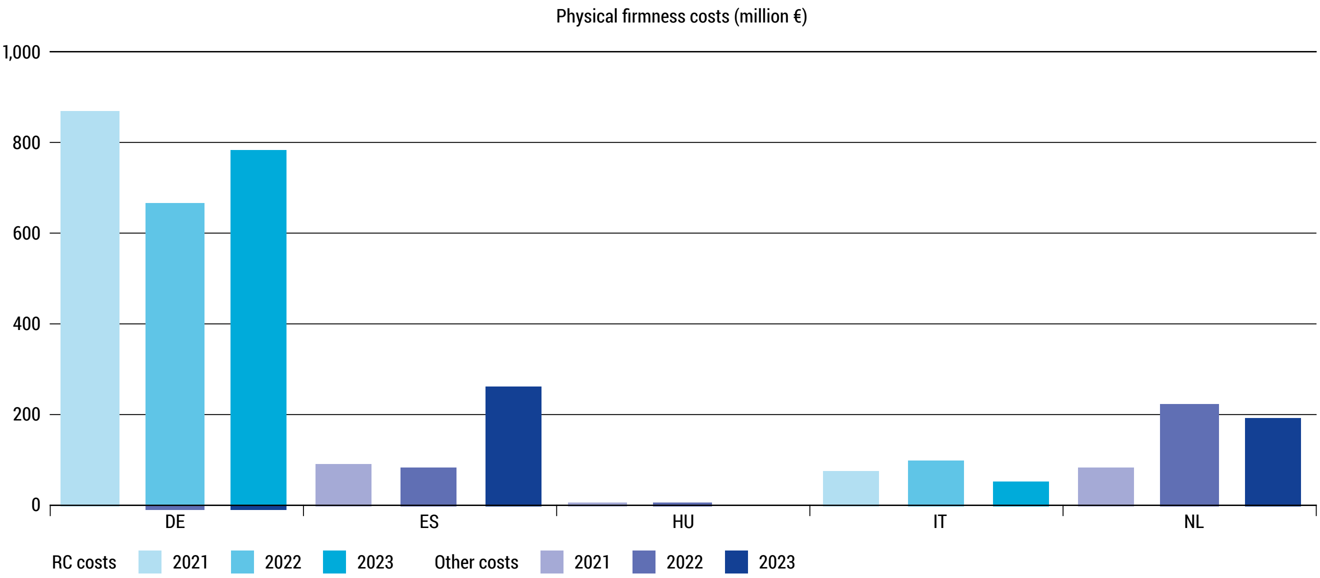


Figure 31: Costs of other physical firmness measures for 2021 to 2023

The costs related to RC are difficult to compare among countries as they result from different compensation rules, which are subject to political decisions. The values in the 'other' category for the Netherlands are related to preventive restriction agreements and for Hungary represent costs related to fuel change test from gas to oil. The values in the 'other' category for Spain represent costs related to distribution system bottlenecks related to ensuring the distribution network security and costs related to planned or unplanned outages. The highest values are observed in Germany due to the special national compensation rule, followed by Spain and the Netherlands.

As previously stated, the physical firmness costs have to be analysed in conjunction with the respective volumes. Therefore, these volumes are presented in the following abstracts.

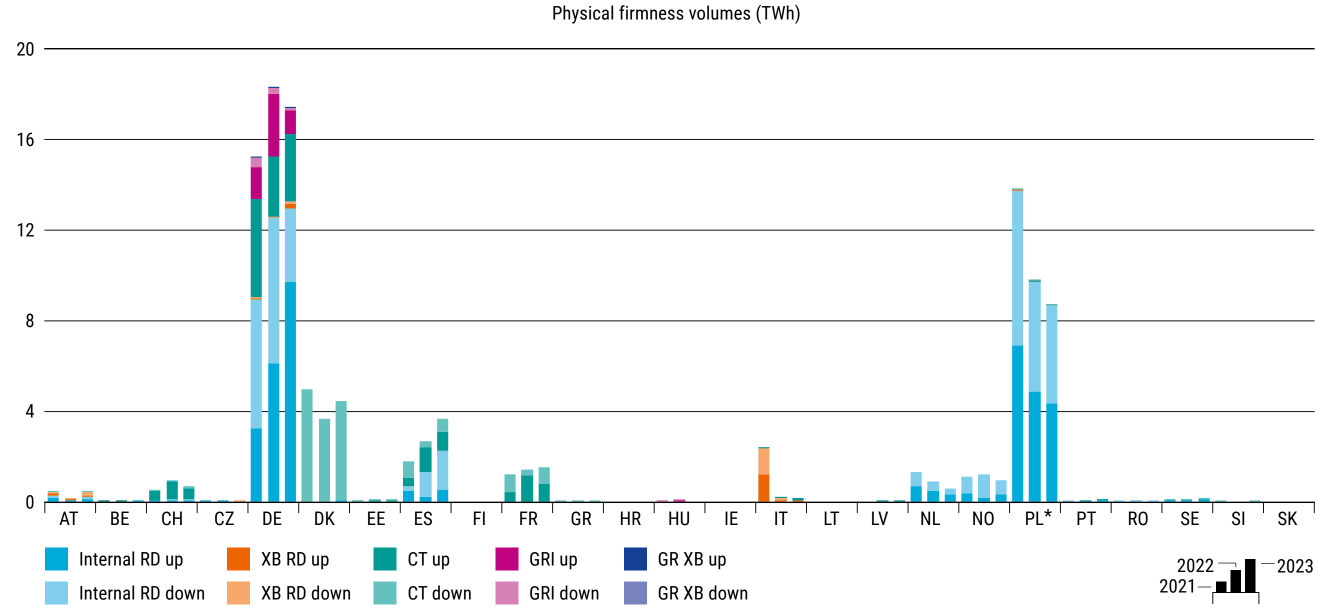


Figure 32: Physical firmness volumes per bidding zone for 2021 to 2023. Note: Since PSE applies an integrated scheduling process (ISP), the cost and volume reported by PSE cover the whole ISP – i. e., not only congestion management – and thus the reported cost and volume should be deemed to be strongly overestimated. For a more detailed explanation, see Section 4.2.2.1.

For better readability, the following diagram includes the same data on physical firmness costs without Germany and Poland with a different scaling.

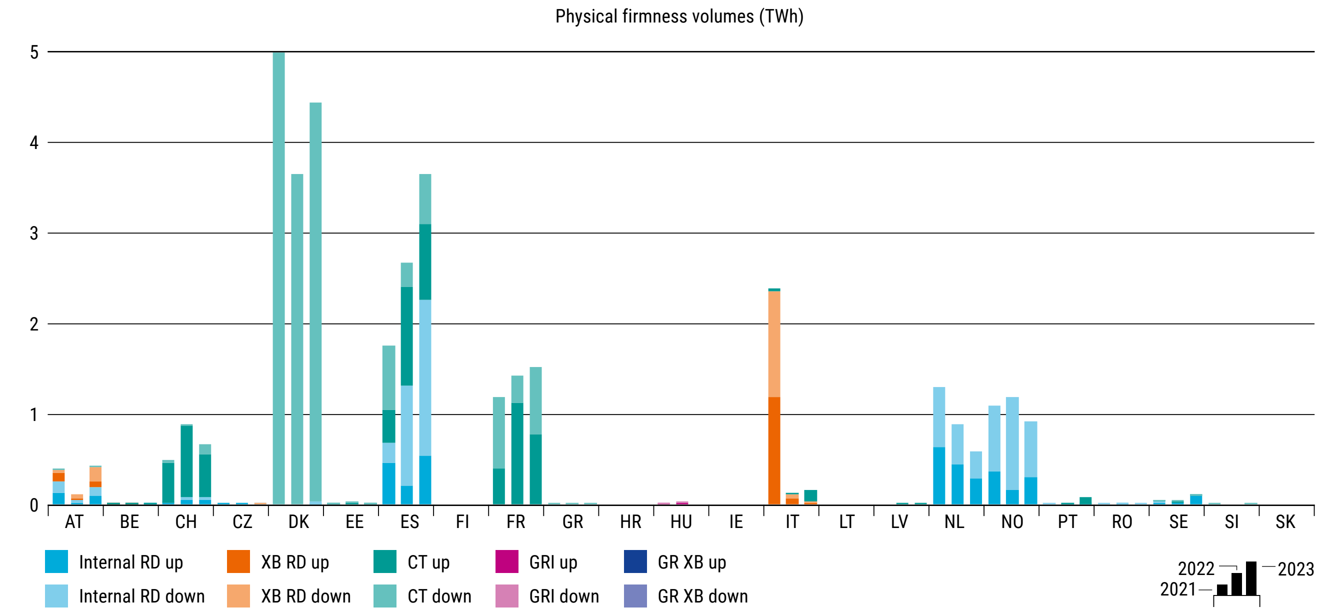


Figure 33: Physical firmness volumes per bidding zone for 2021 to 2023 (zoomed in)

This graph shows volumes related to the measures countertrade (CT up, down), internal redispatch (internal RD up, down) cross-border redispatch (XB-RD up, down), internal grid reserve (GRI up, down), and cross-border grid reserve (XB-GR up, down).

Volumes represent the physics of the system, whereas economic and/or political factors such as prices or regulated components are not included in this measure. Finland, Ireland, and Lithuania did not provide physical firmness volumes. For further details, please refer to the country-specific comments.

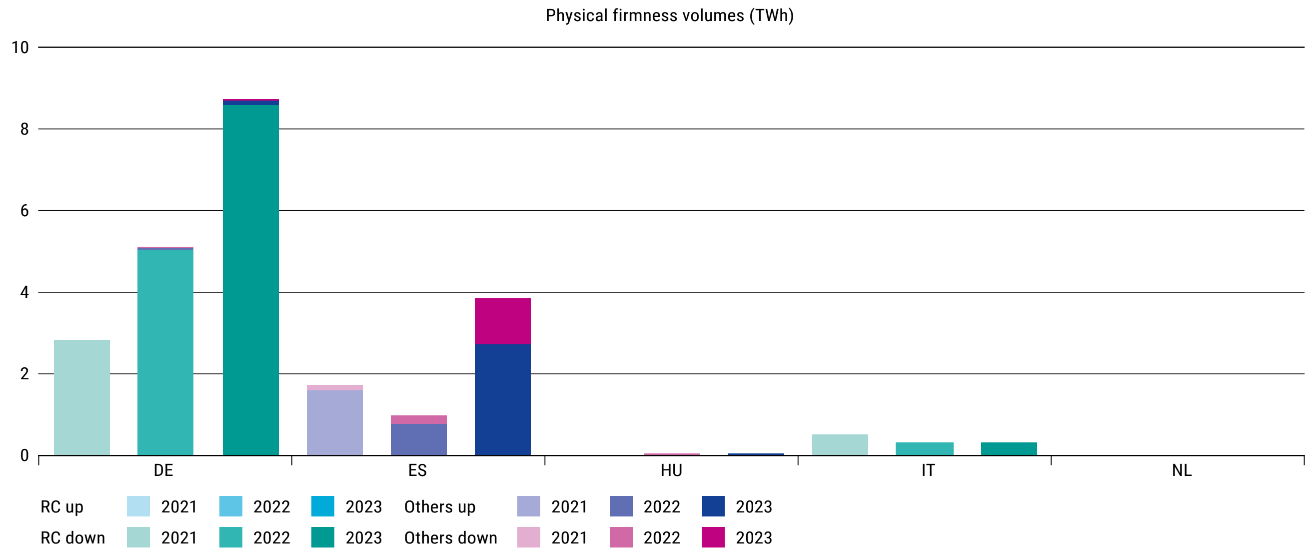


Figure 34: Volumes of other physical firmness measures for 2021 to 2023

The figure shows the evolution of volumes of other measures such as RC and other congestion management measures. RC is closely related to installed RES production capacities in the respective countries. The values in the 'other' category for the Netherlands are related to preventive restriction agreements. For the Netherlands, costs but not volumes were reported for this category. The values in the 'other' category for Hungary represent costs related to the fuel change test from gas to oil, and for Spain they represent costs regarding distribution system bottlenecks related to ensuring the distribution network security and costs related to planned or unplanned outages. Italy provided volumes in the 'other' category but no costs related to them. The highest value in 2023 is observed in Germany, followed by Spain and Italy.

As described for the absolute cost values above, the absolute physical firmness volumes per country need to be put into relation to the size of the countries. Thus, the following maps show the volumes relative to the countries' annual electricity consumption. Again, they show that the differences between the countries become smaller if the size of the countries are considered.

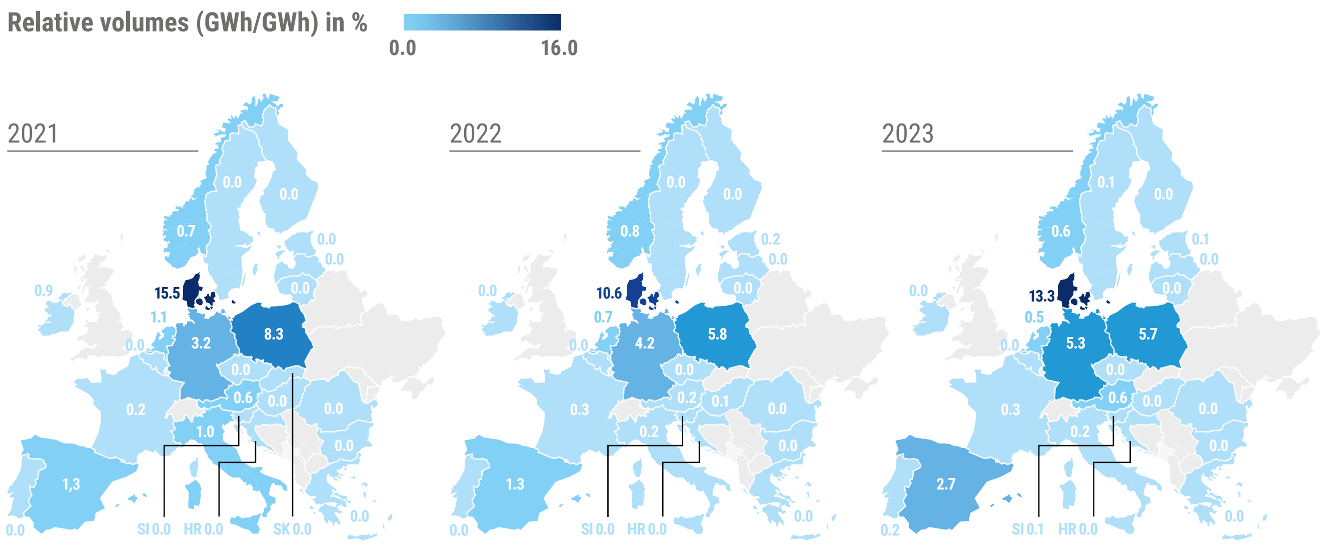


Figure 35: Physical firmness volumes per country relative to annual electricity consumption for 2021 to 2023

4.2.2.1 Summary and comments from TSOs for physical firmness costs and volumes

This report distinguishes between physical firmness costs due to internal and cross-border remedial actions to accommodate a physical flow (under consideration of network security aspects, such as N-1 criteria) resulting from all transactions within and between BZs and to guarantee unchanged cross-zonal capacity rights.

TSOs were asked to report on the costs and respective volumes of all measures taken to manage congestions – regardless of the product design or activation process – for 2021, 2022, and 2023. The measures are categorised and presented in two ways. The first contains congestion management measures such as countertrade, redispatch, and grid reserves, which are divided into internal and cross-border activation. Moreover, measures that might not be relevant for all TSOs are presented under the 'other' category. Generally, the figures contain all measures of TSOs, whether triggered by voltage- or current-related problems and whether or not they hold cross-border relevance.

It is important to keep in mind that the comparison of the delivered costs and volumes can only be indicative, since there are large differences between the different countries. In particular, the costs for RC in Germany – which constitute the majority of physical firmness costs – must be read carefully. These costs are mainly influenced by political decisions such as the German RC compensation scheme, which aims to incentivise and support renewables according to the EU Green Deal. As such, the respective volumes for physical firmness need to be considered. The comments from TSOs about physical firmness costs are briefly presented below.

Austria

Redispatch and grid reserves are presented in this report in a summarised form to avoid unintended market repercussions. The grid reserve costs are only allocated to the Core region as the grid reserve power plants were only utilised in this region. Detailed data has been provided to the regulatory authorities in a transparent manner.

Austria does not engage in counter-trading. However, in this report, all costs and volumes arising from pentalateral activations and cost-sharing in the Italy North region are allocated to counter-trading for the sake of consistency with the other members in the region.

The total physical firmness costs incurred by APG range from € 104 million to € 152 million per year from 2021 to 2023. The volume of redispatch declined in 2022, although the annual costs remained broadly consistent with previous years due to the elevated prices in the energy market, which remained well above pre-2022 levels throughout 2023.

Belgium

Elia uses redispatching as a last resort to solve congestions close to real time when all other non-costly remedial actions (topology changes, PST tap settings) have been exhausted or cannot be further used as they would cause congestions in neighbouring grids.

Elia has invested considerable time and effort into optimising non-costly remedial actions which currently permit it to keep redispatching needs relatively limited.

Bulgaria

Non-costly remedial actions have been used to overcome short-term internal congestions in the Bulgarian transmission system.

Croatia

Non-costly remedial actions have been used to overcome short-term internal congestions in the Croatian transmission system.

Czech Republic

No extra information provided.

Denmark

The high volume of physical firmness is largely due to the strong collaboration between Energinet and TenneT to solve congestions in the northern part of the German grid. This also means that the relative volumes are high since the volume used does not necessarily correlate with the Danish consumption but rather neighbouring TSOs.

Estonia

No extra information provided.

Finland

Historically, counter-trading and internal redispatch have been used to overcome short-term congestions in the Finnish transmission network.

The resources of counter-trading and internal redispatch are market-based, which means that prices are generally slightly higher than the average DA price in Finland.

France

The low values of physical firmness costs incurred in France result from the high availability of topological remedial actions due to regular investment in the grid and its maintenance. Counter-trading activations are mainly concentrated at the FR–ES border. The spike in 2022 is due to high prices and important volumes.

Germany

The total amount of congestion management measures – comprising redispatch, countertrade, RC, and grid reserves – has increased in Germany over the years from 18.0 TWh in 2021 and 23.4 TWh in 2022 to 26.2 TWh in 2023. These total values include both regulations upwards and regulations downwards. About 50 % is for internal redispatch (RD), while cross-border redispatch (XB-RD) and counter-trading (CT) account for about 25 % in 2021 and about 12 % in 2022 and 2023. The share of RC increases from about 16 % in 2021 and 22 % in 2022 to 33 % in 2023.

Costs for congestion management increased from € 2.2 billion in 2021 to a peak of € 3.9 billion in 2022, before declining again to € 2.9 billion in 2023. In 2021, the costs comprised about 11 % internal RD, 39 % XB-RD and CT, 10 % grid reserves, and 40 % RC. For 2022, internal redispatch had a cost share of about 31 %, XB-RD and CT 34 %, grid reserves about 18 %, and RC about 17 %. In 2023, the cost shares were 48 % for internal RD, 15 % for XB-RD and CT, 9 % for grid reserves, and 27 % for RC.

These figures must be viewed with caution as the increasing energy carrier prices in 2022 led to enormous increases in electricity prices, which still had an impact in 2023.

The massive expansion of renewable energies in combination with the completed phase-out of nuclear energy and the ongoing phase-out of coal-fired power is placing high demands on the electricity grid. In order to cope with this, the grid in Germany is being massively expanded. Specifically, once the DC projects have been completed, a decline in congestion management volumes and costs is expected.

Compared to other countries, the figures for Germany appear high, although a direct comparison only makes limited sense due to various aspects, including the central location in Europe and the ongoing energy transition in Germany.

First, it must be acknowledged that RC accounts for a significant share of volume and costs. Germany has 72 GW installed wind power capacity onshore and offshore, and 94 GW installed photovoltaics capacity as of 2024, which represents 64 % of its overall generation capacity. Hence, Germany has already made significant steps towards the overall goal formulated in the EU Green Deal. One measure aiding the faster deployment of RES is an adequate compensation scheme that grants RES producers a fixed and corresponding compensation in case of curtailment. Furthermore, the curtailment of RES producers is subordinate to conventional energy sources. Therefore, RC costs – which are mainly driven by wind production in Germany – cannot easily be compared fairly between countries since the legal framework resulting from political decisions strongly varies. Hence, the volumes representing the actual physics provide a more relevant insight.

Second, when comparing the volumes of congestion management measures, the size of the population and the related energy consumption of Germany must be acknowledged. For example, in 2021, Germany used measures in the order of 3.2 % of its yearly consumption to manage congestions (consumption 563 TWh; sum of measures 18 TWh). The range of these values across Europe is from 0.01 % to 8.3 %.

Further, the processes that TSOs deploy to relief congestion are very different across Europe, which sometimes renders a clear distinction between congestion management and balancing/ancillary services/adequacy impossible. In Germany, there is a clear separation between balancing and congestion management.

Greece

No extra information provided.

Hungary

In the context of financial and physical firmness costs, the currency conversion for countries that do not use the Euro as their official currency becomes relevant. The cost data shown for MAVIR is the summed result for the previous given year. The sum components are converted to Euros as the average daily mid-price exchange rate of the last day of the month in which the quantity was activated, using data provided by the Central Bank of Hungary.[3]

Ireland

No extra information commented.

Italy

Physical firmness costs for Italy also include an estimation of the costs incurred for solving congestions in the Italian power system. Since Italy adopts a central dispatching approach where all system constraints (e.g. reserve, balancing, congestions, etc.) are solved together in a SCOPF algorithm (to minimise system costs), costs and volumes cannot be associated ex-post with a single constraint in a straightforward way.

Most of the costs – and therefore volumes – are associated with cross-border redispatch (including internal bidding zones) and counter-trading measures at the Italy North border.

3 https://www.mnb.hu/en/arfolyamok

Costs and volumes of the 'other' measures applied relate to the RC of wind energy, which in Italy is closely related to where the installed RES capacity is located. Wind generators are mainly located in southern Italy and Sicily, while the areas with most consumers are located in the northern part of the country.

Latvia

No extra information provided.

Lithuania

All Baltic TSOs were in a single common balancing area during 2021–2023 period. To avoid any duplication or misinterpretation of data for counter-trading, it is best to retrieve data for all Baltic TSOs from **https://baltic.transparency-dashboard.eu/download**.

Luxembourg

As part of the common DE/LU BZ, Luxembourg contributes to the costs of the German TSOs associated with congestion management measures, including redispatching, counter-trading, renewable energy curtailments, and grid reserves within the DE/LU BZ. These costs have significantly increased, partly due to market price fluctuations between 2021 and 2023.

Netherlands

In the Netherlands, physical firmness is reported in the form of redispatch and restriction contracts.

Concerning redispatch, for TenneT significant redispatch measures – in terms of both cost and volume – took place at the end of 2021 and during 2022. This was caused by outages due to a very significant grid extension of the important Lelystad Diemen network element.

For 2023 (with the exception of February), the redispatch volumes and costs returned to a level equal to the 2017–2020 period, largely demonstrating that the peak of redispatch measures was caused by the outages due to grid extension.

TenneT uses restriction contracts for planned maintenance and outages. Given that these contracts are not meant to be used to solve observed congestions, these costs do not signal the existence of structural congestion.

Norway

Historically, counter-trading and internal redispatch have been used to overcome short-term congestions in the Norwegian transmission network.

The resources of counter-trading and internal redispatch are market-based, meaning that prices are generally slightly higher than the average DA price in Norway.

Poland

In Poland, network constraints are solved within the integrated scheduling process (ISP), a bid-based security constraint unit commitment and economic dispatch process where balancing, reserve procurement, management of congestions, and dispatching are integrated and co-optimised within one process.

In the ISP, it is not possible to calculate redispatching (costs or volume) as defined in the survey. Network constraints are identified and solved within one process that is integrated with balancing and reserves procurement. There is no sequential process where overload is first identified and then a manual decision is made for congestion management. Thus, the reported volume covers the whole ISP – i.e., not only solving congestions – and should thus be deemed as strongly overestimated.

Portugal

No extra information provided.

Romania.

No extra information provided.

Slovakia

SEPS does not use costly remedial actions to relieve congestion.

Slovenia

Physical firmness costs and volumes in Slovenia have been increasing since 2022 due to the introduction of a transitory cost-sharing solution of redispatching and counter-trading in the Italy North region. In accordance with this cost-sharing solution, ELES has paid its cost share irrespective of the congestion and/or activation location. In 2023, the majority of activations were required to solve physical congestions outside of Slovenia, and only a minor part of congestions were located within Slovenia or on tie lines between Italy and Slovenia. Besides this, no other types of costly measures were applied during this period.

Spain

The costs of internal redispatch in the Spanish electricity system increased in 2023 due to an increase in installed renewable energy units, especially solar photovoltaic. These increased congestions have shown a seasonal behaviour concentrating during the summer period when photovoltaic production is higher and the capacity values of the electric lines are lower. Regarding cross-zonal firmness, there has not been any cross-border redispatch measure in any year, while counter-trading activations are mainly executed at the FR–ES interconnection.

In Spain, most physical firmness costs within the BZ are caused by 'other' costs and strictly comprise costs related to distribution system bottlenecks and planned and unplanned outages, with costs related to ensuring distribution network security representing the principal contribution (over 56 %) to all physical firmness costs incurred in Spain in 2023.

Sweden

Due to the lack of volumes and bids with the correct geographical location (SE4 and parts of SE3) on the mFRR activation market, Svenska kraftnät decided to acquire resources outside the market to manage the newly emerging east–west flows in the Swedish power system.

The geographical location of resources for redispatch is crucial for usability, suitability, and efficiency. If none of the bids in the mFRR activation market are suitably located or if bids are missing in the appropriate areas, other resources (outside the mFRR activation market) have to be activated.

In December 2022, agreements on counter-trading and redispatch were concluded with power producers in SE3 and SE4. These agreements allowed the facilities to be utilised during the 2022/2023 winter period and spring 2023, which resulted in higher costs for redispatch in 2023 than in previous years.

Switzerland

Only volumes but not costs are available for Switzerland. There is no separated and validated data for cross-border redispatch, and thus the full volume is allocated to counter-trading.

4.3 Conclusions

Chapter 4 has delved into details regarding the CI collected, the volumes of congestion management measures, and the respective costs incurred to ensure the firmness of cross-border capacities.

Over the three years analysed, very high CI was received in France, Germany, Italy, Spain, and Sweden. In 2022, CI surged across nearly every country, driven by similarly high electricity prices. By 2023, CI for most countries had decreased to levels resembling those in 2021, although the average remained 2 – 3 times higher than in 2021.

Financial firmness costs incurred by TSOs to ensure the firmness of cross-border capacities were predominantly due to curtailments caused by emergency grid security or safety issues, with other unspecified reasons following. Italy and France faced the highest costs across all three years considered. A significant rise in costs was observed at most Italian external borders from 2022 to 2023 (IT–CH + 693 %, IT–FR + 588 %, IT–AT + 561 %).

Germany incurred the highest costs for physical firmness measures, with Poland closely following. Both countries also reported the highest volumes of these measures. In Germany, the majority of physical firmness costs were due to compensation for renewable energy curtailment. These costs are largely influenced by the compensation rates for RES producers, which are determined by political decisions. This dependency becomes evident when analysing the cost-volume relationship.

There is no universal trend across all countries. Countries with significant installed RES production capacities tend to manage higher volumes to address congestion. However, comparisons of absolute values between countries should be approached with caution. Analysing the physics requires carefully considering the volumes of measures in relation to various factors, including country size, which is also addressed at the end of the respective subchapter.

Accordingly, it is important to consider the specific explanations for each country.

5 Implementation of the CEP's 70% minimum capacity to be available for cross-zonal trade

To foster non-discriminatory and cross-zonal trade in the internal market for electricity, Article 16(8) of the EU Electricity Regulation requires European TSOs to make at least 70 % of the transmission capacity (respecting operational security limits) available for cross-zonal electricity trading. Where TSOs have requested a 'derogation' from this requirement pursuant to Article 16(9) or member states have invoked an 'action plan' pursuant to Article 15, a less ambitious target may apply for a given year or a transitional period defined in the action plan.

Monitoring the fulfilment of the CEP70 requirement: Why do several reports exist?

The assessments pursuant to Article 15(4) of Regulation 2019/943 are based on contributions from each TSO, which again are subject to NRA approval. Since the NRA requirements for approval of individual contributions are not homogeneous, several reports for assessing the fulfilment of the applicable target exist. While acknowledging that NRAs are responsible for assessing TSOs' compliance with the CEP70 provisions, several market reports exist:

National compliance assessments/ ENTSO-E market report

In the annual ENTSO-E market report, TSOs provide an easily accessible overview of the (individual) national assessments for external stakeholders. However, it should be noted that the values shown in these market reports are obviously based on the national compliance methodologies, which can diverge from one another. Therefore, the comparability of the individual values is limited. For instance, some countries evaluate all contingencies for each critical network element per MTU (i.e., leading to multiple values per MTU), whereas some take only a single value per MTU. To provide transparency on the national compliance methodologies, TSOs provide country fact sheets, which comprise a brief description of the national compliance assessment and provide detailed information on the differences between the national methodologies. In particular, it is described whether an NRA's compliance methodology followed ACER's monitoring methodology, and otherwise indicates the main differences between the two assessments.

ACER Market Monitoring Report

As previously mentioned, ACER publishes an independent assessment as part of its annual market monitoring applying a uniform methodology. Here, it is important to understand that ACER's approach is not identical to the approaches of individual NRAs when approving the TSO's contributions. Hence, in order to draw valid conclusions on whether cross-zonal trade capacity reached the minimum requirement or linear trajectory, it is inevitable to check each NRA's approval, as is legally required.

Another difference compared to the ENTSO-E market report/ national assessments is that the ACER report provides a comparison to the target minimum capacity (i.e. 70 %) and – in case action plans or derogation are in place – the transitional minimum capacity. As a summary of the national compliance assessments, the ENTSO-E market report always compares the current fulfilment of the CEP70 provisions to the (transitional) minimum capacity only, which can be lower than 70 % in case action plans or derogations are in place.

In the interests of the best possible transparency and cooperation between the organisations, the graphs provided in the following section (partly also taken from the ACER market report) attempt to create a certain level of comparability. However, TSOs would like to highlight once again the limited comparability of the results of the individual national methods among each other and with the uniform ACER methodology.

5.1 Overview of differences between the national monitoring methodologies and the non-binding ACER Recommendation 01/2019

In the following, an overview is provided on all main differences between the national monitoring methodology as applied by the competent regulatory authority and the non-binding ACER Recommendation 01/2019.

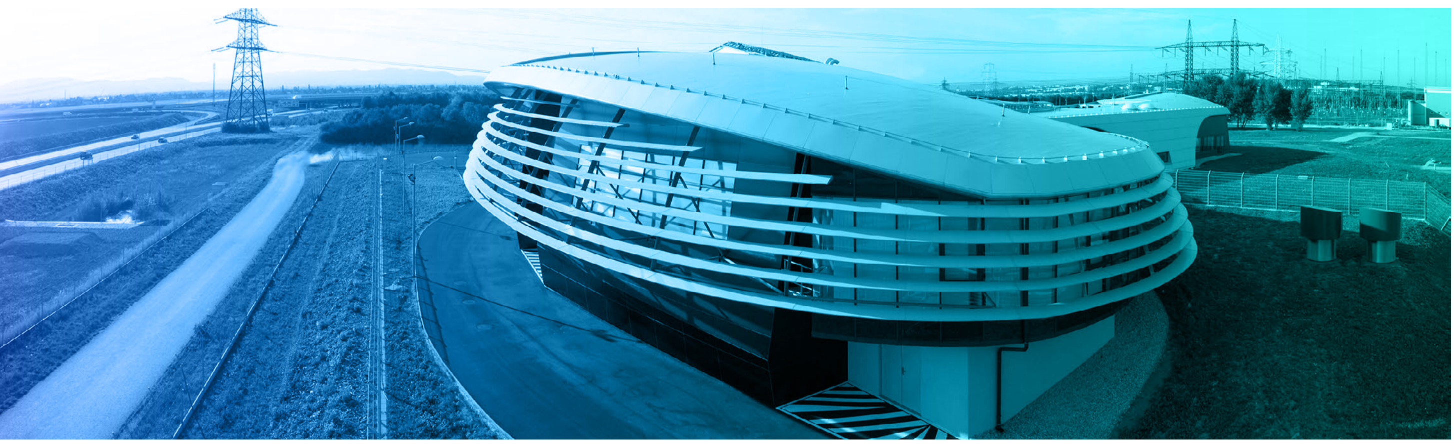
If a country is not listed below, its competent regulatory authority adopted the non-binding ACER Recommendation 01/2019 for its compliance assessment. If no year is mentioned, the differences explained occurred for 2021–2023.

Austria

- Austria has implemented an action plan that specifies the minimum capacity targets for both regions (Core and Italy North), starting with 2021. Furthermore, due to a lack of tools for 2020 and parts of 2021, a complete derogation of the minimum criterion was granted (therefore, Figures 41, 42, 48, 49, 52 and 56 only cover the period after the general derogation; CWE: 28.07.-31.12.2021, AT–CZ/HU/SI: 01.07.-31.12.2021; Italy North: 29.10.-31.12.2021). Starting with 2022, further derogations were approved for the Core region by the Austrian regulatory authority, considering the lack of (cross-CCR) coordination, excessive loop flows, and third-country flows.
- Where the Agency only assesses the Critical Network Element with the lowest trade margin per MTU, E-Control assesses each Critical Network Element (including contingencies, 'CNEC') of each relevant MTU of the respective year.
- Each of those CNEC entries is assessed with a compliance value (respecting the approved derogation and action plan target). The compliance of a CCR is based on the average of all related CNEC entries.
- Whereas in Core all CNECs of the final domain are considered relevant, in Italy North only the CNECs that where potentially limiting the coordinated NTC are assessed.

Croatia

- For the duration of the derogation in 2021, HOPS was committed to allocating capacities no less than the minimum capacity allocated for each market unit in the period 2018 to 2020, and no less than the capacity that corresponds to 20 % of the load for each CNEC.
- For the duration of the derogation in 2022, HOPS was committed to allocating capacities no less than the minimum capacity allocated for each market unit in the period 2018 to 2020, and no less than the capacity that corresponds to 20 % of the load for each CNEC.
- The action plan was approved by Ministry of the Economy and Sustainable Development and entered in force from 25 February 2022.
- According to this action plan, the MACZT target for 2022 (the starting point of the linear trajectory) is 20.4 % for the FB approach, while the starting point using the NTC approach before the operational start of Core flow-based DA market coupling is based on the average value of MACZT between 2019 and 2021, which expects at least 7.6 % with a recommended starting point of at least 20 % at Core borders after the start of the action plan.
- Before the operation start of the Core FB DA market coupling, the outcomes/results of ACER monitoring were used as inputs for the monitoring of MACZT requirements.
- From the middle of 2022, with the start of Core flow-based DA market coupling, HOPS follows the FB approach in accordance with the action plan that specifies the minimum capacity targets of the linear trajectory for the Core region. Where the Agency only assesses the Critical Network Element with the lowest trade margin per MTU, the Croatian Energy Regulatory Agency (HERA) assesses each Critical Network Element (including contingencies, 'CNEC') of each relevant MTU of the respective year.



France

- According to the Smart compliance agreed with CRE, MTU where at least one criterion is fulfilled is deemed as compliant regarding the 70 %:
  - Price convergence is reached with BZs within the corresponding CCR
  - All limiting CNECs are in a neighbouring country
  - Minimum MACZT is above 70 %
  - Only for Italy North CCR: An allocation constraint was applied to the whole Italian import by TERNA

Germany

- Where the Agency only assesses the Critical Network Element with the lowest trade margin per MTU, the BNetzA assesses each Critical Network Element per MTU (taking into account the most limiting contingency).
- Interconnector outages or failures in the capacity calculation process are exempted from the evaluation.
- Diverging MNCC calculation: Where ACER recommends using forecasted transfer capacities, the BNetzA uses the total offered transfer capacities in line with the current regulation.
- BNetzA also considers the additional capacity provided as a result of the extended LTA inclusion.

Hungary

- In 2021, a derogation with respect to all EU BZ borders (HU–HR, HU–AT, HU–RO, HU–SK, HU–SI) was applied until the introduction of a coordinated FB capacity calculation methodology in accordance with CACM. According to the derogation, MAVIR had been expected to make available for cross-border trade at least the following capacities for the limiting CNECs relevant for the interfaces and exchange directions specified below, as a minimum value for the 75 % of MTUs including third-country flows during the derogation period:
  - SK–HU border/import direction: 10 %
  - AT–HU border/import direction: 25 %
  - HR–HU border/import direction: 10 %.
- After the derogation period, Hungary adopted an action plan in December 2021 (to be valid from 1 January 2022), pursuant to Article 15 (1) of the Electricity Market Regulation (EU) 2019/943 to eliminate the congestions by 31 December 2025.
- In 2023, most of the transmission lines fulfilled the 70 % requirement. For the five network elements pre-recorded in the adopted action plan, the threshold values stated in the linear route were met every hour of 2023.

Poland

- ACER only evaluates the Critical Network Element with the lowest trade margin per MTU, whereas URE evaluates each Critical Network Element (including contingencies; CNEC) for each relevant MTU.
- An important difference compared to the approach applied by the Agency is the treatment of allocation constraints, defined as “constraints to be respected during capacity allocation to maintain the transmission system within operational security limits and have not been translated into cross-zonal capacity or that are needed to increase the efficiency of capacity allocation”. As minimal capacity obligations consider the percentage of capacity that respects operational security limits, the application of allocation constraints cannot be considered to reduce capacities below the trajectory thresholds. However, in its monitoring report, ACER has recalculated the CZC figures for Poland by reducing the capacities made available on the Polish DC borders, even though the full capacity of the link was usually offered (or at least the minimal threshold or derogation was respected). The basis for assuming such an interpretation is unclear as the applicable legal framework undoubtedly allows for the application of allocation constraints. Apart from having the purpose of keeping the system within operational security limits, allocation constraints are not listed in Regulation 2019/943 as factors to be included within the 30 % margin that is foreseen for – inter alia – loop flows. It should be emphasised that for hours marked by ACER as not fulfilled, the respective DC borders were used for transits through Poland (often to the full capacity of the links), thus contributing to European social welfare. The above are reasons for differences between the PSE assessment and the one shown by ACER.

Slovakia

- Slovakia was granted a derogation for 2021, 2022, and 2023.
- Before the go-live of the Core FB DA CC (8 June 2022), the outcomes/results of ACER monitoring were used as inputs for the monitoring of the MACZT requirements.

Slovenia

- In the Core region, the CNEC with the lowest MACZT is considered for each MTU.
- In the Italy North region, CNEC(s) that limit the coordinated NTC calculation are considered. Slovenian CNECs did not limit the capacity calculation in 2023.

Spain

- For 2021 and 2022, Spain had a national derogation in place.
- According to the derogation for 2021, the national target was to offer at least the minimum levels of capacity in accordance with Article 16(8)(a) of Regulation 2019/943 during 70 % of the hours, considering the following criteria:
  - The minimum levels shall be provided in accordance with Article 16(8)(a) of Regulation 2019/943 and Paragraphs 4.2 and 5.1 of ACER Recommendation 01/2019 on the limiting CNECs.
  - It is considered fulfilled if the limiting CNEC does not belong to Spain.
  - Those hours where it is not possible to identify a limiting CNEC are discarded to calculate the proportion.
  - It is considered fulfilled if the commercial exchange programme in the concerned border and direction is smaller than the corresponding NTC value.
  - If an unforeseen outage or breakdown does not allow offering the minimum levels of capacity during the period of the derogation, Red Eléctrica shall justify to CNMC (national NRA) this unavailability due to force majeure. CNMC decides whether this justification implies the non-consideration of the corresponding period to calculate the proportion. There was no need to apply this condition.
- The derogation for 2022 established the same criteria, but the percentage of hours to fulfil the criteria increased to 75 %.
- For 2023, no derogation was requested given the high level of compliance reached during 2022 following the ACER Recommendation 01/2019 criteria, after some improvements in the SWE capacity DA calculation methodology.

Portugal

- For 2021, 2022, and 2023, Portugal had a national derogation in place.
- According to the derogation for 2021, the national target was to offer at least the minimum levels of capacity in accordance with Article 16(8)(a) of Regulation 2019/943 and Paragraphs 4.2 and 5.1 of ACER Recommendation 01/2019 on the limiting CNECs, during 70 % of the hours.
- The derogation for 2022 established the same criteria, but the percentage of hours to fulfil the criteria increased to 75 %.
- The derogation for 2023 established the same criteria, but the percentage of hours to fulfil the criteria increased to 82.5 %.

5.2 Overview of national monitoring results and ACER report by region

As already mentioned in the introduction to Section 5.1, the graphs provided in the following attempt to create a certain level of comparability. TSOs aim to provide full transparency on all information available concerning the CEP70 monitoring, in particular by putting together all available monitoring results next to each other. Nonetheless, it should be highlighted and acknowledged that the comparability of these results is limited due to the different methodologies and data behind the visualised values. Please also note that Appendix 3 also provides an overview of the fulfilment of the minimum capacity targets (considering derogations and action plans) for 2021–2023 by region/border.

Furthermore, it should be noted that the minimum capacity of 70 % is not an 'absolute (minimum) target' as deviations for reasons of operational security are legally permitted. TSOs have the legal duty to reconcile it with physical reality. The EU Electricity Regulation foresees the possibility to deviate from the 70 % rule based on the need to ensure the grid's operational security. If necessary, such deviations – i.e. capacity reductions – result from the mandatory validation step in capacity calculation. Capacity reduction is a last-resort measure in case there are insufficient remedial actions to secure the grid.

5.2.1 Core CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the Core CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are provided for 2023 only, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report.

For the sake of transparency, the results from the national monitoring and ACER are shown side by side. However, once again, please note that they are only limited in their comparability due to the different methodologies behind the values. The differences in the methodologies are explained in detail in Section 5.1

5.2.1.1 Monitoring results for 2021–2023 under consideration of the applicable targets stemming from derogations and/or action plans

In order to show the differences in the national methodologies and display them in a concise way, the bar chart in Figure 36 is divided into several panels. Each panel refers to a different unit on the y-axis. The relative value on the y-axis must therefore be interpreted for each panel individually.

For 2021–2023, most of the countries within the Core CCR had a derogation or action plan in place.

Figure 36 visualises the extent to which member states complied with their relevant applicable value stemming from respective action plans and/or derogations. To provide some level of comparison, the same categories as in ACER's monitoring reports have been applied for visualising the national data.

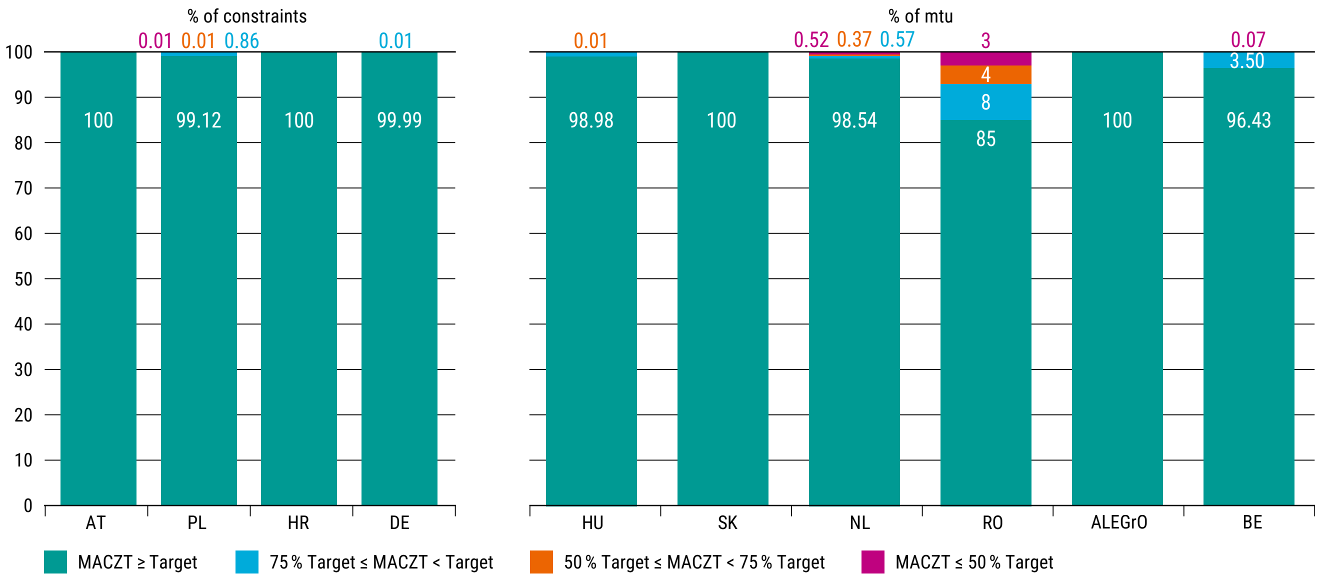


Figure 36: National monitoring results for 2023 for Core CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2023.

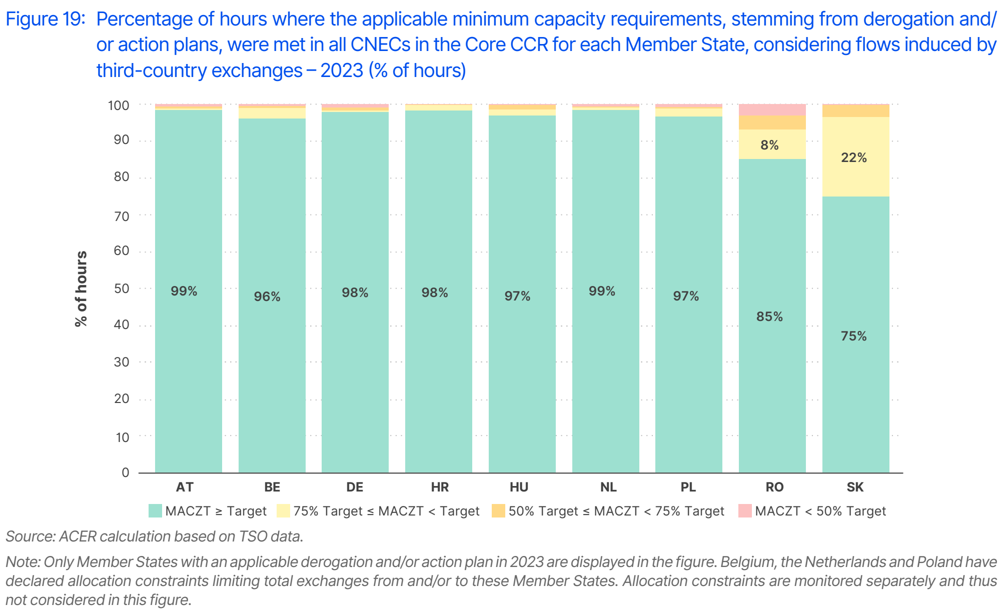


Figure 37: ACER results for 2023 for Core CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: **ACER Market Monitoring Report 2024**.

As already highlighted, national methodologies differ, which limits the comparability of the results. Some differences between the methodologies in the Core CCR regarding the measurement are accounted by classifying the borders into distinct panels. Put simply, the capacity calculation process of the Core CCR produces a value for each CNEC in each MTU. TSOs and ACER filter these data and therefore use only a part of the overall data for the monitoring. ACER itself and member states adopting ACER's Recommendation 01/2019 only assess the CNEC with the lowest trade margin per MTU. Germany assesses the CNEC with the lowest trade margin for each Critical Network Element per MTU, while Austria, Croatia, and Poland assess each Critical Network Element per MTU taking into account all contingencies. Additional differences are explained in detail in Section 5.1.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results (under consideration of derogations and action plans) for the Core CCR (respectively the former CCRs CWE and CEE) for 2022 and 2021. Please note that FB market coupling went live in the Core CCR during 2022. Due to the significant differences in the capacity calculation (NTC vs. FB) before and after its go-live, the results for 2022 have been split into several graphs (before and after FB go-live), as well as under consideration of the former CCRs CWE and CEE.

For Transelectrica, for 2021 and the period between 1 January and 9 June 2022, the values were calculated based on the whole Romanian interface, according to the internal capacity calculation process in place before the Core capacity calculation go-live.

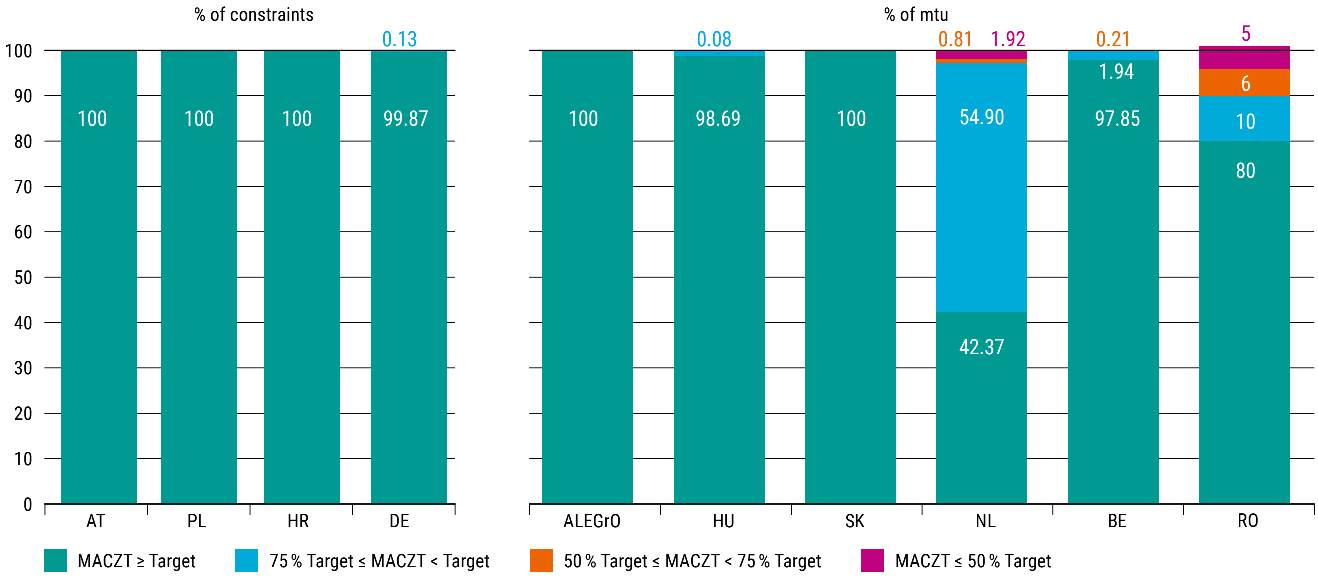


Figure 38: National monitoring results for 2022 after Core FB market coupling go-live for the Core CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2022.

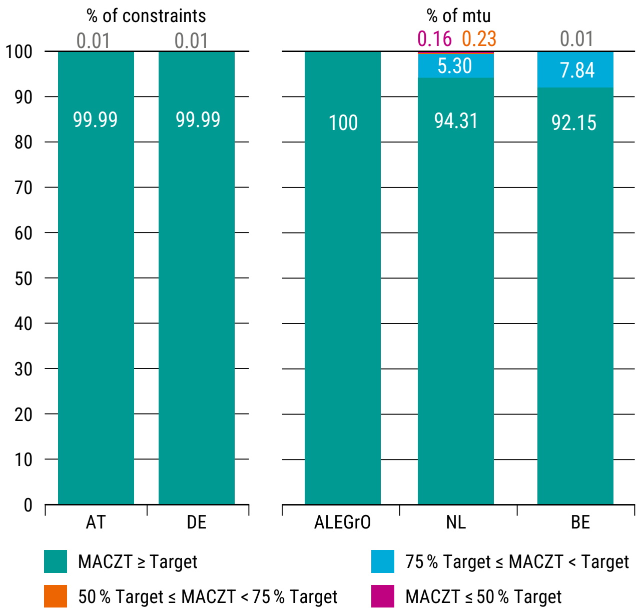


Figure 39: National monitoring results for 2022 before the Core FB market coupling go-Live for CWE as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2022.

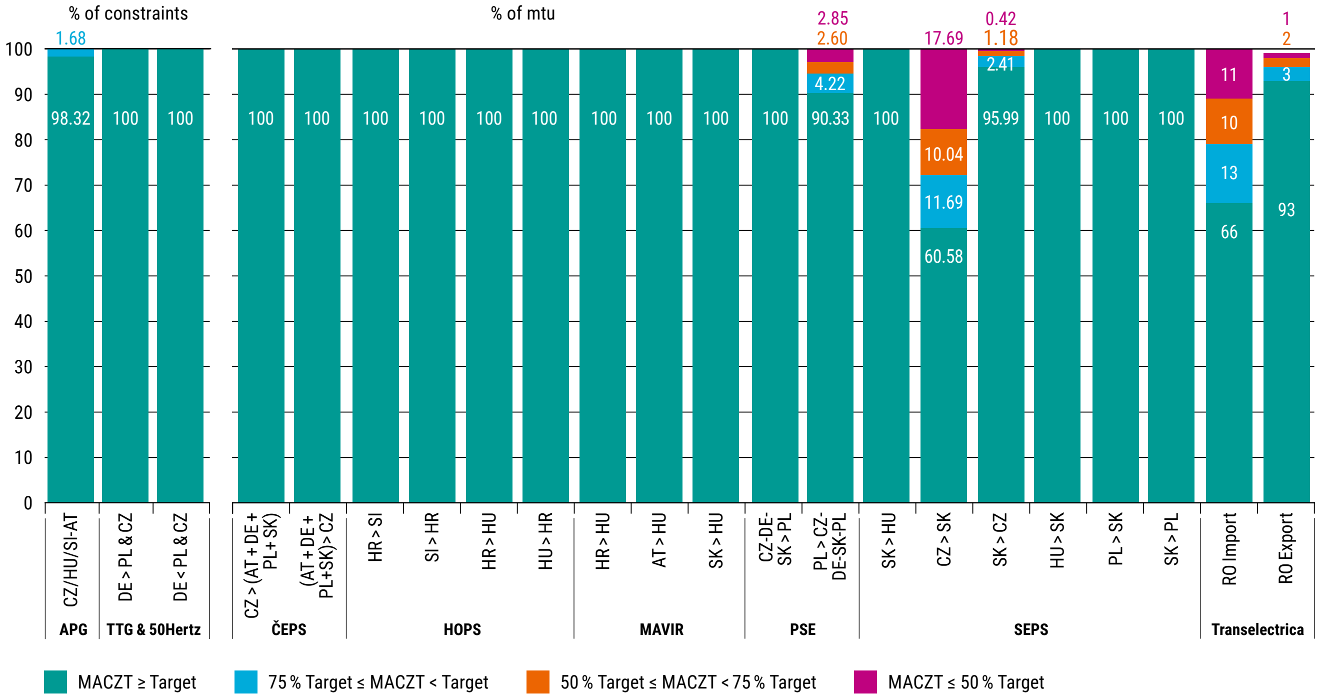


Figure 40: National monitoring results for 2022 before the Core FB market coupling go-live for CEE as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2022.

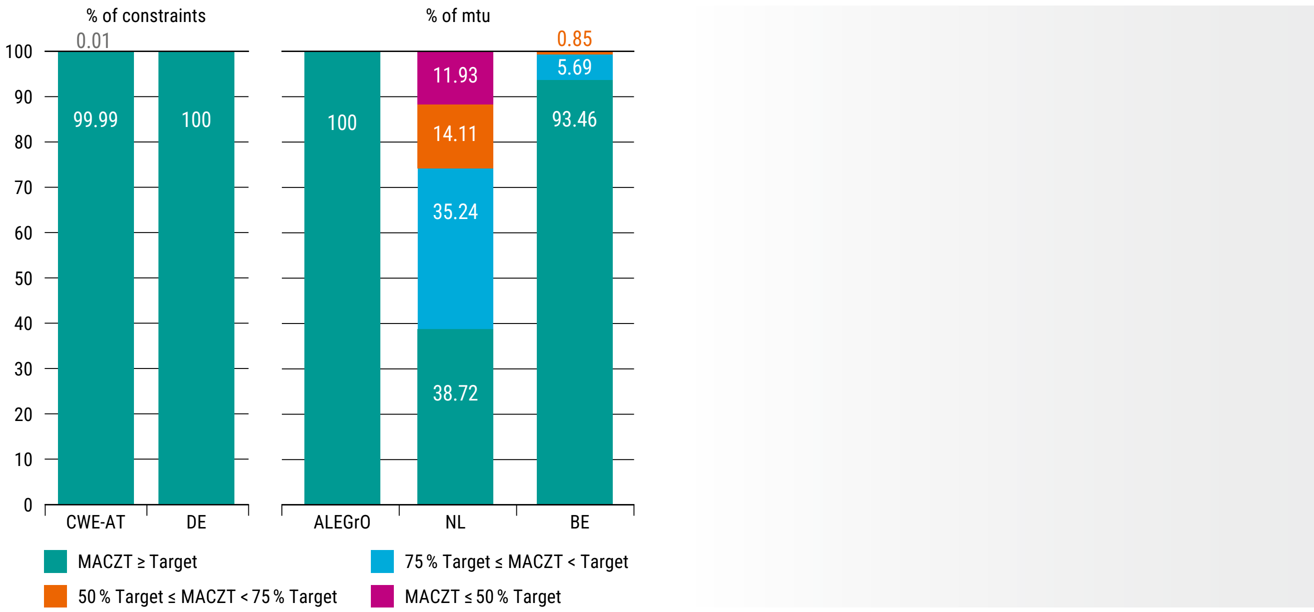


Figure 41: National monitoring results for 2021 before the Core FB market coupling go-live for CWE as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2021.

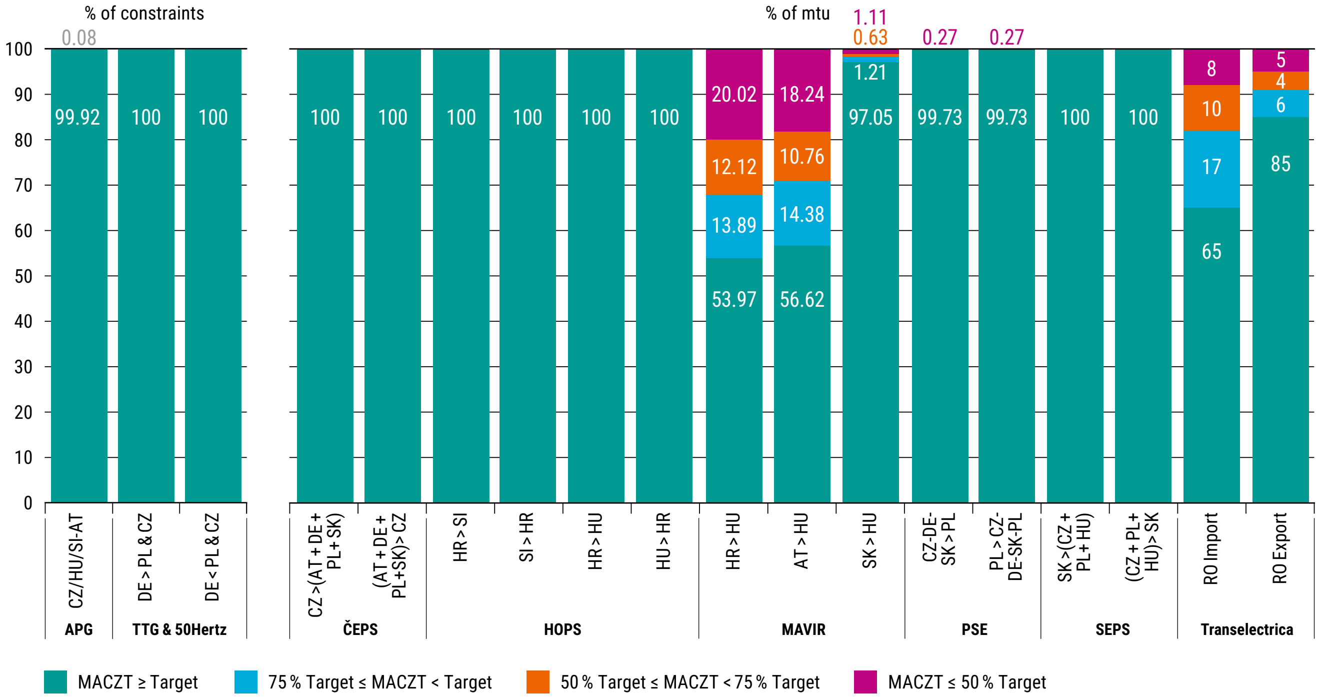


Figure 42: National monitoring results for 2021 before the Core FB market coupling go-live for CEE as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2021.

5.2.1.2 Observations and conclusions

Overall, the Core TSOs show a high degree of fulfilment with the intermediate targets resulting from action plans and derogations. Here, nearly all Core TSOs deliver results close to 100 % fulfilment. Interestingly, the assessments with both the national data and the data generated based on the ACER recommendation lead to the same results as described above. It should therefore be emphasised that national monitoring and ACER monitoring lead to quite a similar result in terms of the currently binding minimum requirement.

5.2.1.3 Monitoring results for 2021–2023 as a comparison to the 70% final target

Unless a derogation has been granted or an action plan is in place, member states need to comply with the target as set out in Article 16(8) of the Electricity Regulation. In case of an action plan, this final target has to be achieved by 2026. While many countries within the Core CCR compliance are currently assessed against the applicable target stemming from an action plan or a derogation (cf. Figure 36), some countries are already assessed against the final target. Figure 43 visualises the extent to which all countries of the Core CCR already reached the final value of 70 % in 2023. Nonetheless, please note that most of the countries still had a derogation or action plan in place in 2023 and therefore neither aimed to comply with the final target value yet nor were they obliged to do so.

As already mentioned in the previous section, in the following facet plots are used to visualise the mentioned differences in the national methodologies while retaining some level of comparability to ACER's results. France only assesses MTUs without price convergence where limiting CNECs were located in France. In line with the publication of its NRA, Belgium provides graphs with both the percentage of constraints and the percentage of MTU, whereby these two graphs are considered complementary in the NRA's compliance monitoring.

Please note that differences between the national monitoring results (cf. Figure 43) and the results calculated based on the ACER recommendation (cf. Figure 44) not only occur due to differences between the national monitoring methodologies and the ACER recommendation (cf. section 5.1), but in the case of Slovakia also due to the derogation considered. The derogation of Slovakia defines a minimum number of hours (fewer than 8,760 hours) during which the applicable minimum capacity has to be offered.

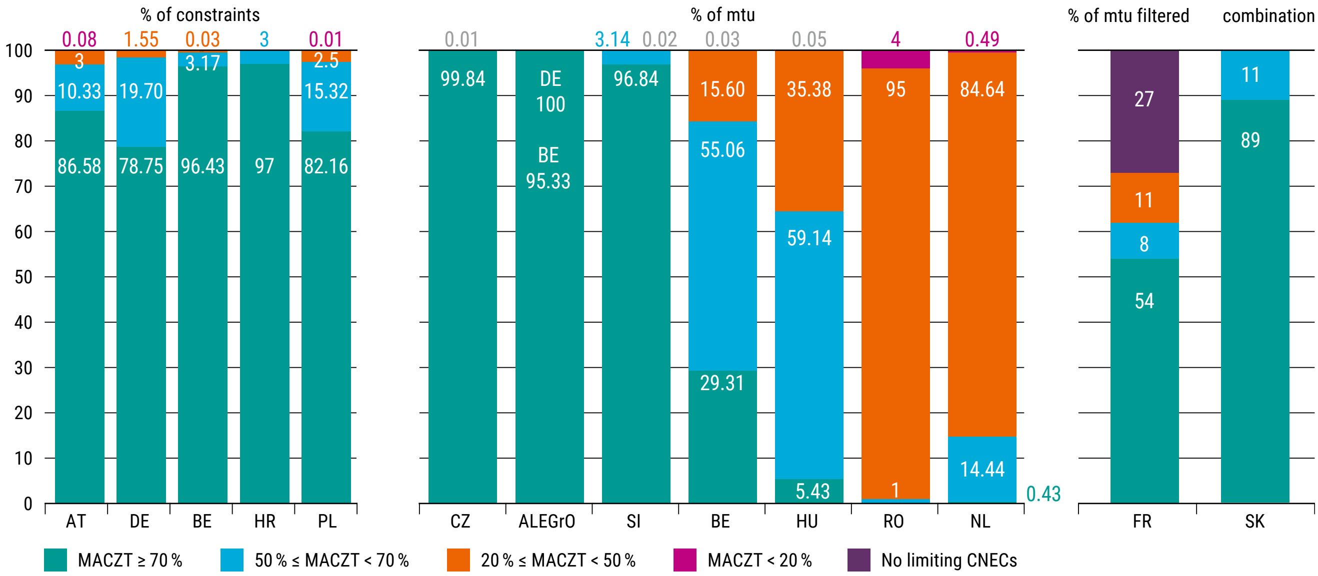


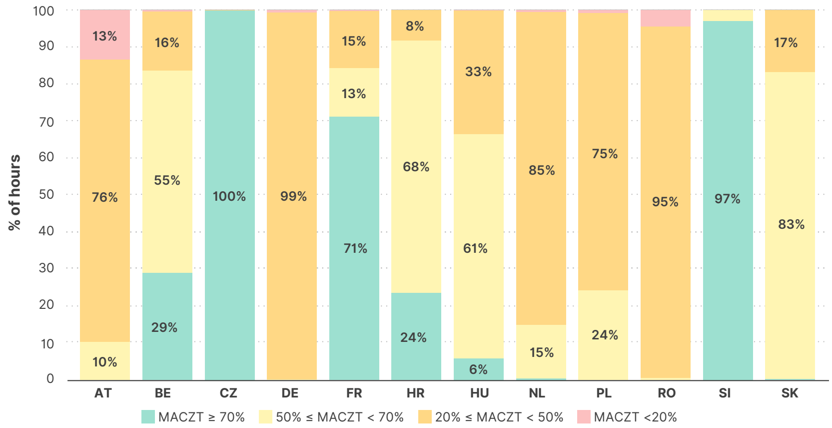
Figure 43: National monitoring results for 2023 for the Core CCR as a comparison to the 70 % final target (mainly[1] excluding the applicable minimum capacity requirements stemming from action plans and/or derogations)[2,3]. Source: National Monitoring Data 2023.

1 Please note that the values illustrated for Slovakia consider the Slovakian derogation (i.e. SEPS offers at least 50 % of the capacity at minimum 80 % of the market time units in 2023).

2 The availability of ALEGrO can differ for Belgium and Germany depending on unplanned outages and the responsible party for such outages.

3 Please note that Belgium is shown twice. In line with the publication of its NRA, Belgium provides graphs with both the percentage of constraints and the percentage of MTU, as these two graphs are considered complementary in the NRA's compliance monitoring.

Figure 16: Percentage of hours when the minimum hourly MACZT was above 70% or within predefined ranges in the Core CCR for each Member State, considering flows induced by third-country exchanges – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Note: Belgium, the Netherlands and Poland have declared allocation constraints limiting total exchanges from and/or to these Member States. Allocation constraints are monitored separately and thus not considered in this figure.

Figure 44: ACER results for 2023 for the Core CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results (excluding derogations and action plans) for the Core CCR (respectively for the former CCRs CWE and CEE) for 2022 and 2021. Please note that FB market coupling went live in the Core CCR during 2022. Due to the significant differences in the capacity calculation (NTC vs. FB) before and after its go-live, the results for 2022 have been split into several graphs (before and after FB go-live), as well as under consideration of the former CCRs CWE and CEE.

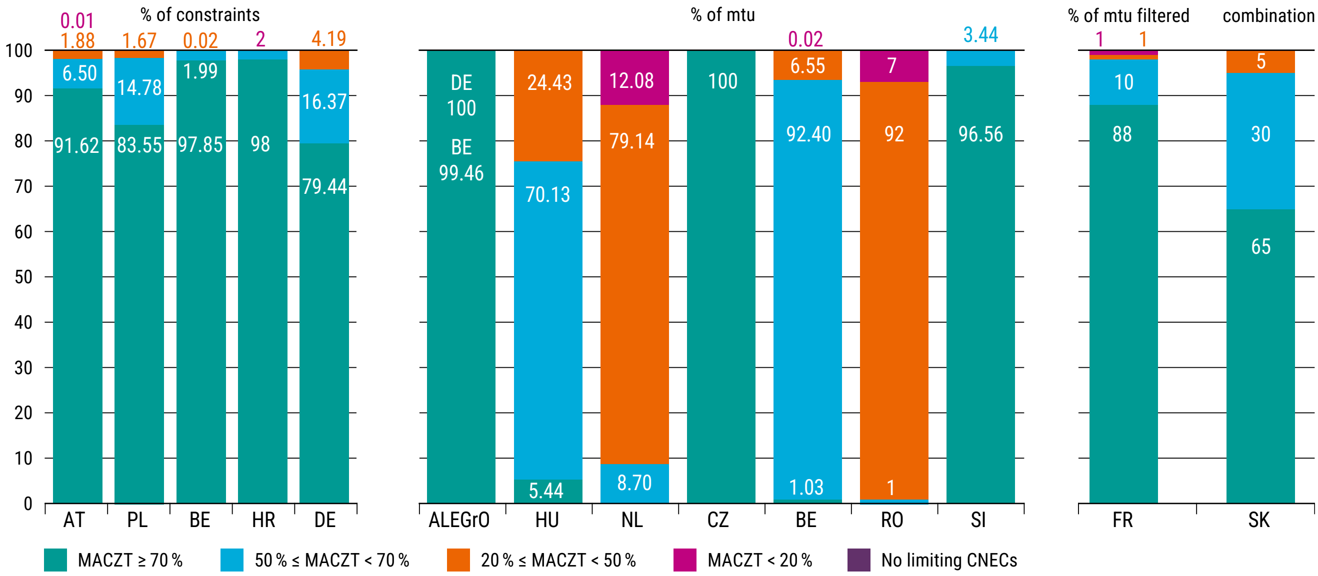


Figure 45: National monitoring results for 2022 after the Core FB market coupling go-live for the CCR Core as a comparison to the 70 % final target (mainly[4] excluding the applicable minimum capacity requirements stemming from action plans and/or derogations)[5,6]. Source: National Monitoring Data 2022.

4 Please note that the values illustrated for Slovakia consider the Slovakian derogation.

5 The availability of ALEGrO can differ for Belgium and Germany depending on unplanned outages and the responsible party for such outages.

6 Please note that Belgium is shown twice. In line with the publication of its NRA, Belgium provides graphs with both the percentage of constraints and the percentage of MTU, as these two graphs are considered complementary in the NRA's compliance monitoring.

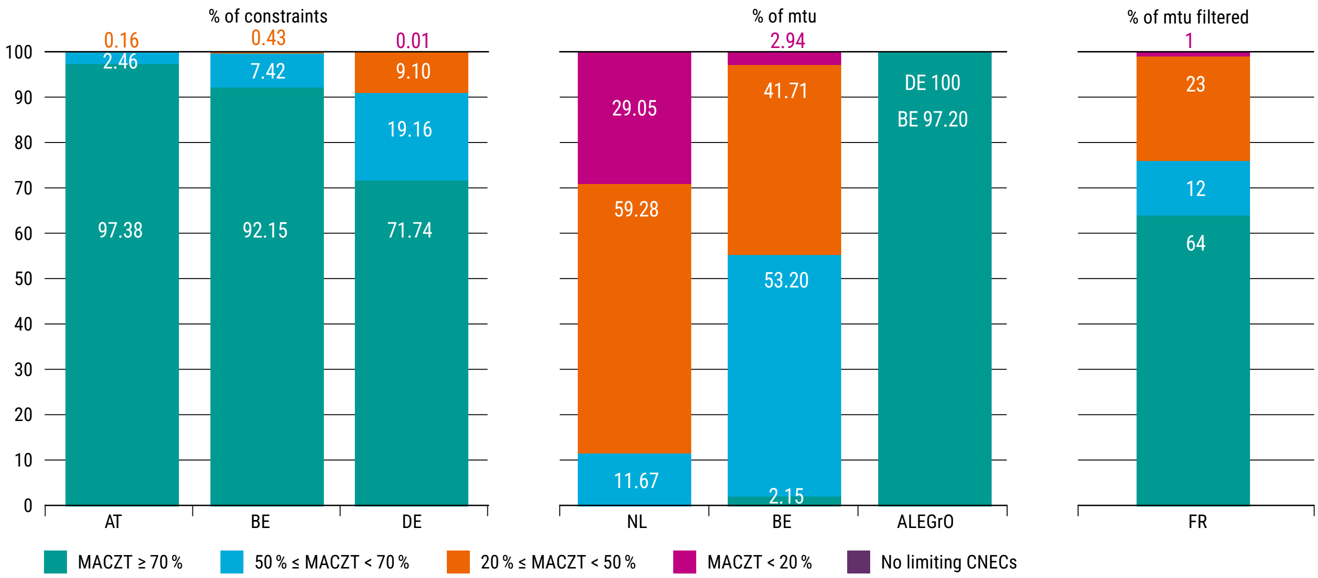


Figure 46: National monitoring results for 2022 before the Core FB market coupling go-live forCWE as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations)[7,8]. Source: National Monitoring Data 2022.

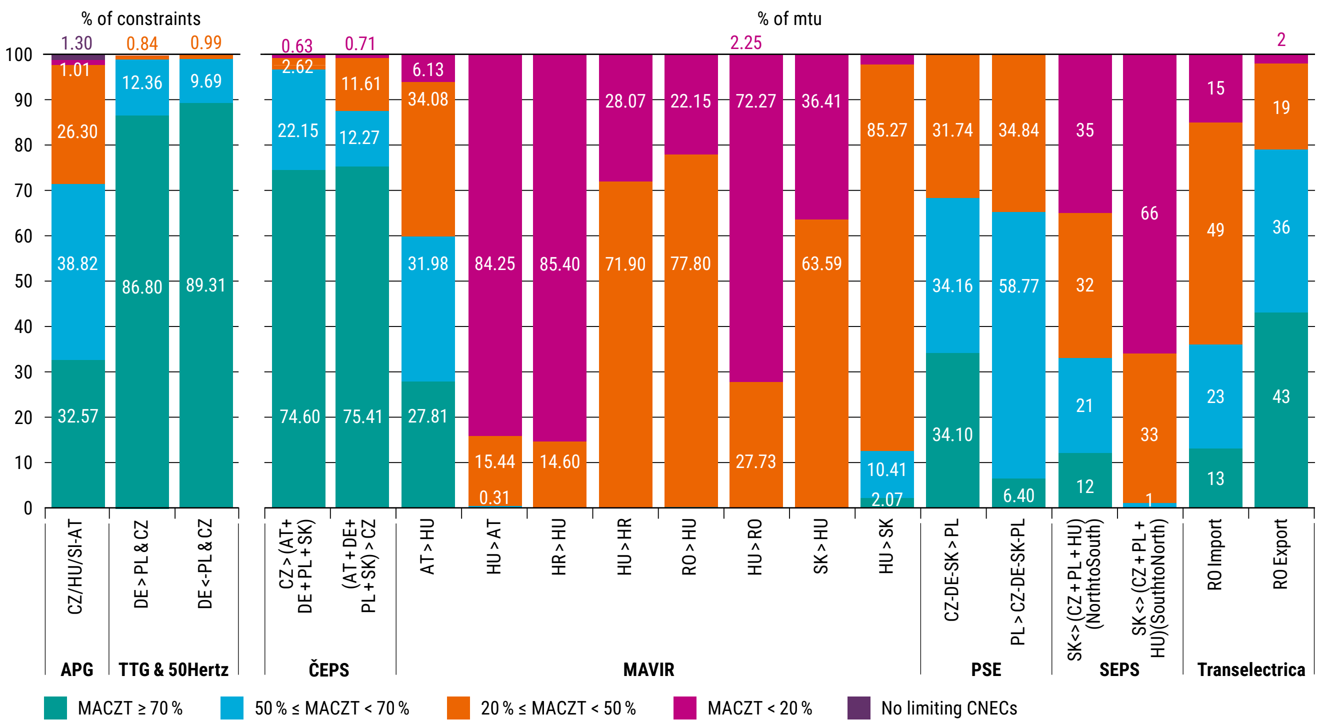


Figure 47: National monitoring results for 2022 before the Core FB market coupling go-Live for CEE as a comparison to the 70 % final target (mainly[9] excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2022.

7 The availability of ALEGrO can differ for Belgium and Germany depending on unplanned outages and the responsible party for such outages.

8 Please note that Belgium is shown twice. In line with the publication of its NRA, Belgium provides graphs with both the percentage of constraints and the percentage of MTU, as these two graphs are considered complementary in the NRA's compliance monitoring.

9 Please note that the values illustrated for Slovakia consider the Slovakian derogation.

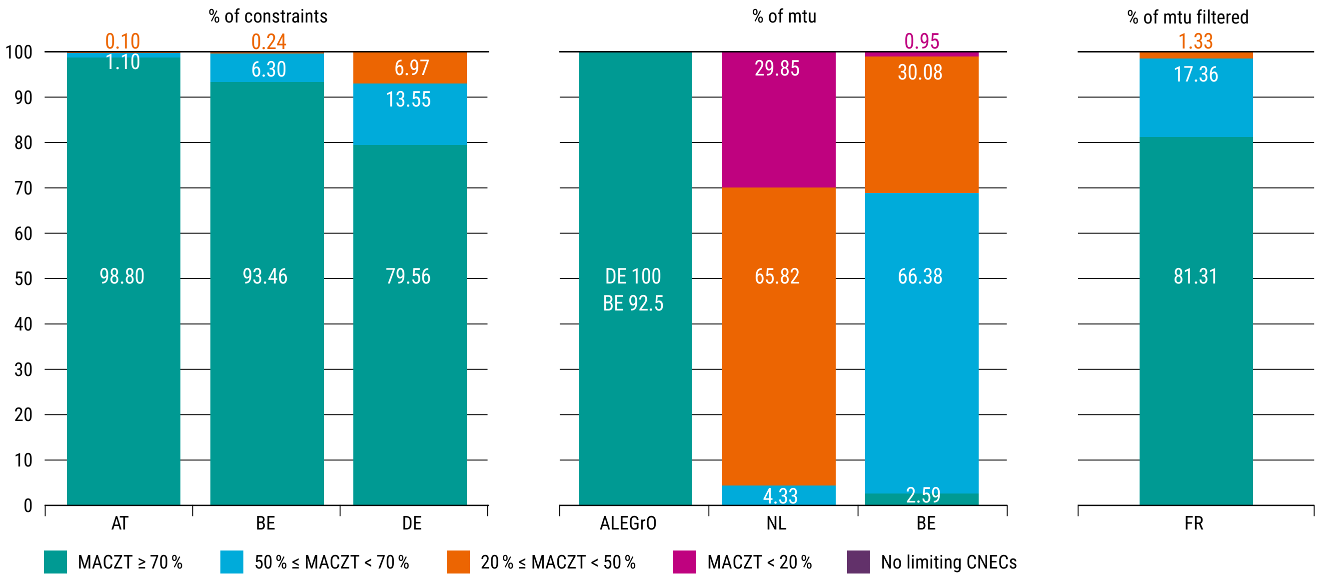


Figure 48: National monitoring results for 2021 before the Core FB market coupling go-live for CWE as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations)[10,11]. Source: National Monitoring Data 2021.

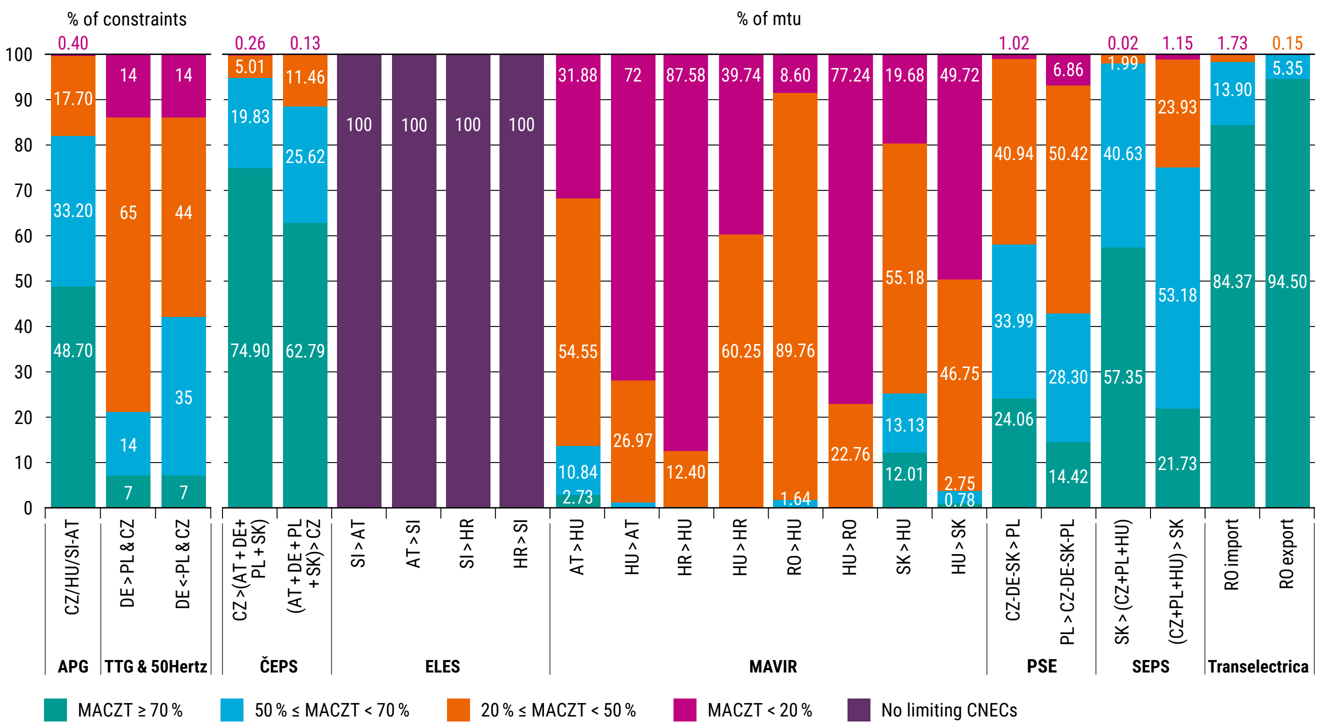


Figure 49: National monitoring results for 2021 before the Core FB market coupling go-live for CEE Core as a comparison to the 70 % final target (mainly[12] excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data.

10 The availability of ALEGrO can differ for Belgium and Germany depending on unplanned outages and the responsible party for such outages.

11 Please note that Belgium is shown twice. In line with the publication of its NRA, Belgium provides graphs with both the percentage of constraints and the percentage of MTU, as these two graphs are considered complementary in the NRA's compliance monitoring.

12 Please note that the values illustrated for Slovakia consider the Slovakian derogation.

5.2.1.4 Observations and conclusions

Overall, the Core TSOs already show a good level of fulfilment with the final 70 % targets. The data shows that in 2023 already more than two-thirds of the Core TSOs met the 70 % target in more than 75 % of the data. Interestingly, the assessment with the data generated based on the ACER recommendation leads to quite different results. Therefore, considering that the results for the intermediate targets are consistent using national or ACER data and that the 70 % target is not binding today for those with an action plan and/or derogation, the extent to which benchmarking today against the 70 % target can add meaningful value to the debate of 70 % fulfilment should be reconsidered.

5.2.2 Italy North CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the Italy North CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are provided for 2023 only, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report. For the sake of transparency, the results from the national monitoring and ACER are shown side by side. Nonetheless, once again, please note that they are only limited in their comparability due to the different methodologies behind the values. The differences in the methodologies are explained in detail in Section 5.1.

5.2.2.1 Monitoring results for 2021–2023 under consideration of the applicable targets stemming from derogations and/or action plans

As already explained for the Core CCR, again facet plots are used to visualise the mentioned differences in the national methodologies while retaining some level of comparability.

For 2021–2023, most of the countries within the Italy North CCR already had the target value of 70 % as the compliance-relevant value in place. Only Austria has an action plan (2021–2023) and a derogation (2021) in place.

Therefore, the following figure visualises the extent to which Austria – as part of the Italy North CCR – fulfilled its compliance-relevant intermediate value. Since ACER did not provide this analysis in their reporting, a comparison to ACER is not possible.

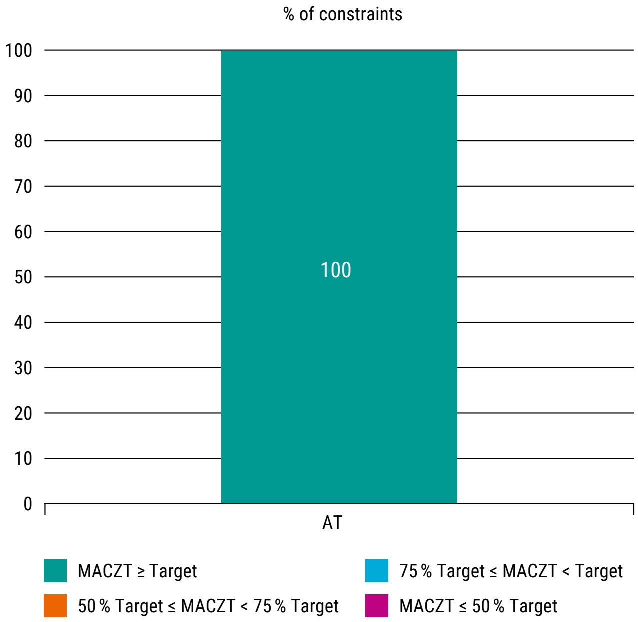


Figure 50: National monitoring results for 2023 for Italy North CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2023.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results under consideration of derogations and action plans for Italy North CCR for 2022 and 2021. Please note that only Austria has an action plan (2021–2023) and derogation (2021) in place.

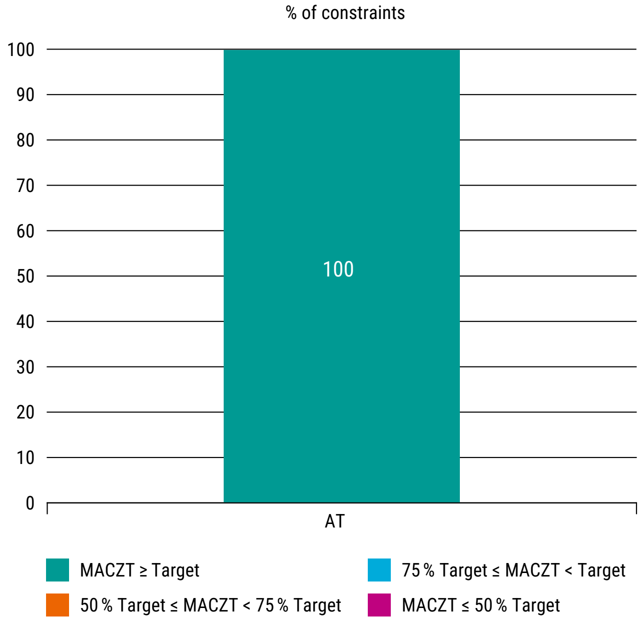


Figure 51: National monitoring results for 2022 for Italy North CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2022.

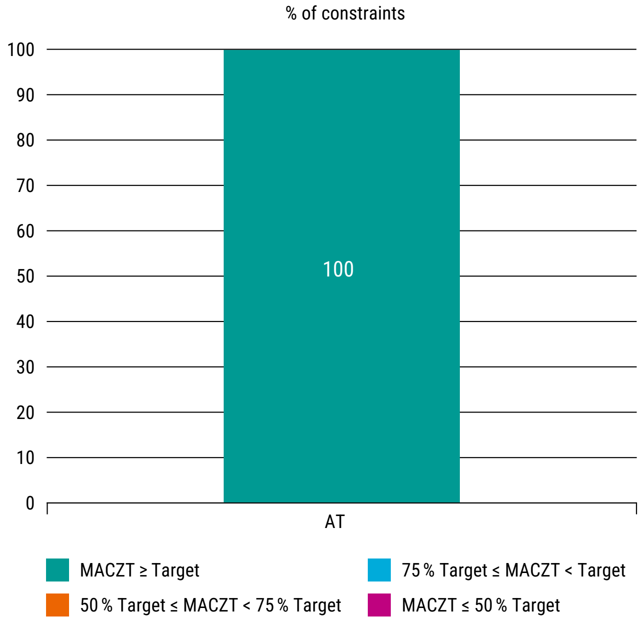


Figure 52: National monitoring results for 2021 for Italy North CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2021.

5.2.2.2 Observations and conclusions

The results shown in Figures 50 to 52 refer to those hours in which an APG CNEC would have potentially limited trading capacities within the Italy North CCR ('limiting CNECs'). In all MTUs (2021: 0 MTUs, 2022: 5 MTUs,2023: 167 MTUs) where this was the case, the corresponding minimum value according to the Austrian action plan was met.

5.2.2.3 Monitoring results for 2021–2023 as a comparison to the 70% final target

Most countries within the Italy North CCR already had the final target value of 70 % as the compliance-relevant value in place in 2021–2023. The following figure visualises the extent to which all countries of the Italy North CCR reached the final value of 70 % in 2023. Please note that Austria had an action plan in place, which defined an intermediate target. For Terna, the monitoring is carried out considering the whole Italy North interconnection according to the methodology in force.

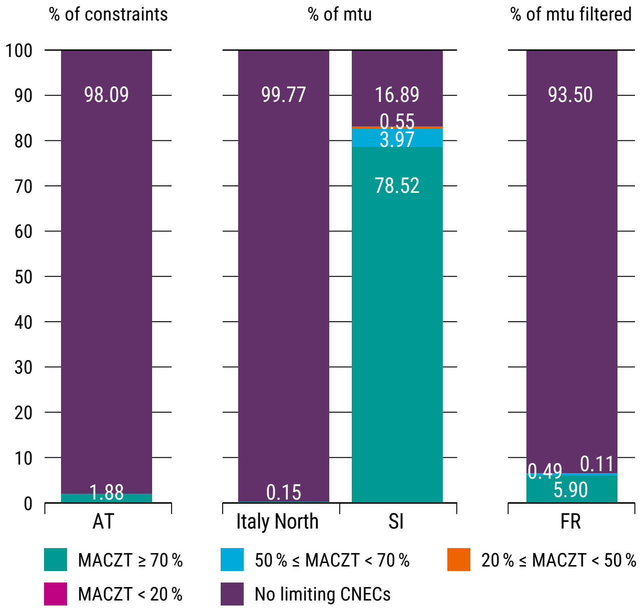
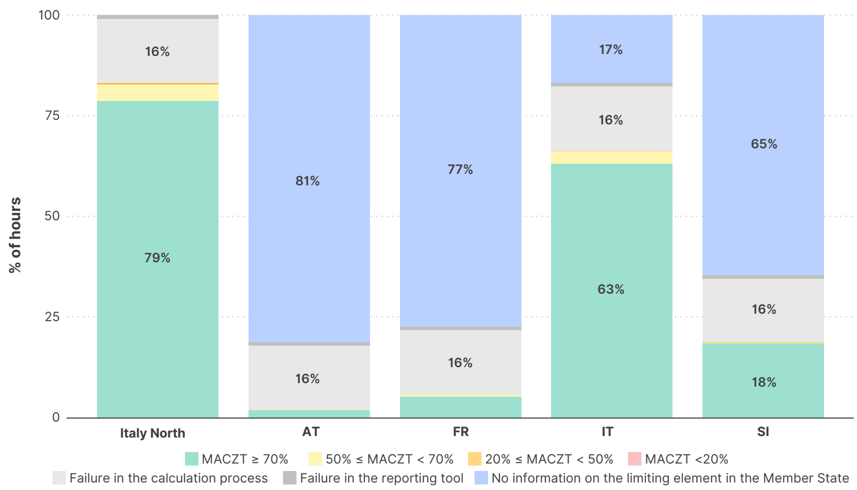


Figure 53: National monitoring results for 2023 for Italy North as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Note: IT monitoring is carried out considering the whole Italy North interconnection according to the methodology in force. Source: National Monitoring Data 2023.

Figure 25: Percentage of hours when the minimum hourly MACZT was above 70% or within predefined ranges in the Italy North CCR for each Member State, considering flows induced by third-country exchanges – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Notes: This figure considers the impact of flows induced by exchanges with Switzerland. 'No limiting element in the Member State' means that the limiting element for capacity calculation was identified in the network of another TSO. When the limiting element is an interconnector, it is counted for the Member State on both sides of the border.

Figure 54: ACER results for 2023 for Italy North CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results with 70 % as the final target under consideration of derogations and action plans for Italy North CCR for 2022 and 2021. Please note that only Austria had an action plan (2021 – 2023) and derogation (2021) in place.

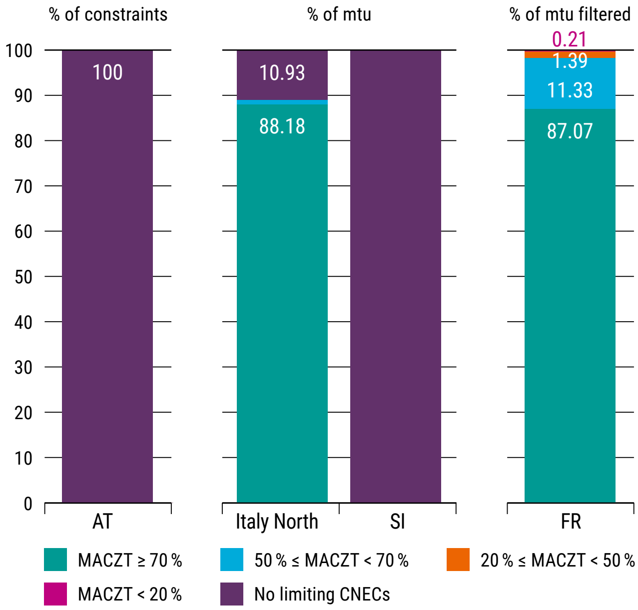


Figure 55: National monitoring results for 2022 for Italy North as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2022.

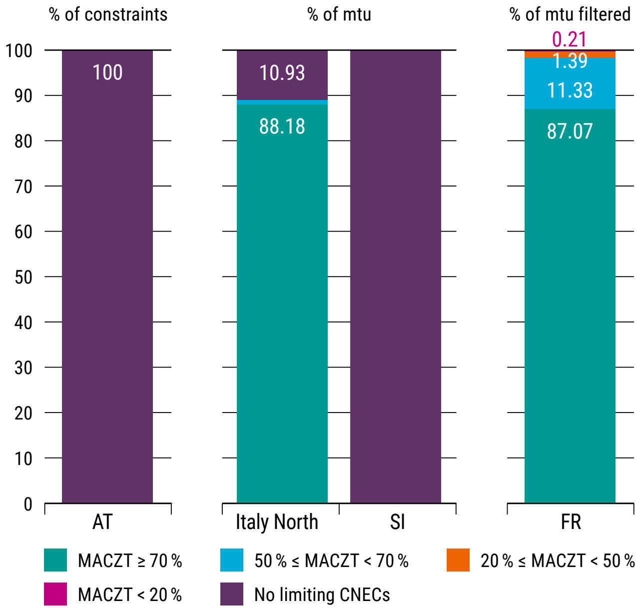


Figure 56: National monitoring results for 2021 for Italy North as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2021.

5.2.2.4 Observations and conclusions

Overall, the Italy North TSOs already show a high level of fulfilment with the final 70 % targets. In 2023, the data shows that most limiting elements are not located in Austria, France, or Slovenia but mostly in Italy and Switzerland. With the data generated based on the ACER recommendation, it leads to the same results.

5.2.3 South-West Europe CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the SWE CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are provided for 2023 only, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report. For the sake of transparency, the results from the national monitoring and ACER are shown side by side. Nonetheless, once again, please note that they are only limited in their comparability due to the different methodologies behind the values. The differences in the methodologies are explained in detail in Section 5.1.

5.2.3.1 Monitoring results for 2021–2023 under consideration of the applicable targets stemming from derogations and/or action plans

As already explained, facet plots are used to visualise the mentioned differences in the national methodologies while retaining some level of comparability.

For 2023, most countries within the SWE CCR had the target value of 70 % as the compliance-relevant value in place.

Only Portugal had a derogation in place. Therefore, the following figure visualises the extent to which Portugal – as part of the SWE CCR – fulfilled its compliance-relevant intermediate value. Since ACER did not provide this analysis in their reporting, a comparison to ACER is not possible.

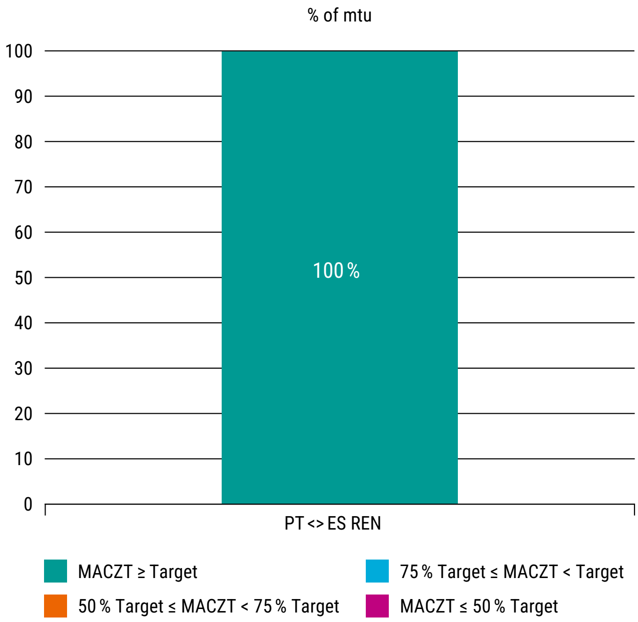


Figure 57: National monitoring results for 2023 for SWE CCR as a comparison to the applicable minimum capacity requirements stemming from derogations. Note: Only those member states that had a derogation in place are visualised. Source: National Monitoring Data 2023.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results under consideration of derogations for SWE CCR for 2022 and 2021. Please note that in 2021 and 2022, in addition to Portugal, Spain also had a derogation in place. RTE only had a derogation for 2021.

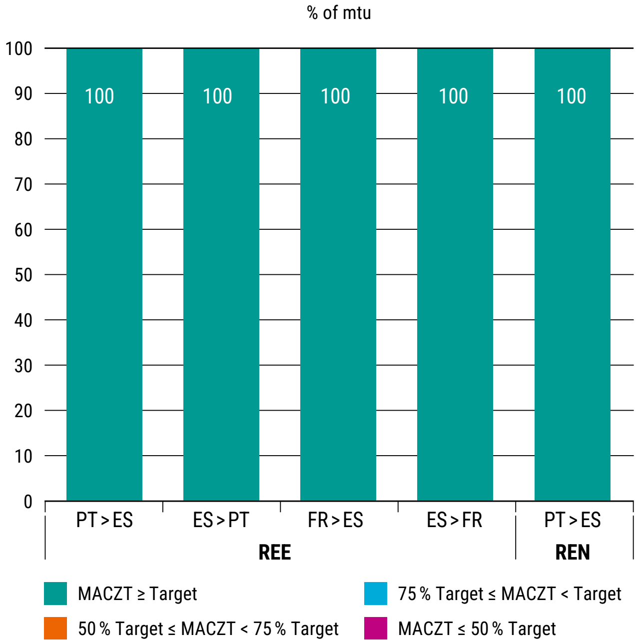


Figure 58: National monitoring results for 2022 for SWE CCR as a comparison to the applicable minimum capacity requirements stemming from derogations. Note: Only those member states that had a derogation in place are visualised. Source: National Monitoring Data 2022.

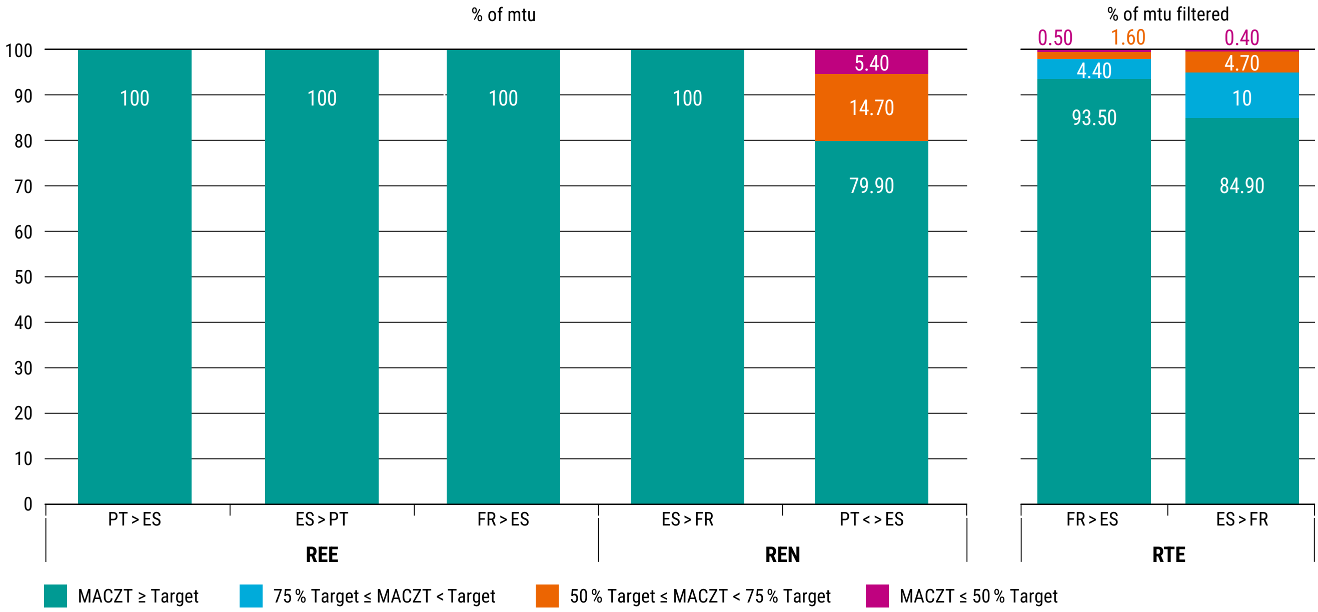


Figure 59: National monitoring results for 2021 for SWE CCR as a comparison to the applicable minimum capacity requirements stemming from derogations. Note: Only those member states that had a derogation in place are visualised. Source: National Monitoring Data 2021.

5.2.3.2 Monitoring results for 2021–2023 as a comparison to the 70% final target

The following figure visualises the extent to which all countries of the SWE CCR reached the final value of 70 % in 2023. Spain and France already had the final target value of 70 % as a compliance-relevant value in place in 2023, while Portugal had a derogation in place defining an intermediate target.

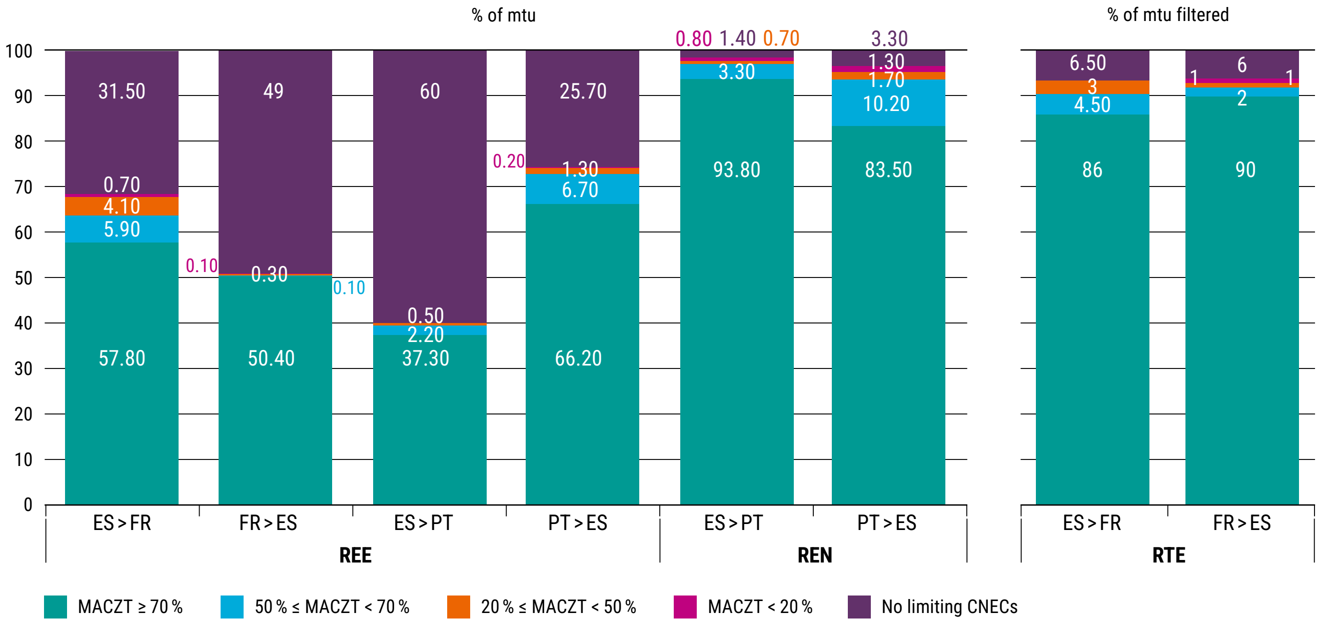
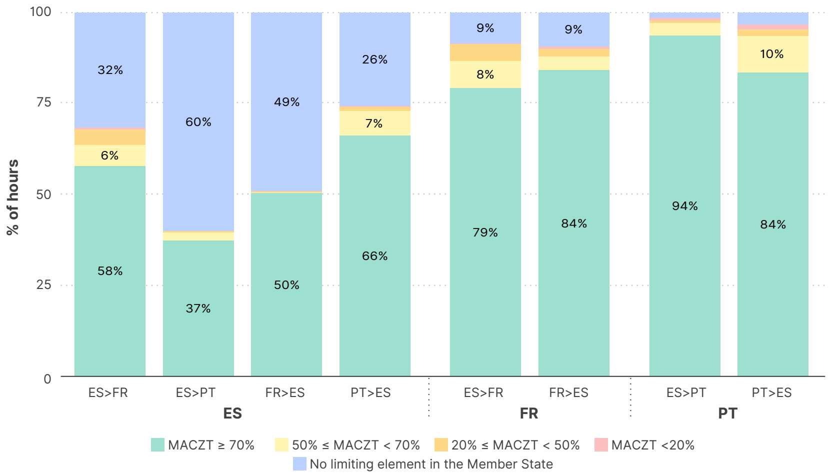


Figure 60: National monitoring results for 2023 for SWE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from derogations). Source: National Monitoring Data 2023.

Figure 27: Percentage of hours when 70% of MACZT, or predefined ranges of values, was offered in the SWE CCR for each Member State and oriented bidding zone border – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Notes: 'No limiting element in the Member State' means that the limiting element for capacity calculation was identified in the network of another TSO. When the limiting element is an interconnector, it is counted for the Member States on both sides of the border.

Figure 61: ACER results for 2023 for SWE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from derogations). Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results with 70 % as the final target for SWE CCR for 2022 and 2021.

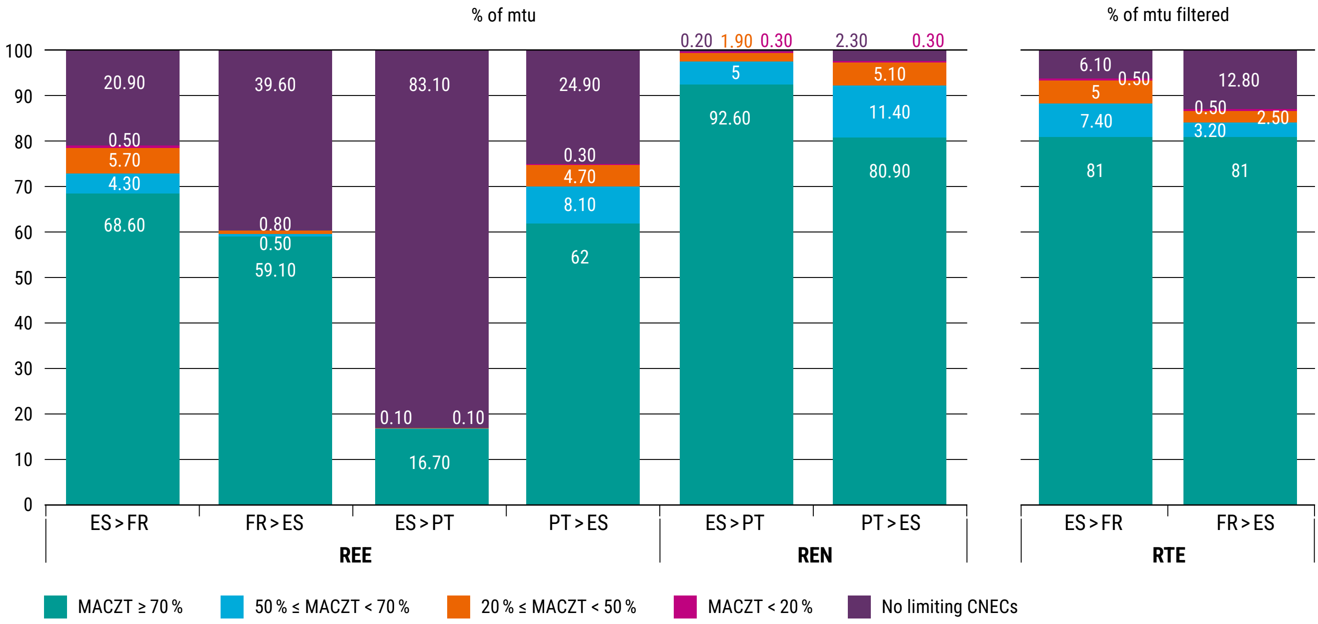


Figure 62: National monitoring results for 2022 for SWE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from derogations). Source: National Monitoring Data 2022.

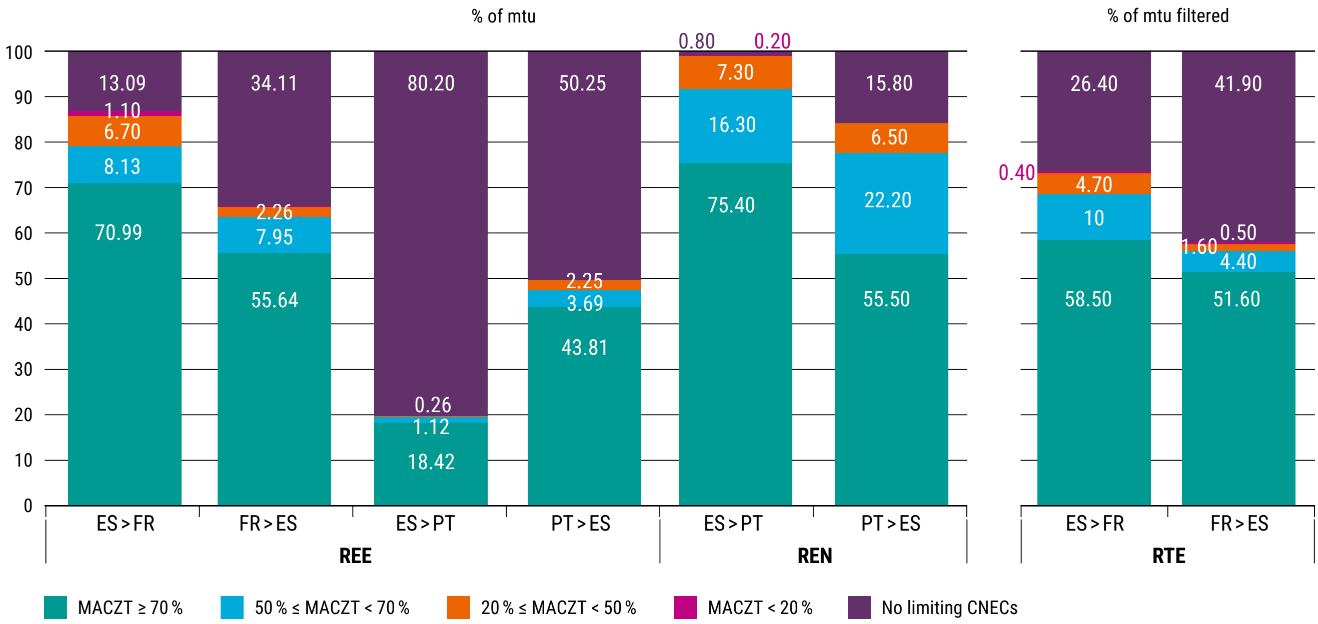


Figure 63: National monitoring results for 2021 for SWE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from derogations). Source: National Monitoring Data 2021.

5.2.3.3 Observations and conclusions

SWE TSOs show a high level of compliance in 2023 regarding the 70 % target. Results are comparable with ACER monitoring. An improvement in compliance can be observed regarding the 70 % target between 2021–2023 for all SWE TSOs, enabled by the application of a derogation (2021–2022 for RE, 2021 for RTE and until 2023 for REN).

5.2.4 South-East Europe CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the SEE CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are only provided for 2023, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report. For the sake of transparency, the results from the national monitoring and ACER are shown side by side. Nonetheless, once again, please note that they are limited in their comparability due to the different methodologies behind the values. The differences in the methodologies are explained in detail in section 5.1.

5.2.4.1 Monitoring results for 2021–2023 under consideration of the applicable targets stemming from derogations and/or action plans

While Bulgaria had a derogation in place until 28 October 2022, it has subsequently implemented then the 70 % target value. For 2023, all other countries within the SEE CCR had a derogation (Greece) or action plan (Romania) in place. Therefore, the following figure visualises the extent to which they fulfilled the compliance-relevant intermediate value. Since ACER did not provide this analysis in their reporting, a comparison to ACER is not possible.

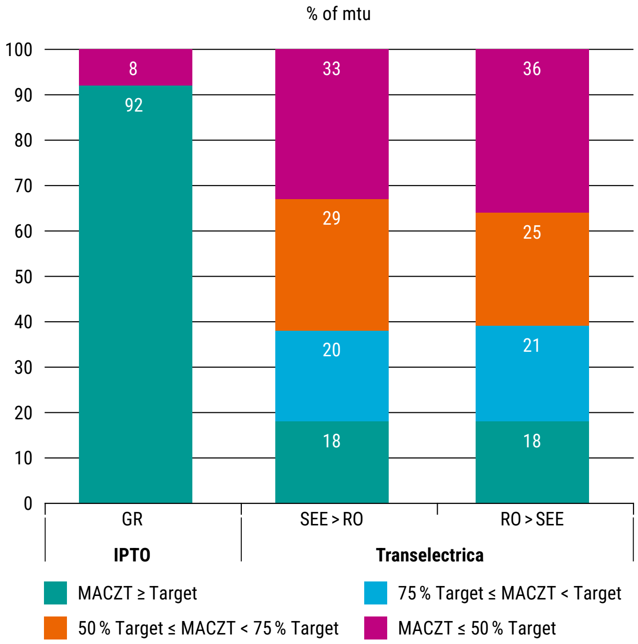


Figure 64: National monitoring results for 2023 for SEE CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2023.

To present the full picture for the period considered in this Technical Report, the following figure also visualises the national monitoring results under consideration of derogations and action plans for SEE CCR for 2022. There is no figure for 2021 as Greece had a derogation for 2021, albeit without a target defined. Furthermore, for Transelectrica, for 2021 and the period between 1 January and 9 June 2022, the values were calculated based on the whole Romanian interface, according to the internal capacity calculation process in place before the Core capacity calculation go-live. They are therefore considered in the comparison prepared for the former CCR CEE (cf. Figures 40 and 42).

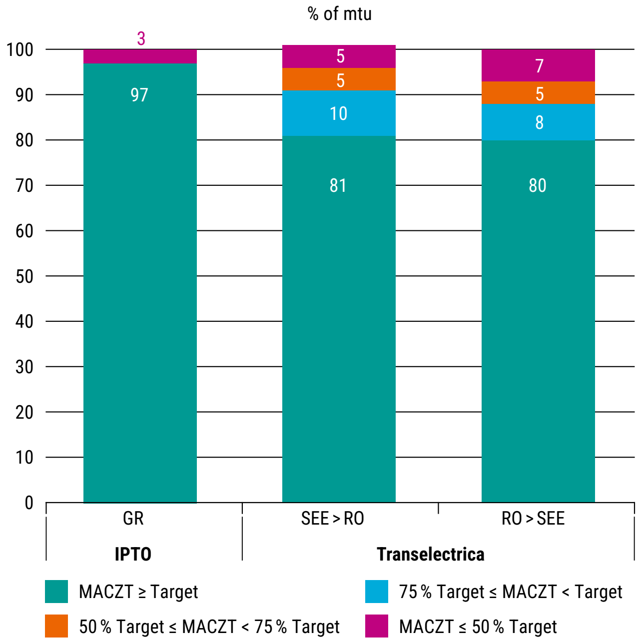


Figure 65: National monitoring results for 2022 for SEE CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2022.

5.2.4.2 Monitoring results for 2021–2023 as a comparison to the 70% final target

Although most countries of the SEE CCR had an action plan (Romania) or derogation (Greece) in place in 2023 and therefore have been considered compliant when reaching the intermediate target defined (see previous figures), the comparison to the final value of 70 % is presented in the following.

Again, facet plots are used to visualise the differences in the national methodologies while retaining some level of comparability to ACER's results.

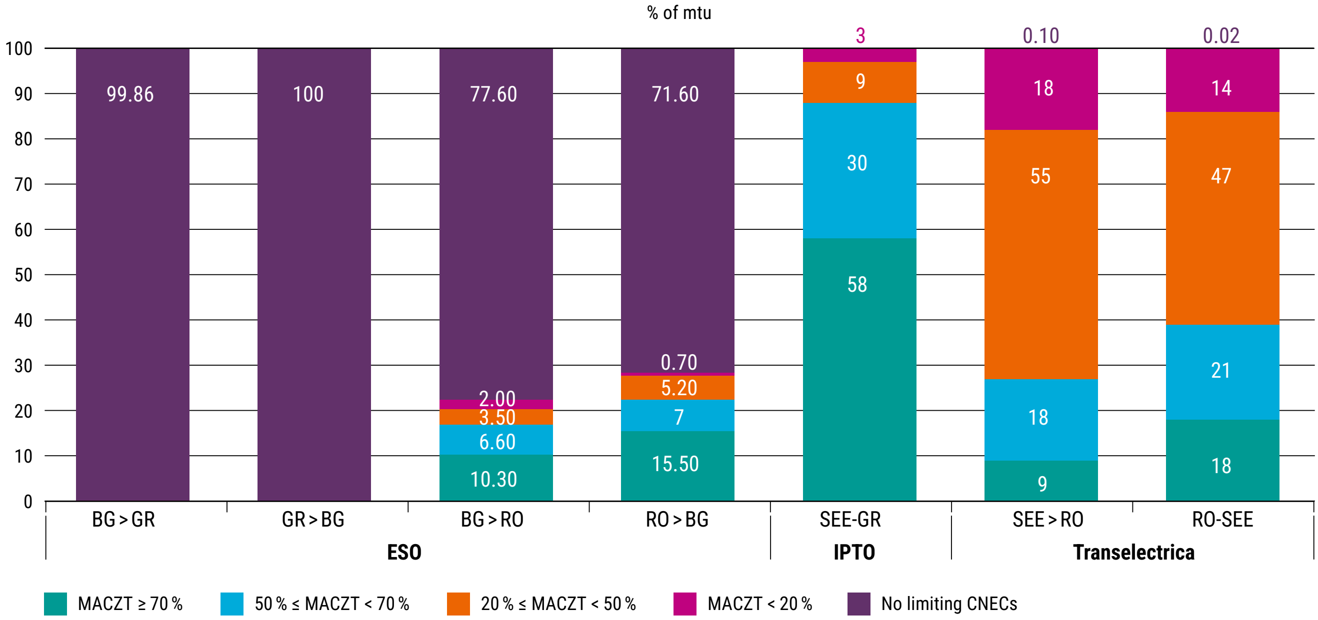


Figure 66: National monitoring results for 2023 for SEE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2023.

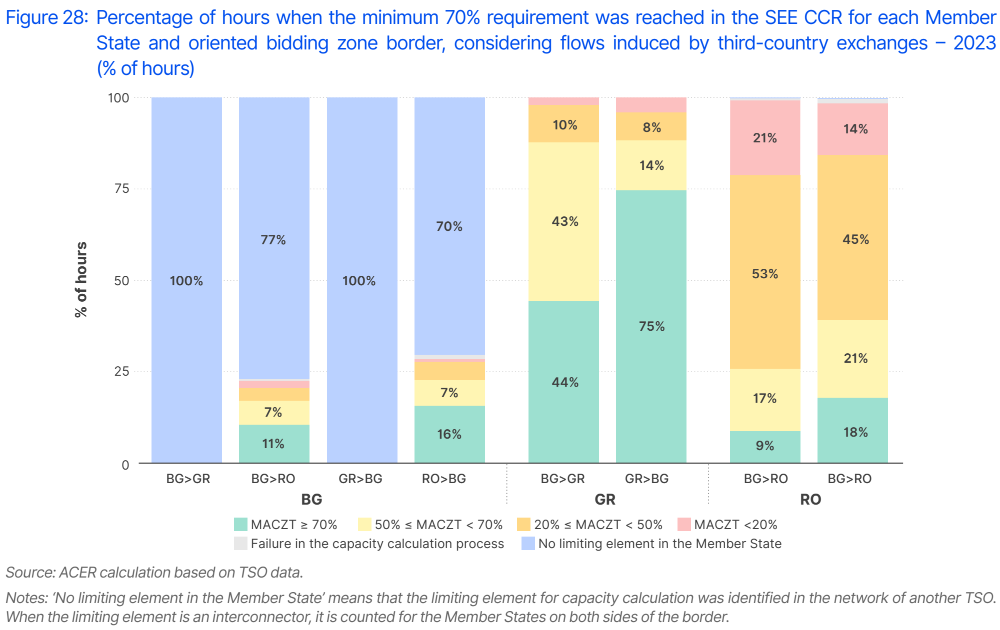


Figure 67: ACER results for 2023 for SEE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results under consideration of derogations (Greece, Bulgaria until 28 October 2022) and action plans (Romania) for SEE CCR for 2022 and 2021.

For 2022, the period for which the MACZT was calculated according to the coordinated capacity calculations results in the SEE CCR was 9 September to 31 December 2022. For 2021 and the period between 1 January and 9 September 2022, each TSO sent its own data for the MACZT monitoring report. For Transelectrica, the results for this period were sent for the capacity calculation on the Romanian interface.

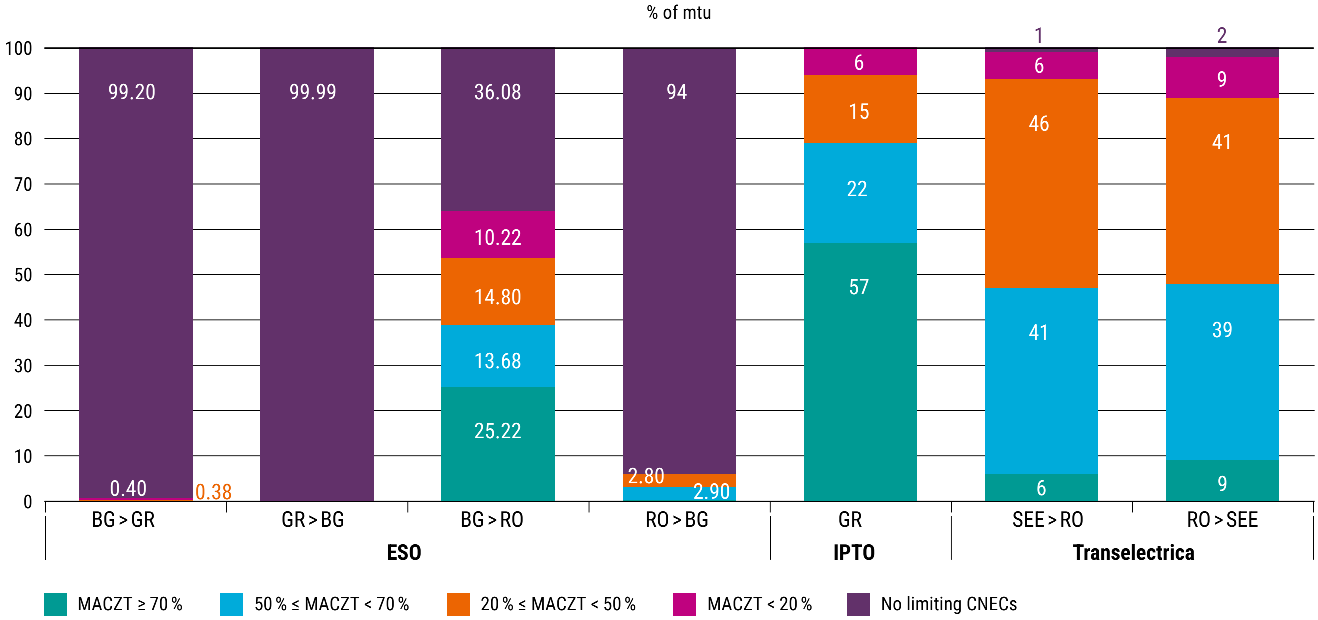


Figure 68: National monitoring results for 2022 for SEE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2022.

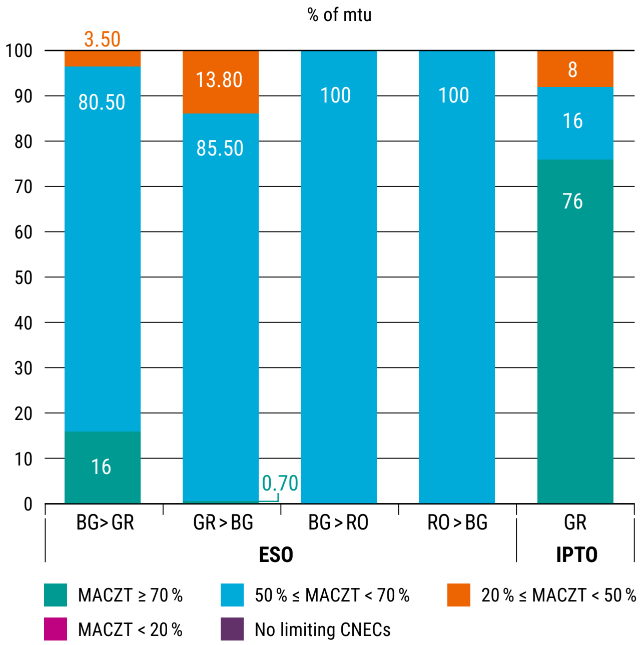


Figure 69: National monitoring results for 2021 for SEE CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2021.

5.2.4.3 Observations and conclusions

Transelectrica has conducted an internal assessment on the figures displayed for the Romanian part and derived the following conclusions, which are also represented in the ACER MMR 2024. While Figure 67 shows the extent to which member states in the SEE region offered a minimum of 70 % MACZT on their limiting CNECs in 2023, it does not assess the reasons for deviating below 70 %. Reductions of capacity may be sent by either TSO on each BZ border during the capacity validation phase. The minimum of this value is then given to the market. In particular, most limitations in the SEE CCR during 2023 for the Romanian CNECs were requested by the Bulgarian TSO, which affected the MACZT results of Transelectrica.

In order to have a more detailed and clear picture of the MACZT evaluation in the future, we have to wait for the go-live of the last adopted SEE DA and ID CCM in which the MACZT is intended to be evaluated.

The evaluation of the MACZT by Selene CC in the SEE region shall start from mid-2025.

Once there is a good amount of historical data, the SEE TSOs will be able to assess the impact of the MACZT target of each TSO side.

5.2.5 Greece–Italy CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the GRIT CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are provided for 2023 only, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report. For the sake of transparency, the results from the national monitoring and ACER are shown side by side. Nonetheless, once again, please note that they are only limited in their comparability due to the different methodologies behind the values. The differences in the methodologies are explained in detail in Section 5.1.

All countries of the GRIT CCR have already implemented the 70 % final target since 2021. No action plans or derogations have been in place.

5.2.5.1 Monitoring results for 2021–2023 as a comparison to the 70% final target

The following figure visualises the extent to which all countries of the GRIT CCR reached the final value of 70 % in 2023.

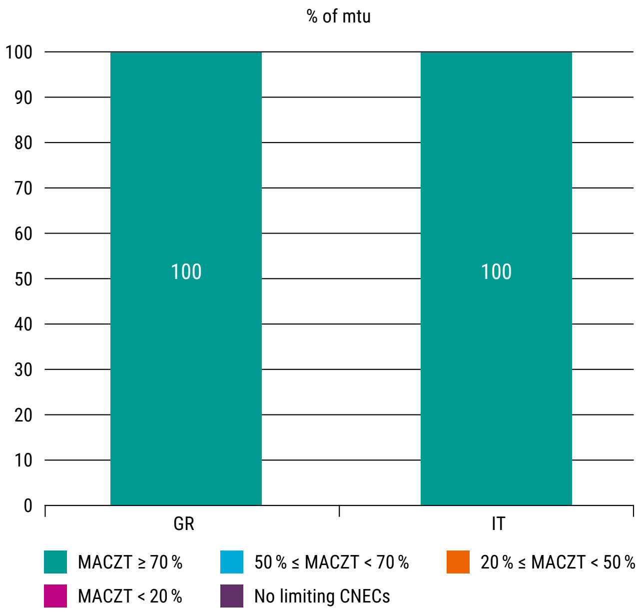
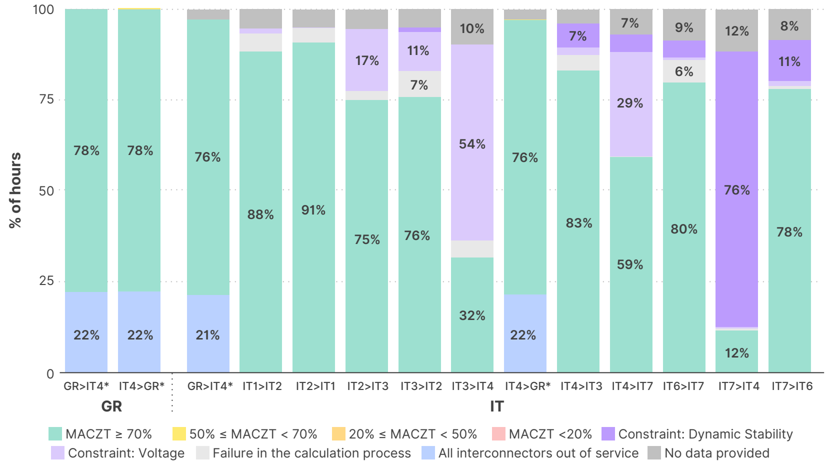


Figure 70: National monitoring results for 2023 for GRIT CCR as a comparison to the 70 % final target. Note: Hours during which the GRIT DC cable was out of service are not considered. Source: National Monitoring Data 2023.

Figure 29: Percentage of hours when the minimum hourly MACZT was above 70% or within predefined ranges in the GRIT CCR for each Member State and oriented bidding zone border – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Notes: Bidding zone borders marked with an asterisk (*) correspond to DC borders and were represented in a separate figure in previous reports. The internal Italian bidding zones are labelled as follows.

IT1	***Italy North***	***IT4***	***Italy South***	***IT7***	***Italy Calabria***
IT2	*Italy Centre North*	***IT5***	*Italy Sardinia*		
IT3	*Italy Centre South*	***IT6***	*Italy Sicily*		

Figure 71: ACER results for 2023 for GRIT CCR as a comparison to the 70 % final target. Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results for GRIT CCR for 2022 and 2021.

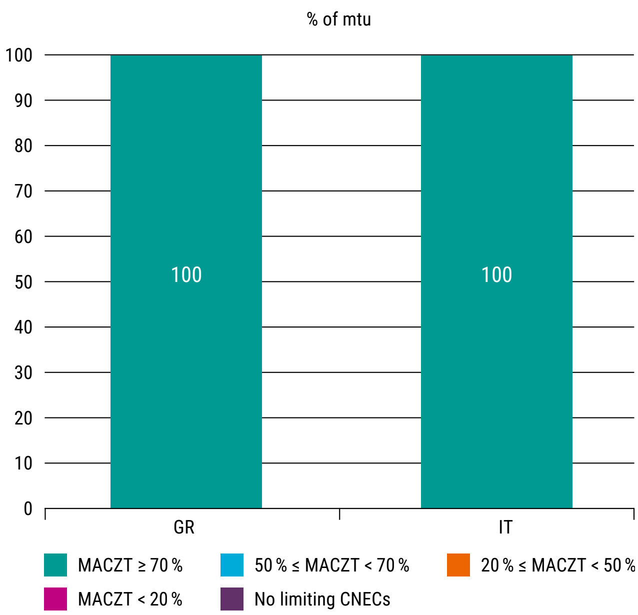


Figure 72: National monitoring results for 2022 for GRIT CCR as a comparison to the 70 % final target. Note: hours during which the GRIT DC cable was out of service are not considered. Source: National Monitoring Data 2022.

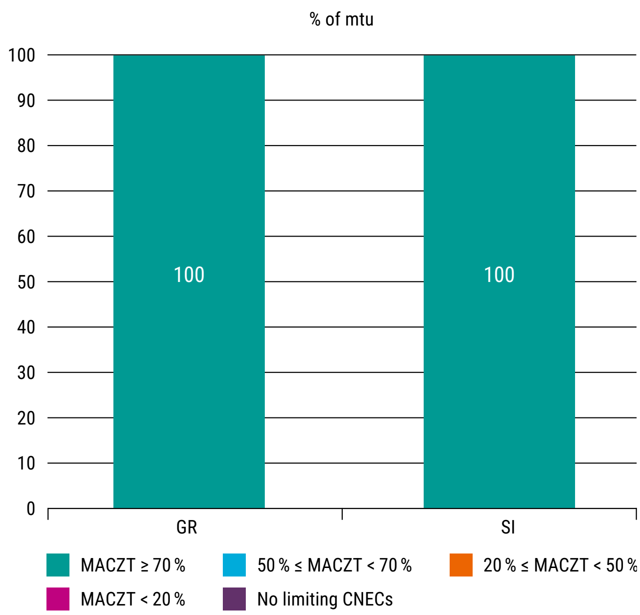


Figure 73: National monitoring results for 2021 for GRIT CCR as a comparison to the 70 % final target. Note: hours during which the GRIT DC cable was out of service are not considered. Source: National Monitoring Data 2021.

5.2.6 Nordic CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the Nordic CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are provided for 2023 only, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report.

Since 2022, all countries of the Nordic CCR have implemented the 70 % final target.

5.2.6.1 Monitoring results for 2021–2023 under consideration of the applicable targets stemming from derogations and/or action plans

While all countries within the Nordic CCR had the target value of 70 % as a compliance-relevant value in place for 2023 and 2022, only Sweden had a derogation[13] in 2021. Therefore, the following figure visualises the extent to which Sweden – as part of the Nordic CCR – fulfilled the applicable minimum capacity requirement stemming from its derogation in 2021. The monitoring results as a comparison to the 70 % target for 2021–2023 can be found in Section 5.2.6.2.

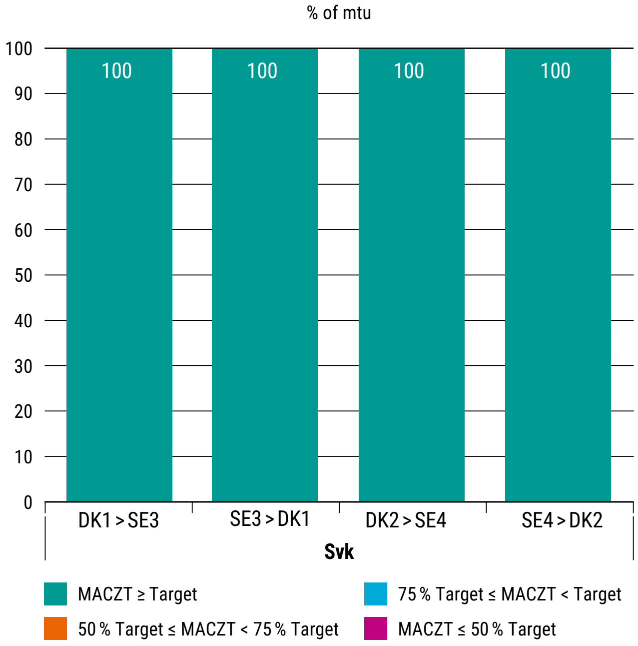


Figure 74: National monitoring results for 2021 for Nordic CCR as a comparison to the applicable minimum capacity requirements stemming from derogations. Note: Only those member states that had a derogation in place are visualised. Source: National Monitoring Data 2021.

13 For 2021, a derogation was granted by Energimarknadsinspektionen – the Swedish NRA – after consulting with its counterparts in relevant countries. The derogation is related to the lack of remedial actions – both costly and non-costly – to resolve overloads. Svenska kraftnät published a methodology to minimise the need for a derogation in March 2021, includinggrid investments and measures to increase the availability of remedial actions.

5.2.6.2 Monitoring results for 2021–2023 as a comparison to the 70% final target

The following figure visualises the extent to which all countries of the Nordic CCR reached the final value of 70 % in 2023.

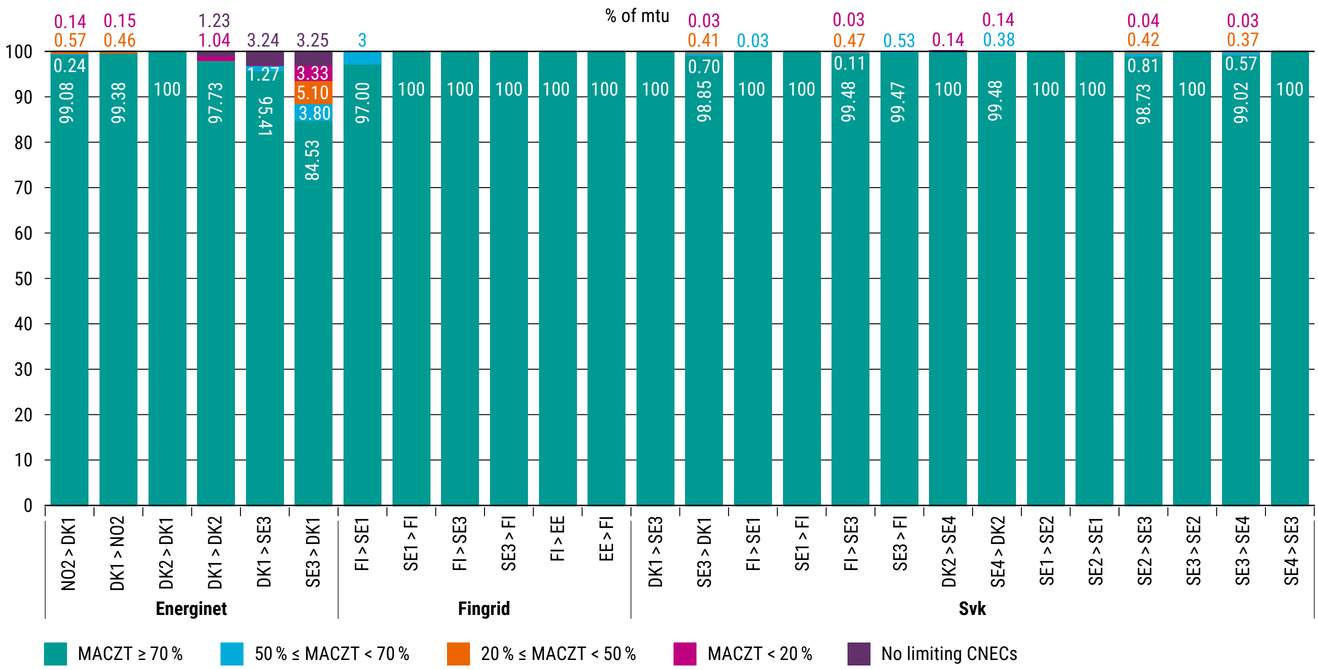


Figure 75: National monitoring results for 2023 for Nordic CCR as a comparison to the 70 % final target. Source: National Monitoring Data 2023.

In 2023, the methodology according to ACER's Recommendation No 01/2019 was applied as close as possible at Svenska kraftnät, with some caveats, e. g. the fact that all information required to perform the assessment was not available until the FB capacity calculation would be implemented in the Nordic CCR. When NTC capacity is calculated at Svenska kraftnät, all boarders are considered simultaneously, i. e. full coordination. The differences seen in comparison between ACER's graft and data from Svenska kraftnät is mainly explained by the choice of coordination areas.

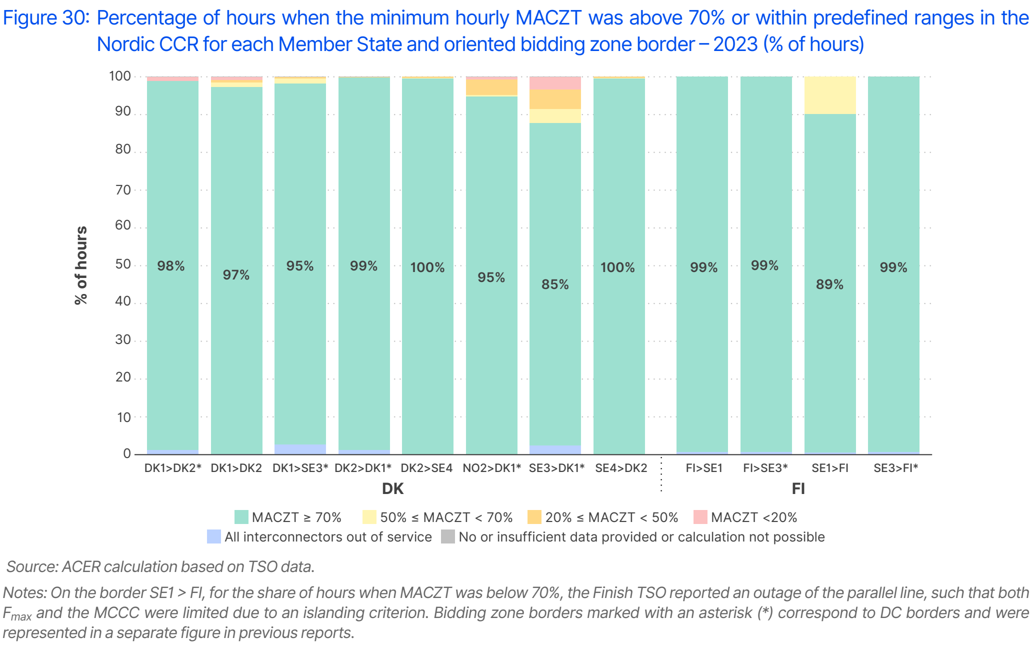
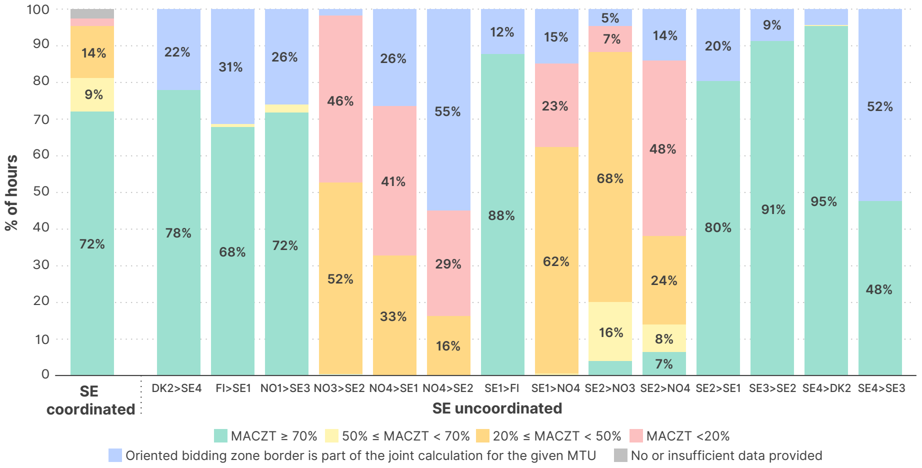


Figure 76: ACER results for 2023 for the Nordic CCR (except Sweden) as a comparison to the 70 % final target. Source: **ACER Market Monitoring Report 2024**.

Figure 34: Percentage of hours when the minimum hourly MACZT was above 70% or within predefined ranges for each bidding zone borders and coordination area – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Notes: Zone-to-zone PTDFs for the internal Norwegian bidding zone borders have not been provided by the Swedish TSO. However, the impact of exchanges on these borders is likely to be not negligible for the borders between Swedish and Norwegian bidding zones. Line-set optimisation in the export of SE3 to NO1 and DK1 has been considered by correcting the NTCs in oriented bidding zone borders SE3 – NO1 and SE3 – DK1 to the combination of feasible NTCs that lead to the highest loading for each CNEC.

Figure 77: ACER results for 2023 for Sweden as a comparison to the 70 % final target. Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results for the Nordic CCR for 2022 and 2021.

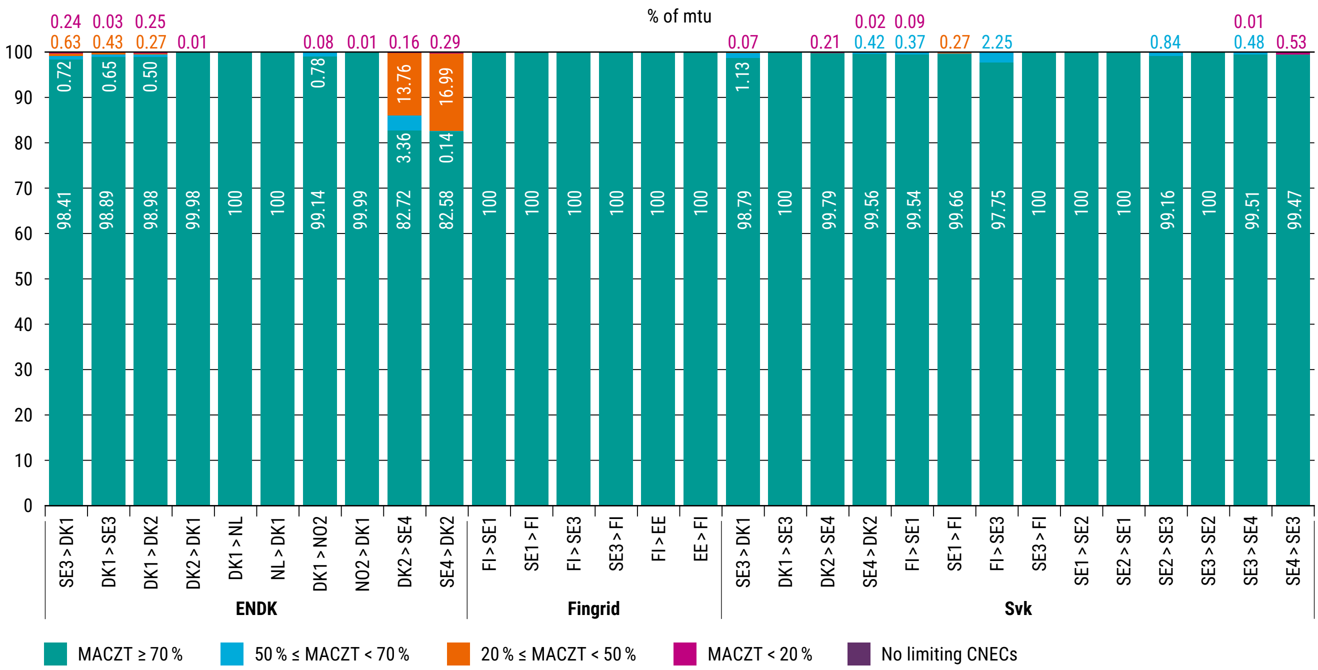


Figure 78: National monitoring results for 2022 for the Nordic CCR as a comparison to the 70 % final target. Source: National Monitoring Data 2022.

In 2021, not all information required to perform the assessment of MACZT was available because the FB capacity calculation was not implemented in the Nordic CCR, nor was the parallel FB operation in place. In 2021, ACER requested data for the specific borders of SE1–FI and SE4–DK2 and an approximation was made based on a method in dialogue with ACER. Data for MACZT 2021 is based on this and presented in this report.

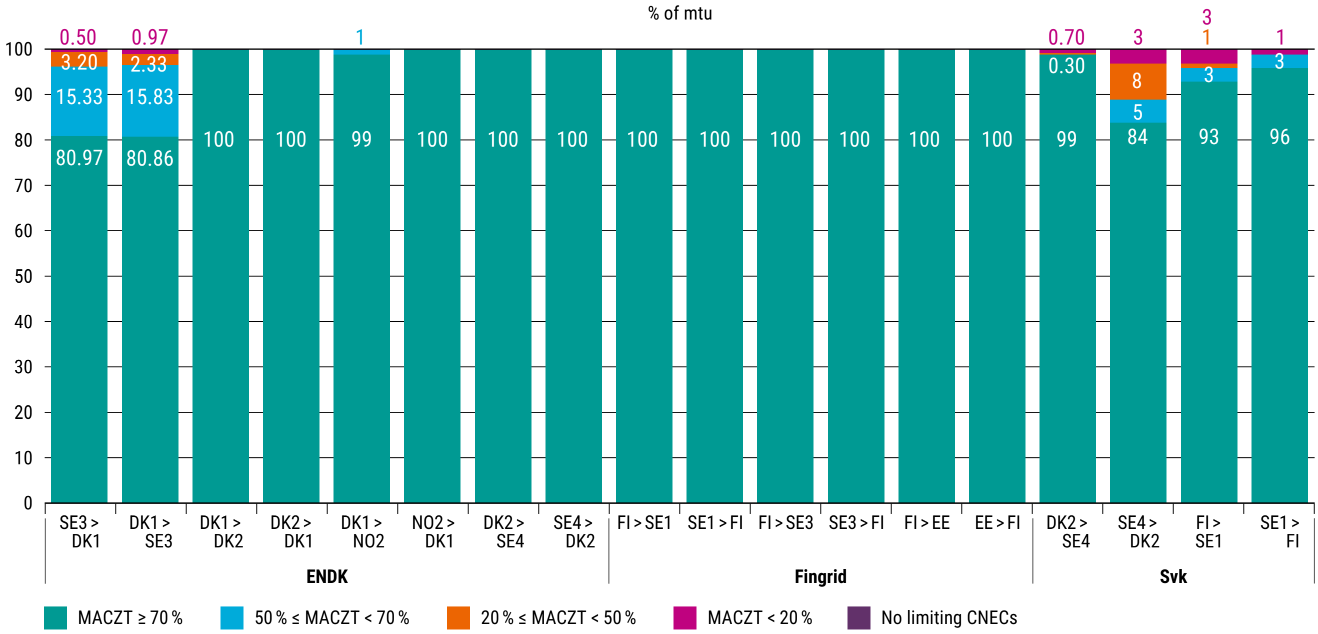


Figure 79: National monitoring results for 2021 for the Nordic CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from derogations). Source: National Monitoring Data 2021.

5.2.7 Hansa CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the Hansa CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are provided for 2023 only, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report. For the sake of transparency, the results from the national monitoring and ACER are shown side by side. Nonetheless, once again, please note that they are only limited in their comparability due to the different methodologies behind the values. The differences in the methodologies are explained in detail in Section 5.1.

5.2.7.1 Monitoring results for 2021–2023 under consideration of the applicable targets stemming from derogations and/or action plans

As for the other CCRs, again facet plots are used to visualise the national monitoring results. For 2021–2023, most countries within the Hansa CCR had a derogation or action plan in place. Therefore, the following figure visualises the extent to which they fulfilled the compliance-relevant intermediate value.

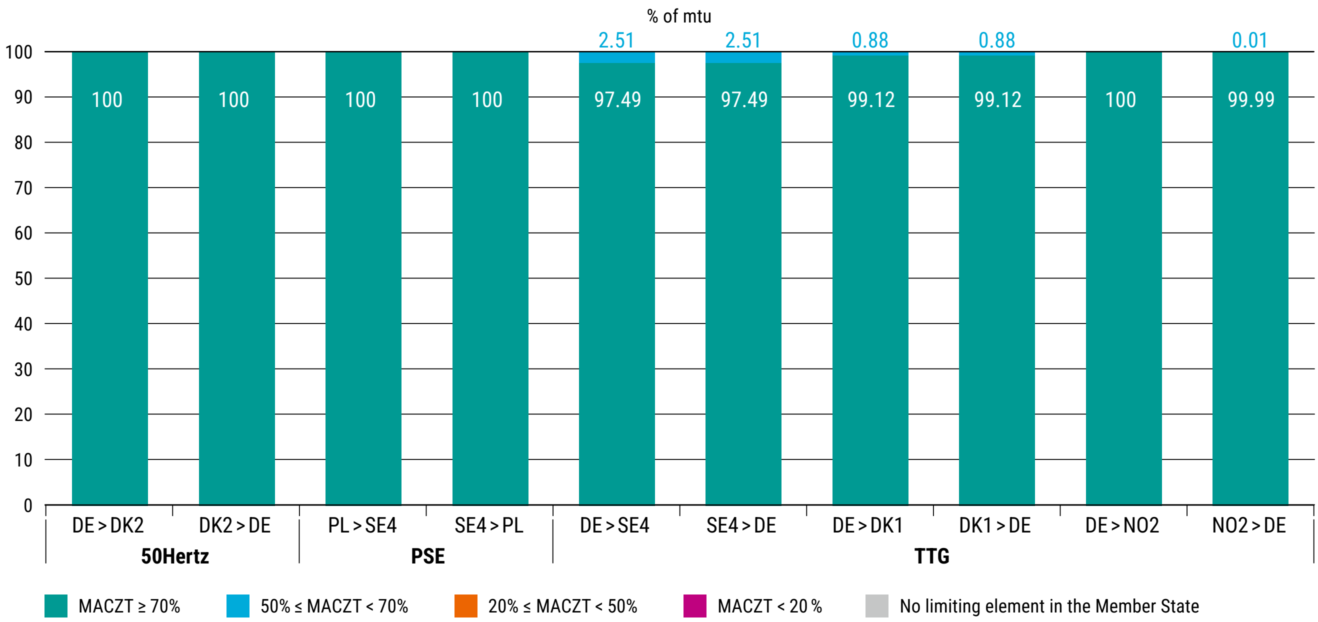


Figure 80: National monitoring results for 2023 for Hansa as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2023.

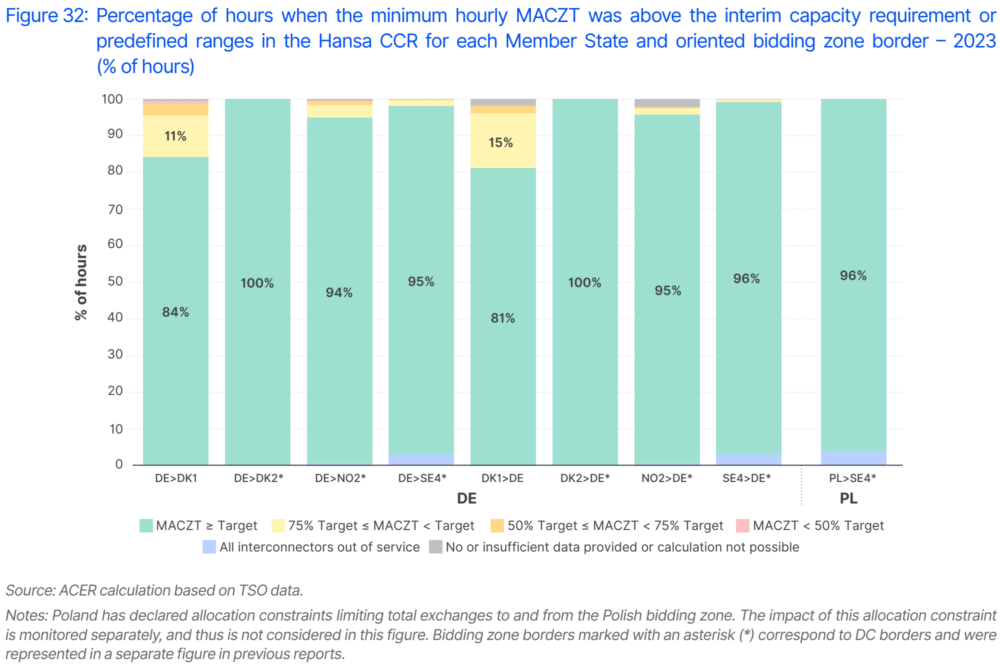


Figure 81: ACER results for 2023 for Hansa as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: **ACER Market Monitoring Report 2024**.

As already highlighted several times, national methodologies differ, which limits the comparability of the results. All details on the differences can be found in section 5.1.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results (under consideration of derogations and action plans) for Hansa CCR for 2022 and 2021.

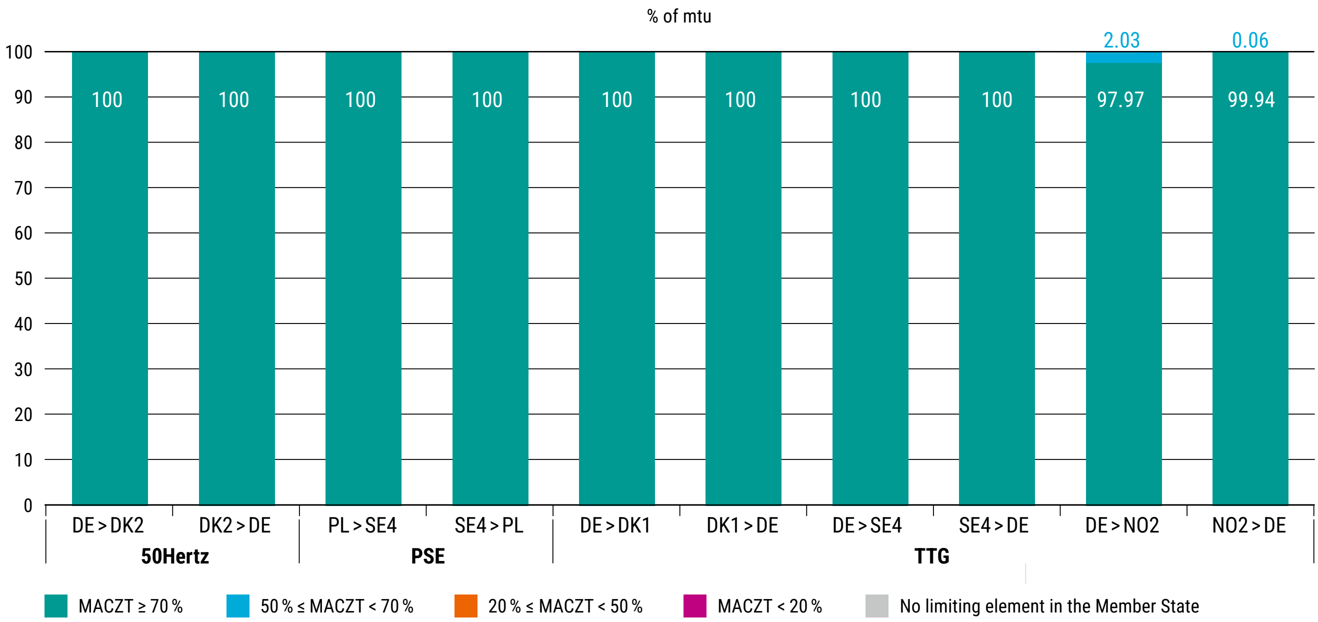


Figure 82: National monitoring results for 2022 for Hansa CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2022.

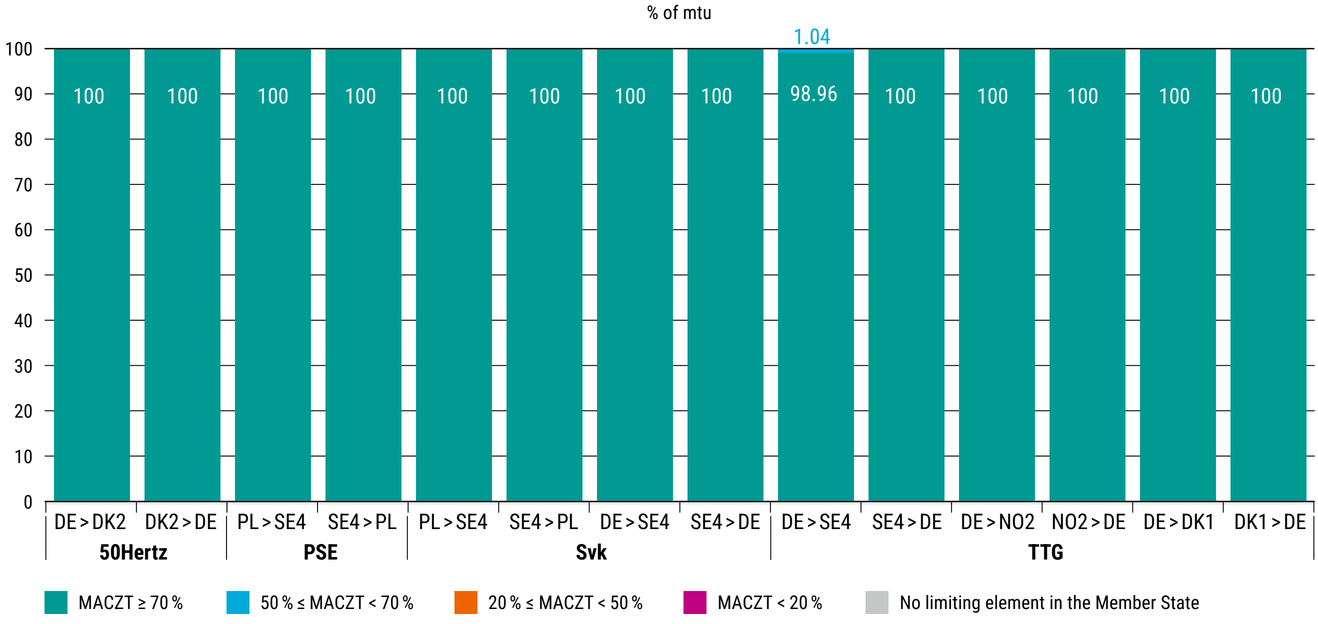


Figure 83: National monitoring results for 2021 for Hansa CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had derogations and/or action plans in place are visualised. Source: National Monitoring Data 2021.

5.2.7.2 Monitoring results for 2021–2023 as a comparison to the 70 % final target

Although compliance has been defined for many countries within the Hansa CCR by reaching an intermediate target (as shown before), some countries already had the final value of 70 % in place. Therefore, the following figure visualises the extent to which all countries of the Hansa CCR already reached the final value of 70 % in 2023. Nonetheless, please note that most of the countries in 2023 still had a derogation or action plan in place and their legally binding values have therefore been defined by an intermediate target. Only Denmark did not have an action plan or derogation in place.

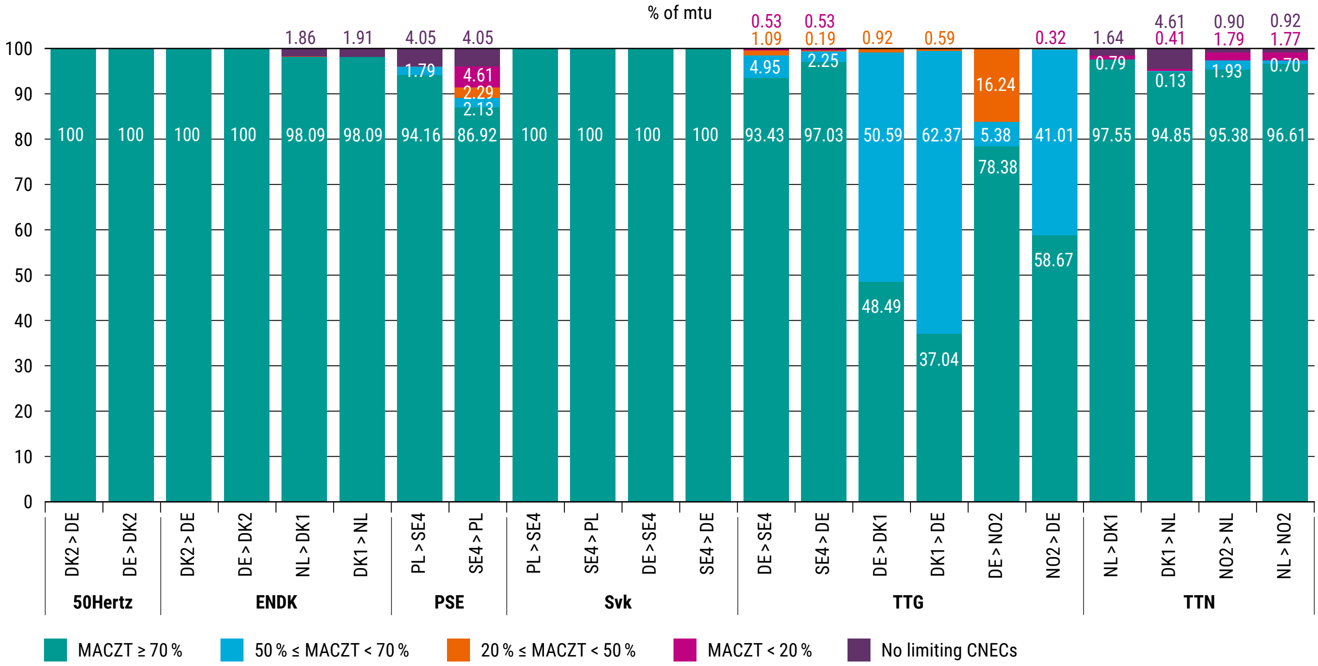
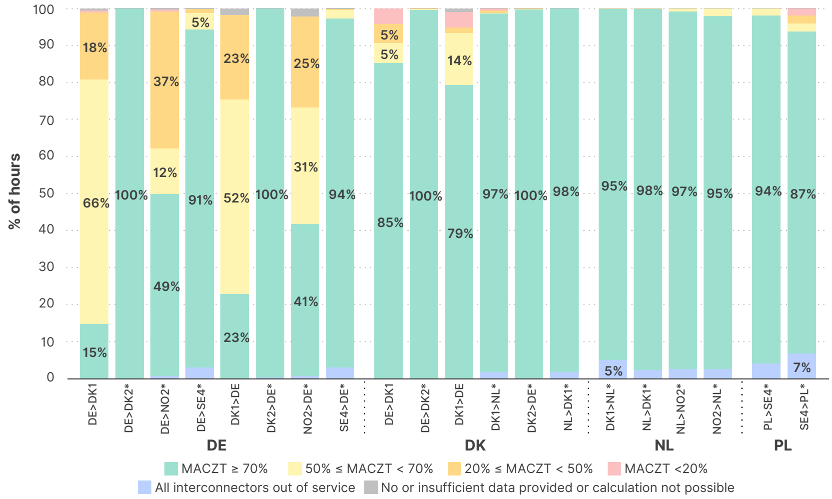


Figure 84: National monitoring results for 2023 for Hansa Core as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2023.

Figure 31: Percentage of hours when the minimum hourly MACZT was above 70% or within predefined ranges in the Hansa capacity calculation region per Member State and oriented border – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Notes: Poland has declared allocation constraints limiting total exchanges to and from the Polish bidding zone. The impact of this allocation constraint is monitored separately, and thus is not considered in this figure. Bidding zone borders marked with an asterisk (*) correspond to DC borders and were represented in a separate figure in previous reports. For the border DK1-NL, data inconsistencies regarding the reported F_{max} were found for 12.4% of MTUs in the direction DK1>NL and 2.2% of MTUs in the direction NL>DK1. These could not be solved at time of publication and the shown data for this share of hours is to be considered approximate.*

Figure 85: ACER results for 2023 for Hansa CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results (excluding derogations and action plans) for the Hansa CCR for 2022 and 2021.

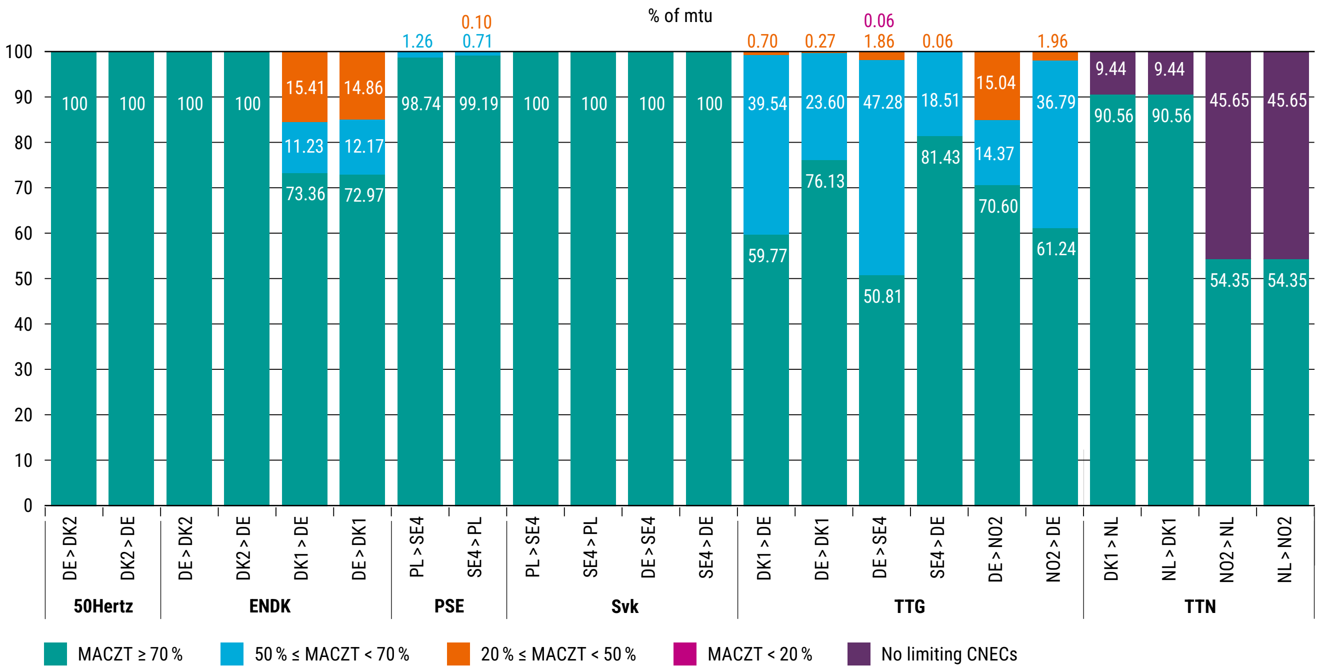


Figure 86: National monitoring results for 2022 for the Hansa CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2022.

For Svk borders, in 2021 not all information required to perform the assessment of MACZT was available because the FB capacity calculation was not implemented in CCR Nordic, nor was the parallel FB operation in place. Therefore, no data for 2021 is available.

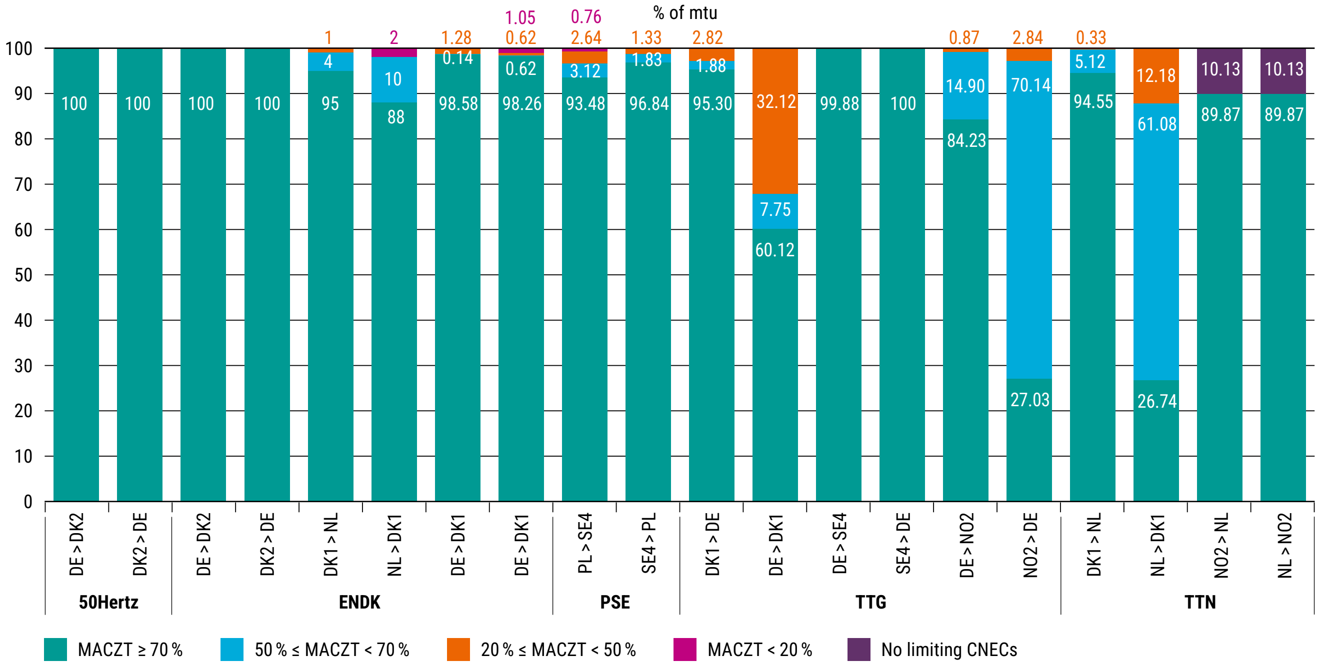


Figure 87: National monitoring results for 2021 for the Hansa CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2021.

5.2.8 Baltic CCR

In the following, the monitoring results for 2021, 2022, and 2023 are provided for the Baltic CCR. While the national monitoring results are provided for all three years, ACER's monitoring results are provided for 2023 only, considering that the most recent year can also be seen as the most relevant/interesting for readers of this report. For the sake of transparency, the results from the national monitoring and ACER are shown side by side. Nonetheless, once again, please note that they are only limited in their comparability due to the different methodologies behind the values. The differences in the methodologies are explained in detail in Section 5.1.

5.2.8.1 Monitoring results for 2021–2023 under consideration of the applicable targets stemming from derogations and/or action plans

For 2023, most countries within the Baltic CCR already had the target value of 70 % as a compliance-relevant value in place. Only Poland has an action plan in place.

Therefore, the following figure visualises the extent to which Poland – as part of the Baltic CCR – fulfilled the applicable minimum capacity requirement stemming from its action plan. A comparison to ACER is not possible because ACER did not provide this analysis in its monitoring report.

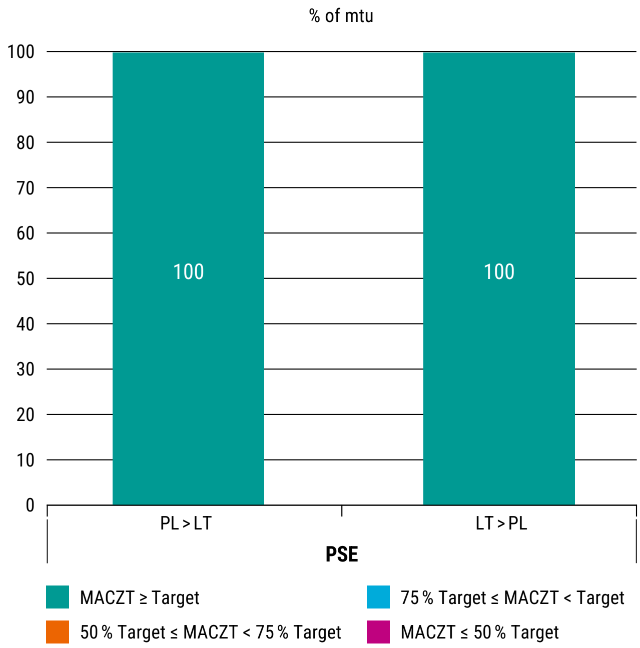


Figure 88: National monitoring results for 2023 for the Baltic CCR as a comparison to the applicable minimum capacity requirements stemming from action plans. Note: Only those member states that had an action plan in place are visualised. Source: National Monitoring Data 2023.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results for the Baltic CCR for 2022 and 2021 under consideration of the action plan of Poland and the Swedish derogation (2021).

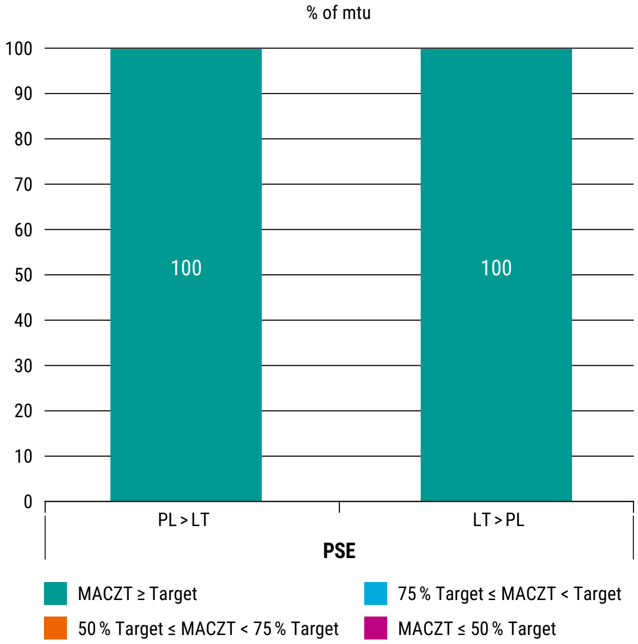


Figure 89: National monitoring results for 2022 for the Baltic CCR as a comparison to the applicable minimum capacity requirements stemming from action plans. Note: Only those member states that had a derogation or action plan in place are visualised. Source: National Monitoring Data 2022.

Figure 90: National monitoring results for 2021 for the Baltic CCR as a comparison to the applicable minimum capacity requirements stemming from derogations and action plans. Note: Only those member states that had a derogation or action plan in place are visualised. Source: National Monitoring Data 2021.

5.2.8.2 Monitoring results for 2021–2023 as a comparison to the 70 % final target

The following figure visualises the extent to which all countries of the Baltic CCR reached the final value of 70 % in 2023.

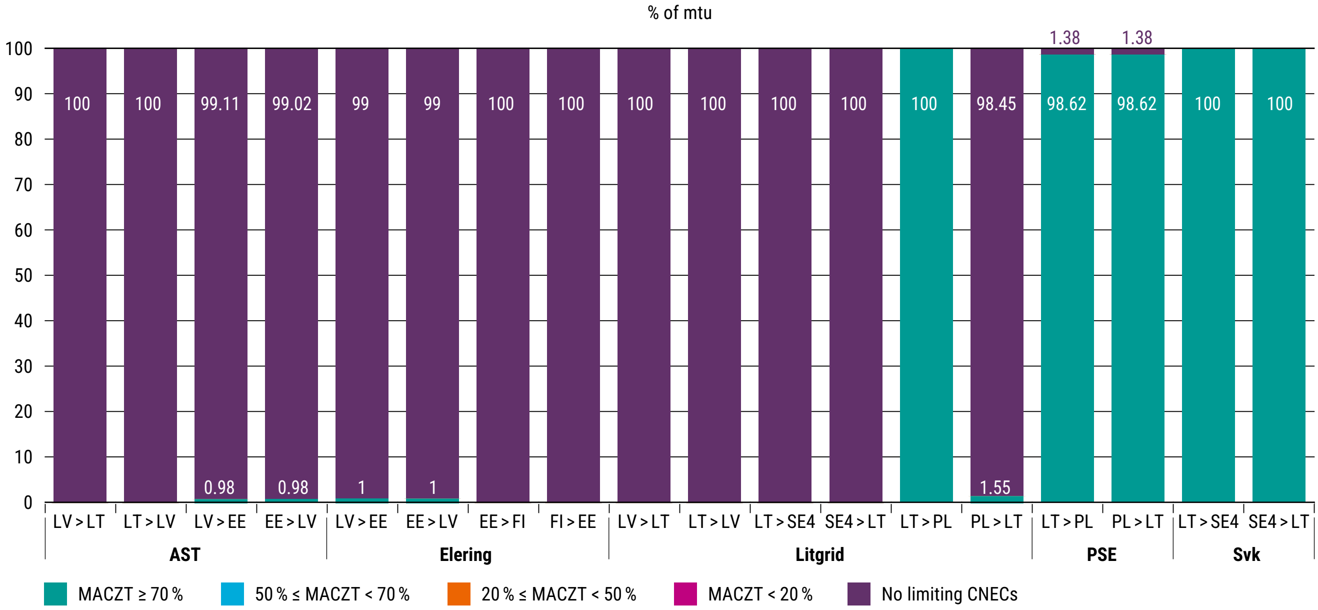
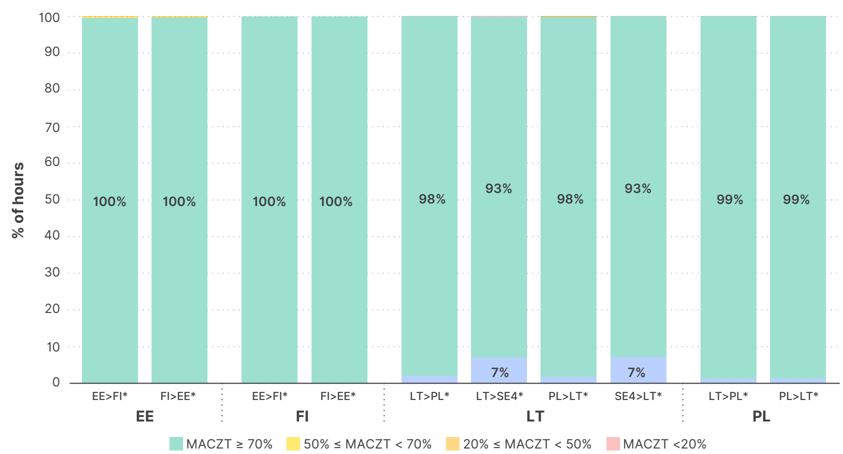


Figure 91: National monitoring results for 2023 for the Baltic CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2023.

Figure 33: Percentage of hours when the minimum hourly MACZT was above 70% or within predefined ranges in the Baltic CCR for each Member State and oriented bidding zone border – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Notes: Poland has declared allocation constraints limiting total exchanges to and from the Polish bidding zone. The impact of such allocation constraint is monitored separately, and thus is not considered in this figure. Bidding zone borders marked with an asterisk (*) correspond to DC borders and were represented in a separate figure in previous reports.

Figure 92: ACER results for 2023 for the Baltic CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: **ACER Market Monitoring Report 2024**.

To present the full picture for the period considered in this Technical Report, the following figures also visualise the national monitoring results for the Baltic CCR for 2022 and 2021.

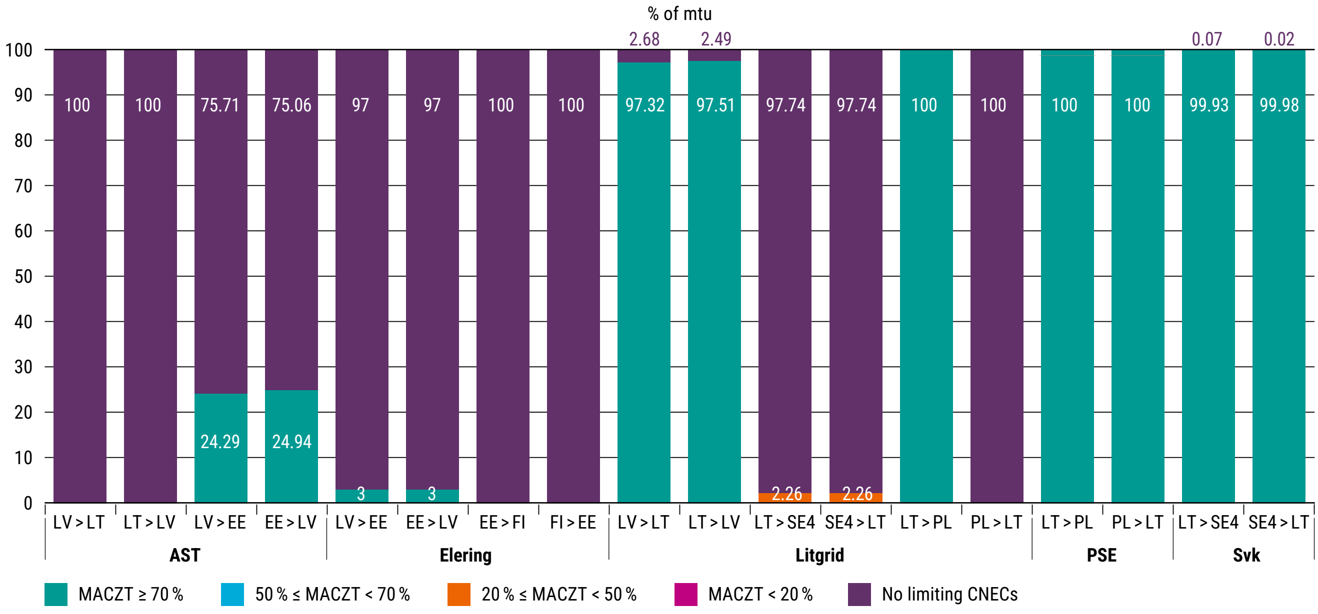


Figure 93: National monitoring results for 2022 for the Baltic CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2022.

For Svk, in 2021 not all information required to perform the assessment of MACZT was available because the FB capacity calculation was not implemented in the Nordic CCR, nor was the parallel FB operation in place. Therefore, no data for 2021 is available.

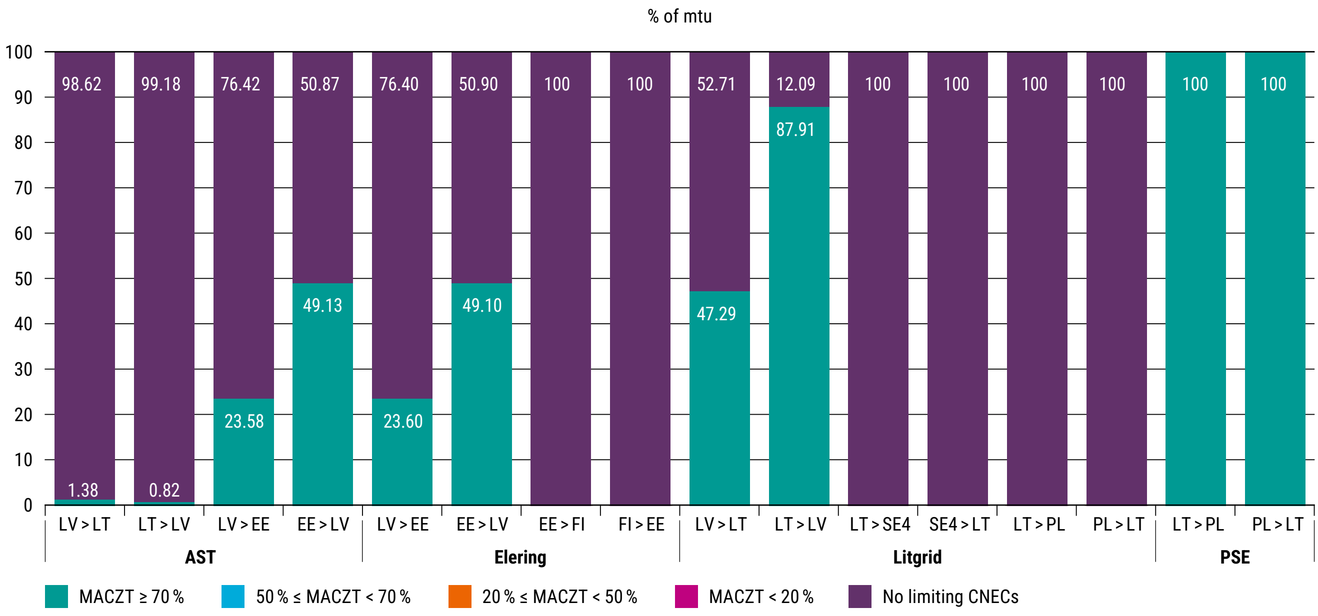


Figure 94: National monitoring results for 2021 for the Baltic CCR as a comparison to the 70 % final target (excluding the applicable minimum capacity requirements stemming from action plans and/or derogations). Source: National Monitoring Data 2021.

5.3 Conclusion

In summary, the figures provided for 2021–2023 show the considerable progress made towards a more integrated and efficient European electricity market. Member states were able to comply with the (temporary) targets applicable at the national level. NRAs (which are responsible for assessing TSOs' compliance with the CEP70 provisions) confirmed that the TSOs fulfilled the 70 % requirement or – where applicable – the linear trajectory and/or conditions stemming from the regulatory approval of individual derogation requests.

Furthermore, in the context of this Technical Report, the differences between the ACER methodology and the national compliance monitoring approaches have been explained and presented in a comprehensible manner.

For the example of the Core CCR, it was found that the national assessment and ACER's market monitoring show similar results when monitoring fulfilment with the currently binding minimum capacities per border (resulting from derogations, action plans or already 70 %). This similarity was not found for the benchmarking against the 70 % target (which excludes derogations and action plans). These ACER figures – which are also presented in this report – provide only a very limited insight into the overall status of the implementation of the 70 % target due to differences in monitoring methods, and more importantly the way in which the percentages categories are broken down in the figure. It should be stressed that other figures such as distribution curves (shown in national and ACER monitoring) provide better insights. Overall, this underlines the importance of focusing monitoring on currently mandatory requirements.

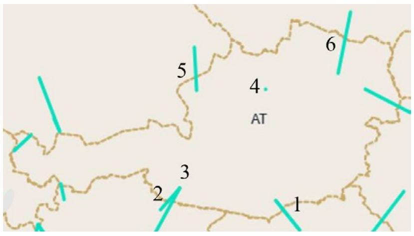
Appendix 1

Detailed expert assessments of major congestions

In the following, for each member state a detailed expert assessment is provided for the major congestions as described in Section 2.1.4, including a map to identify and locate these congestions. The numbering matches the expert assessment list of congestions provided, although this does not necessarily mean that the order reflects the severity of congestions as some are grouped geographically. The lines that do not have a number in the map of a country are not among the main congestions of that country and have been reported by a neighbouring country, where the expert assessment of that line will be provided. Information on the non-allocated flows ('F') can be found in Section 3.1.

Austria

There are five groups of CNEs in Austria.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220 kV Obersielach–Podlog (ELES) **[1]**	Congestions (100 % = 8760 MTU)	42.1 %	27.8 %	8.8 %	0.4 %	3.0 %	2.3 %	0.2 %	0.5 %	0.2 %
	F "mean share of capacity used up by non-allocated flows"		27.5 %	38.4 %						
Assessment of the congestion in the three timeframes	From 2021 to June 2022, the DACC process for the AT–SI border was coordinated NTC-based, together with the borders of AT–HU and AT–CZ. The calculation was made separately for export and import profiles of Austria. In this process, there was (at least) one limiting CNEC in the import and export directions, respectively. The percentages reported above account for both directions (export and import). Since June 2022, a FB allocation approach has been applied. During this period, the active constraints in the FB process accounted for approximately 15 % of the time in 2022 and then fell further to 8.8 % in 2023. The geographical location of the network element between continental and south-east Europe represents a bottleneck for cross-zonal exchange towards the Balkan region, which is why it occasionally appears as an active constraint in the DACC. Moreover, this element is strongly influenced by the PST flows from the IN region. The increase in congestion in the DACF process after 2021 can be explained by the increasing exports to south-east Europe in these years.									
Expert indication on the main type of flows causing the congestion	The main flows on this element are market flows towards south-east Europe due to high import levels in this region. In addition, non-allocated flows place a substantial load on this network element. In 2023, they accounted on average for almost 38.4 % of the load in the case of an active constraint.									
Future evolution including ten-year scenario	TYNDP 2022 project 325 foresees an upgrade of the existing 220 kV line between Obersielach (AT) and Podlog (SI), which will relieve the congestion on the existing line and increase the transport capacity. ELES is considering installing an SSSC FACTS device on their side of the border, which would also reduce the congestions on this element.									
Is the CNE on a bidding zone border?	Yes									

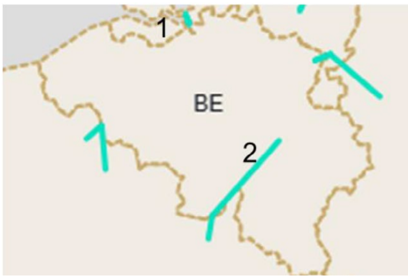
		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220 kV Lienz–Auronzo (TERNA) **[2]**	Congestions (100 % = 8760 MTU)	11.9 %	0.1 %	0.8 %	6.4 %	32.7 %	26.5 %	12.2 %	30.5 %	27.5 %
220/220 kV transformer Lienz **[3]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	44.2 %	8.3 %	7.0 %	4.2 %	10.4 %	6.5 %
CNEs group name	BZB AT–IT Lienz									
Assessment of the congestion in the three timeframes	Disclaimer: Until the end of 2023, line [2] ran from Lienz to Soverzene (right line). This is the reason why two lines are shown. The reason for the change of frequency of the Lienz–Auronzo line being an active constraint in the D-2 timeframe is that from October 2021 onwards there is only one network element (different every hour) that limits the CC outcome in the entire Italy North CCR. The reason is a change in the CC process due to the CEP and the 70 % rule. Since then, the element has rarely appeared as a limiting constraint in this CCR. The phase shifter in Lienz does not appear in the D-2 timeframe as an active constraint because it is not reported as a CNEC. The two network elements have a high congestion rate in the DACF and CTRT because pre-real-time actions are only implemented when the predicted overload (N-1) on the element is 140 % or higher. If the predicted overload is less than 140 %, the tap position of PST Lienz is changed in real time to avoid violations.									
Expert indication on the main type of flows causing the congestion	The central geographical location of the network element in the European electricity grid results in the element being primarily subject to loading caused by cross-zonal transactions in the north–south direction. The element is used by market flows between different BZs (DE, AT, IT, ...).									
Future evolution including ten-year scenario	The commissioning of the additional cross-border line between AT and IT Nauders–Glorenza in December 2023 (TYNDP 2022 project 26) as well as the reinforcement of the existing cross-border line and the phase-shifting transformer with a planned commissioning date of 2030 (TYNDP 2022 project TR375) will have a relieving effect on the Austrian side of this group.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
380/220 kV transformer Ernsthofen **[4]**	Congestions (100 % = 8760 MTU)	46.2 %	0.8 %	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		12.1 %	15.7 %						
Assessment of the congestion in the three timeframes	From 2021 to June 2022, the DACC process for the AT borders with CZ, HU and SI was coordinated using the NTC-based approach. The calculation was made separately for export and import profiles of Austria. In this process, there was (at least) one limiting CNEC in the import and export directions, respectively. The percentages reported above account for both directions (export and import). Due to certain assumptions in the coordinated NTC capacity calculation process, this element was frequently limiting the capacities for the common profile with CZ/HU/SI. From June 2022 onwards, this element was not a relevant active constraint in the Core FB process. In the D-1 timeframe and CTRT, there were hardly any congestions on this network element.									
Expert indication on the main type of flows causing the congestion	The majority of flows that limited the element in the D-2 CC in 2021 were market flows.									
Future evolution including ten-year scenario	The situation is not expected to worsen in the coming years. The construction of an electricity corridor from St. Peter to Dürnrohr (ÖNIP Stombedarfskorridor 1) will further improve the situation.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220 kV St. Peter–Pleinting (TenneT GE) **[5]**	Congestions (100% = 8760 MTU)	12.1%	12.7%	9.7%	0.2%	1.3%	3.0%	0.1%	0.1%	0.4%
	F "mean share of capacity used up by non-allocated flows"		25.8%	22.9%						
Assessment of the congestion in the three timeframes	Due to its central location in the European electricity grid, the St. Peter–Pleinting line between Austria and Germany is a bottleneck for west⇔east as well as north⇔south export/import and transit flows (market flows) and has therefore occasionally been an active constraint that limits the market outcome. The frequency of congestions in D-1 is lower than in the DACC because based on the results of the DACC, remedial actions are already implemented before the first DACF run. Any remaining congestions are resolved in the following steps of the DACF procedure.									
Expert indication on the main type of flows causing the congestion	The main type of flows on the element are market flows. The share of non-allocated flows also indicates substantial loop flows on this element.									
Future evolution including ten-year scenario	The new 380 kV St. Peter–National Border (Isar/Ottenhofen/DE) and St. Peter–National Border (Pleinting/DE) projects (NDP project 11-7 and TYNDP 2022 project TR187 and TR313) are expected to have a relieving effect on this element and provide additional capacities for cross-border exchanges. The expected commissioning of the first project is in 2027.									
Is the CNE on a bidding zone border?	Yes									
380 kV Dürnrohr–Slavetice (ČEPS) **[6]**	Congestions (100% = 8760 MTU)	7.9%	14.2%	1.6%	0.1%	0%	0%	0%	0%	0%
	F "mean share of capacity used up by non-allocated flows"		25.4%	30.4%						
Assessment of the congestion in the three timeframes	From 2021 to June 2022, the DACC process for the AT borders with CZ, HU and SI was coordinated using the NTC-based approach. The calculation was made separately for export and import profiles of AT. In this process, there was (at least) one limiting CNEC in the import and export directions, respectively. The percentages reported above account for both directions (export and import). Due to certain assumptions in the coordinated NTC capacity calculation process, this element was frequently limiting the capacities for the common profile with CZ/HU/SI. From June 2022 onwards, this element was rarely an active constraint in the FB process. Following the modernisation of the line and the installation of dynamic line rating as well as the advancement of grid expansion in the east, there have been minimal instances of overloads on this element in D-1 and CTRT, especially since the FB process has been implemented.									
Expert indication on the main type of flows causing the congestion	The main reason for the congestions are market flows from north/west towards south/east Europe. The share of non-allocated flows also indicates substantial loop flows on this element.									
Future evolution including ten-year scenario	They are currently no grid development projects planned at this cross-border profile.									
Is the CNE on a bidding zone border?	Yes									

Belgium

There are two CNEs in Belgium.

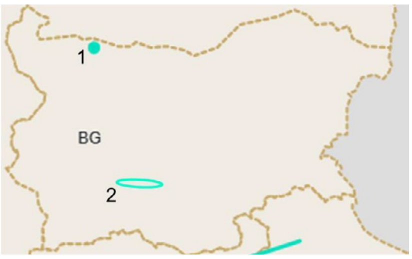


		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
PST Zandvliet 380 kV **[1]**	Congestions (100 % = 8760 MTU)	7.20 %	6.52 %	4.51 %	0 %	0 %	0 %		0.2 %	0.1 %
	F "mean share of capacity used up by non-allocated flows"	N/A	12.1 %	31.8 %						
CNEs group name	This CNEC is a phase shifter transformer located in the Zandvliet substation									
Assessment of the congestion in the three timeframes	**Active constraint for DA allocation:** This is very likely due to lower minRAM targets than 70 % due to the loop flow derogation, although high market flows can also cause it if the market perspective aims to exceed 70 %. Elia has a derogation for excessive loop flows. Elia has installed a number of phase shift transformers (PSTs) on its borders, which allow it to control active power flows on internal and cross-border network elements. This capability makes it possible to reduce loop flows. Elia makes use of this in the Core DACCM to reduce excessive LF with PSTs According to the study (F)2802 carried out by the CREG in 2024, the use of PSTs reduced loop flows on Elia's CNECs to a lower absolute level in 94.4 % of all hours in 2023, with an average reduction of 342 MW. **They do not lead to overloads in other timeframes due to several factors:** **Forecast effects:** The flows were lower in DACF/close-to-real-time than forecasted in the D2CF grid models. **Operational procedure:** In operations, we find international agreements to shift flows elsewhere via various methods: – Using extra tap ranges on the PSTs, resulting in a reduction of loop flows. – Employing other remedial actions with cross-border impact, which cannot be assessed through individual validation in DACC. – Utilizing cross-border redispatch with cross-border impact, similarly not assessable through individual validation in DACC.									
Expert indication on the main type of flows causing the congestion	The PST Zandvliet is a cross-border line and the large portion of the active flow on this CNEC is loop flows and market flows.									
Future evolution including ten-year scenario	Expected BE–NL grid enforcement is scheduled by the 2035 horizon.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
380 kV Gramme–Achene **[2]**	Congestions (100 % = 8760 MTU)	4.70 %	8.79 %	3.77 %	0 %	0.30 %	0.58 %		0.2 %	0.1 %
	F "mean share of capacity used up by non-allocated flows"	N/A	13.0 %	14.2 %						
CNEs group name	CNEC form the connection between Gramme and Achene substations									
Assessment of the congestion in the three timeframes	**Congestion is most visible after DA market coupling** According to the study (F)2802 carried out by the CREG in 2024, the capacity available on this CNEC is above 70 % for more than 75 % of the hours of 2023 and above 50 % for more than 95 % of the hours of 2023. **They do not lead to overloads in other timeframes due to several factors:** **Forecast effects:** The flows were lower in DACF/close-to-real-time than forecasted in the D2CF grid models. **Operational procedure:** In operations, we find international agreements to shift flows elsewhere via various methods: – Using extra tap ranges on the PSTs, resulting in a reduction of loop flows. – Employing other remedial actions with cross-border impact, which cannot be assessed through individual validation in DACC. – Utilizing cross-border redispatch with cross-border impact, similarly not assessable through individual validation in DACC.									
Expert indication on the main type of flows causing the congestion	The large amount of nuclear generation at the Gramme substation is dispatched as a result of internal trade within the Belgium. Hence, a large portion of the active power flow on these CNEs is internal flows. MinRAM: For more information, check Creg's report.									
Future evolution including ten-year scenario	Expected grid enforcement is scheduled: – Upgrade to HTLS line close to Gramme substation. – Installation of new PSTs. – Decommissioning of nuclear generators is also expected around Gramme. Therefore, in the long run (2030>) no congestion is projected for these CNEs.									
Is the CNE on a bidding zone border?	No									

Bulgaria

There are two groups of CNEs analysed in Bulgaria.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV-BG_L1 **[1]**	Congestions (100 % = 8760 MTU)	0 %	5.6 %	1.0 %						
CNEs group name	CNE is a double-circuit interconnection line between bordering substations in Bulgaria and Romania									
Assessment of the congestion in the three timeframes	400 kV-BG_L1 is a double-circuit line and most of the time one of the two circuits is kept as a reserve, which means open/disconnected due to high voltages. In cases with topology like this – which is the usual state for this interconnection line – and when the circuit of BG_L1 in operation appears to be a limiting critical network element during the DA and ID CC, a topology remedial action could be applied, whereby the other circuit that is in reserve/disconnected is put into operation. Taking into account the aforementioned, according to our expert assessment BG_L1 could not be classed as an active market constraint under normal operating conditions. Considering this and according to our expertise based on historical data and our future expectations, such a CNE could not be classed as frequently occurring under normal power system conditions. It could not be assessed as a congestion point and active market constraint on the BG–RO border.									
Expert indication on the main type of flows causing the congestion	400-kV-BG_L1 is a cross-border line and it is assumed the large portion of the active flow on this network elements is cross-border flows, transit flows, and loop flows.									
Future evolution including ten-year scenario										
Is the CNE on a bidding zone border?	Yes									
220-kV-BG_L2 **[2]**	Congestions (100 % = 8760 MTU)	3.3 %	0 %	0 %						
CNEs group name	CNE is an internal network element located in the southern part of Bulgaria									
Assessment of the congestion in the three timeframes	This element was observed as a limiting one only in 2021. Moreover, it appeared only in maintenance operating conditions in our transmission network and it was not and is not an active market constraint. Due to major investments in the last two years in the Bulgarian transmission network, this limiting element had disappeared by 2023.									
Expert indication on the main type of flows causing the congestion	220-kV-BG_L2 is an internal network element and it is assumed that the main portion of the active flow on this network elements is internal flows.									
Future evolution including ten-year scenario	Due to the major investments in the Bulgarian transmission system in recent years, this CNE is not expected to be present in the future.									
Is the CNE on a bidding zone border?	No									

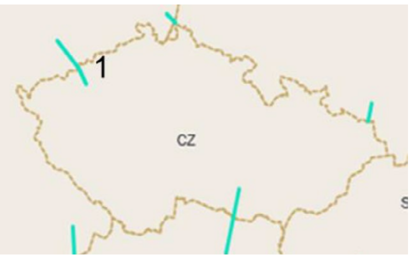
Croatia

There are six CNEs in Croatia. Due to the data source used in the process of the Technical Report preparation, the control block of Slovenia, Croatia, and Bosnia and Herzegovina (CB SHB) is presented as one BZ. In practice, CB SHB comprises three separate BZs, namely one for each aforementioned country.

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220-kV-Senj–Melina	Congestions (100 % = 8760 MTU)		0 %	0 %	2.4 %	3.5 %	7.0 %	8.8 %	7.8 %	11.8 %
220-kV-Pehlin–xnode Divača	Congestions (100 % = 8760 MTU)		7.0 %	4.2 %	0.5 %	0 %	0 %	0.1 %	0.3 %	0 %
	F "mean share of capacity used up by non-allocated flows"		23.9 %	22.5 %						
MRACL 221TR2	Congestions (100 % = 8760 MTU)		0 %	0 %	0 %	0 %	8.5 %	0.2 %	0.1 %	3.1 %
220-kV-Zakučac–xnode Mostar	Congestions (100 % = 8760 MTU)		2.7 %	0.4 %	0 %	0.6 %	0.1 %	0 %	1.3 %	0.1 %
	F "mean share of capacity used up by non-allocated flows"		12.4 %	13.9 %						
MRACL 221TR3	Congestions (100 % = 8760 MTU)		0 %	0 %	0 %	2.2 %	0 %	0.1 %	1.0 %	0 %
400-kV-Zerjavinec–Tumbri	Congestions (100 % = 8760 MTU)		1.5 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		5.8 %	1.0 %						
Assessment of the congestion in the three timeframes	**220-kV-Senj–Melina** In 2023, the Senj–Melina line was upgraded with HTLS to reduce the congestions related to limited transmission capacity. Due to RES integration on the southern part of network (Dalmatia), congestions are still expected. **220-kV-Pehlin–xnode Divača, 220-kV-Zakučac–xnode Mostar, and 400-kV-Zerjavinec–Tumbri** Increasing level of coordination between CCRs until potential reconfiguration; reducing loop flows in general; reducing unscheduled flows coming from other CCRs. **MRACL 221TR2 and MRACL 221TR3** Due to reconstruction in SS Mraclin and the special switching state (availability two out of three transformers) in SS Mraclin, after completing reconstruction this congestion is not expected.									
Expert indication on the main type of flows causing the congestion	**220-kV-Senj–Melina** It is not CORE CNE (congestions caused mainly by internal and transit flows). **220-kV-Pehlin–xnode Divača** Congestions caused mainly by transit and loop flows. **MRACL 221TR2 and MRACL 221TR3** It is not CORE CNE. **220-kV-Zakučac–xnode Mostar and 400-kV-Zerjavinec–Tumbri** Congestions caused mainly by transit flows.									
Future evolution including ten-year scenario	PST transformer in 110 kV SS Gračac, transformer 400/220 kV Konjsko, transformer 400/110 kV Velebit and new double-circuit OHL 400 kV Konjsko-Lika-Melina/Tumbri.									
Is the CNE on a bidding zone border?	220-kV-Senj–Melina, 400-kV-Zerjavinec–Tumbri, MRACL 221TR2, and MRACL 221TR3: No 220-kV-Pehlin–xnode Divača and 220-kV-Zakučac–xnode Mostar: Yes									

Czech Republic

There is one group of CNEs in the Czech Republic.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV-Hradec–Rohrsdorf **[1]**	Congestions (100 % = 8760 MTU)	N/A	0.78 %	0.30 %	0.19 %	3.35 %	8.68 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"	N/A	8.39 %	12.36 %						
400-kV-Hradec–Rohrsdorf **[1]**	Congestions (100 % = 8760 MTU)	N/A	0.19 %	0.11 %	0.19 %	3.34 %	8.73 %	0 %	0 %	0.01 %
	F "mean share of capacity used up by non-allocated flows"	N/A	6.40 %	15.96 %						
CNEs group name	Both CNEs are the connection between Hradec and Rohrsdorf									
Assessment of the congestion in the three timeframes	Congestion is mostly due to the fact that Czechia has a central geographical position in central Europe, which means a lot of loop flows and transit flows. The congestion is partly managed by PST.									
Expert indication on the main type of flows causing the congestion	Transit flows, loop flows									
Future evolution including ten-year scenario	Modernisation of the V445 and V446 tie lines (Hradec East–Röhrsdorf) (2027–2028)									
Is the CNE on a bidding zone border?	Yes									

Denmark

There are five CNEs in Denmark.

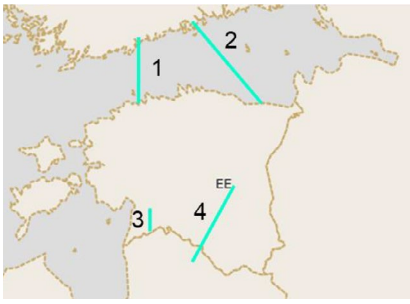
		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
DK1_SE3 **[1]**	Congestions (100 % = 8760 MTU)	84.6 %	72.5 %	79.1 %						
Is the CNE on a bidding zone border?	Yes									
CNEs group name										
Assessment of the congestion in the three timeframes	Energy prices in the Nordic region are frequently lower than those in Central Europe, generating significant interest among market participants regarding the southbound connections with DK1 and DK2 as transit zones. The interconnector has experienced limited capacity due to both planned and unplanned maintenance for 16 %, 14 %, and 7 % of the time, for 2021, 2022, and 2023 respectively. The remaining congestion reflects the full trade activity on the interconnector. The interconnector had above-average outages in 2021 and 2022 due to revision and cable errors.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario										
DK1_NL **[2]**	Congestions (100 % = 8760 MTU)	62.8 %	66.4 %	65.7 %						
Is the CNE on a bidding zone border?	Yes									
CNEs group name										
Assessment of the congestion in the three timeframes	Energy prices in the Nordic region are frequently lower than those in Central Europe, generating significant interest among market participants regarding the southbound connections with DK1 and DK2 as transit zones. The interconnector has experienced limited capacity due to both planned and unplanned maintenance for 8 %, 8 %, and 2 % of the time, for 2021, 2022, and 2023 respectively. The remaining congestion reflects the full trade activity on the interconnector.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario										

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
DK2_DE **[3]**	Congestions (100 % = 8760 MTU)	52.1 %	48.5 %	66.5 %						
Is the CNE on a bidding zone border?	Yes									
CNEs group name										
Assessment of the congestion in the three timeframes	Energy prices in the Nordic region are frequently lower than those in Central Europe, generating significant interest among market participants regarding the southbound connections with DK1 and DK2 as transit zones. The interconnector has experienced limited capacity due to both planned and unplanned maintenance for 4 %, 7 %, and 24 % of the time, for 2021, 2022, and 2023, respectively. The remaining congestion reflects the full trade activity on the interconnector. In the first half of 2023, the capacity was limited for seven weeks due to a cable upgrade in Germany, which led to the increase in congestion and the high rise in limited capacity.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario										
DK1_NO2 **[4]**	Congestions (100 % = 8760 MTU)	58.7 %	44.8 %	47.5 %						
Is the CNE on a bidding zone border?	Yes									
CNEs group name										
Assessment of the congestion in the three timeframes	Energy prices in the Nordic region are frequently lower than those in Central Europe, generating significant interest among market participants regarding the southbound connections with DK1 and DK2 as transit zones. The interconnector has experienced limited capacity due to both planned and unplanned maintenance for 6 %, 4 %, and 13 % of the time, for 2021, 2022, and 2023, respectively. The remaining congestion reflects the full trade activity on the interconnector.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario										
DK2_SE4 **[5]**	Congestions (100 % = 8760 MTU)	34.6 %	59.3 %	44.0 %						
Is the CNE on a bidding zone border?	Yes									
CNEs group name										
Assessment of the congestion in the three timeframes	Energy prices in the Nordic region are frequently lower than those in Central Europe, generating significant interest among market participants regarding the southbound connections with DK1 and DK2 as transit zones. The interconnector has experienced limited capacity due to both planned and unplanned maintenance for 2 %, 13 %, and 2 % of the time, for 2021, 2022, and 2023, respectively. The remaining congestion reflects the full trade activity on the interconnector.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario										

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
DK1_DK2 **[6]**	Congestions (100% = 8760 MTU)	38.2%	31.1%	38.4%						
Is the CNE on a bidding zone border?	Yes									
CNEs group name										
Assessment of the congestion in the three timeframes										
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario										

Estonia

There are two groups of CNEs analysed by Estonia.

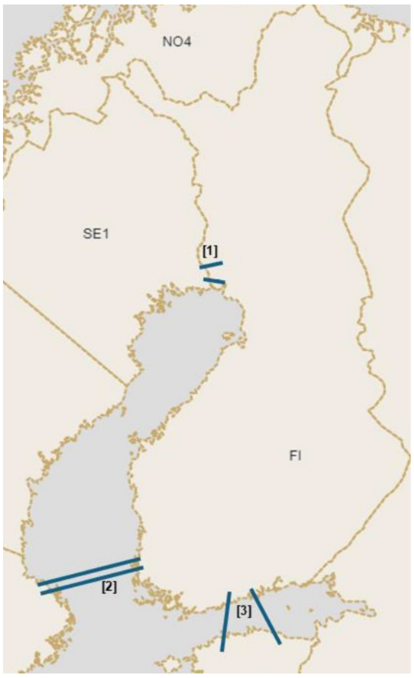


		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
150-kV-DC-EE–FI **[1]**	Congestions (100 % = 8760 MTU)	40.3 %	38.2 %	53.8 %	5.47 %	5.71 %	7.90 %	0.76 %	1.15 %	0.24 %
400-kV-DC-EE–FI **[2]**	Congestions (100 % = 8760 MTU)									
CNEs group name	EE–FI interconnectors									
Assessment of the congestion in the three timeframes	Congestions have appeared on these CNEs mostly in the D-2 timeframe. The higher percentage of cross-zonal congestions during the D-2 timeframe was caused by Baltics' dependency on cheaper electricity produced in the Nordic countries, which caused the north to south flow in Estonian BZ.									
Expert indication on the main type of flows causing the congestion	The primary cause of these congestions is the high utilization factor of these interconnector CNEs due to cross-border flows.									
Future evolution including ten-year scenario	To reduce cross-border congestions, further initial planning processes for Estlink 3 are ongoing. The construction works of Estlink 3 are expected to be finished by the end of 2035. Final investment decision for the project is expected to be confirmed by 2027 (**https://elering.ee/node/2229**).									
Is the CNE on a bidding zone border?	Yes									

330-kV-AC-Kilingi-Nõmme–Riga TEC-2 L502 **[3]**	Congestions (100 % = 8760 MTU)	5.31 %	24.9 %	7.03 %	1.54 %	5.99 %	2.23 %	0 %	0.23 %	0.21 %
330-kV-AC-Tsirguliina–Valmiera L354 **[4]**	Congestions (100 % = 8760 MTU)									
330-kV-AC-Tartu–Valmiera L301 **[4]**	Congestions (100 % = 8760 MTU)									
CNEs group name	EE–LV interconnectors									
Assessment of the congestion in the three timeframes	Congestions have appeared on these CNEs mostly in the D-2 timeframe. The higher percentage of cross-zonal congestions during the D-2 timeframe was caused by the Baltics' dependency on cheaper electricity produced in the Nordic countries, which caused the north to south flow in the Estonian BZ.									
Expert indication on the main type of flows causing the congestion	The primary cause of these congestions is the high utilization factor of these interconnector CNEs due to cross-border flows.									
Future evolution including ten-year scenario	Investments planned for synchronisation in 2025 have been finished. Thus, the number of congestions on the EE–LV cross-border is expected to decrease. To reduce cross-border congestions, further initial planning processes for a fourth EE–LV power line are ongoing, with the construction works expected to be finished by the end of 2033. A final investment decision for the project is expected to be confirmed by 2027 (**https://elering.ee/node/2229**).									
Is the CNE on a bidding zone border?	Yes									

Finland

There are three groups of CNEs analysed by Finland.

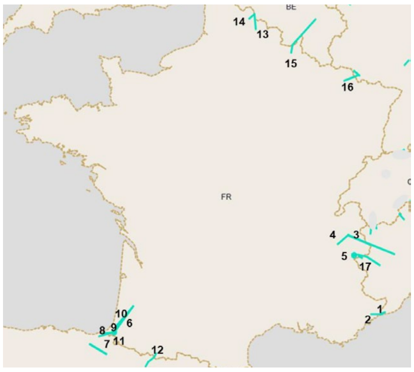


		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV-FI–SE1 **[1]**	Congestions (100 % = 8760 MTU)	66.3 %	76.5 %	48.8 %				0 %	1.3 %	1.1 %
400-kV-FI–SE1 **[1]**	Congestions (100 % = 8760 MTU)									
CNEs group name	CNEs are double circuits of the same interconnector									
Assessment of the congestion in the three timeframes	Congestions have appeared on these CNEs mostly in the D-2 timeframe. After DA market coupling, these CNEs remain fully loaded and a limiting factor will continue to the cross-border intra-day market. Finally, congestions remain relevant in close to real time, which means that insufficient RA or acceptable overloads were observed on CNEs.									
Expert indication on the main type of flows causing the congestion	The primary cause of these congestions is the high utilization factor of these interconnector CNEs									
Future evolution including ten-year scenario	Additional interconnector and grid development are planned to reduce the amount of congestions of these CNEs.									
Is the CNE on a bidding zone border?	Yes									
400-kV-DC-FI–SE3 **[2]**	Congestions (100 % = 8760 MTU)	30.7 %	35.4 %	15.9 %				0.1 %	0.1 %	0.1 %
500-kV-DC-FI–SE3 **[2]**	Congestions (100 % = 8760 MTU)									
CNEs group name	CNEs are double circuits of the same interconnector									
Assessment of the congestion in the three timeframes	Congestions have appeared on these CNEs mostly in the D-2 timeframe. After DA market coupling, these CNEs remain fully loaded and a limiting factor will continue to the cross-border intra-day market. Finally, congestions remain relevant in close to real time, which means that insufficient RA or acceptable overloads were observed on CNEs.									
Expert indication on the main type of flows causing the congestion	The primary cause of these congestions is the high utilization factor of these interconnector CNEs.									
Future evolution including ten-year scenario	Additional interconnector and grid development are planned to reduce the amount of congestions of these CNEs.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
150-kV-DC-FI–EE **[3]**	Congestions (100 % = 8760 MTU)	40.9 %	30.9 %	41.2 %				0 %	0.9 %	8.0 %
450-kV-DC-FI–EE **[3]**	Congestions (100 % = 8760 MTU)									
CNEs group name	CNEs are double circuits of the same interconnector									
Assessment of the congestion in the three timeframes	Congestions have appeared on these CNEs mostly in the D-2 timeframe. After DA market coupling, these CNEs remain fully loaded and a limiting factor will continue to the cross-border intra-day market. Finally, congestions remain relevant in close to real time, which means that insufficient RA or acceptable overloads were observed on CNEs.									
Expert indication on the main type of flows causing the congestion	The primary cause of these congestions is the high utilization factor and transit flows of these interconnector CNEs.									
Future evolution including ten-year scenario	Additional interconnector and grid development are planned to reduce the amount of congestions of these CNEs.									
Is the CNE on a bidding zone border?	Yes									

France

There are nine groups of CNEs analysed by France, allocated to seventeen geographical locations.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
225 kV-Menton–Camporosso **[1]**	Congestions (100 % = 8760 MTU)	6.88 %	0 %	0.03 %	0 %	0 %	0 %	0 %	0 %	0 %
225 kV-Menton–Trinité Victor **[2]**	Congestions (100 % = 8760 MTU)	5.07 %	0 %	0.03 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name	Menton–Camporosso and Menton–Trinité Victor are one cross-border line and one line in a row.									
Assessment of the congestion in the three timeframes	These CNEs no longer appear as limiting in the cross-border exchanges since 2022. Indeed, with the implementation of the CNEC selection (selection criterion based on sensitivity to Italian imports >5 %), they are no longer selected by the calculation because they are not very sensitive to exchanges (225 kV lines). The frequency of the congestion decreases from the CC to the D-1 timeframe, with congestions mainly solved by topological remedial actions.									
Expert indication on the main type of flows causing the congestion	The Menton–Camporosso line is a cross-border line between France and Italy. Hence, a large portion of the active power flow on these CNEs is cross-border flows.									
Future evolution including ten-year scenario	No evolution in the future.									
Is the CNE on a bidding zone border?	Yes									
400-kV-Albertville–Rondissone 2 **[3]**	Congestions (100 % = 8760 MTU)	6.68 %	0.07 %	0.32 %	0.09 %	0 %	0 %	0 %	0 %	0.05 %
400-kV-Albertville–Rondissone 1 **[3]**	Congestions (100 % = 8760 MTU)	4.51 %	0.07 %	0.34 %	0.06 %	0 %	0.05 %	0 %	0.02 %	0 %
400-kV-Albertville–Grande Ile **[4]**	Congestions (100 % = 8760 MTU)	4.56 %	0.57 %	0 %	0.52 %	0.07 %	0.78 %	0 %	0 %	0 %
CNEs group name	Albertville–Rondissone and Albertville–Grande Ile are one cross-border line and one line in a row.									
Assessment of the congestion in the three timeframes	Those two CNEs appear less limiting in the CC in 2022 and 2023 because a change in the calculation of IN capacity was made. Indeed, in 2021 all limiting elements were raised, and from 2022 only the most limiting element is included in the calculation. This most limiting element is very often a Swiss element, therefore excluding FR–IT CNEs. The frequency of the congestion decreases from the CC to the D-1 timeframe, with congestions mainly solved by topological remedial actions.									
Expert indication on the main type of flows causing the congestion	The Albertville–Rodissone line is a cross-border line between France and Italy. Hence, a large portion of the active power flow on these CNEs is cross-border flows.									
Future evolution including ten-year scenario	in the future, no evolution is expected and those two CNEs in a row will appear as a limiting element in particular situations since it is dimensioning for FR–IT exchanges.									
Is the CNE on a bidding zone border?	Yes									

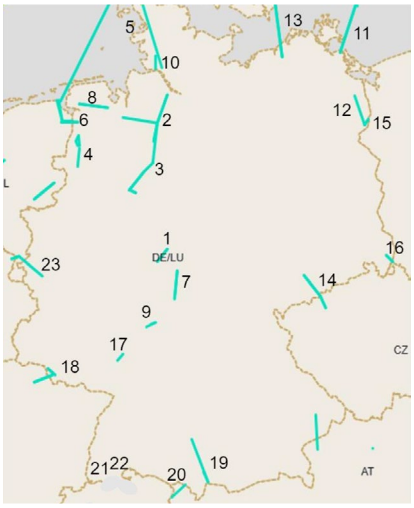
		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
PST LA PRAZ **[5]**	Congestions (100% = 8760 MTU)	17.1%	0.31%	0.66%	0%	0%	0%	0%	0%	0%
By-pass PST LA PRAZ **[5]**	Congestions (100% = 8760 MTU)	0.49%	0%	1.70%	0%	0%	0%	0%	0%	0%
CNEs group name	PST LA PRAZ									
Assessment of the congestion in the three timeframes	This is an important PST at the border. It allows redirecting flows between interconnections. Hence, it is widely used by the RAO and therefore potentially limiting when the PST intake is at its maximum. The frequency of the congestion decreases from the CC to the D-1 timeframe.									
Expert indication on the main type of flows causing the congestion	The congestions at the PST La Praz are due to cross-border flows.									
Future evolution including ten-year scenario	In the future, no evolution is expected.									
Is the CNE on a bidding zone border?	Yes									
Argia–Cantegrit 400 kV **[6]**	Congestions (100% = 8760 MTU)	9.42%	0%	0%	0%	0%	0%	0.01%	0%	0%
Argia–Hernani 400 kV **[7]**	Congestions (100% = 8760 MTU)	0%	4.85%	2.33%	0%	0%	0%	0%	0%	0%
CNEs group name	400kVCNEs in a row from the Argia substation at the west of the French-Spanish border									
Assessment of the congestion in the three timeframes	The capacity calculation process in the SWE region only reports the most limiting element. Argia–Cantegrit does not appear as the most limiting element in the CC after 2021, which is why the frequencies are equal to zero in 2022 and 2023. Reconductoring of Argia–Hernani and Argia–Cantegrit might explain decreasing frequencies. Between the CC and D-1 timeframes, congestions are mainly solved by topological remedial actions. Close to real time, congestions are often solved with counter-trading.									
Expert indication on the main type of flows causing the congestion	The Argia–Hernani line is a cross-border line between France and Spain. Hence, a large portion of the active power flow on these CNEs is cross-border flows.									
Future evolution including ten-year scenario	The Biscay Gulf project – whose commissioning is planned in 2028 – should almost double the cross-zonal capacity between France and Spain. Subsequently, Argia–Hernani new cables will have a higher transit capacity, making it possible to increase exchange capacity.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Argia–Arkale 220 kV **[8]**	Congestions (100 % = 8760 MTU)	25.4 %	28.2 %	12.3 %	0 %	0 %	0 %	0 %	0.01 %	0 %
Argia–Mouguerre 2 220 kV **[9]**	Congestions (100 % = 8760 MTU)	0 %	13.1 %	2.61 %	0 %	0 %	0 %	0 %	0 %	0 %
Cantegrit–Mouguerre **[10]**	Congestions (100 % = 8760 MTU)	0 %	0 %	17.6 %	0 %	0 %	0 %	0 %	0.01 %	0 %
AT Argia 1 220 kV **[11]**	Congestions (100 % = 8760 MTU)	1.75 %	1.30 %	8.37 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name	225 kV CNEs from the Argia substation at the west side of the FE–ES border									
Assessment of the congestion in the three timeframes	Argia–Mouguerre 2 appears as the most congested element during the second semesters of 2022 and 2023 in N-1. Those congestions mostly happen due to important imports from Spain. For Cantegrit–Mouguerre, the congestions in 2023 happen in export situations. Between the CC and D-1 timeframes, congestions are mainly solved by topological remedial actions. Close to real time, congestions are often solved with counter-trading.									
Expert indication on the main type of flows causing the congestion	The Argia–Arkale line is a cross-border line between France and Spain. Hence, a large portion of the active power flow on these CNEs is cross-border flows.									
Future evolution including ten-year scenario	The Biscay Gulf project – whose commissioning is planned in 2028 – should almost double the cross-zonal capacity between France and Spain. Subsequently, Argia–Hernani new cables will have a higher transit capacity, making it possible to increase exchange capacity.									
Is the CNE on a bidding zone border?	Yes									
Biescas–Pragneres 225 kV **[12]**	Congestions (100 % = 8760 MTU)	0 %	12.9 %	11.7 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name										
Assessment of the congestion in the three timeframes	225 kV line in a row of the Pragnères PST, it is the only interconnection in the middle of the French-Spanish border. It appears as often congested in N-1. Congestions mostly happen due to important imports from Spain. Between the CC and D-1 timeframes, congestions are mainly solved by topological remedial actions. Close to real time, congestions are often solved with counter-trading.									
Expert indication on the main type of flows causing the congestion	The Biescas–Pragnères line is a cross-border line between France and Spain. Hence, a large portion of the active power flow on these CNEs is cross-border flows.									
Future evolution including ten-year scenario	No future evolution.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
[BE–FR] Avelgem–Mastaing **[13]**	Congestions (100 % = 8760 MTU)	0.07 %	1.23 %	0 %	0 %	0 %	0 %	0 %	0.11 %	0 %
	F "mean share of capacity used up by non-allocated flows"		9.70 %	0 %						
[BE–FR] Avelgem–Avelin **[14]**	Congestions (100 % = 8760 MTU)	1.92 %	11.1 %	0.63 %	0 %	0 %	0 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		16.0 %	19.3 %						
[BE–FR] Achene–Lonny **[15]**	Congestions (100 % = 8760 MTU)	0.56 %	2.31 %	0 %	0 %	0 %	0 %	0.01 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		10.6 %	0 %						
CNEs group name	These CNEs are BE/FR tie lines.									
Assessment of the congestion in the three timeframes	In 2022. important work was undertaken on the double axis [BE–FR] Avelgem–Mastaing 79 and [BE–FR] Avelgem–Avelin 80 to increase capacity . These plan outages have a significant impact on flows on [BE–FR] Achene–Lonny 19. Between the CC and D-1 timeframes, congestions are mainly solved by topological remedial actions and the validation process.									
Expert indication on the main type of flows causing the congestion	Congestion are mainly due to cross-border exchanges BE/FR and transit flow due to FR/DE exchanges.									
Future evolution including ten-year scenario	No evolution.									
Is the CNE on a bidding zone border?	Yes									
[D7-FR] Ensdorf–Vigy VIGY2 S **[16]**	Congestions (100 % = 8760 MTU)	0.23 %	1.07 %	0.78 %	0.53 %	0.39 %	0.74 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		7.82 %	14.0 %						
[D7-FR] Ensdorf–Vigy VIGY1 N **[16]**	Congestions (100 % = 8760 MTU)	0.15 %	1.27 %	1.05 %	0 %	0.30 %	0.65 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		15.9 %	15.1 %						
CNEs group name	These CNEs are DE/FR tie lines									
Assessment of the congestion in the three timeframes	Congestions on this double axis are limited, they are mainly due to plan outages.									
Expert indication on the main type of flows causing the congestion	Congestion are mainly due to DE/FR cross-border exchange and transit flow due to FR/BE exchanges. Between the CC and D-1 timeframes, congestions are mainly solved by topological remedial actions and the validation process.									
Future evolution including ten-year scenario	No evolution.									
Is the CNE on a bidding zone border?	Yes									
400 kV-Villarodin–Venaus **[17]**	Congestions (100 % = 8760 MTU)	2.32 %	0.17 %	0.23 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name										
Assessment of the congestion in the three timeframes	The congestions strongly decreased between 2021 and 2023. Between the D-2 and D-1 timeframes, congestions are solved with topological remedial actions. Counter-trading can be activated close to real time.									
Expert indication on the main type of flows causing the congestion	The Villarodin–Venaus line is a cross-border line between France and Switzerland. Hence, a large portion of the active power flows on this CNE is cross-border flows.									
Future evolution including ten-year scenario	No evolution.									
Is the CNE on a bidding zone border?	Yes									

Germany

There are nineteen groups of CNEs analysed by Germany, allocated to 23 geographical locations.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Eickum 380 kV [1]										
380 kV-Bechterdissen–Eickum 3 **[1]**	Congestions (100 % = 8760 MTU)	21 %	24 %	11 %	6.28 %	9.51 %	19.0 %	0.03 %	0 %	0.38 %
380 kV-Ovenstädt–Eickum 3 **[1]**	Congestions (100 % = 8760 MTU)	16 %	12 %	14 %	4.7 %	7.55 %	16.6 %	0 %	0 %	0.17 %
380 kV-Bechterdissen–Eickum 1 **[1]**	Congestions (100 % = 8760 MTU)	0 %	1 %	1 %	0.25 %	10.1 %	19.1 %	0.4 %	0.08 %	0.24 %
380 kV-Ovenstädt–Eickum 4 **[1]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	5.24 %	7.44 %	16.51 %	0.89 %	0.15 %	0.63 %
380 kV-Ovenstädt–Landes-bergen 4 **[1]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	10 %	6.84 %	16.7 %	5.68 %	0.62 %	2.87 %
CNEs group name	Eickum 380 kV									
Assessment of the congestion in the three timeframes	These group of internal network elements are mostly congested in D-1 due to the electricity produced by the wind parks located just north of them and transported southwards. Due to grid construction in the area, some of the elements near this CNE group had to be turned off, resulting in an increased occurrence in congestion.									
Expert indication on the main type of flows causing the congestion	Internal flows.									
Future evolution including ten-year scenario	This area in the grid will be strengthened through multiple grid building projects, as can be reviewed in the German Investment Plan (NEP 2023), starting with P135/ BBPIG 57 (2029), then P116/ BBPIG 57 (2033), and being completely solved by DC42/NordOst-Link in 2037.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Sottrum 380 kV [2]										
380 kV-Sottrum–Landesbergen 2 **[2]**	Congestions (100 % = 8760 MTU)	1 %	0 %	1 %	9.5 %	9.66 %	10.5 %	0.19 %	1.16 %	1.1 %
380 kV-Sottrum–Dollern DOLL SW **[2]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	15.3 %	17.1 %	17.1 %	2.17 %	5.9 %	7.01 %
380 kV-Sottrum–Dollern DOLL GN **[2]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	15.4 %	13.4 %	20.1 %	13.0 %	11.5 %	7.56 %
CNEs group name	Sottrum 380 kV									
Assessment of the congestion in the three timeframes	These group of internal network elements are mostly congested in D-1 due to the electricity produced by the wind parks located just north of them and transported southwards. Due to grid construction in the area, some of the elements near this CNE group have to be turned off, resulting in an increased occurrence in congestion.									
Expert indication on the main type of flows causing the congestion	Internal flows.									
Future evolution including ten-year scenario	This centre part of the grid will be strengthened through multiple grid building projects as can be reviewed in the German Investment Plan (NEP 2023), starting with 380 kV cables from project P24/ BBPIG 07 (2026), P119 /BBPIG 54 (Zuleitung, 2031), and finally P116 /BBPIG 57(2033).									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
Eickum/Sottrum 220 kV [3]										
220 kV-Y Wechold–Sottrum 1 **[3]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	13.2 %	11.3 %	6.0 %	0 %	0.31 %	0.03 %
220 kV-Y Wechold–Sottrum 2 **[3]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	12.7 %	11.4 %	5.59 %	0 %	0.11 %	0.18 %
220 kV-Y Huntorf–Sottrum GELB **[3]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	16.5 %	10.2 %	0 %	0.07 %	0.25 %	0.11 %
CNEs group name	Eickum/Sottrum 220 kV									
Assessment of the congestion in the three timeframes	This area was upgraded with a new 380 kV trace in parallel due to its congestions in the past. The 220 kV line has been decommissioned.									
Expert indication on the main type of flows causing the congestion	Internal flows.									
Future evolution including ten-year scenario	The line no longer exists.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Emsland [4]										
380 kV-D7HANE D7MEPP MEPPEN **[4]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	22.5 %	24.1 %	16.2 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		0 %	0 %						
380 kV-Meppen–Y Niederlangen EOWS **[4]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	28.8 %	29.8 %	23.9 %	19.9 %	11.5 %	5.56 %
	F "mean share of capacity used up by non-allocated flows"		0 %	71.2 %						
380 kV-Hanekenfähr–Dörpen West EWBL **[4]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	28.5 %	29.3 %	24.4 %	5.21 %	4.33 %	2.34 %
	F "mean share of capacity used up by non-allocated flows"		67.4 %	55.1 %						
380 kV-Y Niederlangen–Dörpen West EOWS **[4]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	26.5 %	28.9 %	20.5 %	0 %	11.5 %	0.27 %
	F "mean share of capacity used up by non-allocated flows"		0 %	59.5 %						

CNEs group name	Emsland
Assessment of the congestion in the three timeframes	Emsland has the peak of congestions happening in D-1 (and formerly also quite often occurring close to real time). This area has many offshore wind connections, with direct wind infeed into the substation and quite some impact from the surrounding stations that have similar conditions. This means that the number of hours of congestions is strongly related to the weather profile of that year. "An often congested line is the so-called 'Emslandleitung' between TenneT Germany and Amprion (Dörpen/West (TTG) – Hanekenfähr – Meppen – Niederlangen). The load on these lines has been particularly affected by the increase in installed offshore production capacity in recent years. Consequently, the resulting congestion is highly dependent on the weather conditions of the analysed year. The application of minimum capacities has shifted congestion from the day-ahead CC stage to the D-1 stage, counteracting the positive effects of targeted grid expansions and more efficient grid utilization. While the elements show no congestion in the CC for DA allocation stage, the congestion occurring in the D-1 timeframe is relatively high. Nevertheless, there is a positive trend of reducing congestion over time, attributed to the commissioning of the 94 km long 380 kV line Ganderkesee-St. Hülfe-Wehrendorf in Q3 2023, a project undertaken in cooperation between TenneT Germany and Amprion. The congestion situation in real time depends on the forecasts for the wind and solar feed-in compared to the day-ahead situation and its development and the possible feed-in management, which can generally only be activated very close to real time. As for the D-1 timeframe also close to real time a positive trend over time is clearly visible resulting from the above mentioned grid expansion project which will also positively affect the congestions in the following years."
Expert indication on the main type of flows causing the congestion	Internal flow As the network elements under consideration only very rarely represent an active constraint in the CC for DA allocation, the consideration of the type of flows using the values shown for non-allocated flows should be treated with caution. In the very few hours of the year in which the elements are restrictive, the largest proportion of flows is accounted for by non-allocated (loop and internal) flows.
Future evolution including ten-year scenario	This area in the grid will be strengthened, as can be reviewed in the German Investment Plan (NEP 2023). This congestion will be solved through the newly constructed line Dörpen/West-Niederrhein EnLAG 05 (2027). "A major influencing factor in the future is the continuing development of the grid as well as its increasingly efficient utilisation. The German TSOs continually review and optimise the planned grid expansion in the framework of the national grid development plan (Netzentwicklungsplan) to solve identified congestions in combination with innovative measures which help to increase the efficiency of the grid utilisation (e. g., dynamic line rating). In the next ten years, over 6,000 km of new DC lines with a total capacity of nearly 30 GW will be commissioned, related to the analysed elements. These lines will primarily transport electricity generated by offshore wind farms to high-demand areas in Germany, thereby alleviating pressure on the congested lines under analysis. Additionally, 229 km of AC lines will either be newly commissioned or reinforced using high temperature low sag (HTLS) conductors by 2029, directly impacting the network elements analysed here. Notably, the 181 km long grid expansion project between Dörpen/West and Niederrhein, scheduled for completion by 2027, should be highlighted (NEP-ID: AMP-009 and TTG-007). Furthermore, a phase-shifting transformer at the Hanekenfähr site was commissioned in 2024 (NEP-ID: AMP-346)."
Is the CNE on a bidding zone border?	No

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Nordlink [5]										
380 kV-NordLink cable **[5]**	Congestions (100 % = 8760 MTU)	26 %	29 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name	Nordlink									
Assessment of the congestion in the three timeframes	Nordlink cable (itself) limited the cross-zonal capacity between DE and NO2 in some hours in D-2 because no internal network elements were congested. This also explains why significantly fewer congestions were reported in the subsequent timeframes.									
Expert indication on the main type of flows causing the congestion	Cross-border flow.									
Future evolution including ten-year scenario	Nordlink has a set capacity at a BZ border, and therefore any future congestions are not dimensioned in the NEP and shall be operated with a phase shift transformer to control.									
Is the CNE on a bidding zone border?	Yes, Norway									
Meeden/Diele [6]										
380 kV-Meeden–Diele MEED SW **[6]**	Congestions (100 % = 8760 MTU)	1 %	0 %	0 %	11.8 %	19.6 %	16.5 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		168 %	0 %						
380 kV-Meeden–Diele MEED WS **[6]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	14.4 %	12.9 %	16.5 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		81.3 %	0 %						
CNEs group name	Meeden/Diele									
Assessment of the congestion in the three timeframes	The congestions for Meeden/Diele happen in the D-1. Although they are parallel lines, they do not fully have the same congested hours due to changes in substation configurations happening over the year. This connection is strongly weather-dependent due to the location near offshore wind production, with direct wind infeed and infeed from the surrounding stations having a similar profile. The amount of hours congestion per year are strongly correlated with the wind profile in that year.									
Expert indication on the main type of flows causing the congestion	Internal flows and cross-border flows. The F values should be interpreted with caution as the hours where the constrains are active are rounded to 0 %.									
Future evolution including ten-year scenario	Future congestions can be controlled by using the phase shift transformers that are present at the substation. Furthermore, the Südlink (BBPIG 03, BBPIG 04), SüdOstlink (BBPIG 05, BBPIG 05a) and the other planned DC lines will have a significant effect on Meeden/Diele to reduce congested hours.									
Is the CNE on a bidding zone border?	Yes, the Netherlands									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Bergshausen/ Mecklar [7]										
380 kV-Bergshausen–Borken 2 **[7]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	18.3 %	11.7 %	11.5 %	0.9 %	0 %	1.93 %
380 kV-Borken–Bergshausen 1 **[7]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	15.2 %	9.88 %	11.4 %	0.48 %	0.03 %	0.64 %
380 kV-Mecklar–Dipperz 2 **[7]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	10.1 %	10.2 %	12.1 %	1.26 %	2.23 %	1.63 %
380 kV-Mecklar–Dipperz 1 **[7]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	7.63 %	10.6 %	12.5 %	1.4 %	3.82 %	1.39 %
CNEs group name	Bergshausen/Mecklar									
Assessment of the congestion in the three timeframes	The congestions for this area happen in D-1. They seem quite stable overloads but have different causes for being overloaded. This area is a very central line where flows go over from north to south depending on the weather profiles, east to west between German control areas, and it is affected by the constructions happening around it where some lines were switched off accordingly.									
Expert indication on the main type of flows causing the congestion	Internal flows.									
Future evolution including ten-year scenario	This area in the grid will be strengthened as can be reviewed in the German Investment Plan (NEP 2023) with P43/ BBPIG 17 (2031), P212/BBPIG 88 (2035), and P231/BBPIG 17 (2037).									
Is the CNE on a bidding zone border?	No									

Conneforde/Emden [8]										
220 kV-Conneforde–Y Emden/ O SCHWARZ **[8]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	27.4 %	13.0 %	0 %	5.82 %	0.26 %	0 %
220 kV-Conneforde–Y Emden/ O WEISS **[8]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	25.7 %	13.1 %	0 %	1.48 %	4.2 %	0 %
220 kV-Emden/O–Y Emden/ O SCHWARZ **[8]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	25.7 %	12.4 %	0 %	5.82 %	0.26 %	0 %
220 kV-Emden/O–Y Emden/ O WEISS **[8]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	19.1 %	13 %	0 %	1.48 %	0.3 %	0 %
CNEs group name	Conneforde/Emden									
Assessment of the congestion in the three timeframes	This congestion happened in D-1 and was caused by wind production. The grid was strengthened with project P69 and the high hours of congestions were solved due to the construction finishing.									
Expert indication on the main type of flows causing the congestion	Internal flows.									
Future evolution including ten-year scenario	The congestions have been resolved. In the future, the area will be further strengthened by P491 (2034).									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Rhine–Main [9, 17]										
380 kV-D7BUER D7LAMB BUERST W **[17]**	Congestions (100 % = 8760 MTU)	10.17	15.72	3.55	6.28	8.01	4.59	2.01	0.79	0.25
	F "mean share of capacity used up by non-allocated flows"		43.04	45.46						
380 kV-Urberach–Grosskrotzen-burg 2 **[9]**	Congestions (100 % = 8760 MTU)	0 %	1.2 %	1.21 %	6.99 %	13.5 %	11.3 %	0.22 %	0.35 %	1.11 %
	F "mean share of capacity used up by non-allocated flows"		0 %	70.8 %						
380 kV-Dettingen–Grosskrotzen-burg 1 **[9]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	6.77 %	13 %	10.8 %	0.32 %	0.97 %	0.46 %
	F "mean share of capacity used up by non-allocated flows"		54.8 %	49.7 %						
CNEs group name	Rhine-Main area									
Assessment of the congestion in the three timeframes	The congestions for this area happen mainly in D-1. This area is a very central line where flows go over from north to south depending on the weather profiles and demand profiles and east to west between German control areas. Most of the congestion in the German grid occurs when renewable energy generation is high in the northern regions and Germany exports electricity to the south (France, Switzerland, Austria). This pattern is also observed in the Rhine–Main area. Strong winds in Germany lead to substantial wind power feed-in, causing electricity prices to drop and resulting in increased exports. The reduction in nuclear power capacity in France – particularly in 2022 – has amplified exports and consequently heightened the strain on the grid elements under consideration. However, the increased availability of French nuclear energy combined with the reduced capacities of conventional power plants in Germany in 2023 has resulted in a shift from the exports to France seen in 2022 to imports from France to Germany in 2023. This shift has led to less congestion in the Rhine–Main region.									
Expert indication on the main type of flows causing the congestion	Internal flows. As most of the network elements under consideration only very rarely represent an active constraint in the CC for DA allocation, the consideration of the type of flows using the value shown for non-allocated flows should be treated with caution. In the very few hours of the year in which the elements are restrictive, less than half of the flows is accounted for by non-allocated (loop and internal) flows.									
Future evolution including ten-year scenario	This area of the grid will be strengthened through multiple grid building projects as can be reviewed in the German Investment Plan (NEP 2023). The projects are P161/BBPIG 66 from Amprion (2028), P475 (2032), P500 (2035), P471 (2037), P486 (2037), and the PST Gambach (2037). "A major influencing factor in the future is the continuing development of the grid as well as its increasingly efficient utilisation. The German TSOs continually review and optimise the planned grid expansion in the framework of the national grid development plan (Netzentwicklungsplan) to solve identified congestions in combination with innovative measures which help to increase the efficiency of the grid utilisation (e.g., dynamic line rating). By 2035, more than 2,500 km of new DC lines with a total capacity of 10 GW will be commissioned, related to the analysed elements (NEP-IDs: DC2, DC3, DC4, DC34, DC35). These lines will primarily transport electricity generated by renewables from northern to southern Germany, thereby alleviating pressure on the congested lines under analysis. Additionally, over 420 km of AC lines will either be newly commissioned or reinforced using high temperature low sag (HTLS) conductors by 2031, directly affecting the network elements analysed here. This will result in an increase in the voltage level of many lines in the region from 220 kV to 380 kV. Specifically, for the congested line BUERST W, the two grid expansion projects between Bürstadt and Hoheneck (NEP-ID: P310) as well as between Bürstadt and Kühmoos (NEP-ID: AMP-P310) will help reduce future congestion. For the other two analysed elements (Urberach–Grosskrotzenburg and Dettingen–Grosskrotzenburg), the reinforcement of the line between Grosskrotzenburg and Dettingen using HTLS conductors (NEP-ID: P161), as well as the newly constructed line between Aschaffenburg and Urberach (NEP-ID: P500), are particularly noteworthy."									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Büttel – Brunsbüttel [10]										
380 kV-Büttel–Brunsbüttel BUTL BL **[10]**	Congestions (100 % = 8760 MTU)	23 %	3 %	2 %	1.27 %	0.01 %	0 %	0.41 %	0 %	0.05 %
CNEs group name	Büttel/Brunsbüttel									
Assessment of the congestion in the three timeframes	After 2021, this CNE limited cross-zonal capacity less frequently in D-2 due to the introduction of the 380 kV substation Stade/West close by. The substation increased the transmission capacity of the grid in close proximity to this CNE. In D-1, congestions that occurred were caused by wind production. This line has a direct connection to the Sylwin and Helwin offshore wind parks and is also affected by exchanges over Baltic cable and Nordlink.									
Expert indication on the main type of flows causing the congestion	Internal flows.									
Future evolution including ten-year scenario	In 2024, a phase shift transformer (PST) was placed in Krempermarsch to further resolve this congestion. Further strengthening of this area will happen by P26/BBPIG 50 (2030).									
Is the CNE on a bidding zone border?	No									
Lubmin/Wikinger [11]										
220 kV-Arkona Becken/Südost–Lubmin 261 **[11]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	19.7 %	19.5 %	25.4 %	0 %	0 %	0 %
220 kV-Lubmin–Wikinger 282 **[11]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	17.8 %	18.1 %	24.3 %	0 %	0 %	0 %
220 kV-Wikinger–Arkona-Becken/Südost 265 **[11]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	16.2 %	19.1 %	24.4 %	0 %	0 %	0 %
220 kV-Wikinger–Lubmin/281 **[11]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	17.8 %	17.02	24.5 %	0 %	0.02 %	0 %
CNEs group name	Offshore wind parks									
Assessment of the congestion in the three timeframes	These offshore power lines were mainly overloaded in the D-1 timeframe, with a slight increase in the number of congested time frames over recent years. No further assessment of these grid elements is provided because they are not relevant for this analysis, as they only transport offshore wind and do not fundamentally affect the flow in the grid.									
Expert indication on the main type of flows causing the congestion	Since these lines connect offshore wind farms to the mainland, the flows can be considered internal flows.									
Future evolution including ten-year scenario	No further assessment of these grid elements is provided because they are not relevant for this analysis, as they only transport offshore wind and do not fundamentally affect the flow in the grid.									
Is the CNE on a bidding zone border?	No									
Vierraden– Pasewalk [12]										
220-kV-Vierraden–Pasewalk 306 **[12]**	Congestions (100 % = 8760 MTU)	27.4 %	18.1 %	3.78 %	16.1 %	12.3 %	20.2 %	1.08 %	1.70 %	2.71 %
	F "mean share of capacity used up by non-allocated flows"		60.1 %	64.2 %						
CNEs group name										
Assessment of the congestion in the three timeframes	This is a stub line to the Polish TSO PSE on an old 220 kV system. Congestion on this line can mainly be attributed to high wind feed-in. While the number of congested time intervals has significantly decreased over the years for the D-2 timeframe, a slight upward trend can be observed for D-1.									
Expert indication on the main type of flows causing the congestion	A detailed examination is beyond the scope of this analysis. However, it should be noted that loop flows to Poland are explicitly avoided through the use of phase shifting transformers in this region. Moreover, note that the provided F-value should be treated with caution as it only refers to time intervals with active constraints.									
Future evolution including ten-year scenario	This specific grid element is now permanently out of service. Please note that load flows in the region will be strongly influenced by the overall commissioning of the reinforced and expanded Uckermark line at the beginning of 2025, after some sections of the line already entered into operation last year and this year, respectively. The line enables wind energy to be transported from northern Germany and is also important for the energy transition at a European level thanks to its connection to the Vierraden substation and the interconnector there with Krajnik in Poland.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Kontek [13]										
KONTEK/KF CGS **[13]**	Congestions (100 % = 8760 MTU)	36.6 %	27.4 %	38.0 %	0 %	0 %	0 %	11.7 %	16.7 %	19.7 %
CNEs group name										
Assessment of the congestion in the three timeframes	KONTEK is a submarine HVDC cable that connects Germany and Denmark and should be assessed together with the Kriegers Flak Combined Grid Solution. The high numbers of congested time intervals for D-2 and close to real time (with an increasing trend for the latter) should be interpreted with caution for the following reasons. As this is a coupling via NTC, the full capacity of the submarine cable is often utilised by the market. In this respect, this should not be treated as a congestion but simply as a full utilization of the network element. In addition, the connection is often used as a tool for congestion management in the course of counter-trading during close to real time.									
Expert indication on the main type of flows causing the congestion	Flows on the KONTEK cable can be defined 100 % as cross-border flows.									
Future evolution including ten-year scenario	The ambitious goals for offshore development in the Nordic and Baltic Sea will likely influence flows on the KONTEK cable in the next years. Most importantly, Bornholm Energy Island – an innovative new hybrid offshore interconnection between the Danish Zealand, the Danish Island of Bornholm, and Germany – is planned to be established by 2032. Bornholm Energy Island is intended both as an interconnection between the two countries, as well as an integrator of 2 GW of offshore wind farm capacity. Furthermore, the planned shortening of the gate closure time will affect counter-trading during close to real time.									
Is the CNE on a bidding zone border?	Yes									
Interconnectors Czech Republic [14]										
380-kV-Röhrsdorf–Hradec 445 **[14]**	Congestions (100 % = 8760 MTU)	0.19 %	1.67 %	3.40 %	0.20 %	3.35 %	8.72 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		35.1 %	58.7 %						
380-kV-Röhrsdorf–Hradec 446 **[14]**	Congestions (100 % = 8760 MTU)	0.19 %	2.39 %	3.70 %	0.19 %	3.35 %	8.71 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		35.6 %	53.1 %						
CNEs group name	Interconnectors to Czech Republic									
Assessment of the congestion in the three timeframes	Congestion on these grid elements mainly occurred in the D-2 and D-1 timeframe, showing an increasing trend over the years. In real time, export and import flows are regulated by phase shifting transformers, which is not considered in DACF. Due to these PSTs, one can consider the congestions as comparably less severe.									
Expert indication on the main type of flows causing the congestion	The load flows are cross-border flows, transit flows and loop flows. A detailed examination is beyond the scope of this analysis. Note that the F-value provided should be treated with caution as it only refers to time intervals with active constraints.									
Future evolution including ten-year scenario	The existing double-circuit 400 kV line will be reinforced on the CZ side. This project contributes to maintaining reliable supply for domestic demand in case of power shortage in the Czech Republic, using imports from surplus generation in the north of Germany.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Interconnectors Poland [15, 16]										
380 kV-Krajnik–Vierraden 508 **[15]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	2.78 %	0.73 %	0.04 %	0.13 %	0 %	0 %
380 kV-Krajnik–Vierraden 507 **[15]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	1.55 %	0.07 %	0.28 %	0.07 %	0 %	0 %
380 kV-Hagenwerder–Mikulowa 567 **[16]**	Congestions (100 % = 8760 MTU)	0.37 %	0.07 %	0 %	0.11 %	0 %	0.06 %	0 %	0 %	0 %
380 kV-Hagenwerder–Mikulowa 568 **[16]**	Congestions (100 % = 8760 MTU)	0.07 %	0.02 %	0 %	0.01 %	0 %	0.06 %	0 %	0 %	0 %
CNEs group name	Interconnectors to Poland									
Assessment of the congestion in the three timeframes	The grid elements 507 and 508 are parts of a double-circuit power line that is operated alternately. Congestions on these lines mainly occurred in the D-1 timeframe in 2021.									
Expert indication on the main type of flows causing the congestion	The load flows are cross-border flows, transit flows and loop flows. A detailed examination is beyond the scope of this analysis.									
Future evolution including ten-year scenario	Load flows in the region will be strongly influenced by the overall commissioning of the reinforced and expanded Uckermark line at the beginning of 2025, after some sections of the line already entered into operation last year and this year, respectively. The line enables wind energy to be transported from northern Germany and is also important for the energy transition at a European level thanks to its connection to the Vierraden substation and the interconnector there with Krajnik in Poland.									
Is the CNE on a bidding zone border?	Yes									
Interconnectors France [18]										
380 kV D7ENSD XEN_VI VIGY2 S **[18]**	Congestions (100 % = 8760 MTU)	8.37 %	1.30 %	19.7 %	2.23 %	1.05 %	11.3 %	0.08 %	0.21 %	0.10 %
			7.82 %	14.0 %						
380 kV XEN VI D7ENSD VIGY1 N **[18]**	Congestions (100 % = 8760 MTU)	0.82 %	0.66 %	2.82 %	2.02 %	0.95 %	10.4 %	0.27 %	0.32 %	0.38 %
	F "mean share of capacity used up by non-allocated flows"		1.59 %	15.1 %						
CNEs group name	Interconnector DE–FR									
Assessment of the congestion in the three timeframes	In 2021 and 2022, the congestions of the so-called Vigy line were low for all timeframes. Due to nuclear power being more available in 2023 on the French side and reduced conventional power in Germany at the same time, imports from France to Germany increased especially during hours with low renewable electricity generation in Germany. Thereby, congestions of the Vigy line increased in D-2 and D-1 in 2023. Congestions in the RT timeframe were very low in all years (<0.4 %).									
Expert indication on the main type of flows causing the congestion	The share of non-allocated flows increased from 2022 to 2023 but remain at a low level.									
Future evolution including ten-year scenario	A major influencing factor in the future is the continuing development of the grid as well as its increasingly efficient utilisation. The German TSOs continually review and optimise the planned grid expansion in the framework of the national grid development plan (Netzentwicklungsplan) to solve identified congestions in combination with innovative measures that help to increase the efficiency of the grid utilisation (e.g., dynamic line rating). Besides the planned commissioning of 34 km reinforced AC lines using high-temperature low sag (HTLS) conductors until 2030 between Uchtelfangen and the DE–FR border (NEP-ID: AMP-P170), a phase-shifting transformer will be installed at the Ensdorf site by 2031 (NEP-ID: P314). Thereby, the analysed congestions will be reduced.									
Is the CNE on a bidding zone border?	Yes									

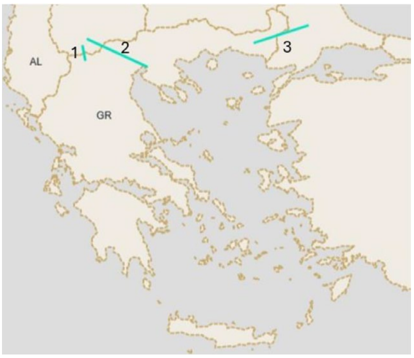
		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Interconnectors Austria [19, 20]										
220 kV XWE_VO D7VOEH FUESSN W **[19]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0 %	0.12 %	0.78 %	0 %	0 %	0.13 %
	F "mean share of capacity used up by non-allocated flows"		42.7 %	37.3 %						
220 kV XWE_WB D73YWB DELLM O **[20]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.63 %	0.16 %	0 %	0.06 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		0 %	0 %						
380 kV D7LEUP XWE LE FUESSN O **[19]**	Congestions (100 % = 8760 MTU)	0 %	0.13 %	0.01 %	0 %	0.05 %	0 %	0 %	0.05 %	0.05 %
	F "mean share of capacity used up by non-allocated flows"		21.3 %	36.8 %						
CNEs group name	Interconnectors DE–AT									
Assessment of the congestion in the three timeframes	This border is mainly affected by the transit across Germany and Austria. In particular, in conjunction with high solar feed-in in Bavaria, the Pirach–Simbach–Altheim–Pleinting–St. Peter lines were congested. Any congestion remaining or appearing close to real time is mainly handled by feed-in management, which can only be activated very close to real time. The elements show congestions at a very low level (<0.8 %) across all years and timeframes analysed.									
Expert indication on the main type of flows causing the congestion	As the network elements under consideration only very rarely represent an active constraint in the CC for DA allocation, the consideration of the type of flows using the value shown for non-allocated flows should be treated with caution. In the few hours per year where the analysed elements are active constraints in CC for DA allocation, accounted flows make up the majority of occurring flows on these elements.									
Future evolution including ten-year scenario	A major influencing factor in the future is the continuing development of the grid as well as its increasingly efficient utilisation. The German TSOs continually review and optimise the planned grid expansion in the framework of the national grid development plan (Netzentwicklungsplan (NEP)) to solve identified congestions in combination with innovative measures that help to increase the efficiency of the grid utilisation (e.g., dynamic line rating). More than 350 km of AC lines will be newly commissionedor reinforced by 2030,located close to the DE–AT border and thus helping to support the cross-border flows. Of particular note is the renewal of the 110 km line from Vöhringen to the border with Austria by 2030, which involves a changeover from 220 to 380 kV (NEP-ID: P74).									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Interconnectors Switzerland [21, 22]										
220 kV XBE TI D7TIEN AARE O **[21]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0.16 %	0.07 %	0.02 %	0.31 %	0 %	0.05 %	0 %
	F "mean share of capacity used up by non-allocated flows"		0 %	9.09 %						
380 kV XLA_TI D7TIEN ANDLSB **[22]**	Congestions (100 % = 8760 MTU)	0 %	0.07 %	0 %	0 %	0.02 %	0 %	0 %	0.03 %	0 %
	F "mean share of capacity used up by non-allocated flows"		44.4 %	0 %						
220 kV XBE TI D7TIEN AARE W **[21]**	Congestions (100 % = 8760 MTU)	0 %	0.03 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		19.9 %	0 %						
CNEs group name	Interconnectors DE–CH									
Assessment of the congestion in the three timeframes	This border is mainly affected by the transit across Germany and Switzerland. In particular, in conjunction with high solar feed-in in southern Germany, the Aare Ost and West lines as well as Andelsbach between Tiengen and Switzerland were congested. The elements show congestions at a very low level (<0.4 %) across all years and timeframes analysed.									
Expert indication on the main type of flows causing the congestion	As the network elements under consideration only very rarely represent an active constraint in the CC for DA allocation, the consideration of the type of flows using the value shown for non-allocated flows should be treated with caution. In the very few hours of the year in which the elements are restrictive, the largest proportion of flows is accounted for by accounted flows.									
Future evolution including ten-year scenario	A major influencing factor in the future is the continuing development of the grid as well as its increasingly efficient utilisation. The German TSOs continually review and optimise the planned grid expansion in the framework of the national grid development plan (Netzentwicklungsplan (NEP)) to solve identified congestions in combination with innovative measuresthat help to increase the efficiency of the grid utilisation (e.g., dynamic line rating). Two relevant grid expansion projects from the NEP regarding the analysed interconnectors between Germany and Switzerland are the newly built switchgear at the Kühmoos site until 2032 (NEP-ID: TNG-P428) and the 35 km long renewal of the line between Kühmoos and the border to Switzerland until 2035 (NEP-ID: P204).									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
Interconnectors Netherlands- Maasbracht [23]		2021	2022	2023	2021	2022	2023	2021	2022	2023
380 kV XOB_MB D7OBZI SELFK WS **[23]**	Congestions (100 % = 8760 MTU)	0.62 %	2.97 %	3.71 %	0.06 %	0.39 %	0.58 %	0.02 %	0.25 %	0.09 %
	F "mean share of capacity used up by non-allocated flows"		4.96 %	17.1 %						
380 kV XSI_MB D7SIER SELFK SW **[23]**	Congestions (100 % = 8760 MTU)	0.43 %	0.83 %	2.23 %	0.04 %	0.24 %	0.28 %	0 %	0.09 %	0.05 %
	F "mean share of capacity used up by non-allocated flows"		6.42 %	15.1 %						
CNEs group name	Interconnectors DE–NL Maasbracht									
Assessment of the congestion in the three timeframes	In general, the congestions of the analysed interconnectors are low for all three timeframes and all years. Especially in D-1 and C2RT, the congestions are very low (<0.6 % and <0.3 %).									
Expert indication on the main type of flows causing the congestion	As the network elements under consideration only rarely represent an active constraint in the CC for DA allocation, the consideration of the type of flows using the value shown for non-allocated flows should be treated with caution. In the very few hours of the year in which the elements are restrictive, the largest proportion of flows are accounted flows with a slight trend towards non-allocated flows.									
Future evolution including ten-year scenario	A major influencing factor in the future is the continuing development of the grid as well as its increasingly efficient utilisation. The German TSOs continually review and optimise the planned grid expansion in the framework of the national grid development plan (Netzentwicklungsplan (NEP)) to solve identified congestions in combination with innovative measures that help to increase the efficiency of the grid utilisation (e.g., dynamic line rating). Regarding the analysed interconnectors between Germany and the Netherlands, two grid expansion projects in the Rhineland are worth mentioning. A 16 km long replacement construction between Blatzheim and Oberzier until 2027 will strengthen transmission capacities to the neighbouring countries, among other things (NEP-ID: AMP-P347). Furthermore, a PST that will be put into operation at the Oberzier site in 2024 (NEP-ID: P200) will help to control the flows at the analysed border, especially after the PST is switched to the analysed circuit (SELFK WS and SELFK SW), which is made possible due to the previously mentioned project.									
Is the CNE on a bidding zone border?	Yes									

Greece

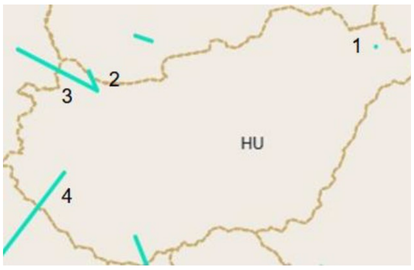
There are three groups of CNEs analysed by Greece.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400 kV-Bitola–Meliti **[1]**	Congestions (100 % = 8760 MTU)	0 %	2.9 %	8.8 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name	400 kV-Bitola–Meliti									
Assessment of the congestion in the three timeframes	In 2022, commercial congestions appeared on Greek imports for DA, the vast majority during April–May and December. In 2023, congestions appeared on Greek imports, the vast majority until June.									
Expert indication on the main type of flows causing the congestion	Only commercial congestion appeared in the DA timeframe for Greek imports for 2022, 2023									
Future evolution including ten-year scenario	The operation of the second line between GR–BG since July 2023 has led to a significant decrease in active constraints.									
Is the CNE on a bidding zone border?	Yes									
400 kV-Dubrovo–Thessaloniki **[2]**	Congestions (100 % = 8760 MTU)	0 %	1.7 %	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name	400 kV-Dubrovo–Thessaloniki									
Assessment of the congestion in the three timeframes	In both 2022 and 2023, the Dubrovo–Thessaloniki tie line was commercially congested for a relatively low number of hours.									
Expert indication on the main type of flows causing the congestion	The Dubrovo–Thessaloniki tie line was commercially congested mainly when the Bitola–Meliti tie line was out for maintenance purposes.									
Future evolution including ten-year scenario										
Is the CNE on a bidding zone border?	Yes									
400 kV-Babaeski–Nea Santa **[3]**	Congestions (100 % = 8760 MTU)	0 %	0.7 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name	400 kV-Babaeski–Nea Santa									
Assessment of the congestion in the three timeframes, and is there a specific, identifiable, cause of the congestion?	In 2022, the Nea Santa–Babaeski tie line was commercially congested for a relatively low number of hours.									
Expert indication on the main type of flows causing the congestion	The identified commercial congestions on the Babaeski–Nea Santa tie line are related to Greek imports.									
Future evolution including ten-year scenario	A second line between Greece and Turkey will be developed, which will further increase cross-border trading between the two countries.									
Is the CNE on a bidding zone border?	Yes									

Hungary

There three groups of CNEs in Hungary.

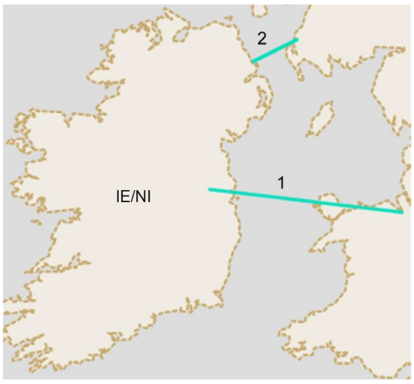


		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
750/400 kV Szabolcsbáka transformer **[1]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	N/A	9.26 %	29.0 %	N/A	11.5 %	18.8 %
CNEs group name	750 kV connection between HU–UA									
Assessment of the congestion in the three timeframes	Congestion is mostly visible D-1 and close to real time because the congestions are usually managed with topological interventions. On borders such as UA–HU, where long-term NTC allocation is challenged by changing flow direction situations, congestions there closer to real time can be solved. The 2023 congestion close to real time indicates an increasing challenge to solve expected overload.									
Expert indication on the main type of flows causing the congestion	The relevant part of the west–east and east–west electricity transmission between continental Europe and Ukraine is via 750/400 kV Szabolcsbáka transformer. In addition, scheduled transport at other borders also has an impact on transformer load conditions because the transformer provides the strongest connection in the region. For these reasons, it is classified as a transit flow.									
Future evolution including ten-year scenario	The establishment of new non-HU-UA cross-border transmission lines in the future would reduce the role of the 750/400 kV Szabolcsbáka transformer in the realisation of transit flows.									
Is the CNE on a bidding zone border?	Yes									
400 kV-Hévíz–Zerjavinec **[4]**	Congestions (100 % = 8760 MTU)	9.90 %	4.35 %	0 %	N/A	0 %	0 %	N/A	0 %	0 %
CNEs group name	Hévíz–Zerjavinec (HR–HU)									
Assessment of the congestion in the three timeframes	By 2023, congestion had completely disappeared due to topological improvements. Hévíz–Zerjavinec's role in transit decreased with the development of the new HU–HR–SI network connection.									
Expert indication on the main type of flows causing the congestion	Due to the geographical location of the line, it still plays an important role in both north–south and south–north transit, and therefore it is considered as a transit flow.									
Future evolution including ten-year scenario	No remaining congestions are expected.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220 kV-Győr–Wien SO **[3]**	Congestions (100 % = 8760 MTU)	9.93 %	4.11 %	0.01 %	N/A	0 %	0 %	N/A	0 %	1.93 %
	F "mean share of capacity used up by non-allocated flows"	N/A	15.3 %	11.4 %						
400 kV-Győr–Gabcikovo **[2]**	Congestions (100 % = 8760 MTU)	8.7 %	4.36 %	0.02 %	N/A	0 %	0 %	N/A	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"	N/A	20.3 %	17.8 %						
CNEs group name	Győr substation-related CNECs (AT–HU, SK–HU)									
Assessment of the congestion in the three timeframes	By introducing the flow-based capacity allocation methodology in June 2022, the frequency of contingencies has decreased due to simultaneous consideration of AT–HU and SK–HU cross-effects. No congestions occur as a result of the DA market coupling process approaching real time. In 2023, close to real time, transmission line load capacity and capacity calculation limit are assumed by experts to be presumably not consistent all of the time.									
Expert indication on the main type of flows causing the congestion	Due to the geographical location of the lines, they play a major role in the transit, and therefore it is considered as a transit flow.									
Future evolution including ten-year scenario	The congestions related to AT–HU and SK–HU cross-border lines are expected to remain in the medium-term time horizon. These results are from congestions in the Austrian 220 kV and Slovakian grids. Looking over a longer horizon, it can be concluded that only partial remaining congestions are expected on the AT–HU cross-border lines. HU–SK congestions are expected to improve due to Slovakian internal investments and the new Sajóivánka-R. Sobotá second circuit cross-border line (by the end of 2027).									
Is the CNE on a bidding zone border?	Yes									

Ireland and Northern Ireland

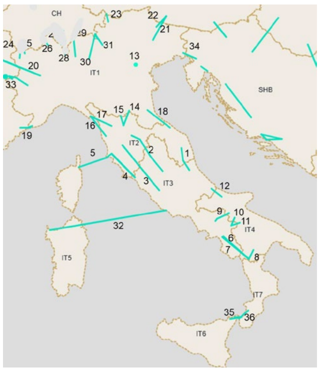
There are two CNEs in Ireland and Northern Ireland.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV-EWIC HVDC Interconnector **[1]**	Congestions (100 % = 8760 MTU)	4.42 %	25.36 %	7.55 %	0 %	0 %	0 %	0 %	0 %	0 %
250-kV-Moyle HVDC Interconnector **[2]**	Congestions (100 % = 8760 MTU)	6.98 %	28.29 %	12.14 %	0 %	0 %	0 %	0 %	0 %	0 %
Is the CNE on a bidding zone border?	On the border between the Ireland/Northern Ireland synchronous area and Great Britain synchronous area									
CNEs group name	SEM–GB HVDC Interconnectors									
Assessment of the congestion in the three timeframes	The SEM on the island of Ireland and the BETTA market arrangement in Great Britain are not coupled at the DA stage. Scheduled flows on the HVDC interconnectors are set by the intra-day market gate closures. The scheduled flows do not change from IDA schedules to different flows at real time unless the TSOs countertrade for security or priority dispatch on market firm schedules. Net transfer capacity can be reduced at times for adequacy reasons to prevent interconnector flows that are likely to cause either or both Ireland/Northern Ireland to enter a system alert (amber) state ormitigate the severity of a probable system alert (amber) or system emergency (red) state in either jurisdiction. This is the driving cause for the level of NTC reduction observed in 2022. The cause of congestion after market allocation is the price differential between the SEM and the BETTA market arrange-ment in Great Britain 'fill up' the two HVDC interconnectors, usually Moyle first as it hasfewer losses.									
Expert indication on the main type of flows causing the congestion	Cross-border flows between two markets around HVDC interconnectors.									
Future evolution including ten-year scenario	A third HVDC interconnector (Greenlink)is due to be commercial in early 2025. A new HVDC Interconnector planned from Ireland to France is expected to be completed by 2026. The UK energy regulator Ofgem has approved two additional HVDC interconnectors, 700 MW LirIC between Scotland and Northern Ireland and 750 MW Mares Connect between Wales and Ireland.									

Italy

There are eleven groups of CNEs in Italy.



CSUD–CNOR (IT3–IT2)

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220 kV ABBADIA NK–ROSARA NK **[1]**	Congestions (100% = 8760 MTU)	4.92%	3.52%	0.90%	0%	0%	0%	0%	2.17%	0%
220 kV AREZZO C–PIETRAFITTA 220 **[2]**	Congestions (100% = 8760 MTU)	10.5%	2.18%	0.31%	0%	0%	0%	0%	0%	0%
220 kV AREZZO C–S.BARBARA **[2]**	Congestions (100% = 8760 MTU)	12.1%	0.13%	0.72%	0%	0%	0%	0%	0.01%	0.10%
220 kV PIETRAFITTA 220–VILLAVALLE **[2]**	Congestions (100% = 8760 MTU)	8.98%	0.54%	0.70%	0%	0%	0%	0%	0.02%	0%
ATR 380/220 kV S.GIACOMO SE **[1]**	Congestions (100% = 8760 MTU)	1.24%	0%	0.92%	3.64%	1.67%	1.32%	0%	0%	0%
380 kV PIAN DELLA SPERANZA–ROMA NORD **[3]**	Congestions (100% = 8760 MTU)	0.32%	0.02%	0.09%	0.10%	0%	0%	1.26%	4.78%	3.23%
380 kV SUVERETO–MONTALTO **[4]**	Congestions (100% = 8760 MTU)	0%	0%	0%	0.31%	0%	0%	0%	0%	0.20%
CNEs group name	CSUD–CNOR									
Assessment of the congestion in the three timeframes	AllCNECs are connected to the flows between the CSUD and CNORD internal BZs. Higher values in D2CC because the CNECs represent the limiting elements during the capacity calculation in the DA timeframe, between the CSUD and CNORD BZs whenever a saturation of the transit limit occurs. The separation between zones allows congestions to already be intercepted in phase D-2, so the values in D-1 are lower. The reductions in the percentages for years 2022 and 2023 are thank to improvements made on the conductors. Furthermore, since 2022 SELENE (the GRIT's RCC) has managed the new daily capacity calculation process, which has brought an improvement to this forecasting phase. For the ATR S. GIACOMO CNEC, the higher values for the transformer are only in D-1 timeframe due to the equivalent lower grid in the forecasting model. Indeed, we observe very low values for the real-time timeframe.									
Expert indication on the main type of flows causing the congestion	Cross-border flow.									
Future evolution including ten-year scenario	Adriatic HVDC link/Central Link The Adriatic Link is a new HVDC submarine cable link between Villanova and Fano that should be ready for 2027. The Central Link is part of the "Hypergrid Project", involving reinforcement of 220 kV S.Barbara–Villavalle with 5F high capacity overhead lines (2027–2030).									
Is the CNE on a bidding zone border?	Yes									

SARD (IT5)

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
SACOI link **[5]**	Congestions (100% = 8760 MTU)	28.7%	0%	0%	0%	0%	0%	0%	0%	0%
SAPEI link **[32]**	Congestions (100% = 8760 MTU)	1.1%	0%	0%	0.27%	0%	0%	0.02%	0.13%	0.09%
CNEs group name	SARD									
Assessment of the congestion in the three timeframes	These elements are the HVDC connections between Sardinia and the rest of Italy. Higher values in 2021 are due to saturation on the SARD–CNOR border in the DA timeframe, while the clear decrease in 2022 and 2023 is due to the increase of RES share in Italy and the changes in the amount of flows between the island and the rest of Italy.									
Expert indication on the main type of flows causing the congestion	Cross-border flow.									
Future evolution including ten-year scenario	SACOI3 The SACOI3 project comprises the repowering of existing HVDC link betweenmainland Italy, Corsica, and Sardinia (2027).									
Is the CNE on a bidding zone border?	Yes									

SICI–CALA (IT6–IT7)

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
380 kV PARADISO–BOLANO **[35]**	Congestions (100% = 8760 MTU)	0.78%	0.79%	6.40%	2.11%	0%	0.92%	0%	0.02%	0%
380 kV RIZZICONI–BOLANO **[36]**	Congestions (100% = 8760 MTU)	17.18%	0%	0.02%	0.07%	0%	0%	0%	0%	0%
380 kV SORGENTE–PARADISO **[35]**	Congestions (100% = 8760 MTU)	12.92%	0%	0%	2.42%	0%	0.95%	0%	0%	0%
ATR 380/220 kV SORGENTE **[35]**	Congestions (100% = 8760 MTU)	26.64%	0.15%	3.26%	0.09%	0.05%	0%	0%	0%	0%
380 kV VILLAFRANCA TIRRENA–SCILLA **[36]**	Congestions (100% = 8760 MTU)	0.30%	0%	0%	0%	0%	0%	0.01%	0%	0%
CNEs group name	These lines connectSicilyto the rest of Italy.									
Assessment of the congestion in the three timeframes	There are higher values in D2CC because the CNECs represent the limiting elements during the capacity calculation in the DA timeframe between the SICI and CALA BZs whenever a saturation of the transit limit occurs. The separation between zones allows congestions to already be intercepted in phase D-2, so the values in D-1 are lower. The reductions of the percentages for 2022 and 2023 are thanks to improvements made to the conductors. Furthermore, since 2022 SELENE (the GRIT's RCC) manages the new daily capacity calculation process, which has brought an improvement to this forecasting phase.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario	HVDC Thyrrenian Corridor The Tyrrenian Corridor is part of the Hypergrid Project. For the SICI,CALA, SUD, and CSUD areas, it comprises a new HVDC overhead/submarine cable between Priolo, Rossano,Montecorvino, and Latina.									
Is the CNE on a bidding zone border?	Yes									

SUD–CALA (IT4–IT7)

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
ATR 380/220 kV MONTECORVINO **[7]**	Congestions (100 % = 8760 MTU)	0.10 %	0.62 %	0.10 %	6.30 %	5.45 %	0.45 %	0 %	0.64 %	1.57 %
220 kV LAINO–TUSCIANO **[6]**	Congestions (100 % = 8760 MTU)	1.04 %	0 %	0 %	0 %	0 %	0 %	0.11 %	0.12 %	0.29 %
380 kV ALIANO–LAINO **[8]**	Congestions (100 % = 8760 MTU)	0.07 %	0.08 %	0.05 %	0.30 %	0 %	0 %	0 %	0.97 %	0 %
380 kV LAINO–MONTECORVINO **[7]**	Congestions (100 % = 8760 MTU)	0.94 %	0 %	0.01 %	1.71 %	0 %	0 %	0.01 %	0.04 %	0 %
CNEs group name	SUD-CALA All five CNECs are connected to the flows betweenthe SUD and CALA (Calabria region) internal BZs									
Assessment of the congestion in the three timeframes	In this BZs, no particular trends are highlighted among the three years or three timeframes. High values of transformers are only in the D-1 timeframe due to the equivalent lower grid in the forecasting model. Indeed, it is possible to observe very low values for the real-time timeframe.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario	HVDC Thyrrenian Corridor/Aliano–Tito–Montecorvino/Southern Italy – The Tyrrenian Corridor is part of the Hypergrid Project. For the SICI, CALA, SUD, and CSUD area, it comprisesa new HVDC overhead/submarine cable between Priolo, Rossano, Montecorvino, and Latina (2027). – The Southern Italy project will include the 400 kV substations of M.Corvino, Avellino, Benevento and Laino–Altomonte.									
Is the CNE on a bidding zone border?	Yes									

SUD–CSUD (IT4–IT3)

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
380 kV BENEVENTO 2–BENEVENTO 3 **[9]**	Congestions (100 % = 8760 MTU)	1.61 %	2.24 %	0.11 %	3.77 %	1.85 %	0.07 %	0 %	0.78 %	2.48 %
380 kV BENEVENTO 3–TROIA 380 **[9]**	Congestions (100 % = 8760 MTU)	1.27 %	0 %	0 %	0.50 %	0.06 %	0 %	0 %	0 %	0.47 %
380 kV BISACCIA 380–DELICETO **[10]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0 %	0.01 %	0.18 %	0 %	0 %	0 %
380 kV GISSI–LARINO **[12]**	Congestions (100 % = 8760 MTU)	1.24 %	1.37 %	0.02 %	0.75 %	0.08 %	0.05 %	0.16 %	0 %	0.26 %
380 kV MELFI 380–BISACCIA 380 **[11]**	Congestions (100 % = 8760 MTU)	0.90 %	0 %	0 %	0.05 %	0 %	0 %	0.09 %	0 %	0 %
CNEs group name	All five CNECs are connected to the flows between the SUD and CSUD internal BZs									
Assessment of the congestion in the three timeframes	The values on the 380 kV Benevento2–Benevento3 line are connected to the flows on the SUD–CSUD section and are due to both the high concentration of RES in that area andthe deviations of the physical flows compared to the forecasted flows.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario	Basilicata–Campania reinforcement/Southern Italy – Basilicata and Campania reinforcement is a project that involves a new 400 kV OHLs between Montecorvino–Avellino N. –Benevento and Benevento Nord. – The Southern Italy project will include the 400 kV substations of M.Corvino, Avellino, Benevento, and Laino–Altomonte. Both projects involve the SUD and CSUD areas, aiming to increase the exchange capacity between these two zones.									
Is the CNE on a bidding zone border?	Yes									

NORD

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
ATR 380/132 kV DUGALE **[13]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	2.04 %	7.24 %	0 %	0 %	0 %	0 %
ATR 380/220 kV LEYNI **[20]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.06 %	0 %	23.1 %	0 %	0 %	0 %
ATR 380/220 kV RONDISSONE **[20]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0.11 %	0 %	0.01 %	32.3 %	0 %	0 %	0 %
CNEs group name	NORD Allelements belong to a high load area, located in Italy's northern region.									
Assessment of the congestion in the three timeframes	High values of transformers only in the D-1 timeframe due to equivalent lower grid in forecasting model. Indeed, it is possible to observe very low values in the real-time timeframe.									
Expert indication on the main type of flows causing the congestion	Internal flow									
Future evolution including ten-year scenario										
Is the CNE on a bidding zone border?	No									

NORD–CNOR (IT1–IT2)

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
380 kV BARGI–CALENZANO **[15]**	Congestions (100 % = 8760 MTU)	4.18 %	0.41 %	1.92 %	2.69 %	0.07 %	0.47 %	0 %	0.01 %	0 %
220 kV CALENZANO–S.BENEDETTO QUERCETO **[14]**	Congestions (100 % = 8760 MTU)	1.03 %	0.17 %	0.75 %	0 %	0 %	0 %	5.40 %	0 %	0.05 %
380 kV ACCIAIOLO–SPEZIA STAZIONE **[16]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.11 %	0 %	0.02 %	0 %	0 %	0 %
380 kV FORLÍ–FANO E.T. **[18]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.05 %	0 %	0 %	0 %	0 %	0 %
380 kV MARGINONE–SPEZIA STAZIONE **[17]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.54 %	0 %	0 %	0.01 %	0 %	0.04 %
CNEs group name	NORD–CNOR All five CNECs are connected to the flows between theNORD and CNOR internal BZs.									
Assessment of the congestion in the three timeframes	The values on the 380 kV Bargi–Calenzano line are linked to the transit on the NORD–CNOR border: for this reason, the higher values observed for 2021 are due to higher flows between the two BZs. During the observed period, the line underwent improvements on the conductor and this explains the reduction over the three years.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario	– HVDC Adriatic Corridor Hypergrid Project: New HVDC overhead/submarine cable between Foggia–Villanova–Fano–Forlì – HVDC North Thyrrenian Corridor Hypergrid Project: new HVDC overhead/submarine cable between Montalto and Codogno									
Is the CNE on a bidding zone border?	Yes									

CH–ITA

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220 kV VALPELLINE–RIDDES **[25]**	Congestions (100 % = 8760 MTU)	2.34 %	3.82 %	6.99 %	0 %	0 %	0 %	0 %	0.03 %	0.09 %
380 kV Sils–Soazza **[29]**	Congestions (100 % = 8760 MTU)	0.40 %	4.94 %	8.02 %	0 %	0 %	0 %	0 %	0.05 %	0.30 %
380 kV BULCIAGO–SOAZZA **[29]**	Congestions (100 % = 8760 MTU)	9.35 %	5.98 %	8.42 %	0.94 %	0.05 %	0.10 %	0 %	0 %	0 %
380 kV MUSIGNANO–LAVORGO **[27]**	Congestions (100 % = 8760 MTU)	8.52 %	6.47 %	7.67 %	1.23 %	0.01 %	0.08 %	0 %	0 %	0 %
380 kV S.FIORANO–ROBBIA **[31]**	Congestions (100 % = 8760 MTU)	0.62 %	1.86 %	3.43 %	0.09 %	0 %	6.69 %	0 %	0.05 %	0 %
220 kV AVISE–RIDDES **[24]**	Congestions (100 % = 8760 MTU)	0.16 %	0.67 %	0.70 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV PALLANZENO–SERRA **[26]**	Congestions (100 % = 8760 MTU)	0.13 %	0.51 %	0 %	0 %	0 %	0 %	0 %	0 %	0.06 %
380 kV Robbia–Gorlago **[30]**	Congestions (100 % = 8760 MTU)	0 %	0.08 %	0.83 %	0 %	0 %	0 %	0.74 %	1.96 %	1.34 %
380 kV CAGNO–MENDRISIO **[28]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.06 %	0 %	0.09 %	0 %	0 %	0 %
CNEs group name	CH–ITA The CNECs belong to the interconnection between Italy (ITNorth region) and Switzerland.									
Assessment of the congestion in the three timeframes	The critical issues are intercepted in the D-2 phase, and in fact in the subsequent phases the values are residual. The values over the three years are not appreciably different, although they are higher in 2023 due to the increase in exchange capacity on the border and the increase in import flows from Switzerland. The percentage of overload among the main CNEs are balanced, indicating that it is not a specific issue but an overall import from the border.									
Expert indication on the main type of flows causing the congestion	Cross-border flow									
Future evolution including ten-year scenario	New interconnection between IT–CH A new interconnection is planned between the Valchiavenna area and Switzerland to increase the exchange capacity of the regions.									
Is the CNE on a bidding zone border?	Yes									

FR–ITA

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
380 kV PIOSSASCO–VENAUS **[33]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0.06 %	0 %	0 %	9.54 %	0 %	0.77 %	1.05 %
380 kV VENAUS–VILLARODIN **[33]**	Congestions (100 % = 8760 MTU)	0.04 %	0.10 %	0.13 %	0 %	0 %	9.81 %	0 %	0.02 %	0 %
220 kV CAMPOROSSO–MENTON ALL **[19]**	Congestions (100 % = 8760 MTU)	1.92 %	0 %	0.11 %	0 %	0 %	0 %	0.14 %	0.30 %	0.57 %
400 kV RONDISSONE–ALBERTVILLE 1 **[20]**	Congestions (100 % = 8760 MTU)	0.96 %	0 %	0.39 %	0 %	0 %	0.30 %	0.27 %	0.76 %	0.25 %
400 kV RONDISSONE–ALBERTVILLE 2 **[20]**	Congestions (100 % = 8760 MTU)	1.56 %	0.17 %	0.37 %	0.50 %	0 %	0.30 %	0 %	0 %	0.19 %
CNEs group name	FR–ITA These elements connect Italy (Italy North region) and France									
Assessment of the congestion in the three timeframes	Increasing values in 2023 due to higher flows on the FR–IT border (between 2022 and 2023 a new interconnection has been realised: HVDC FIL). The highest values occur in the D-1 timeframe, mainly due to deviation in forecasts between D-2 and D-1. Typically, the forecasted congestions are resolved with corrective actions (preventive and curative) that allow congestions to be minimised almost in real time.									
Expert indication on the main type of flows causing the congestion										
Future evolution including ten-year scenario	Cross-border flow									
Is the CNE on a bidding zone border?	Yes									

AT–IT

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220 kV Lienz–Auronzo **[21]**	Congestions (100 % = 8760 MTU)	0 %	0.01 %	0.84 %	0 %	0 %	0 %	0.12 %	0.33 %	0.16 %
220 kV Nauders–Glorenza **[23]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0.51 %	0 %	0 %	0 %	0.76 %	0 %	0 %
220 kV SOVERZENE–LIENZ **[22]**	Congestions (100 % = 8760 MTU)	1.58 %	0 %	0 %	0 %	0 %	0 %	0.08 %	0 %	0 %
CNEs group name	AT–IT These elements connect Italy (Italy North region) and Austria.									
Assessment of the congestion in the three timeframes	On this border there is no particular evidence,including due to the lower available capacity compared to the other borders.									
Expert indication on the main type of flows causing the congestion										
Future evolution including ten-year scenario										
Is the CNE on a bidding zone border?	Yes									

SI–IT

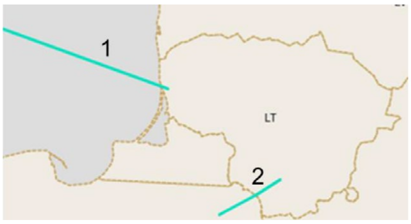
		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
380 kV REDIPUGLIA–DIVACA **[34]**	Congestions (100 % = 8760 MTU)	2.92 %	1.19 %	0 %	0.09 %	0.17 %	0.15 %	3.29 %	1.30 %	14.57 %
CNEs group name	SI–IT This element connects Italy (Italy North region) and Slovenia.									
Assessment of the congestion in the three timeframes	The increase in congestion percentages in 2023 in the close-to-real-time timeframe is linked to the different distribution of flows in the area between the scheduled flows and the physical flows. The use of Divaccia's PST (if available) as a remedial action allows mitigating the critical issues. The increase of the percentages in the period is also linked to the increase in flows between the Western and Eastern areas of Europe.									
Expert indication on the main type of flows causing the congestion	Cross-border flow and transit flow									
Future evolution including ten-year scenario	– 132 kV Redipuglia–Vrtijba (3PP) New 132 kV Redipuglia–Vrtijba tie line (third-party project) – Reinforcement ITN–SI and new HVDC Salgareda–Divaca New HVDC link between Salgareda and Divaca									
Is the CNE on a bidding zone border?	Yes									

Latvia

Latvia does not have relevant congested CNEs.

Lithuania

There are two congested groups of CNEs in Lithuania.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
330/400 kV NordBalt **[1]**	Congestions (100 % = 8760 MTU)	30.9 %	49.9 %	61.2 %						
330/400 kV NordBalt **[1]**	Congestions (100 % = 8760 MTU)	0.13 %	0.18 %	0 %						
330/400 kV LitPol Link **[2]**	Congestions (100 % = 8760 MTU)	7.95 %	10.7 %	12.8 %						
330/400 kV LitPol Link **[2]**	Congestions (100 % = 8760 MTU)	20.8 %	20.9 %	0 %						
CNEs group name	330/400 kV NordBalt: Connection from Nybro to Klaipeda substations, second row is in reverse direction. 330/400 kV LitPol Link: Connection from Elk to Alytus substations, second row is in reverse direction.									
Assessment of the congestion in the three timeframes	No data for D-1 and RT timeframes									
Expert indication on the main type of flows causing the congestion	Both NordBalt and LitPol Link are affected by transit cross-border flows from North to Central Europe due to price differences.									
Future evolution including ten-year scenario	Planned Harmony link between Lithuania and Poland will increase total transfer capacity and relieve congestions on this border after 2030.									
Is the CNE on a bidding zone border?	Yes									

Luxembourg

Luxemburg does not have relevant congested CNEs.

Netherlands

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Meeden–Diele										
380-kV-MEE–DIL Z **[1]**	Congestions (100 % = 8760 MTU)	0.8 %	0.8 %	11.6 %	14.7 %	20.6 %	25.6 %	0 %	0 %	24.7 %
	F “mean share of capacity used up by non-allocated flows”		56.0 %	77.9 %						
380-kV-MEE–DIL W **[1]**	Congestions (100 % = 8760 MTU)	3.6 %	13.2 %	4.9 %	16.7 %	15.3 %	25.6 %	0 %	0 %	24.4 %
	F “mean share of capacity used up by non-allocated flows”		54.9 %	67.4 %						
CNEs group name	Meeden–Diele. CNEs are double circuit of the same network element.									
Assessment of the congestion in the three timeframes and expert indication on the main type of flows causing the congestion	Congestions have appeared on this CNE(s) on all different timeframes. First congestions appear in D-2, then are carried over to the market coupling (limiting optimal efficiency). After market coupling, the observed congestions are solved with RA, but these CNEs remain fully loaded and a limiting factor for the cross-border ID market. Finally, congestions remain relevant in close to real time, which means that insufficient RA are applied to solve the overload. The primary cause of the congestions on these CNEs is loop flows with up to 78 % of the physical capacity used for loop flows. MEE–DIL is an interconnector, which means that the reported F mean values are the sum of loop flows on the CNE(s).									
Future evolution including ten-year scenario	This is an AC interconnector between the Netherlands and Germany. The flow in this line is expected to increase in the coming ten years. The main driver for the flow increase in the increased connection of offshore wind in the north of both countries (i.e. in the vicinity of this line). There are currently no concrete projects to upgrade this interconnector.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Eemshaven–Meeden										
380-kV-EMT–MEE W **[2]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	9.4 %	7.4 %	4.7 %	0 %	0 %	2.0 %
	F “mean share of capacity used up by non-allocated flows”			48.5 %						
380-kV-EEM–EHH Z **[2]**	Congestions (100 % = 8760 MTU)	0.3 %	0.2 %	0 %	9.3 %	7.3 %	4.8 %	0 %	0 %	5.2 %
	F “mean share of capacity used up by non-allocated flows”		55.9 %							
380-kV-EHH–MEE Z **[2]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	9.3 %	7.3 %	4.8 %	0 %	0 %	5.2 %
CNEs group name	Eemshaven–Meeden. CNEs collectively form the line element.									
Assessment of the congestion in the three timeframes and expert indication on the main type of flows causing the congestion	Several factors caused congestions on these combined network elements: Weakened topology for many years, significant planned outages due to maintenance, traditionally high infeed from generators and influence of cross-zonal exchanges. Primarily loop flows are causing the congestions, as the sum of internal flows and transit flows is always well below the physical capabilities.									
Future evolution including ten-year scenario	The grid-configuration in this area has changed due to the recent commissioning of a project. Therefore, these exact lines do not exist as of mid-2023. However, the loading of the axis is expected to increase in the next ten years, leading to constraints. The cause of this flow increase are current expectations regarding development of RES and flexible demand in the north of the Netherlands. A number of projects that will be commissioned in the next years will help alleviate these constraints.									
Is the CNE on a bidding zone border?	No									
Diemen–Lelystad										
380-kV-DIM–LLS Z **[3]**	Congestions (100 % = 8760 MTU)	3.9 %	0.7 %	0.3 %	8.8 %	2.9 %	6.4 %	0 %	0 %	5.1 %
	F “mean share of capacity used up by non-allocated flows”		58.7 %	62.3 %						
380-kV-DIM–LLS W **[3]**	Congestions (100 % = 8760 MTU)	0.6 %	4.6 %	4.2 %	1.8 %	6.6 %	6.4 %	0 %	0 %	4.5 %
	F “mean share of capacity used up by non-allocated flows”		54.7 %	61.3 %						
CNEs group name	Diemen–Lelystad. CNEs are double circuit of the same network element									
Assessment of the congestion in the three timeframes and expert indication on the main type of flows causing the congestion	Due to local circumstances the operational limit on this line set is 3 kA, while other line sets in series have an 4 kA operational limit. This explains why the DIM–LSS line set is congested first. Primarily loop flows are causing the congestions, as the sum of internal flows and transit flows is always well below the physical capabilities.									
Future evolution including ten-year scenario	In general, it is expected that flows in the DIM–LLS axis will increase in the coming ten years, due to increased RES connections in the north of the Netherlands and need to transport this power to large load centres in the south of the country. This axis is also susceptible to transit flows originating from Germany and going further south to Belgium and France. Due to this expectation, a project has been initiated to expand the transmission capacity of this axis by building additional lines in parallel to the existing ones. This will mitigate constraints in those lines in the long run. Furthermore, in theshort term the operational limit on this line will increase by 33 %.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Maasbracht–OBZ										
380-kV-MBT–OBZ W **[4]**	Congestions (100 % = 8760 MTU)	0.7 %	0.9 %	0.6 %	0.3 %	0.3 %	0.5 %	0 %	0 %	1.2 %
	F "mean share of capacity used up by non-allocated flows"		23.2 %	24.0 %						
CNEs group name										
Assessment of the congestion in the three timeframes and expert indication on the main type of flows causing the congestion	Limited congestions visible, and no trend is visible the past three years. Congestions are caused due to a combination of loop flows and transit flows.									
Future evolution including ten-year scenario	No substantial increase of loading of this line is expected in the coming ten years. No projects are foreseen for upgrading this line.									
Is the CNE on a bidding zone border?	Yes									
Rilland–Zuidvlakte										
380-kV-RLL–ZVL W **[5]**	Congestions (100 % = 8760 MTU)	0.1 %	0.3 %	1.1 %	0 %	0 %	0 %	0 %	0 %	0.5 %
	F "mean share of capacity used up by non-allocated flows"		20.4 %	16.5 %						
380-kV-RLL–ZVL G **[5]**	Congestions (100 % = 8760 MTU)	0.2 %	0.2 %	0.4 %	0 %	0 %	0.2 %	0 %	0 %	0.8 %
	F "mean share of capacity used up by non-allocated flows"		5.4 %	26.5 %						
CNEs group name	Rilland–Zuidvlakte. CNEs are double circuit of the same network element									
Assessment of the congestion in the three timeframes and expert indication on the main type of flows causing the congestion	Limited congestions visible, andno trend is visible the past three years. Congestions are caused due to a combination of loop flows and transit flows.									
Future evolution including ten-year scenario	A small loading increase is expected in the coming ten years, primarily due to increase import needs in Belgium. This load increase can lead to a constraint in a limited amount of hours throughout the year.									
Is the CNE on a bidding zone border?	Yes									

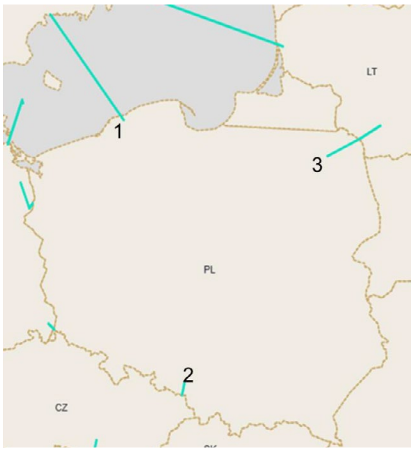
		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
Maasbracht–VYK										
380-kV-MBT–VYK Z **[6]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.1 %	0.2 %	0.2 %	0 %	0 %	0.1 %
	F "mean share of capacity used up by non-allocated flows"			9.1 %						
380-kV-MBT–VYK W **[6]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.3 %	1.1 %	0.1 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		8.8 %	25.4 %						
CNEs group name	Maasbracht–VYK . CNEs are double circuits of the same network element									
Assessment of the congestion in the three timeframes and expert indication on the main type of flows causing the congestion	Limited congestions visible, and no trend is visible the past three years. Congestions are caused due to a combination of loop flows and transit flows.									
Future evolution including ten-year scenario	A substantial increase in the loading of these lines is expected in the coming ten years. This increase is related to increasing import needs in Belgium in combination with large amounts of offshore wind expected to connect in Zeeland. The line is already upgraded and there are no plans for further reinforcements.									
Is the CNE on a bidding zone border?	Yes									
Doetinchem–HGL										
380-kV-DTC–HGL Z **[7]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0.2 %	0.3 %	0.3 %	0.4 %	0 %	0 %	0.4 %
	F "mean share of capacity used up by non-allocated flows"			64.6 %						
380-kV-DTC–HGL Z **[7]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.2 %	0 %	0.4 %	0 %	0 %	0.4 %
CNEs group name	Doetinchem – HGL. CNEs are double circuits of the same network element									
Assessment of the congestion in the three timeframes and expert indication on the main type of flows causing the congestion	Limited congestions visible, and no trend is visible the past three years. Congestions are caused due to a combination of loop flows and transit flows.									
Future evolution including ten-year scenario	A moderate increase of the loading of this line is expected in the coming ten years that could lead to constraints. Upgrade of this line using high temperature-low sag conductors is being considered. This is expected to solve the constraint.									
Is the CNE on a bidding zone border?	No									

Norway

No congestion data available.

Poland

There is one group of CNEs in Poland

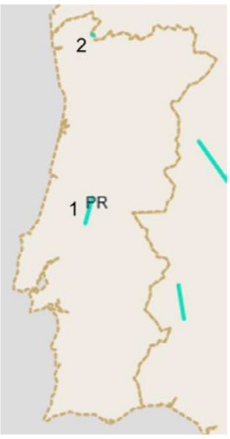


		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
DC-LINK-Slupsk–Starno **[1]**	Congestions (100 % = 8760 MTU)	2.79 %	11.1 %	8.6 %	0 %	0 %	0 %	0 %	0 %	0 %
400-kV-Wielopole–Nosovice **[2]**	Congestions (100 % = 8760 MTU)	7.8 %	9.59 %	3.18 %	0.13 %	0 %	0.02 %	0 %	0 %	0 %
BtB-Elk–Alytus **[3]**	Congestions (100 % = 8760 MTU)	12.9 %	1.6 %	1.38 %	0 %	0 %	0 %	0 %	0 %	0 %

CNEs group name	1) DC-LINK-Slupsk–Starno: Connection from Slupsk to Starno substations 2) 400-kV-Wielopole–Nosovice:Interconnector to Czech Republic 3) BtB-Elk–Alytus: Connection from Elk to Alytus substations
Assessment of the congestion in the three timeframes	The Wielopole–Nosovice interconnector is highly influenced by loop flows from Germany and further towards Czech Republic. Congestion is most prominent in the DA timeframe. In the intra-day timeframe, congestion remains noticeable, albeit less so than in DA. However, in real-time operations, it is often possible to resolve the congestion using topological remedial actions. The PL–SE and PL–LT DC connections have no data for D-1 and real timeframes. For the D-2 timeframe, it should be emphasised that energy prices in the Nordic region are often lower than in Poland. This has led to considerable interest from market participants in the SE–PL direction, as well astransit from Sweden via Lithuania to Poland or further to other Polish neighbours.
Expert indication on the main type of flows causing the congestion	Loop flows
Future evolution including ten-year scenario	All investments reduce the number of limiting internal lines active constraints in DA capacity allocation, as well as internal line congestions frequency in the DA and close-to-real-timetimeframes. After 2030: 1) Upgrade of AC/DC Słupsk converter station. 2) Construction new 220 kV lines from Podborze substation towards the Kopanina–Liskovec line, from Podborze substation towards the Bujaków–Liskovec line, from Podborze substation towards the Bieruń-Komorowice line, from Podborze substation towards the Czeczott–Moszczenica line and 400 kV lines from Podborze substation towards the Nosovice–Wielopole line, from Podborze substation towards the Dobrzeń–Detmarovice line together with construction of the 400/220/110 kV Podborze substation. 3) The planned Harmony link between Poland and Lithuania will reduce congestion on this border and boost overall transfer capacity.
Is the CNE on a bidding zone border?	Yes

Portugal

There are two CNEs in Portugal.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
150 kV Bouçã–Zêzere 2 **[1]**	Congestions (100 % = 8760 MTU)				5.49 %				0.03 %	
400 kV Alto Lindoso–Cartelle 1/2 **[2]**	Congestions (100 % = 8760 MTU)	1.1 %	0.3 %	0.4 %						
CNEs group name										
Assessment of the congestion in the three timeframes	**150 kV Bouçã–Zêzere 2:** In 2021 and 2022, there were identified thermal N violations in 150 kV Bouçã–Zêzere 2 in the D-1 timeframe and close to real time due to the particular case of an outage of 150 kV Bouçã–Zêzere 1, namely during some hours in the summer. Since this lines are a connecting corridor to two hydro plants, the congestions were solved with application of redispatch. **400 kV Alto Lindoso–Cartelle 1/2:** The contingency of these double circuit line is associated with the non-conditions for reclosure the circuits (after contingency) due to high voltage angle difference. The curative remedial action is the coordinated redispatch with Red Eléctrica.									
Expert indication on the main type of flows causing the congestion	**150 kV Bouçã–Zêzere 2:** This congestion is caused by internal flows. **400 kV Alto Lindoso–Cartelle 1/2:** This congestion is caused by cross-border flows.									
Future evolution including ten-year scenario	**150 kV Bouçã–Zêzere 2:** In the future, the uprating of the lines can minimise the congestions, but it is not foreseeable in the near future. **400 kV Alto Lindoso–Cartelle 1/2:** This CNE will be significantly reduced with the new 400 kV Ponte de Lima–Fonte Fria tie line.									
Is the CNE on a bidding zone border?	**400 kV Alto Lindoso–Cartelle 1/2** is on a BZ border.									

Romania

There are six CNEs in Romania.

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
TIE 400 kV Portile de Fier–Djerdap	Congestions (100 % = 8760 MTU)	22.0 %	11.4 %	3.9 %						
	F "mean share of capacity used up by non-allocated flows"	0 %	9.3 %	5.13 %						
OHL 220 kV Resita–Timisoara c.1	Congestions (100 % = 8760 MTU)		2.8 %	6.2 %	17.0 %	6.8 %	11.7 %	4.0 %	1.2 %	3.1 %
	F "mean share of capacity used up by non-allocated flows"	0 %	71.6 %	66.8 %						
OHL 220 kV Resita–Timisoara c.2	Congestions (100 % = 8760 MTU)		2.8 %	6.2 %	17.0 %	6.8 %	11.7 %	4.0 %	1.2 %	3.1 %
	F "mean share of capacity used up by non-allocated flows"	0 %	56.1 %	57.4 %						
OHL 220 kV Portile de Fier–Resita c. 1	Congestions (100 % = 8760 MTU)	1.0 %	1.2 %	2.8 %	21.2 %	8.6 %	17.8 %	4.5 %	1.5 %	3.5 %
	F "mean share of capacity used up by non-allocated flows"	0 %	73.4 %	59.7 %						
OHL 220 kV Portile de Fier–Resita c. 2	Congestions (100 % = 8760 MTU)	1.0 %	1.2 %	2.8 %	21.2 %	8.6 %	17.8 %	4.5 %	1.5 %	3.5 %
	F "mean share of capacity used up by non-allocated flows"	0 %	80.6 %	65.1 %						
TR 400/220 kV Bucuresti Sud 3 (4)	Congestions (100 % = 8760 MTU)				16.3 %	6.4 %	2.4 %			
	F "mean share of capacity used up by non-allocated flows"	0 %								
CNEs group name	The first five CNEs are located in the western part of Romania, one of the main axis overloaded with cross-border flows. In this part of Romania, the system operates mainly at 220 kV. OHL 400 kV Portile de Fier–Djerdap is affecting both SEE and Core CCR capacity calculation processes.									
Assessment of the congestion in the three timeframes	**OHL 220 kV Portile de Fier–Resita, OHL 220 kV Resita–Timisoara and OHL 400 kV Portile de Fier–Djerdap:** HPP Portile de Fier I is connected at 220 kV in Portile de Fier substation (on the Danube) with an installed power of around 1160 MW. On the Serbian side of the Danube there is a similar power plant with an installed power of around 1140 MW in 400 kV Djerdap substation. The elements connected in these substations are used for transferring the power generation in the area to the main consumption areas in the grid. Moreover, OHL 400 kV Portile de Fier–Djerdap is a tie line between Romania and Serbia, both countries having tie lines with Bulgaria and Hungary. Because of this, the power flows on OHL 400 kV Portile de Fier–Djerdap are highly impacted by the cross-border exchanges between RO–BG, RO–RS, and RO–HU. Internal OHLs 220 kV Portile de Fier–Resita and Resita–Timisoara are critical elements for capacity calculation in the Core region due to their proximity to the Hungarianborder. These elements have a low admissible flow due to their operation at 220 kV. DA coordinated capacity calculation process go live for SEE and Core CCRs in 2021 and 2022, respectively. These processes take place closer to real time and use updated data to try to find the maximum available capacity to be provided to the market. The increase of cross-border capacities can lead to operational issue in D-1 and up to real-time. Increase of capacities due to minMACZT requirement, which has been implemented in Core CCR starting from 2022. Any virtual capacities added on top of the physical ones and that are not chosen for validation can pose a potential operational security risk and materialise into congestions close to real-time. As in Romania there were no investment projects commissioned to alleviate these congestions and that have a high impact on the cross-zonal capacities, the capacities offered to the market can be achieved only by using costly and non-costly remedial actions. **TR 400/220 kV Bucuresti Sud:** This element only appears in the D-1 and close to real-time analysis. These elements have the purpose to transfer power to the large consumption area of Bucharest and distribute it to other areas through the 220 kV network. They can become easily overloaded due to a big amount of WPP connected in the south-eastern part of Romania with a low degree of predictability.									

	CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
	2021	2022	2023	2021	2022	2023	2021	2022	2023
Expert indication on the main type of flows causing the congestion	**OHL 220 kV Portile de Fier–Resita, OHL 220 kV Resita–Timisoara and OHL 400 kV Portile de Fier–Djerdap:** Transit flows, cross-border flows, internal flows. **TR 400/220 kV Bucuresti Sud:** internal flows								
Future evolution including ten-year scenario	Expected grid developments are scheduled: 400 kV OHL Portile de Fier–Resita and 400 kV TIE Resita–Pancevo circ.2 to be commissioned in November 2024. Circuit 1 of 400 kV TIE Resita-Pancevo will be commissioned in Q1 2025. 400 kV OHL Resita–Timisoara–Sacalaz to be commissioned in 2026; 400 kV d.c. OHL Timisoara–Arad to be commissioned in 2027; These investment projects will replace the 220 kV network in some areas or help alleviate overloads by creating a new path for power transfer. It will also help to increase the available capacity for cross-border trades.								

Slovakia

There is one group of CNEs in Slovakia.

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV-SK_L1 **[1]**	Congestions (100 % = 8760 MTU)	0 %	1.07 %	6.82 %	0.08 %	0.19 %	2.18 %	0.14 %	0.25 %	6.5 %
	F "mean share of capacity used up by non-allocated flows"	N/A	36 %	53.2 %						
CNEs group name	There is just one single CNEC in the grid that is in the top 5 %+congested elements									
Assessment of the congestion in the three timeframes	The particular CNEC is heavily loaded by the nuclear power plants in the vicinity of the node V. Dur. This leads to the high F0, all flows and prevents the fulfilment of the 70 % minRAM and the derogation is needed. The problem can not be facilitated sufficiently by the redispatch, as there is no power plant with the efficient redispatch in the vicinity of this network element. The element has frequently assigned the shadow price and we can observe the congestion in the real time as well.									
Expert indication on the main type of flows causing the congestion	As already mentioned above, this congestion is mainly caused by the internal flows, but the transit flows also create additional burden on this element.									
Future evolution including ten-year scenario	The intention is to strengthen the infrastructure in this corridor. The additional line from node V.Dur will be commissioned. The further details are in our TYNDP.									
Is the CNE on a bidding zone border?	No									

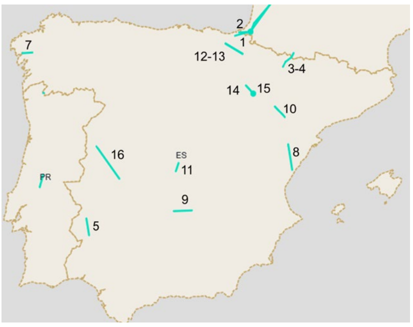
Slovenia

There is one group of CNEs in Slovenia. Due to the data source used in the process of the Technical Report preparation, the control block of Slovenia, Croatia, and Bosnia and Herzegovina (CB SHB) is presented as one BZ. In practice, CB SHB comprises three separate bidding zones, namely for each of the aforementioned countries.

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
[AT–SI] Obersielach–Podlog 247 [AT]	Congestions (100 % = 8760 MTU)	0 %	8.1 %	8.8 %	0 %	2.9 %	2.4 %	0 %	0 %	0 %
	F "mean share of capacity used up by non-allocated flows"		10.3 %	15.2 %						
Assessment of the congestion in the three timeframes	Congestion is mostly visible in the DA timeframe. There is an effective topological remedial action to solve the congestion, but is rarely used in the Core FB CC (during non-costly remedial action optimisation). The reason for this is two-fold: first due to the optimisation function of the CORE, which focus on the CNEC with lowest relative RAM, and second, given that the mentioned remedial action could overload other neighbouring element(s). In the intra-day timeframe, this congestion is still visible (but not to the same extent as in DA), although in real time we often are able to solve the congestion by using topological remedial actions.									
Expert indication on the main type of flows causing the congestion	The Podlog–Obersielach line is the only 220 kV line between Austria and Slovenia and it is positioned in a such way that it is largely affected by transit flows in Europe in east–west direction (and opposite) as well as north–south. Additionally, Slovenia is a part of two regions (Core and IN) and there are some flows on this element (which is located in the Core region) due to market exchanges in the IN region (which includes the SI–IT and AT–IT borders). The third factor is the PST Divaca, which is located on SI–IT border and is an important remedial action in the IN CCR. The mentioned PST can increase in certain circumstances the flow on Podlog–Obersielach.									
Future evolution including ten-year scenario	At ELES, we are aware of the congestions on the element, especially in the DA timeframe. We expect that such congestion will continue in the future, especially with the trend of transit flows between east and west (due to location of the element in the centre of Europe). Therefore, we are currently evaluating the option to build a SSSC in the Podlog substation to manage the physical flows through Podlog–Obersielach and reduce the occurrences ofcongestions.									

Spain

There are eleven groups of CNEs in Spain. Congestions in ES are anonymised due to their classification as 'sensitive critical infrastructure protection-related information' as per the CACM Regulation and national legislation.



		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV-ES_L1 **[1]**	Congestions (100 % = 8760 MTU)	6.1 %	10.5 %	8.7 %	0 %	0 %	0 %	1.0 %	1.3 %	1.7 %
220-kV-ES_L2 **[2]**	Congestions (100 % = 8760 MTU)	16.1 %	22.4 %	16.8 %	0 %	0 %	0 %	2.6 %	5.5 %	2.7 %
CNEs group name	They form the ES–FR interconnection lines on the western side of the border									
Assessment of the congestion in the three timeframes	Significant congestions in CC DA because it is an interconnection line on the ES–FR western border. Additionally, since early 2022, the coordinated capacity calculation maximises the exchanges between France and Spain to comply with the objective of 70 % set forth by 2019/943 increasing congestion in the interconnection. On the other hand, congestions occurring close to real time are typically caused by unexpected events or operational situations and are handled through topological measures (such as phase-shifting transformer) and counter-trading.									
Expert indication on the main type of flows causing the congestion	Cross-border flows									
Future evolution including ten-year scenario	Future scenarios continue showing congestions in this line as it is an interconnection line in the ES–FR border. Nevertheless, the commissioning of future ES–FR interconnections as well as some new developments in the North Region of Spain will increase the NTC in the border and will relieve congestions in the ES–FR border.									
Is the CNE on a bidding zone border?	Yes									
220-kV-ES_L3 **[3]**	Congestions (100 % = 8760 MTU)	8.1 %	15.9 %	12.0 %	0 %	0 %	0 %	0 %	0.4 %	1.1 %
220-kV-ES_L4 **[4]**	Congestions (100 % = 8760 MTU)	3.9 %	1.6 %	1.8 %	0 %	0 %	0 %	0 %	0 %	0 %
CNEs group name	The 220 kV ES_L3 line is an interconnection on the border between Spain and France, and the 220 kV ES_L4 line serves as an extension of this interconnection.									
Assessment of the congestion in the three timeframes	Significant congestions in CC DA because it is an interconnection line on the ES–FR border. Additionally, since early 2022, the coordinated capacity calculation maximises the exchanges between France and Spain to comply with the objective of 70 % set forth by 2019/943 increasing congestion in the interconnection. In contrast, minor congestions that arise close to real time are usually the result of unexpected events or operational situations, showing a slight upward trend over the years. They are handled through topological measures (such as phase-shifting transformer) and counter-trading.									
Expert indication on the main type of flows causing the congestion	Cross-border flows									
Future evolution including ten-year scenario	Future scenarios continue showing congestions in these lines as they are part of the interconnections in the ES–FR border. Nevertheless, the commissioning of future ES–FR interconnections as well as some new developments in the north region of Spain will increase the NTC in the border and will relieve congestions in the ES–FR border.									
Is the CNE on a bidding zone border?	Yes									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220-kV- ES_L5 **[5]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0 %	5.6 %	15.7 %	0.9 %	1.0 %	5.6 %
CNEs group name										
Assessment of the congestion in the three timeframes	Congestion observed in D-1 does not appear at the CC DA stage since this CNE is not part of the critical elements that are monitored in the CC DA, because it does not present any relevant sensitivity to cross-border exchanges. In both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy – especially solar photovoltaic – in south-west Spain. Nonetheless, scheduled works have led to an increase in hours of congestion during 2022 and 2023. These works are responsible for 17 % of the congestion hours reported in 2022 and 19 % in 2023. Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of PV generation. Furthermore, this congestion is highly seasonal an occurs mainly in the summer months, when the PV production is higher and the capacity values of the electric lines is lower. In this aspect, last year Red Eléctrica started using monthly capacity values instead of a seasonal approach, optimizing the use of the grid.									
Expert indication on the main type of flows causing the congestion	Large portion of the active power flow on these CNEs are internal flow to evacuate the large amount of photovoltaic generation installed in the area.									
Future evolution including ten-year scenario	Future reinforcement of ES_L5 circuit as well as the restringing (upgrade) of ES_L6 kV line will solve the observed congestions.									
Is the CNE on a bidding zone border?	No									
220-kV- ES_L7 **[7]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0 %	3.9 %	16.5 %	0.1 %	1.6 %	5.4 %
CNEs group name										
Assessment of the congestion in the three timeframes	Congestion observed in D-1 does not appear at the CC DA stage since this CNE is not part of the critical elements that are monitored in the CC DA, because it does not present any relevant sensitivity to cross-border exchanges. In both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy – especially wind farms – in North-West Spain. Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of Wind generation.									
Expert indication on the main type of flows causing the congestion	Large portion of the active power flow on these CNEs are internal flow to evacuate the large amount of wind generation installed in the area									
Future evolution including ten-year scenario	New 220 kV Tibo-Lousame deployed in Q3 2024 has already solved the congestion.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV-ES_L8 **[8]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	7.8 %	1.5 %	4.8 %	1.3 %	0.2 %	0.9 %
CNEs group name										
Assessment of the congestion in the three timeframes	Congestion observed in D-1 does not appear at the CC DA stage since this CNE is not part of the critical elements that are monitored in the CC DA. However, in the context of high import from France to Spain and a planned outage in the network there is significant traffic from Catalonia to Valencia region via the 400 kV Network. To manage this, it's necessary to apply topological measures in combination with internal redispatching measures involving the generation in both the Catalonia and Valencia areas. Moreover, the high penetration of wind generation in Aragon region (nearby these areas) could potentially worsen the constraint. In D-1, most of the time reflects normal conditions, but 2021 had a notable planned network outage (16 % of overall congestion). Nevertheless, there appears to be an upward trend. Furthermore, this congestion is highly seasonal an occurs mainly in the summer months, when the demand on the Levante zone is higher and the capacity values of the electric lines is lower. In this aspect, last year Red Eléctrica started using monthly capacity values instead of a seasonal approach, optimizing the use of the grid.									
Expert indication on the main type of flows causing the congestion	Mainly internal flows with some influence from cross-border flows.									
Future evolution including ten-year scenario	New DC 400-kV- ES_L8 as well as other reinforcements in the area will solve the congestions observed.									
Is the CNE on a bidding zone border?	No									

220-kV-ES_L9 **[9]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0 %	4.7 %	7.4 %	0 %	0.1 %	0.3 %
CNEs group name										
Assessment of the congestion in the three timeframes	Congestion observed in D-1 does not appear at the CC DA stage since this CNE is not part of the critical elements that are monitored in the CC DA, because it does not present any relevant sensitivity to cross-border exchanges. In both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy – especially solar photovoltaic – in Central Spain.In D-1, most of the time reflects normal conditions, but 2023 had a notable planned network outage (18 % of overall congestion). Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of PV generation. Furthermore, this congestion is highly seasonal and occurs mainly in the summer months, when the PV production is higher and the capacity values of the electric lines is lower. In this aspect, last year Red Eléctrica started using monthly capacity values instead of a seasonal approach, optimizing the use of the grid.									
Expert indication on the main type of flows causing the congestion	Large portion of the active power flow on these CNEs are internal flow to evacuate the large amount of photovoltaic generation installed in that area.									
Future evolution including ten-year scenario	The congestions due to renewable energy production will be solved with the reinforcement of the circuit as well as the commissioned of the future new DC Manzanares–Picón 400 kV in parallel with the existing line. Additionally, a new FACT will be commissioned in the area in order to accommodate power flows									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220-kV-ES_L10 **[10]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.2 %	3.7 %	7.7 %	0.7 %	0.8 %	1.2 %
CNEs group name										
Assessment of the congestion in the three timeframes	Congestion observed in D-1 does not appear at the CC DA stage since this CNE is not part of the critical elements that are monitored in the CC DA, because it does not present any relevant sensitivity to cross-border exchanges. In both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy – especially wind farm –, in Aragón region. Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of wind generation.									
Expert indication on the main type of flows causing the congestion	Large portion of the active power flow on these CNEs are internal flow to evacuate the large amount of wind generation installed in the Aragón region									
Future evolution including ten-year scenario	The restringing (upgrade) of the axis ES_L10 220 kV.									
Is the CNE on a bidding zone border?	No									

220-kV- ES_L11 **[11]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.3 %	5.0 %	5.9 %	0 %	1.1 %	0.7 %
CNEs group name										
Assessment of the congestion in the three timeframes	Congestion observed in D-1 does not appear at the CC DA stage since this CNE is not part of the critical elements that are monitored in the CC DA, because it does not present any relevant sensitivity to cross-border exchanges. In both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy – especially solar photovoltaic – in Central Spain. Nonetheless, scheduled works have led to an increase in hours of congestion during 2022 and 2023. These works are responsible for 37 % of the congestion hours reported in 2022 and 33 % in 2023. Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of PV generation. Furthermore, this congestion is highly seasonal an occurs mainly in the summer months, when the PV production is higher and the capacity values of the electric lines is lower. In this aspect, last year Red Eléctrica started using monthly capacity values instead of a seasonal approach, optimizing the use of the grid.									
Expert indication on the main type of flows causing the congestion	Large portion of the active power flow on these CNEs are internal flow to evacuate the large amount of photovoltaic generation installed in that area.									
Future evolution including ten-year scenario	The reinforcement of the line as well as the future new axis Picón–Manzanares–Manchega–Belinchón 400 kV will improve the power flows and reduce the congestions.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
220-kV-ES_L12 **[12]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.6 %	0.9 %	6.7 %	2.5 %	0.4 %	3.1 %
220-kV-ES_L13 **[13]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	1.0 %	4.6 %	4.6 %	1.7 %	2.8 %	4.7 %
CNEs group name	220 kV double circuit									
Assessment of the congestion in the three timeframes	Congestions observed in D-1 do not appear at the CC DA stage since these CNEs are not part of the critical elements that are monitored in the CC DA. In both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy, especially wind, in North Spain. Nonetheless, scheduled works have led to an increase in hours of congestion during the period analysed. These works are responsible for 62 % of the congestion hours reported in 2021, 22 % in 2022 and 34 % in 2023.									
Expert indication on the main type of flows causing the congestion	Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of wind generation.									
Future evolution including ten-year scenario	Large portion of the active power flow on these CNEs are internal flows to evacuate the large amount of wind generation installed in the north region.									
Is the CNE on a bidding zone border?	The reinforcements of both circuits will solve the congestions.									

220-kV- ES_L14 **[14]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0.1 %	1.0 %	7.3 %	1.2 %	0.8 %	4.2 %
400/220-kV- ES_L15 **[15]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0 %	0 %	0.8 %	6.0 %	5.2 %	3.8 %	4.2 %
CNEs group name	CNEs located at the same substation									
Assessment of the congestion in the three timeframes	Congestion observed in D-1 does not appear at the CC DA stage since this CNE is not part of the critical elements that are monitored in the CC DA, because it does not present any relevant sensitivity to cross-border exchanges. In both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy – especially wind farms – in Aragón region. Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of wind generation.									
Expert indication on the main type of flows causing the congestion	Large portion of the active power flow on these CNEs are internal flow to evacuate the large amount of wind generation installed in the Aragón region.									
Future evolution including ten-year scenario	New 400/220 kV transformer in Magallón and new DC La Serna–Magallón 400 kV will improve the distribution of the power flows and solve the congestions.									
Is the CNE on a bidding zone border?	No									

		CC for DA allocation (D-2) – Active constraints			Congestion frequency in D-1 timeframe (DACF)			Close to real time		
		2021	2022	2023	2021	2022	2023	2021	2022	2023
400-kV- ES_L16 **[16]**	Congestions (100 % = 8760 MTU)	0 %	0 %	0.1 %	1.7 %	1.0 %	4.5 %	0 %	0.4 %	5.2 %
CNEs group name										
Assessment of the congestion in the three timeframes	Relevant congestion in both D-1 and close to real time timeframes, there is an upward trend in frequency over the years due to the gradual increase in renewable energy, especially solar photovoltaic, in South-West Spain. Possible measures applied: topology measures and advanced tools to maximise grid use by applying very fast remedial actions (run-back automatism) to avoid initiating redispatching, and redispatch as a last resort. The congestions that arise close to real-time are mainly due to variability in the forecast of PV generation. It is worth mentioning that the line was upgraded in June 2024, so congestion is expected to decrease significantly in the coming years. Furthermore, this congestion is highly seasonal an occurs mainly in the summer months, when the PV production is higher and the capacity values of the electric lines is lower. In this aspect, last year Red Eléctrica started using monthly capacity values instead of a seasonal approach, optimising the use of the grid.									
Expert indication on the main type of flows causing the congestion	The main type are internal and cross-border too to evacuate the large amount of photovoltaic generation installed in south-west Spain.									
Future evolution including ten-year scenario	In future scenarios, congestions are not observed in this line as the nuclear power plant will be decommissioned									
Is the CNE on a bidding zone border?	No									

Sweden

No congestion data available.

Appendix 2

Congestions without frequency threshold

Austria

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Bisamberg – Kledering	3.9%	17.2%	0%	0%	0.5%	0%	0%	0.3%	0.1%
220 kV – Bisamberg – Wien Südost	7.8%	0%	0.1%	0.1%	0.6%	0.1%	0.1%	0.4%	0.2%
220 kV – Bisamberg – Ybbsfeld	0%	0%	0.1%	0.1%	0%	0%	0.1%	0%	0%
220 kV – Ernsthofen – Hausruck	0%	0.3%	0.6%	0.6%	0.6%	2.8%	0.2%	0.1%	0.4%
220 kV – Ernsthofen – Klaus	0%	0%	0%	0%	0.2%	0.3%	0%	0%	0.2%
220 kV – Ernsthofen – Wallsee	0%	0%	0%	0%	0.1%	0.6%	0%	0%	0.2%
220 kV – Ernsthofen – Weissenbach	0%	0%	0%	0%	0.1%	0.4%	0%	0.1%	0.2%
220 kV – Ernsthofen – Ybbsfeld	0%	0%	0%	0%	0%	0.6%	0%	0%	0%
220 kV – Feistritz-Ludmannsdorf – Obersielach	0.4%	0.2%	0%	0%	0.2%	0.1%	0%	0%	0%
220 kV – Feistritz-Ludmannsdorf – Villach Süd	0%	0%	0%	0%	0.2%	0.2%	0%	0%	0%
220 kV – Hausruck – Sattledt	0%	0.1%	0.4%	0.3%	0.6%	1.3%	0.1%	0.1%	0.2%
220 kV – Hausruck – Weibern	0%	0%	0.1%	0.4%	0.5%	1.2%	0.2%	0%	0.2%
220 kV – Hessenberg – Obersielach	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Hessenberg – Ternitz	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – Hessenberg – Weissenbach	0%	0.2%	0.8%	0.3%	0%	0%	0.1%	0.1%	0%
220 kV – Hessenberg – Zeltweg	0%	0.2%	0%	0%	0%	0%	0%	0%	0%
220 kV – Klaus – Pyhrn	0%	0%	0%	0%	0.6%	0.5%	0%	0.3%	0.2%
220 kV – Kledering – Wien Südost	0%	0.1%	0.1%	0%	0.3%	0%	0%	0.1%	0%
220 kV – Lienz – Auronzo (TERNA)	11.9%	0.1%	0.8%	6.4%	32.7%	26.5%	12.2%	30.5%	27.5%
220 kV – Meiningen – Bürs (TransnetBW)	1.4%	1.8%	0.2%	0.3%	0.3%	0.1%	0%	0%	0%
220 kV – Meiningen – Ruethi (Swissgrid)	0%	0.8%	0.1%	0.4%	0%	0%	0%	0%	0%
220 kV – Nauders – Glorenza (TERNA)	0%	0%	0.3%	0%	0%	0.1%	0%	0%	0.1%
220 kV – Neusiedl – Györ (MAVIR)	5.0%	1.6%	1.3%	0.1%	0%	0.2%	0%	0%	0.5%
220 kV – Neusiedl – Wien Südost	0%	0%	0.2%	0.2%	0%	0.3%	0%	0%	0.3%
220 kV – Obersielach – Podlog (ELES)	42.1%	27.8%	8.8%	0.4%	3.0%	2.3%	0.2%	0.5%	0.2%
220 kV – Obersielach – Rosegg	0.2%	0.6%	0.2%	0.1%	0.3%	0.4%	0%	0%	0%
220 kV – Obersielach – Zeltweg	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – Pyhrn – Weissenbach	0%	0%	0.1%	0%	0.2%	0.4%	0%	0.1%	0.2%
220 kV – Rosegg – Villach Süd	0%	0.5%	0.5%	0.1%	0.3%	0.4%	0%	0%	0%
220 kV – Salzburg – Tauern	0%	0.1%	1.1%	0.2%	1.0%	1.5%	0.1%	0.8%	0.7%
220 kV – St. Peter – Altheim (TenneT GE)	0%	0.4%	0.7%	0%	0%	0%	0%	0%	0%
220 kV – St. Peter – Pirach (TenneT GE)	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – St. Peter – Pleinting (TenneT GE)	12.1%	12.7%	9.7%	0.2%	1.3%	3.0%	0.1%	0.1%	0.4%
220 kV – St. Peter – Salzburg	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
220 kV – St. Peter – Weibern	0%	0%	0.1%	0%	0%	0.1%	0%	0%	0%
220 kV – Strass – Thaur	1.5%	0.6%	1.9%	0.2%	1.1%	2.4%	0.1%	0.1%	0.2%
220 kV – Strass – Zell/Ziller	0%	0.2%	0.4%	0.2%	0.2%	0.9%	0.1%	0%	0.1%
220 kV – Tauern – Weissenbach	7.5%	1.1%	1.2%	1.2%	0.3%	0.8%	0.1%	0.2%	0.3%

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Ternitz – Wien Südost	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Thaur – Silz	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Walgauwerk – Bürs (TransnetBW)	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Walgauwerk – Werben	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Werben – Werben (Amprion)	0%	0.1%	0%	0.2%	0.2%	0.1%	0%	0%	0%
220 kV – Westtirol – Bürs (TransnetBW)	0%	0%	0%	0%	0.4%	0.4%	0%	0%	0%
220 kV – Westtirol – Silz (TenneT GE)	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – Westtirol – Vöhringen (Amprion)	0%	0.3%	0.5%	0%	0.3%	1.1%	0%	0%	0.1%
220 kV – Westtirol – Zell/Ziller	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Wien Südost – Györ (MAVIR)	8.1%	1.1%	2.0%	0.6%	0%	0.3%	0%	0.1%	0.5%
220 kV – Zaya – Sokolnice (ČEPS)	11.5%	6.3%	0%	0.1%	0.1%	0%	0%	0%	0%
220/220 kV – transformer Ernsthofen	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220/220 kV – transformer Lienz	0%	0%	0%	44.2%	8.3%	7.0%	4.2%	10.4%	6.5%
220/220 kV – transformer Nauders	0%	0%	0%	0%	0%	0.7%	0%	0%	0.3%
220/220 kV – transformer Tauern	0.8%	2.0%	0.2%	0.1%	0.9%	0.9%	0.1%	0.6%	0.3%
380 kV – Bisamberg – Dürnrohr	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
380 kV – Dürnrohr – Etzersdorf	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
380 kV – Dürnrohr – Slavetice (ČEPS)	11.9%	14.2%	1.6%	0.1%	0%	0%	0%	0%	0%
380 kV – Kainachtal – Maribor (ELES)	13.9%	5.6%	0.1%	0%	0.1%	0%	0%	0%	0%
380 kV – Nauders – Pradella (Swissgrid)	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – Nauders – Westtirol	0%	0.3%	0.9%	0%	0.1%	0.8%	0%	0%	0.2%
380 kV – Oststeiermark – Wien Südost	0%	0.6%	0%	0%	0%	0%	0%	0%	0%
380 kV – Sarasdorf – Wien Südost	1.5%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Sarasdorf – Zurndorf	0%	0.7%	0.1%	0%	0%	0%	0%	0%	0%
380 kV – Südburgenland – Wien Südost	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
380 kV – Westtirol – Leupholz (Amprion)	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – Zurndorf – Györ (MAVIR)	6.3%	4.7%	0.1%	0%	0%	0%	0.1%	0%	0%
380 kV – Zurndorf – Szombathely (MAVIR)	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
380/220 kV – transformer Ernsthofen	46.2%	7.7%	0.1%	0%	0%	0%	0%	0%	0%
380/220 kV – transformer Lienz	3.7%	1.1%	0.9%	0.1%	1.1%	0%	0.1%	0.5%	0%
380/220 kV – transformer Nauders	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380/220 kV – transformer Obersielach	0%	0.1%	0%	0%	0.1%	0.1%	0%	0%	0%
380/220 kV – transformer St. Peter	0%	0.3%	0.1%	0.1%	0.5%	0.3%	0%	0%	0%
380/220 kV – transformer Tauern	0%	0%	0.1%	0.1%	0.1%	0.7%	0%	0%	0.3%
380/220 kV – transformer Westtirol	1.8%	1.6%	3.8%	0.9%	2.1%	4.1%	0.5%	0.6%	0.4%
380/220 kV – transformer Zaya	0%	0.1%	0.7%	0%	0.3%	0%	0%	0%	0%
380/220 kV – transformer Zell/Ziller	0%	0%	0.1%	0%	0%	0.6%	0%	0%	0%

Belgium

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Aubange – Moulaine	0 %	0 %	0 %	0 %	0 %	1.9 %	0 %	0 %	0 %
221 kV – Aubange – Moulaine	0.4 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0.1 %	0 %
380 kV – Achene – Lonny	3.3 %	3.6 %	7.3 %	0 %	0.3 %	0.8 %	0 %	0.3 %	0.3 %
380 kV – Avelgem – Avelin	10.3 %	5.6 %	0 %	0 %	0.1 %	0 %	0 %	0.9 %	0.1 %
380 kV – Avelgem – Horta	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Avelgem – Mastaing	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Bruegel – Mercator	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.7 %	0 %
380 kV – Doel – Mercator	1.2 %	0.3 %	0.2 %	0.2 %	0.2 %	0.3 %	0 %	4.5 %	0.2 %
380 kV – Doel – Zandvliet	0.9 %	0.4 %	2.0 %	0 %	0.3 %	0.1 %	0 %	0.2 %	0.1 %
380 kV – Gramme – Achene	4.7 %	8.8 %	3.8 %	0 %	0.3 %	0.6 %	0 %	0.2 %	0.1 %
380 kV – Gramme – Champion	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Gramme – Courcelles	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380 kV – Mercator – Horta	0 %	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %	0 %
380 kV – Van Eyck – Maasbracht	0.1 %	0.5 %	0.1 %	0 %	0.5 %	0.2 %	0 %	0.2 %	0 %
380 kV – Zandvliet – Rilland	0 %	0 %	0.3 %	0 %	0 %	0.3 %	0 %	0 %	0.1 %
PST Van Eyck 380 kV	1.1 %	3.7 %	1.0 %	0 %	0 %	0 %	0 %	0.2 %	0.4 %
PST Zandvliet 380 kV	7.2 %	6.5 %	4.5 %	0 %	0 %	0 %	0 %	0.2 %	0.4 %

Bulgaria

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400 kV – BG_L1	0 %	5.6 %	1.0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – BG_L2	3.3 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – BG_L3	2.0 %	0.4 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – BG_L4	0 %	1.1 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – BG_L5	1.3 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – BG_L6	0.7 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – BG_L7	0 %	0.6 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – BG_L8	0.6 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – BG_L9	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – BG_L10	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – BG_L11	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – BG_L12	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – BG_L13	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %

Croatia

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Brinje – Mraclin	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Đakovo – xnode Tuzla	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Konjsko – VE Pađene	0%	0%	0%	0%	0%	0.2%	0.5%	0%	0.3%
220 kV – Međurić – Sisak	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Međurić – xnode Prijedor	0%	0%	0%	0%	0%	0%	0.3%	0.1%	0%
220 kV – Melina – Pehlin 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Melina – Plomin	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Mraclin – TE Sisak 1	0%	0%	0%	0.1%	0%	0.3%	0.2%	0.3%	1.4%
220 kV – Mraclin – TE Sisak 2	0%	0%	0%	0%	0%	0%	0.1%	0.2%	0%
220 kV – Mraclin – Žerjavinec	0%	0%	0%	0.1%	0.1%	0%	0.3%	0%	0%
220 kV – Pehlin – xnode Divača	0%	7.0%	4.2%	0.5%	0%	0%	0.1%	0.3%	0%
220 kV – Senj – Brinje	0%	0%	0%	0%	0%	0.3%	0%	0.9%	0.3%
220 kV – Senj – Melina	0%	0%	0%	2.4%	3.5%	7.0%	8.9%	7.8%	11.8%
220 kV – Sisak- xnode Prijedor	0%	0%	0%	0%	0%	0.1%	0.2%	0%	0.6%
220 kV – VE Pađene – Brinje	0%	0.6%	0.1%	0.4%	0%	0.1%	3.9%	0.3%	0.1%
220 kV – Zakučac – Konjsko	0%	0.1%	0%	0.4%	0%	0%	1.9%	0%	0.1%
220 kV – Zakučac – xnode Mostar	0%	2.7%	0.4%	0%	0.6%	0.1%	0%	1.3%	0.1%
220 kV – Žerjavinec – xnode Cirkovce	0%	0%	0%	0.1%	0%	0%	0.1%	0%	0%
220 kV – Žerjavinec – xnode Podlog	0%	0%	0%	0%	0%	0.2%	0%	0.2%	0.1%
400 kV – Ernestinovo – Pecs 1	0%	0.8%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – Ernestinovo – Pecs 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Ernestinovo – S. Mitrovica	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Konjsko – xnode Mostar	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Melina – Tumbri	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Melina – xnode Divača	0%	0.1%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – Tumbri – xnode Krsko 1	0%	0.9%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – Zerjavinec – Ernestinovo	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Zerjavinec – Tumbri	0%	1.5%	0%	0%	0%	0%	0%	0%	0%
BIL 220 AT2	0%	0%	0%	0%	0.1%	0.1%	0.2%	0.2%	0%
BIL 220 AT4	0%	0%	0%	0%	0.1%	0.2%	0.2%	0.2%	0%
DAKOV 220 TR1	0%	0%	0%	0%	0%	0%	2.3%	0.1%	0%
DAKOV 220 TR2	0%	0%	0%	0%	0%	0%	2.2%	0.1%	0%
ERNES 401 TR1	0%	0%	0%	0%	0%	0%	0.6%	0%	0%
ERNES 401 TR2	0%	0%	0%	0%	0%	0.1%	0.4%	0.1%	0.1%
HEZAK 220 ATR	0%	0%	0%	0%	0%	0%	0.3%	0%	0%
KONJ 220 T1	0%	0%	0%	0.1%	0%	0%	0.6%	0%	0%
KONJ 220 T3	0%	0%	0%	0%	0%	0%	0.4%	0%	0%
KONJSKO 400/220 AT1	0%	0%	0%	0%	0%	0%	0%	0%	0%
KONJSKO 400/220 AT2	0%	0%	0%	0%	0%	0.()%	0%	0%	0%
MEDUR 220 TR3	0%	0%	0%	0%	0%	0.6%	0.5%	0.4%	0%
MELIN 220 AT5	0%	0%	0%	0%	0%	0%	0%	0%	0%
MELIN 220 AT6	0%	0%	0%	0%	0%	0%	0%	0%	0%
MELINA 400/220 ATR1	0%	0%	0%	0%	0%	0%	0.2%	0%	0.1%
MELINA 400/220 ATR2	0%	0%	0%	0%	0%	0%	0%	0%	0%
MRACL 221 TR1	0%	0%	0%	0%	0%	0.4%	0.1%	0%	0%
MRACL 221 TR2	0%	0%	0%	0%	0%	8.5%	0.2%	0.1%	3.1%

Croatia (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
MRACL 221 TR3	0%	0%	0%	0%	2.2%	0%	0.1%	1.0%	0%
RHEVE 401 AT	0%	0%	0%	0%	0%	0%	0%	0%	0%
TEPLO 220 AT1	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
TEPLO 220 AT2	0%	0%	0%	0%	0.5%	0%	0%	0%	0%
TEPLO 220 AT3	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
TUMBR 401 TR1	0%	0%	0%	0%	0%	0%	0%	0%	0%
TUMBR 401 TR3	0%	0%	0%	0%	0.1%	0%	0.1%	0%	0%
ZERJA 401 TR1	0%	0%	0%	0%	0.2%	0%	0%	0.1%	0%
ZERJA 401 TR2	0%	0%	0%	0%	0.2%	0%	0.1%	0.1%	0%
ZERJA Z2 TR4	0%	0%	0%	0%	0%	0%	0%	0%	0%

Czech Republic

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
200 kV – Liskovec – Bujakow	0%	0%	0.1%	0%	0%	0.4%	0%	0%	0%
200 kV – Liskovec – Kopanina	0%	0%	0.1%	0%	0.2%	0%	0%	0%	0%
200 kV – Liskovec – P. Bystrica	0%	0.3%	0.4%	0.2%	0%	0%	0%	0%	0%
200 kV – Sokolnice – Senice	0%	0.4%	0%	0%	0%	0%	0%	0%	0%
200 kV – Sokolnice – Zaya	0%	0.9%	0%	0%	0.1%	0%	0%	0%	0%
400 kV – Hradec – Rohrsdorf	0%	0.8%	0.3%	0.2%	3.3%	8.7%	0%	0%	0%
400 kV – Hradec – Rohrsdorf	0%	0.2%	0.1%	0.2%	3.3%	8.7%	0%	0%	0%
400 kV – Nosovice – Varin	0%	0.5%	0.4%	0.1%	0.2%	0.1%	0%	0%	0%
400 kV – Prestice – Kocin	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Slavetice – Durnrohr	0%	0.3%	0.1%	0.1%	0%	0%	0%	0%	0%
400 kV – Sokolnice – Krizovany	0%	0%	0.2%	0%	0%	0%	0%	0%	0%
Transformer 220/400 kV – Sokolnice	0%	0%	0.3%	0.1%	0.1%	0.3%	0%	0%	0%

Denmark

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
ASR_400_REV	0.1%	0.3%	0%	0%	0%	0%	0%	0%	0%
BAZ_132_KFE_2	16.8%	1.0%	1.2%	0%	0%	0%	0%	0%	0%
BDR_150_LAG	0.3%	0%	0%	0%	0%	0%	0%	0%	0%
BJS Busbar 1	0.1%	0.1%	1.3%	0%	0%	0%	0%	0%	0%
BJS Busbar 2	0.1%	0.1%	0.4%	0%	0%	0%	0%	0%	0%
DK1_DE	35.8%	40.9%	42.0%	0%	0%	0%	0%	0%	0%
DK1_DK2	38.2%	31.1%	38.4%	0%	0%	0%	0%	0%	0%
DK1_NL	62.8%	66.4%	65.8%	0%	0%	0%	0%	0%	0%
DK1_NO2	58.7%	44.8%	47.5%	0%	0%	0%	0%	0%	0%
DK1_SE3	84.6%	72.5%	79.1%	0%	0%	0%	0%	0%	0%
DK2_DE	52.0%	48.5%	66.5%	0%	0%	0%	0%	0%	0%
DK2_SE4	34.6%	59.3%	44.0%	0%	0%	0%	0%	0%	0%
EDR_400_REV_1	0.2%	0.8%	0%	0%	0%	0%	0%	0%	0%
FER Busbar 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
FER_400_NVV	3.0%	2.4%	0%	0%	0%	0%	0%	0%	0%
FER_400_TJE	0.1%	0%	0%	0%	0%	0%	0%	0%	0%
FER_400_TRI	1.3%	0.9%	6.7%	0%	0%	0%	0%	0%	0%
FER_400_VHA	0.1%	0.1%	0%	0%	0%	0%	0%	0%	0%
FGD_400_LAG	0%	0%	0%	0%	0%	0%	0%	0%	0%
GØR_400_SÅN	0.5%	3.4%	0%	0%	0%	0%	0%	0%	0%
HVE Busbar 4	0.8%	0.1%	0.2%	0%	0%	0%	0%	0%	0%
HVE_400_SÅN	0.4%	6.4%	0%	0%	0%	0%	0%	0%	0%
KAS Busbar 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
KAS_150_MAG	0.1%	0%	0.1%	0%	0%	0%	0%	0%	0%
KAS_400_LAG	0.4%	4.9%	0%	0%	0%	0%	0%	0%	0%
KAS_400_REV_1	0.7%	2.5%	0.4%	0%	0%	0%	0%	0%	0%
KFB Busbar	0%	0%	0.4%	0%	0%	0%	0%	0%	0%
KIN_400_LAG	9.9%	1.3%	0.4%	0%	0%	0%	0%	0%	0%
LAG_400_MAL	0.2%	9.3%	1.4%	0%	0%	0%	0%	0%	0%
MAL_400_TRI	4.5%	0.6%	11.6%	0%	0%	0%	0%	0%	0%
MRP_132_TEG_2	0.7%	0.2%	0.9%	0%	0%	0%	0%	0%	0%
NVV_400_VHA	0.5%	0%	0%	0%	0%	0%	0%	0%	0%
REV_400_TJE	0.3%	0.3%	4.6%	0%	0%	0%	0%	0%	0%
STA_132_TEG_1	0.4%	0.1%	0.3%	0%	0%	0%	0%	0%	0%
STA_132_TEG_2	0.2%	0.4%	0%	0%	0%	0%	0%	0%	0%

Estonia

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
150 kV – DC-EE-FI	40.3 %	38.2 %	53.8 %	5.5 %	5.7 %	7.9 %	0.8 %	1.2 %	0.2 %
330 kV – AC-Kilingi-Nõmme – Riga TEC-2 L502	5.3 %	24.9 %	7.0 %	1.5 %	6.0 %	2.2 %	0 %	0.2 %	0.2 %
330 kV – AC-Tartu – Valmiera L301	5.3 %	24.9 %	7.0 %	1.5 %	6.0 %	2.2 %	0 %	0.2 %	0.2 %
330 kV – AC-Tsirguliina – Valmiera L354	5.3 %	24.9 %	7.0 %	1.5 %	6.0 %	2.2 %	0 %	0.2 %	0.2 %
400 kV – DC-EE-FI	40.3 %	38.2 %	53.8 %	5.5 %	5.7 %	7.9 %	0.8 %	1.2 %	0.2 %

Finland

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – P1 Haapavesi-Petäjävesi	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %
400 kV – P1 Pysäysperä-Petäjävesi	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %
400 kV – P1 Pikkarala-Alajärvi	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %
400 kV – P1 Pyhänselkä-Alajärvi	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %
400 kV – P1 Vuolijoki-Alapitkä	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %
400 kV – P1 Hirvisuo-Tuovila	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %
400 kV – P0 Keminmaa-Pikkarala	0 %	0 %	0 %	0 %	0 %	0 %	0.1 %	0.7 %	0 %
400 kV – P0 Isokangas-Pyhänselkä	0 %	0 %	0 %	0 %	0 %	0 %	0.1 %	0.7 %	0 %
400 kV – P0 Pirttikoski-Pikkarala	0 %	0 %	0 %	0 %	0 %	0 %	0.1 %	0.7 %	0 %
400 kV – FI-SE1 Keminmaa-Djuptjärn	66.3 %	76.4 %	48.8 %	0 %	0 %	0 %	0 %	1.3 %	1.1 %
400 kV – FI-SE1 Petäjäskoski-Letsi	66.3 %	76.4 %	48.8 %	0 %	0 %	0 %	0 %	1.3 %	1.1 %
400 kV – DC-FI-SE3 Rauma-Dannebo	30.7 %	35.3 %	15.9 %	0 %	0 %	0 %	0.1 %	0.1 %	0.1 %
500 kV – DC-FI-SE3 Rauma-Finnböle	30.7 %	35.3 %	15.9 %	0 %	0 %	0 %	0.1 %	0.1 %	0.1 %
150 kV – DC-FI-EE Espoo-Harku	40.8 %	30.9 %	41.2 %	0 %	0 %	0 %	0 %	0.9 %	8.0 %
450 kV – DC-FI-EE Anttila-Püssi	40.8 %	30.9 %	41.2 %	0 %	0 %	0 %	0 %	0.9 %	8.0 %

France

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
PERTAIN-ROYE 1	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
[BE-FR] Avelgem – Avelin 80	1.9 %	11.0 %	0.6 %	0 %	0 %	0 %	0 %	0 %	0 %
[FR-FR] Avelin – Mastaing 1	0 %	0.2 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
[FR-FR] Avelin Gavrelle	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
[FR-FR] Faux Fresnay – Mery sur Seine 1	0.1 %	0 %	0.7 %	0 %	0 %	0 %	0 %	0.1 %	0 %
225 kV – Malgovert Passy	0.2 %	0 %	0 %	0.4 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – Menton – Trinité Victor	5.1 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
225 kV – Menton-Camporosso	6.9 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
225 kV – ALBERTVILLE – CHAVANOD – 1	0 %	0 %	0 %	0.1 %	0 %	0.2 %	0 %	0 %	0 %
225 kV – ALBERTVILLE – CONTAMINE – 1	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – ALBERTVILLE – LONGEFAN – 1	0 %	0 %	0 %	0.2 %	0.1 %	0.4 %	0 %	0 %	0 %
225 kV – ALBERTVILLE – PIQUAGE RANDENS – 2	0 %	0 %	0 %	0.2 %	0 %	0.3 %	0 %	0 %	0 %
225 kV – AOSTE – BISSY – 1	0 %	0 %	0 %	0.2 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – ARENC – VIEUX-PORT – 1	0 %	0 %	0 %	0 %	0 %	0.3 %	0 %	0 %	0 %
225 kV – ARRIGHI – VITRY-NORD (SIEGE GMR EST) – 1	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
225 kV – AUBUSSON – MOLE – 2	0 %	0 %	0 %	0 %	0 %	0.5 %	0 %	0 %	0 %
225 kV – AUBUSSON – STE-FEYRE – 1	0 %	0 %	0 %	0 %	0 %	0.5 %	0 %	0 %	0 %
225 kV – AVOINE – DISTRE – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – AVOINE (POSTE 400 KV) – AVOINE – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – BEAULIEU – SIRMIERE – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0.1 %	0 %	0 %
225 kV – BEAUTOR (POSTE) – HAUT-VINAGE (LIEU DE STOCKAGE DE MATERIEL)	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – BEAUTOR (POSTE) – HERIE-LA-VIEVILLE (LE) – 1	0 %	0 %	0 %	0.3 %	0 %	0 %	0 %	0 %	0 %
225 kV – BLOCAUX – LIMEUX – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – BREUIL (LE) – PEYRAT-LE-CHATEAU – 1	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %
225 kV – BREUIL (LE) – PIQUAGE A SAINT GERONS – 1	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – BRIOUX-SUR-BOUTONNE – FLEAC – 1	0 %	0 %	0 %	0 %	0 %	0.6 %	0 %	0 %	0 %
225 kV – BRIOUX-SUR-BOUTONNE – NIORT – 1	0 %	0 %	0 %	0 %	0 %	0.4 %	0 %	0 %	0 %
225 kV – CHALON – CHAMPVANS – 1	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – CHAMPAGNIER – EYBENS – 2	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – CHAMPAGNIER – SERRE-PONCON – 1	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – CHAMPAGNOLE – SAONE – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – CHAMPVANS – PYMONT – 1	0 %	0 %	0 %	0.1 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – CHAMPVANS TRANSFORMER	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
225 kV – CORNIER – GENISSIAT – 2	0 %	0 %	0 %	0.3 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – CORNIER – PRESSY – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – CROIX-DE-METZ – LANEUVEVILLE – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – DONZAC – VERLHAGUET – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
225 kV – EGUZON – MAUREIX (LE) – 1	0 %	0 %	0 %	0 %	0 %	0.3 %	0 %	0 %	0 %
225 kV – EGUZON – STE-FEYRE – 1	0 %	0 %	0 %	0 %	0 %	0.5 %	0 %	0 %	0 %
225 kV – EYBENS – LANCE/EYBEN FROGE 1 – 1	0 %	0 %	0 %	0.2 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – FLEAC – ROUMAGNOLLE – 1	0 %	0 %	0 %	0 %	0 %	0.6 %	0 %	0 %	0 %
225 kV – FROGES – LANCE/EYBEN FROGE 1 – 1	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %	0 %	0 %
225 kV – FROGES – MERCI/FROGE G.ILE 1 – 1	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %	0 %	0 %
225 kV – GARCHIZY – GIEN/GARCH TABAR 1 – 1	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
225 kV – GENISSIAT – PIQUAGE CRUSEILLES – 1	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %

France (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
225 kV – GENISSIAT – VIELMOULIN – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – GODIN – PIQUAGE A NEGREPELISSE – 1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
225 kV – GRANDE-ILE – MERCI/FROGE G.ILE 1 – 1	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
225 kV – GRANDE-SYNTHE – WARANDE – 2	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – GROSNE – MACON – 1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
225 kV – ISSOIRE – PRATCLAUX – 1	0%	0%	0%	0%	0%	0.5%	0%	0%	0%
225 kV – JONQUIERES – MONTAGNETTE (LA) – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – LEGUEVIN – LESQUIVE – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – LEGUEVIN – PORTET-ST-SIMON – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
225 kV – LONGEFAN – PIQUAGE RANDENS – 2	0%	0%	0%	0.2%	0%	0.4%	0%	0%	0%
225 kV – LONGEFAN – PIQUAGE VIEUX-MOULIN – 1	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
225 kV – LONGEFAN TRANSFORMER	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – MACON – JOUX/BOISS MACON 1 – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
225 kV – MARCKOLSHEIM – VOGELGRUN – 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
225 kV – MARNISE (LA) TRANSFORMER	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
225 kV – MAUGES (LES) – VERTOU – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – MONTOIS – ST-HUBERT – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
225 kV – NIORT – VAL-DE-SEVRE – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – PASSY – PRESSY – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – PLAN-D ORGON – ROQUEROUSSE – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – PRAZ-ST-ANDRE – SAUSSAZ II (LA) – 1	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
225 kV – PRESSY – VALLORCINE – 1	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%
225 kV – PRESSY TRANSFORMER	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
225 kV – PUSY – PIQUAGE A RIGOTTE (LA) – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
225 kV – PYMONT – VOUGLANS – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
225 kV – RIDDES – CORNIER – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
225 kV – ROGNAC – ROQUEROUSSE – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – ROQUEROUSSE – PIQUAGE A VILASSOLE – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
225 kV – ROUMAGNOLLE – PIQUAGE A GRANZ – 1	0%	0%	0%	0%	0%	0.6%	0%	0%	0%
225 kV – SAINT-TRIPHON – CORNIER – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
225 kV – SAUSSAZ II (LA) – PIQUAGE VIEUX-MOULIN – 1	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
225 kV – SAUSSAZ II (LA) TRANSFORMER	0%	0%	0%	0%	0%	0%	0%	0%	0%
225 kV – ST-CESAIRE – ST-CHRISTOL – 1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
225 kV – ST-CHRISTOL – PIQUAGE PONT TRINQUAT (LIAISON MTPELZ61SSCHR) – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
225 kV – ST-VULBAS – EST TRANSFORMER	0%	0%	0%	0%	0%	0%	0%	0%	0%
225 kV – TROIS DOMAINES – VANDIERES – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
225 kV – VERBOIS – GENISSIAT – 1	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%
225 kV – VERBOIS – GENISSIAT – 2	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%
225 kV – VERLHAGUET – PIQUAGE A NEGREPELISSE – 1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
225 kV – VINCEY – PIQUAGE LA MADELEINE – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – Albertville Coche	0.1%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Creys-Génissiat 2	0.1%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – La Coche-La Praz	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – La Praz-Villarodin	0.3%	0%	0.6%	0%	0%	0%	0%	0%	0%
400 kV – Villarodin-Venaus	2.3%	0.2%	0.2%	0%	0%	0%	0%	0%	0%

France (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400 kV – Chavanod Génissiat	0.2%	0%	0%	0.1%	0%	0.2%	0%	0%	0%
400 kV – ALBERTVILLE – COCHE (LA) – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – ALBERTVILLE – MONTAGNY-LES-LANCHES – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – ALBERTVILLE TRANSFORMER	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – Albertville-Grande Ile	4.6%	0.6%	0.4%	0.5%	0.1%	0.8%	0%	0%	0%
400 kV – Albertville-Rondissone	6.7%	0.1%	0.3%	0.1%	0%	0%	0%	0%	0%
400 kV – AVOINE (POSTE 400 KV) TRANSFORMER	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – BEZAUMONT TRANSFORMER	0%	0%	0%	0.2%	0%	0.1%	0%	0%	0%
400 kV – BOCTOIS – MORBRAS – 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – BOISSE (LA) TRANSFORMER	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – BOIS-TOLLOT – GENISSIAT – 1	0%	0%	0%	0.2%	0%	0.2%	0%	0%	0%
400 kV – BOUTRE TRANSFORMER	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – BRAUD – CUBNEZAIS – 3	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
400 kV – BREUIL (LE) – RUEYRES – 1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
400 kV – CHAFFARD (LE) – MIONS – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – CHAFFARD (LE) – ST-VULBAS-OUEST – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – CHAFFARD (LE) – ST-VULBAS-OUEST – 2	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
400 kV – CHAFFARD (LE) – ST-VULBAS-OUEST – 3	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
400 kV – CHAFFARD (LE) – ST-VULBAS-OUEST – 4	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – CHESNOY (LE) – MORBRAS – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – COCHE (LA) – PRAZ-ST-ANDRE – 1	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
400 kV – CORDEMAIS – DISTRE – 2	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
400 kV – CORDEMAIS – GALOREAUX (LES) – 1	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
400 kV – CORNIER – GENISSIAT – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – CORNIER – MONTAGNY-LES-LANCHES – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – CORNIER TRANSFORMER	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
400 kV – COULANGE – TRICASTIN-POSTE (LE) – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – CRENEY TRANSFORMER	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – CREYS – GENISSIAT – 1	0%	0%	0%	0.3%	0%	0.2%	0%	0%	0%
400 kV – CREYS – GENISSIAT – 2	0%	0%	0%	0.1%	0%	0.7%	0%	0%	0%
400 kV – CREYS – GRANDE-ILE – 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – CREYS – ST-VULBAS-OUEST – 1	0%	0%	0%	0.3%	0.1%	0.4%	0%	0%	0%
400 kV – CREYS – ST-VULBAS-OUEST – 2	0%	0%	0%	0%	0.1%	0.3%	0%	0%	0%
400 kV – CUBNEZAIS – SAUCATS – 2	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – DISTRE – GALOREAUX (LES) – 1	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
400 kV – DISTRE – JUMEAUX (LES) – 2	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – EGUZON – RUEYRES – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – ENSDORF – VIGY – 1	0.1%	1.3%	1.1%	0%	0.3%	0.6%	0%	0%	0%
400 kV – ENSDORF – VIGY – 2	0.2%	1.1%	0.8%	0.5%	0.4%	0.7%	0%	0%	0%
400 kV – FRASNE – GENISSIAT – 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – FRASNE TRANSFORMER	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – GENISSIAT – VIELMOULIN – 3	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – GENISSIAT TRANSFORMER	0%	0%	0%	0.1%	0.1%	0.4%	0%	0%	0%
400 kV – GRANDE-ILE TRANSFORMER	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – GRANZAY – JUMEAUX (LES) – 2	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – GRANZAY TRANSFORMER	0%	0%	0%	0%	0%	0.1%	0%	0%	0%

France (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400 kV – MARMAGNE – TABARDERIE – 2	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – MARQUIS(LE) – SAUCATS – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – MOULAINE TRANSFORMER	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – PLAN-D ORGON TRANSFORMER	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – PRAZ-ST-ANDRE – PIQUAGE A LA PRAZ-ST-ANDRE – 2	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
400 kV – PRAZ-ST-ANDRE TRANSFORMER	0%	0%	0%	0.1%	0%	0.2%	0%	0%	0%
400 kV – REALTOR – TAVEL – 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – REALTOR – TAVEL – 2	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – SAINT AVOLD – VIGY – 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – ST-AVOLD TRANSFORMER	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – TAVEL – TRICASTIN-POSTE (LE) – 5	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – VALDIVIENNE TRANSFORMER	0%	0%	0%	0.1%	0%	0%	0%	0.2%	0%
400 kV – VENAUS – VILLARODIN – 1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
400 kV – VIGY TRANSFORMER	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
400 kV – VILLARODIN – PIQUAGE A LA PRAZ-ST-ANDRE – 1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
ACHENE-LONNY 1	0.6%	2.3%	0%	0%	0%	0%	0%	0%	0%
Argia-Arkale 220 kV	25.4%	28.2%	12.3%	0%	0%	0%	0%	0%	0%
Argia-Cantegrit 400 kV	9.4%	0%	0%	0%	0%	0%	0%	0%	0%
Argia-Hernani 400 kV	0%	4.9%	2.3%	0%	0%	0%	0%	0%	0%
Argia-Mouguerre 2 220 kV	0%	13.2%	2.6%	0%	0%	0%	0%	0%	0%
ARGIAY762	0%	0%	0%	0%	0%	0%	0%	0%	0%
AT Argia 1 220 kV	1.7%	1.3%	8.4%	0%	0%	0%	0%	0%	0%
AT Cantegrit 1 400 kV	0%	0.7%	0%	0%	0%	0%	0%	0%	0%
AVELGEM-MASTAING 1	0.1%	1.2%	0%	0%	0%	0%	0%	0%	0%
AVRON – PLAISANCE – VILLEVAUDE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
AVRON – PLAISANCE – VILLEVAUDE 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
Baixas-Vic 400 kV	0%	0.5%	0%	0%	0%	0%	0%	0.1%	0%
BEAULIEU-FARRADIERE (LA) 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
BELLE-EPINE-DOMLOUP 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
BIANCON-MOUGINS 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
BIANCON-PLAN-DE-GRASSE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biescas-Pragneres 225 kV	0%	12.9%	11.7%	0%	0%	0%	0.1%	0%	0%
BOISSE (LA)-JOUX/BOISS MACON 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
BOUCHAIN – MASTAING 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
BOUTRE-TRANS	0%	0%	0%	0%	0%	0%	0%	0%	0%
Braud-Preguillac 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
BREUIY762	0%	0%	0%	0%	0%	0%	0%	0%	0%
BUTTES-CHAUMONT-ROMAINVILLE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
By-pass PST LA PRAZ	0.5%	0%	1.7%	0%	0%	0%	0%	0%	0%
CAGNES-SUR-MER-MOUGINS 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cantegrit-Mouguerre 220 kV	0%	0%	17.6%	0%	0%	0%	0%	0%	0%
CARRIERES-GOUVIEUX 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
CERGY – PIQUAGE A SAINT-OUEN-L AUMONE (ZLIE5)	0%	0%	0%	0%	0%	0%	0%	0%	0%
CHAMPAGNOLE – FRASNE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
CHAPON-TROIS DOMAINES	0%	0%	0%	0%	0%	0%	0%	0%	0%
CORDEAC-SAUTET (LE) 1	0%	0%	0%	0%	0%	0%	0%	0%	0%

France (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
CORDEMAIS-POSTE-LOUISFERT 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
CORDEMAIS-POSTE-LOUISFERT 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
CORMEILLES-NANTERRE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
CROIX-ROUSSE-VAISE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
CUBNEZAIS-MONTGUYON 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
DANTOU-VERLHAGUET 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
DIGUE-DES-FRANCAIS-LINGOSTIERE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
DIGUE-DES-FRANCAIS-LINGOSTIERE 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
DISTRY765	0%	0%	0%	0%	0%	0%	0%	0%	0%
EGUZON – ORANGERIE	0%	0%	0%	0%	0%	0%	0%	0%	0%
EPIZON – LES HAUTS PAYS-PIQUAGE A EPIZON	0%	0%	0%	0%	0%	0%	0%	0%	0%
FALLOU – TILLIERS 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
FLOIRAC-PESSAC 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
FROMAINVILLE/CORMEILLES 3	0%	0%	0%	0%	0%	0%	0%	0%	0%
GABION-RATIER 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
GALERES – PIQUAGE GALERES A CHELLES 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
GANGES – ST VICTOR 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
GARCHIZY-ST-ELOI	0%	0%	0%	0%	0%	0%	0%	0%	0%
GENISSIAT-POSTE-SERRIERES 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
GIVORS-MIONS 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
GIVORS-MIONS 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
GODIN-PIQUAGE A SAINT GERONS	0%	0%	0%	0%	0%	0%	0%	0%	0%
HAUTES – FALAISES-SAINNEVILLE N°1	0%	0%	0%	0%	0%	0%	0%	0%	0%
HOLQUE-RUMIN/ATTAQ HOLQU 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
ISSOIRE-LIGNAT 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
ISSOIRE-PRATCLAUX 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lannemezan-Pragneres 220 kV	0%	0%	2.2%	0%	0%	0%	0%	0%	0%
LAVEYRUNE-PIED-DE-BORNE	0%	0%	0%	0%	0%	0%	0%	0%	0%
LIESSE – PIQUAGE A SAINT-OUEN-L AUMONE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
LINGOSTIERE-TRINITE-VICTOR 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
MANDARINS – PEUPLINGUES	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
MARSILLON-PRAGNERES 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
MARTYRE – PONANT 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
MARTYRE (LA) – Z TREFLEVENEZ 2	0%	0%	0%	0%	0%	0%	0%	0.2%	0%
MERCIERS (LES)-MERCI/FROGE G.ILE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
MOIRANS-PIQUAGE AUX PETITES ILES	0%	0%	0%	0%	0%	0%	0%	0%	0%
MUREMONT – PIQUAGE A EPIZON	0%	0%	0%	0%	0%	0%	0%	0%	0%
ONET-LE-CHATEAU-RUEYRES 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
ORVAULT- St JOSEPH 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
P.ORGY761	0%	0%	0%	0%	0%	0%	0%	0%	0%
PELTR/BEZAUMONT	0%	0%	0%	0%	0%	0%	0%	0%	0%
PERELLE-PIQUAGE AUX PETITES ILES 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
PLAISANCE – PIQUAGE A NEUILLY-SUR-MARNE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
PONT-SEPT-SAINNEVILLE n°2	0%	0%	0%	0%	0%	0%	0%	0%	0%
PST LA PRAZ	17.1%	0.3%	0.7%	0%	0%	0%	0.1%	0%	0%
PST Pragnères 1	0%	0%	0%	0%	0%	0%	0%	0%	0%

France (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
PST Pragnères 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
RASSUEN – SALON-BEL-AIR 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
ROUGEMONTIER-YAINVILLE 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
RUMINGHEM/ ATTAQ HOLQU 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
S.A.F.E.-VIGY 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAUSSAZ – Z VIEUX MOULIN	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAUVETERRE-DE-GUYENNE-PIQUAGE A FONCROSE	0%	0%	0%	0%	0%	0%	0%	0%	0%
SEINE – SAINT OUEN 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
SSELOY765	0%	0%	0%	0%	0%	0%	0%	0%	0%
SSELOY766	0%	0%	0%	0%	0%	0%	0%	0%	0%
TR Albertville	0%	0%	0%	0%	0%	0%	0%	0%	0%
TR Frasnes	0%	0%	0%	0%	0%	0%	0%	0%	0%
TRI.PY761	0%	0%	0%	0%	0%	0%	0%	0%	0%
TRI.PY762	0%	0%	0%	0%	0%	0%	0%	0%	0%
TRI.PY765	0%	0%	0%	0%	0%	0%	0%	0%	0%
VALDEROURE-PIQUAGE A VALDEROURE	0%	0%	0%	0%	0%	0%	0%	0%	0%
VAUPALIERE (LA)-YAINVILLE	0%	0%	0%	0%	0%	0%	0%	0%	0%
VILLEJUST – PIQUAGE LES CARRES A MARCOUSSIS 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
VILLEJUST – PIQUAGE LES CARRES A MARCOUSSIS 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
VILLEVAUDE – PIQUAGE GALERES A CHELLES 2	0%	0%	0%	0%	0%	0%	0%	0%	0%

Germany

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Altheim – Sittling 219	1.0%	0%	0%	6.3%	4.7%	2.7%	0.4%	0.2%	0.2%
220 kV – Altheim – Sittling 220	5.0%	4.0%	1.0%	7.4%	4.9%	3.0%	0.2%	0.2%	0.4%
220 kV – Altheim – Y Simbach 233/230	0%	1.0%	1.0%	8.0%	6.3%	2.6%	1.0%	0.9%	0.1%
220 kV – Altheim – Y Simbach 234/230	0%	0%	1.0%	0%	3.8%	2.6%	0%	0%	0.1%
220 kV – Altheim – Y Simbach 234/230/20	0%	0%	0%	4.5%	0.7%	0%	0%	0%	0.2%
220 kV – Cloppenburg/O – Conneforde CLPO RT	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – Conneforde – Conneforde Ost 421	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – Conneforde – Conneforde Ost 422	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – Conneforde – Fedderwarden BLAU	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – Conneforde – Fedderwarden ROT	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – Conneforde – Unterweser CONN RT	0%	0%	0%	0.6%	0%	0.9%	0%	0%	0%
220 kV – Conneforde – Y Emden/O SCHWARZ	0%	0%	0%	27.4%	13.0%	0%	5.8%	0.3%	0%
220 kV – Conneforde – Y Emden/O WEISS	0%	0%	0%	25.7%	13.1%	0%	1.5%	4.2%	0%
220 kV – Emden/Borssum – Y Emden/O EMOS SW	0%	0%	0%	12.3%	5.5%	0%	5.8%	0.5%	0%
220 kV – Emden/Borssum – Y Emden/O WEISS	0%	0%	0%	10.5%	7.7%	0%	1.5%	4.2%	0.1%
220 kV – Emden/O – Y Emden/O SCHWARZ	0%	0%	0%	25.7%	12.4%	0%	5.8%	0.3%	0%
220 kV – Emden/O – Y Emden/O WEISS	0%	0%	0%	19.0%	13.0%	0%	1.5%	0.3%	0%
220 kV – Etzenricht – Schwandorf 248	0%	0%	0%	0%	0.3%	0%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Fedderwarden – Maade SCHWARZ	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
220 kV – Fedderwarden – Maade WEISS	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
220 kV – Frankfurt/N – Y Dörnigheim 2	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
220 kV – Godenau – Lehrte 1	0%	0%	0%	3.4%	4.3%	0.2%	0.6%	1.0%	0%
220 kV – Godenau – Y Erzhausen 3	0%	0%	0%	0%	0%	0.2%	0.2%	0%	0%
220 kV – Göttingen – Würgassen 3	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – Göttingen – Würgassen 4	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – Grosskrotzenburg – Trennfeld 217	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Grosskrotzenburg – Trennfeld 218	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Grosskrotzenburg – Y Dörnigheim 2	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
220 kV – Hamburg/N – Brokdorf BLAU	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
220 kV – Hardegsen – Göttingen 1	0%	0%	0%	0%	0.4%	0%	0%	0%	0%
220 kV – Hardegsen – Göttingen 1/3	0%	0%	0%	0%	0%	1.6%	0%	0%	0%
220 kV – Hardegsen – Göttingen 2	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Hardegsen – Göttingen 3	0%	0%	0%	1.0%	0.7%	0.5%	0%	0.2%	0%
220 kV – Hardegsen – Y Erzhausen 2	0%	0%	0%	0.1%	0.7%	0.6%	0%	0.1%	0%
220 kV – Inhausen – Maade SCHWARZ	0%	0%	0%	0.1%	0.2%	0%	0%	0%	0%
220 kV – Itzehoe/W – Brokdorf GRUEN	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Landesbergen – Landesbergen	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Landesbergen – Lehrte 1	0%	0%	0%	0%	0%	0.6%	0%	0.2%	0%
220 kV – Ludersheim – Raitersaich 237	0%	0%	0%	0.1%	0%	0.3%	0%	0%	0.2%
220 kV – Ludersheim – Sittling 221	0%	0%	0%	0.3%	0.7%	0.6%	0%	0%	0%
220 kV – Mehrum – Hallendorf 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Mehrum – Lehrte 1	0%	0%	0%	1.1%	4.0%	0%	0.3%	0.8%	0%
220 kV – Mehrum – Lehrte 2	0%	0%	0%	1.1%	4.0%	0%	0.3%	0.5%	0%
220 kV – Mehrum – Y Hallendorf 2	0%	0%	0%	0%	0.1%	0.3%	0%	0%	0%
220 kV – Neufinsing – Zolling 258	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Oberbrunn – Y Krün 250	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
220 kV – Pleinting – Pirach 257	0%	0%	0%	0.3%	0%	0%	0%	0%	0%
220 kV – Raitersaich – Trennfeld 211	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Schwandorf – Ludersheim 223	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – Schwandorf – Pleinting 226	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Schwandorf – Regensburg 275	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Silz – Y Krün 250	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
220 kV – Silz – Y Krün 251	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – Simbach – Y Simbach 233/230	0%	0%	0%	0%	0%	0.1%	0%	0.2%	0.1%
220 kV – Sottrum – Blockland SOTT BL	0%	0%	0%	0.5%	0.7%	0.2%	0%	0%	0%
220 kV – St. Peter – Pirach 256	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – St. Peter – Pleinting 258	0%	0%	0%	1.3%	0.9%	1.7%	0.1%	0.1%	0.4%
220 kV – St. Peter – Y Simbach 233/230	0%	0%	0%	3.2%	2.1%	2.1%	0%	0.2%	0%
220 kV – St. Peter – Y Simbach 234/230	0%	0%	0%	0%	0.9%	1.2%	0%	0%	0.1%
220 kV – St. Peter – Y Simbach 234/230/20	0%	0%	0%	0.3%	0%	0%	0%	0.1%	0%
220 kV – Voslapp – Inhausen ROT	0%	0%	0%	0.1%	0.1%	0%	0%	0%	0%
220 kV – Wahle – Braunschweig/N 1	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – Wahle – Lehrte 1	0%	0%	0%	0.7%	5.7%	1.2%	0.2%	0.5%	0%
220 kV – Westtirol – Silz 414	0%	0%	0%	0%	0%	0%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Y Erzhausen – Godenau 3	0%	0%	0%	0.8%	1.3%	0%	0.2%	0%	0%
220 kV – Y Erzhausen – Göttingen 3	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – Y Erzhausen – Hardegsen 3	0%	0%	0%	0.4%	0.5%	0%	0%	0.2%	0%
220 kV – Y Erzhausen – Lehrte 2	0%	0%	0%	0.8%	1.2%	0.9%	0.1%	0.1%	0%
220 kV – Y Huntorf – Blockland CONN WS/	0%	0%	0%	6.4%	3.8%	0.7%	0%	0%	0.1%
220 kV – Y Huntorf – Conneforde CONN GE/	0%	0%	0%	11.9%	7.7%	0.7%	0.1%	0.3%	0%
220 kV – Y Huntorf – Conneforde CONN WS/	0%	0%	0%	6.4%	3.8%	0.7%	0%	0%	0%
220 kV – Y Huntorf – Sottrum CONN GE/	0%	0%	0%	0%	1.5%	1.4%	2.0%	0.2%	0%
220 kV – Y Huntorf – Sottrum GELB	0%	0%	0%	16.5%	10.2%	0%	0.1%	0.3%	0.1%
220 kV – Y Wechold – Landesbergen 1	0%	0%	0%	5.0%	8.3%	7.6%	0.1%	0.3%	0%
220 kV – Y Wechold – Landesbergen 2	0%	0%	0%	4.9%	8.3%	6.9%	0.2%	0.1%	0.2%
220 kV – Y Wechold – Sottrum 1	0%	0%	0%	13.2%	11.3%	5.9%	0%	0.3%	0%
220 kV – Y Wechold – Sottrum 2	0%	0%	0%	12.7%	11.4%	5.6%	0%	0.1%	0.2%
220 kV – Zolling – Irsching 262	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – D73YWB D7YHBT BLUDNZ W	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – D7AKLE D7OPLA BIGGE O	0%	0%	0%	0%	0%	0%	0.4%	0%	0%
220 kV – D7AKLE D7YBIX BIGGE O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7AKLE D7YGAR BIGGE W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7AMEL D7GERS WERSE W	0%	0%	0%	0%	0%	0.5%	0%	0%	0.1%
220 kV – D7BABA D7UCHT BABARA	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
220 kV – D7BABA D7YMUT OTTERB N	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – D7BAUL D7NSTE ENZ N	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7BAUL D7NSTE ENZ S	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7BGLU D7YBEL POLSUM S	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – D7BGLU D7YGEL GLADBK W	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – D7BOCH D7EIBE BOCHUM W	0%	0%	0%	0.4%	0.1%	0%	0%	0%	0%
220 kV – D7BOCH D7YPOE HOCHLR W	0%	0%	0%	0.3%	0.6%	0%	0%	0%	0%
220 kV – D7BOCH D7YWEL WELPER O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7BOCK D7BRAU BOCKLE N	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7BOCK D7BRAU BOCKLE S	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – D7BRAU D7ROKI ROKI O	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
220 kV – D7BRAU D7ROKI VORGBG W	0%	0%	0%	0%	0%	0.6%	0%	0%	0%
220 kV – D7BRAU D7YROK STOMM N	0%	0%	0%	0.4%	0.4%	0.1%	0%	0%	0%
220 kV – D7BUER D7BW21 ANILIN	0%	0%	0%	0.1%	2.2%	0%	0%	0.1%	0%
220 kV – D7BUER D7MAXA WEINGT	0%	0%	0%	0%	0.3%	1.7%	0%	0%	0%
220 kV – D7BUER D7PFUN REINAU W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7BUER D7YBIB BIBLIS3C	0%	0%	0%	4.1%	5.0%	1.6%	0.2%	0%	0%
220 kV – D7BW21 D7MAXA WEINGT	0%	0%	0%	0.6%	0.6%	0%	0%	0%	0%
220 kV – D7BW21 D7MUTT ROXHM S	0%	0%	0%	3.1%	1.9%	0.3%	0.2%	0%	0%
220 kV – D7BW21 D7YMUT OTTERB N	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7DUEN D7GREM MERHM W	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – D7DUEN D7OPLA DUENNW O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7DUEN D7OPLA DUENNW W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7EIBE D7ITTE ITTERB W	0%	0%	0%	1.8%	0.2%	0%	0%	0%	0%
220 kV – D7EIBE D7REIS ITTERB W	0%	0%	0%	0.1%	0%	0.6%	0%	0.1%	0%
220 kV – D7EIBE D7YGEL GLADBK W	0%	0%	0%	0%	0.3%	0.1%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – D7EIBE D7YHAT ITTERB O	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – D7EIBE D7YMTM ITTERB O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7ELLE D7OPLA ELLER O	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – D7ELME D7GERS CAPPEN S	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
220 kV – D7ELME D7RUHR ELMENH S	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – D7ELME D7YELM ELMENH S	0%	0%	0%	0%	0%	1.4%	0%	0%	0%
220 kV – D7FUEH D7OPLA KASSEL S	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7FWS D7URBE SHWANH O	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – D7FWS D7URBE SHWANH W	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – D7GELL D7MUEN STRATM W	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – D7GERS D7YPOE CAPPEN N	0%	0%	0%	0.3%	0.2%	0%	0%	0%	0%
220 kV – D7GRON D7KUSE GRAFSH W	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – D7HAMB D7KOPE KOPERN24	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7HANE D7YHAN AMELSB	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7HANE D7YHAN GRAFSH W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7HATT D7YHAT ITTERB O	0%	0%	0%	0.2%	0.5%	0%	0.4%	0%	0%
220 kV – D7HATT D7YMTM ITTERB O	0%	0%	0%	0%	0%	1.4%	0%	0%	0%
220 kV – D7HATT D7YWEL WELPER O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7ITTE D7REIS ITTERB W	0%	0%	0%	0.5%	0.2%	0%	0%	0%	0%
220 kV – D7ITTE D7YMET ITTERB O	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7KUSE D7YBEL POLSUM S	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – D7KUSE D7YHAN GRAFSH W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7KUSE D7YPOE HOCHLR W	0%	0%	0%	0.1%	0%	0.3%	0%	0%	0%
220 kV – D7LAER D7POEP POEPPI W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7MAXA D7MUTT BIENWD W	0%	0%	0%	0.1%	0.1%	0.1%	0%	0%	0.1%
220 kV – D7MUEN D7RHAU RHAUSN W	0%	0%	0%	0.2%	0%	0.1%	0%	0%	0%
220 kV – D7MUEN D7YRHA PRSTORHW	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
220 kV – D7MUTT D7YHOM OTTERB S	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7MUTT D7YMUT OTTERB N	0%	0%	0%	0%	0.1%	0.8%	0%	0%	0%
220 kV – D7NORF D7PETE NORF W	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
220 kV – D7NORF D7PETE STUERZ O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7NORF D7PETE STUERZ W	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7NSTE D7WENG WENGER	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7OPLA D7ROKI STOMM N	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7OSTR D7PETE ZONS O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7OSTR D7RHAU STRATM O	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7OSTR D7YOST FRIXHM N	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
220 kV – D7OSTR D7YRHA PRSTORHW	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
220 kV – D7PETE D7ROKI FRIXHM S	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
220 kV – D7PETE D7YPET FRIXHM S	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7POEP D7YELM ELMENH S	0%	0%	0%	0%	0%	1.3%	0%	0%	0%
220 kV – D7POEP D7YKRC POEPPI O	0%	0%	0%	0%	0.2%	1.3%	0%	0%	0%
220 kV – D7POEP D7YPOE CAPPEN N	0%	0%	0%	0.3%	0.2%	0%	0%	0%	0%
220 kV – D7QUIN D7UCHT OSBURG	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7REIS D7YPET FRIXHM S	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7ROKI D7YOST FRIXHM N	0%	0%	0%	0%	0%	0.4%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – D7ROKI D7YPET FRIXHM S	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7ROKI D7YROK STOMM N	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7TIEN D7YHBT BLUDNZ W	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – D7UCHT D7YHOM OTTERB S	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7UERD D7UTFO UERDIN W	0%	0%	0%	0.1%	0%	0.3%	0%	0%	0%
220 kV – D7URBE D7YBIB BIBLIS3C	0%	0%	0%	4.4%	5.5%	1.8%	0%	0.2%	0%
220 kV – D7UTFO D7YEDE UTFORT W	0%	0%	0%	1.1%	0.6%	0.6%	0%	0%	0%
220 kV – D7UTFO D7YOSS WESEL O	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – D7VIAN D7NSTE VIANDN3C	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – D7VOEH D73YWB DELLM O	0.1%	0%	0%	0.3%	0%	0%	0%	0%	0%
220 kV – D7VOEH D7YKEM FUESSN W	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
220 kV – D7WENG D7WTHU KONDLW	0%	0%	0%	0.4%	0.1%	0%	0%	0.2%	0%
220 kV – D7WEST D7YHAN AMELSB	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – D7YBIB D7PFUN BIBLIS3C	0%	0%	0%	0%	0%	0%	0.1%	0.1%	0%
220 kV – DBA_FL D7BAUL FLE BA N	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
220 kV – DBA_FL D7BAUL FLE BA S	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – DDA_MA D7MAXA GOLDGR	0%	0%	0%	5.7%	2.3%	2.1%	0.6%	0.1%	0%
220 kV – DGK_MU D7MUTT RHEIN N	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – DGK_MU D7MUTT RHEIN S	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – Emden/Borssum – Conneforde /WEISS	0%	0%	0%	0%	0%	0%	0.4%	1.7%	0%
220 kV – XBE TI D7TIEN AARE O	0%	0%	0.2%	0.1%	0%	0.3%	0%	0%	0%
220 kV – XBE TI D7TIEN AARE W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – XWE_VO D7VOEH FUESSN W	0%	0%	0%	0%	0.1%	0.8%	0%	0%	0.1%
220 kV – XWE_WB D73YWB DELLM O	0%	0%	0%	0.6%	0.2%	0%	0.1%	0%	0%
220/380 kV – Wendlingen Trafo 324	0%	0%	0%	0.1%	0%	0.4%	0%	0%	0%
220 kV – Eichstetten-Vogelgrün (Kaiserstuhl)	0%	0%	0%	0.2%	0.1%	0%	0%	0%	0%
220 kV – Gurtweil-Laufenburg-Stokack rot-gelb	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Neurott – Heidelberg Süd rot	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Altlußheim – Daxlanden – GKM blau/gelb	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Altlußheim – GKMB blau	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Baltic 1 – Baltic 2 153	0%	0%	0%	5.4%	0%	0.1%	0%	0%	0%
220 kV – Baltic 1 – Baltic 2 154	0%	0%	0%	4.9%	0%	0.1%	0%	0%	0%
220 kV – Bentwisch – Baltic 1 151	0%	0%	0%	6.0%	0%	0.2%	0%	0%	0%
220 kV – Bentwisch – Baltic 1 152	0%	0%	0%	7.4%	0%	0.2%	0%	0%	0%
220 kV – Bentwisch – Güstrow 275	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Bentwisch – Lüdershagen 318	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Bertikow – Neuenhagen 303	0%	0%	0%	2.7%	8.7%	14.6%	2.9%	3.4%	2.1%
220 kV – Bertikow – Pasewalk 305	0%	0.1%	0%	1.8%	6.1%	7.5%	1.8%	2.6%	1.2%
220 kV – Buehl – Daxlanden – Kuppenheim rot	0%	0%	0%	0.3%	1.4%	0.9%	0%	0%	0%
220 kV – Buers – Meiningen grün	0%	0.5%	0%	0.2%	0%	0%	0%	0%	0%
220 kV – Buers – Westtirol 421 weiss	0.2%	0.4%	0.1%	0%	0%	0%	0%	0%	0%
220 kV – Daxlanden – Karlsruhe West gelb (Waidfeld)	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Daxlanden – Karlsruhe West rot (Rappenwörth)	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Daxlanden – Kuppenheim – Weier gelb	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Daxlanden – Kuppenheim – Weier rot	0%	0%	0%	0.1%	0%	0%	0.7%	0.3%	0.1%
220 kV – Daxlanden – Neurott gelb	0%	0%	0%	0%	0%	0%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – GKMB – Weinheim braun	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Gurtweil – Laufenburg gelb	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Hennigsdorf – Wustermark 293	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Karlsruhe Ost – Oberwald rot	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %
220 kV – Krajnik – Vierraden 507	0 %	0 %	0 %	1.6 %	0.1 %	0.3 %	0.1 %	0 %	0 %
220 kV – Krajnik – Vierraden 508	0 %	0 %	0 %	2.8 %	0.7 %	0 %	0.1 %	0 %	0 %
220 kV – Kriegers Flak – Baltic 2 155	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %	0 %	0 %
220 kV – Kriegers Flak – Baltic 2 156	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %	0 %	0 %
220 kV – Kuehmoos – Laufenburg weis	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Kühmoos-Laufenburg-Lindenholz bl	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Lubmin – Lubmin 261	0 %	0 %	0 %	19.7 %	19.5 %	25.4 %	0 %	0 %	0 %
220 kV – Lubmin – Wikinger 282	0 %	0 %	0 %	17.8 %	18.0 %	24.3 %	0 %	0 %	0 %
220 kV – Neuenhagen – Vierraden 304	1.4 %	3.4 %	3.7 %	4.6 %	1.2 %	2.0 %	0.2 %	0 %	0.1 %
220 kV – Neuenhagen – Vierraden 304-303	0 %	0.5 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Neuenhagen – Wustermark 294	0 %	0 %	0 %	0 %	0.8 %	0.4 %	0 %	0 %	0 %
220 kV – Parchim/Süd – Güstrow 468	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Pasewalk – Güstrow – Iven 316	0 %	0 %	0 %	0 %	0.1 %	0.8 %	0 %	0 %	0.6 %
220 kV – Pasewalk – Güstrow 315	0 %	0 %	0 %	0 %	0.1 %	0.1 %	0 %	0 %	0 %
220 kV – Thyrow – Wuhlheide 302	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Vierraden – Pasewalk 306	27.4 %	18.1 %	3.8 %	16.0 %	12.3 %	20.2 %	1.1 %	1.7 %	2.7 %
220 kV – Wikinger – Arkona-Becken/Südost 265	0 %	0 %	0 %	16.2 %	19.1 %	24.4 %	0 %	0 %	0 %
220 kV – Wikinger – Lubmin/281	0 %	0 %	0 %	17.8 %	17.0 %	24.5 %	0 %	0 %	0 %
220 kV – Wuhlheide – Thyrow 291	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Wustermark – Brandenburg/West 319	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
220 kV – Wustermark – Brandenburg/West 324	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
230 kV – Eula – Röhrsdorf 203	0 %	0 %	0 %	0.1 %	0.4 %	1.1 %	0 %	0 %	0 %
380 kV – Alfstedt – Dollern DOLL GE	0 %	0 %	0 %	0 %	0 %	1.8 %	0 %	0 %	0 %
380 kV – Alfstedt – Dollern DOLL RT	0 %	0 %	0 %	0 %	0 %	3.6 %	0 %	0 %	0.4 %
380 kV – Algermissen – Mehrum/N 2	0 %	0 %	0 %	0 %	0 %	2.4 %	0 %	0 %	0.2 %
380 kV – Algermissen – Wahle 2	0 %	0 %	0 %	0.2 %	1.0 %	0 %	0.1 %	0.9 %	0 %
380 kV – AudorfS – Wilster/W AUDS BL	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – AudorfS – Wilster/W AUDS RT	0 %	0 %	1.0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Bechterdissen – Eickum 1	0 %	1.0 %	1.0 %	0.3 %	10.1 %	19.1 %	0.4 %	0.1 %	0.2 %
380 kV – Bechterdissen – Eickum 3	21.0 %	24.0 %	11.0 %	6.3 %	9.5 %	19.0 %	0 %	0 %	0.4 %
380 kV – Bechterdissen – Y Eickum 3	0 %	0 %	0 %	3.5 %	0 %	0 %	0.5 %	0 %	0 %
380 kV – Bechterdissen – Y Eickum 4/1	0 %	0 %	0 %	3.0 %	0 %	0 %	0.2 %	0.1 %	0 %
380 kV – Bergshausen – Borken 2	0 %	0 %	0 %	18.3 %	11.7 %	11.5 %	0.9 %	0 %	1.9 %
380 kV – Bergshausen – Würgassen 1	0 %	0 %	0 %	0 %	1.2 %	8.6 %	0 %	0 %	0.1 %
380 kV – Bergshausen – Würgassen 2	0 %	0 %	0 %	2.0 %	1.3 %	4.8 %	0 %	0 %	0 %
380 kV – Bergshausen – Y Vörden 1	0 %	0 %	0 %	3.2 %	0.8 %	0 %	0.2 %	0.3 %	0 %
380 kV – Bergshausen – Y Würgassen 2	0 %	0 %	0 %	0 %	0 %	3.4 %	0 %	0.3 %	0 %
380 kV – Borken – Bergshausen 1	0 %	0 %	0 %	15.2 %	9.9 %	11.4 %	0.5 %	0 %	0.6 %
380 kV – Borken – Giessen/N 1	0 %	0 %	0 %	5.5 %	6.6 %	9.1 %	0.5 %	0.7 %	0.2 %
380 kV – Borken – Giessen/N 2	0 %	0 %	0 %	5.6 %	6.6 %	8.7 %	1.2 %	0.9 %	0.3 %
380 kV – Borken – Mecklar 1	0 %	0 %	0 %	0.2 %	0.2 %	1.5 %	0 %	0.3 %	0.3 %
380 kV – Borken – Mecklar 2	0 %	0 %	0 %	0.2 %	0.5 %	2.0 %	0 %	0.2 %	0.5 %

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – Büttel – Brunsbüttel BUTL BL	23.0 %	3.0 %	2.0 %	1.3 %	0 %	0 %	0.4 %	0 %	0.1 %
380 kV – Büttel – Brunsbüttel BUTL GN	9.0 %	2.0 %	1.0 %	1.3 %	0 %	0 %	0 %	0 %	0.2 %
380 kV – Conneforde – Diele DIEL RT	0 %	0 %	0 %	1.0 %	1.4 %	8.2 %	0 %	0.1 %	0.6 %
380 kV – Conneforde – Diele DIEL WS	0 %	0 %	0 %	1.5 %	1.4 %	8.5 %	0.2 %	0 %	0.3 %
380 kV – Conneforde Ost – Unterweser CONO GE	0 %	0 %	0 %	0.4 %	0.1 %	1.4 %	0.1 %	0 %	0.1 %
380 kV – Dauersberg – Asslar 1	0 %	0 %	0 %	0 %	0.1 %	0.2 %	0 %	0 %	0 %
380 kV – Dettingen – Grosskrotzenburg 1	0 %	0 %	0 %	6.8 %	13.0 %	10.8 %	0.3 %	1.0 %	0.5 %
380 kV – Diele – Dörpen West GELB	0 %	0 %	0 %	2.4 %	5.7 %	11.7 %	0.5 %	0.1 %	0.1 %
380 kV – Dipperz – Grosskrotzenburg 1	0 %	0 %	0 %	4.4 %	10 %	9.7 %	0.5 %	1.6 %	1.8 %
380 kV – Dipperz – Grosskrotzenburg 2	0 %	0 %	0 %	5.0 %	7.2 %	10.6 %	0.6 %	0.4 %	1.4 %
380 kV – Dollern – Y Alfstedt DOLL SW/	0 %	0 %	1.0 %	0 %	0 %	0.3 %	0 %	0 %	0 %
380 kV – Elsen – Twistetal 1	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380 kV – Elsen – Twistetal 2	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380 kV – Elsfleth/W – Alfstedt ALFS SW	0 %	0 %	0 %	0 %	0 %	2.4 %	0 %	0 %	0.3 %
380 kV – Elsfleth/W – Farge FARG GN	0 %	0 %	0 %	0.1 %	0 %	2.6 %	0 %	0 %	0 %
380 kV – Elsfleth/W – Ganderkesee GANK RT	0 %	0 %	0 %	0 %	0 %	1.6 %	0 %	0 %	0 %
380 kV – Elsfleth/W – Niedervieland NVLD GN	0 %	0 %	0 %	0 %	0 %	1.2 %	0 %	0 %	0.2 %
380 kV – Eltmann – Redwitz 428	0 %	0 %	0 %	0.4 %	2.2 %	1.7 %	0.1 %	0.3 %	0 %
380 kV – Farge – Alfstedt ALFS BL	0 %	0 %	0 %	0 %	0 %	2.2 %	0 %	0 %	0 %
380 kV – Farge – Y Alfstedt BLAU	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Farge – Y Alfstedt DOLL BL/	0 %	0 %	0 %	0 %	0 %	0.4 %	0 %	0 %	0 %
380 kV – Ganderkesee – Dickel/W HU SW	0 %	0 %	0 %	0 %	0 %	2.8 %	0 %	0 %	0 %
380 kV – Ganderkesee – Dickel/W HU WS	0 %	0 %	0 %	0 %	0 %	2.8 %	0 %	0 %	0 %
380 kV – Giessen/N – Asslar 4	0 %	0 %	0 %	0 %	0.1 %	0.2 %	0 %	0 %	0 %
380 kV – Giessen/N – Karben 1	0 %	0 %	0 %	1.3 %	4.0 %	2.3 %	0 %	0.5 %	0.1 %
380 kV – Giessen/N – Karben 2	0 %	0 %	0 %	1.7 %	3.7 %	2.7 %	0 %	0.4 %	0.1 %
380 kV – Grafenrheinfeld – Bergrheinfeld West 427	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
380 kV – Grafenrheinfeld – Eltmann 422	0 %	0 %	0 %	0.2 %	1.0 %	1.2 %	0 %	0 %	0 %
380 kV – Grafenrheinfeld – Oberhaid 423	0 %	0 %	0 %	0.1 %	0.5 %	0.1 %	0 %	0 %	0 %
380 kV – Grafenrheinfeld – Raitersaich 434	0 %	0 %	0 %	0 %	0.5 %	0.2 %	0 %	0 %	0 %
380 kV – Grohnde – Algermissen 2	0 %	0 %	0 %	0.1 %	0.4 %	2.1 %	0 %	0.3 %	0 %
380 kV – Grohnde – Klein Ilsede 1	0 %	0 %	0 %	0.1 %	0.4 %	0 %	0 %	0 %	0 %
380 kV – Grohnde – Mehrum/N 1	0 %	0 %	0 %	0 %	0 %	3.3 %	0 %	0 %	0 %
380 kV – Gütersloh – Bechterdissen 1	0 %	0 %	0 %	0.9 %	0.2 %	4.3 %	0 %	0 %	0 %
380 kV – Gütersloh – Bechterdissen 2	0 %	0 %	0 %	1.0 %	0.2 %	4.3 %	0 %	0 %	0.1 %
380 kV – Hanekenfähr – Dörpen West EWBL	0 %	0 %	0 %	28.5 %	29.3 %	24.4 %	5.2 %	4.3 %	2.3 %
380 kV – Hattorf – Helmstedt 1	0 %	0 %	0 %	0 %	0.3 %	0 %	0 %	0 %	0 %
380 kV – Hattorf – Helmstedt 2	0 %	0 %	0 %	0 %	0.3 %	0.1 %	0.3 %	0 %	0 %
380 kV – Heide/W – Süderdonn HEIW BL	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Heide/W – Süderdonn HEIW GN	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Höpfingen – Grafenrheinfeld 411	0 %	0 %	0 %	0.4 %	1.1 %	1.2 %	0.1 %	0.1 %	0 %
380 kV – Hradec A – Etzenricht 441	0 %	1.0 %	1.0 %	0.1 %	0.4 %	1.5 %	0 %	0 %	0 %
380 kV – Irsching – Ottenhofen 421	0 %	0 %	0 %	0 %	0.2 %	0.1 %	0 %	0 %	0 %
380 kV – Irsching – Raitersaich 424	0 %	0 %	0 %	0 %	0.2 %	0.3 %	0 %	0 %	0.1 %
380 kV – Irsching – Raitersaich 425	0 %	0 %	0 %	0 %	0.4 %	0.3 %	0 %	0.2 %	0 %
380 kV – Isar – Ottenhofen 443	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – Isar – Ottenhofen 446	0%	0%	0%	0%	0%	0%	0%	0.3%	0%
380 kV – Isar – Pleinting 451	0%	0%	0%	0%	0%	0.5%	0%	0%	0.2%
380 kV – Isar – Pleinting 452	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – Jardelund – Handewitt JARD BL	0%	0%	1.0%	0%	0%	0%	0%	0%	0%
380 kV – Jardelund – Handewitt JARD GN	0%	1.0%	2.0%	0%	0%	0%	0%	0%	0%
380 kV – Jardelund – Kassoe/ENDK 1	0%	0%	2.0%	0%	0%	0%	0%	0%	0%
380 kV – Jardelund – Kassoe/ENDK 2	0%	0%	1.0%	0%	0%	0%	0%	0%	0%
380 kV – Karben – Frankfurt/SW 3	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – Karben – Grosskrotzenburg 1	0%	0%	0%	0%	0%	0.1%	0%	0%	0.1%
380 kV – Karben – Grosskrotzenburg 3	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%
380 kV – Kassö – Handewitt 1	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%
380 kV – Kassö – Handewitt 2	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – Klein Ilsede – Wahle 3	0%	0%	0%	0.1%	0.7%	6.9%	0%	0.3%	1.0%
380 kV – Kriegenbrunn – Raitersaich 438	0%	0%	0%	0.6%	0.7%	0%	0%	0%	0%
380 kV – Kriftel – Y Frankfurt/SW 2	0%	0%	0%	0.4%	0.6%	0.5%	0.1%	0.1%	0%
380 kV – Krümmel – Stadorf 2	1.0%	0%	0%	0.4%	0%	4.3%	0%	0%	0%
380 kV – Landesbergen – Grohnde 2	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – Lüneburg – Krümmel KRUE GN	0%	0%	0%	1.1%	0.3%	3.9%	0%	0.2%	0%
380 kV – Lüneburg – Stadorf 1	0%	0%	0%	1.1%	0.5%	3.8%	0%	0%	0%
380 kV – Mecklar – Dipperz 1	0%	0%	0%	7.6%	10.6%	12.5%	1.4%	3.8%	1.4%
380 kV – Mecklar – Dipperz 2	0%	0%	0%	10.1%	10.2%	12.1%	1.3%	2.2%	1.6%
380 kV – Meeden – Diele MEED SW	1.0%	0%	0%	11.8%	19.6%	16.5%	0%	0%	0%
380 kV – Meeden – Diele MEED WS	0%	0%	0%	14.4%	12.9%	16.5%	0%	0%	0%
380 kV – Mehrum/N – Klein Ilsede 1	0%	0%	0%	0%	0%	6.1%	0%	0%	0.1%
380 kV – Mehrum/N – Wahle 2	0%	0%	0%	0%	0%	7.2%	0%	0.1%	0.7%
380 kV – Meitingen – Oberbachern 419	1.0%	0%	0%	0%	1.1%	1.3%	0%	0.1%	0.1%
380 kV – Meitingen – Oberbachern 420	0%	0%	0%	0%	1.0%	1.3%	0%	0.2%	0.1%
380 kV – Meppen – Y Niederlangen EOWS	0%	0%	0%	28.8%	29.8%	23.9%	19.9%	11.5%	5.6%
380 kV – Niedervieland – Ganderkesee NVLD SW	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
380 kV – NordLink cable	19.0%	26.0%	29.0%	0%	0%	0%	0%	0%	0%
380 kV – Oberhaid – Redwitz 435	0%	0%	0%	0.1%	0.7%	0.7%	0%	0.1%	0.2%
380 kV – Ohlensehlen – Landesbergen 1	0%	0%	0%	0.2%	0%	0.1%	0%	0%	0%
380 kV – Ottenhofen – Oberbachern 461	0%	0%	0%	0.8%	9.8%	6.9%	0.2%	1.6%	0.3%
380 kV – Ottenhofen – Oberbachern 462	0%	0%	0%	0.8%	9.8%	6.9%	0%	0.6%	0.3%
380 kV – Ovenstädt – Eickum 3	16.0%	12.0%	14.0%	4.7%	7.6%	16.6%	0%	0%	0.2%
380 kV – Ovenstädt – Eickum 4	0%	0%	0%	5.2%	7.4%	16.5%	0.9%	0.2%	0.6%
380 kV – Ovenstädt – Landesbergen 4	0%	0%	0%	10.1%	6.8%	16.7%	5.7%	0.6%	2.9%
380 kV – Ovenstädt – Sottrum 3	0%	0%	0%	7.5%	7.2%	9.5%	1.0%	0%	0%
380 kV – Ovenstädt – Y Eickum 3	0%	0%	0%	4.2%	0%	0%	0.4%	0%	0%
380 kV – Ovenstädt – Y Eickum 4/1	0%	0%	0%	3.5%	0%	0%	0.5%	0%	0%
380 kV – Prestice – Etzenricht 442	0%	0%	0%	0%	0%	0.5%	0%	0%	0%
380 kV – Raitersaich – Würgau 431	0%	0%	0%	0.4%	1.7%	0%	0%	0%	0%
380 kV – Redwitz – Kriegenbrunn 432	0%	0%	0%	1.8%	4.2%	0%	0.1%	0%	0%
380 kV – Sottrum – Dollern DOLL GN	0%	0%	0%	15.4%	13.4%	20%	12.8%	11.5%	7.6%
380 kV – Sottrum – Dollern DOLL SW	0%	0%	0%	15.3%	17.0%	17.1%	2.2%	5.9%	7.0%
380 kV – Sottrum – Landesbergen 2	1.0%	0%	1.0%	9.5%	9.7%	10.3%	0.2%	1.2%	1.1%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – Sottrum – Landesbergen 3	0 %	0 %	6.0 %	0 %	0 %	6.9 %	0 %	0 %	2.4 %
380 kV – Sottrum – Ovenstädt 2	0 %	0 %	0 %	0 %	0 %	4.1 %	0 %	0 %	0.1 %
380 kV – Stade/W – Dollern STAW SW	0 %	0 %	5.0 %	0 %	0 %	5.7 %	0 %	0 %	0 %
380 kV – Stade/W – Dollern STAW WS	0 %	0 %	9.0 %	0 %	0 %	6.0 %	0 %	0 %	0.1 %
380 kV – Stadorf – Wahle 1	0 %	0 %	0 %	1.2 %	0.2 %	8.1 %	0 %	0.2 %	0 %
380 kV – Stadorf – Wahle 2	0 %	0 %	0 %	1.2 %	1.8 %	8.1 %	0 %	0.2 %	0 %
380 kV – Stalldorf – Grafenrheinfeld 416	0 %	0 %	0 %	1.1 %	3.7 %	4.2 %	0.3 %	0.2 %	0 %
380 kV – Süderdonn – Brunsbüttel SDON BL	0 %	0 %	0 %	0 %	0 %	2.4 %	0 %	0 %	4.0 %
380 kV – Süderdonn – Brunsbüttel SDON GE	0 %	0 %	0 %	0 %	0 %	2.4 %	0 %	0 %	0.3 %
380 kV – Unterweser – Elsfleth/W ELWE RT	0 %	1.0 %	1.0 %	0.3 %	0 %	0.6 %	0 %	0 %	0 %
380 kV – Unterweser – Elsfleth/W ELWE WS	0 %	0 %	0 %	0.3 %	0 %	0.6 %	0 %	0 %	0 %
380 kV – Urberach – Grosskrotzenburg 2	0 %	1.2 %	1.2 %	7.0 %	13.5 %	11.3 %	0.2 %	0.4 %	1.1 %
380 kV – W11_D2DOLL12_GELB	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Wahle – Hattorf 1	0 %	0 %	0 %	0 %	0.2 %	0.1 %	0 %	0 %	0 %
380 kV – Wahle – Hattorf 2	0 %	0 %	0 %	0 %	0.4 %	0.1 %	0 %	0 %	0 %
380 kV – Wehrendorf – Ohlensehlen 1	0 %	0 %	0 %	0.7 %	0.1 %	0.4 %	0 %	0 %	0.1 %
380 kV – Wilster/W – Büttel WILW GE	0 %	3.0 %	3.0 %	0 %	0.2 %	3.8 %	0 %	0 %	0.2 %
380 kV – Wilster/W – Büttel WILW RT	0 %	6.0 %	3.0 %	0 %	0.2 %	3.7 %	0 %	0 %	0.2 %
380 kV – Wilster/W – Dollern ROT	1.0 %	0 %	0 %	0.1 %	0 %	0 %	0.1 %	0 %	0 %
380 kV – Wilster/W – Stade/W	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
380 kV – Wilster/W – Stade/W STAW GE	0 %	0 %	0 %	0 %	0 %	1.2 %	0 %	0 %	0 %
380 kV – Wilster/W – Stade/W STAW RT	0 %	0 %	0 %	0 %	0 %	1.6 %	0 %	0 %	0 %
380 kV – Würgassen – Grohnde 2	0 %	0 %	0 %	0.9 %	0.2 %	7.4 %	0.1 %	0 %	0 %
380 kV – Würgassen – Würgassen 2	0 %	0 %	0 %	2.2 %	0.9 %	5.0 %	0 %	0 %	0 %
380 kV – Würgassen – Y Vörden 1	0 %	0 %	0 %	0 %	0.3 %	7.4 %	0 %	0.3 %	0.9 %
380 kV – Würgassen – Y Würgassen 2	0 %	0 %	0 %	0 %	0 %	3.5 %	0 %	0 %	0 %
380 kV – Würgau – Redwitz 436	0 %	0 %	0 %	0 %	1.0 %	0.1 %	0 %	0 %	0 %
380 kV – Würgau – Redwitz 457	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.1 %	0.1 %
380 kV – Würgau – Y Kriegenbrunn 431/438	0 %	0 %	0 %	0 %	0 %	0.3 %	0 %	0 %	0 %
380 kV – Würgau – Y Kriegenbrunn 438/432	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %
380 kV – Y Alfstedt – Dollern DOLL BL/	0 %	0 %	0 %	0.1 %	0 %	0.3 %	0 %	0 %	0 %
380 kV – Y Alfstedt – Elsfleth/W DOLL SW/	0 %	0 %	0 %	0 %	0 %	0.7 %	0 %	0 %	0 %
380 kV – Y Frankfurt/SW – Karben 2	0 %	0 %	0 %	0 %	0 %	0.3 %	0.1 %	0.1 %	0 %
380 kV – Y Niederlangen – Dörpen West EOWS	0 %	0 %	0 %	26.5 %	28.9 %	20.5 %	0 %	11.5 %	0.3 %
380 kV – Y Niederlangen – Niederlangen EOWS	0 %	0 %	0 %	0 %	0 %	0.1 %	19.9 %	11.5 %	5.6 %
380 kV – Y Rhede – Diele SCHWARZ	0 %	0 %	0 %	2.4 %	4.8 %	10.5 %	0.2 %	0.6 %	0.5 %
380 kV – Y Rhede – Dörpen West SCHWARZ	0 %	0 %	0 %	7.2 %	5.5 %	11.1 %	0.2 %	0.6 %	0.1 %
380 kV – Y Vörden – Grohnde 1	0 %	0 %	0 %	3.9 %	1.3 %	8.0 %	0 %	0.6 %	0.9 %
380 kV – Y Waldeck 1&2 – Borken 2	0 %	0 %	0 %	0 %	0.3 %	1.4 %	0.7 %	0.2 %	1.5 %
380 kV – Y Waldeck 1&2 – Borken 3	0 %	0 %	0 %	0.1 %	1.3 %	0.5 %	0 %	0.1 %	0.3 %
380 kV – Y Waldeck 1&2 – Twistetal 2	0 %	0 %	0 %	0.1 %	0.3 %	2.1 %	0.7 %	0.2 %	1.5 %
380 kV – Y Waldeck 1&2 – Twistetal 3	0 %	0 %	0 %	0.1 %	1.2 %	0.9 %	0 %	1.4 %	0.3 %
380 kV – D7BACH D7WTHU SOONWD O	0 %	0.2 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %
380 kV – D7BACH D7YWDL WONNEG O	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0.1 %	0 %
380 kV – D7BISC D7KRIF TREBUR S	0 %	0 %	0 %	0 %	0.1 %	0.1 %	0 %	0 %	0 %
380 kV – D7BISC D7YPFU RIED W	0.5 %	0.8 %	0.8 %	1.4 %	4.8 %	4.7 %	0 %	0 %	0 %

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – D7BRAU D7KNAP BURBAC O	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7BUER D7LAMB BUERST W	10.2%	15.7%	3.6%	6.3%	8.0%	4.6%	2.0%	0.8%	0.3%
380 kV – D7BUER D7PFUN RIED O	0.2%	0%	0%	0.4%	0.4%	3.7%	0%	0%	0%
380 kV – D7BUER D7REIN KURPFA O	0%	0%	0%	0.2%	0%	0.3%	0%	0%	0%
380 kV – D7BUER D7REIN KURPFA W	0%	0%	0%	0%	0.3%	0.3%	0%	0.1%	0%
380 kV – D7BUER D7WDLA WONNEG W	0%	0%	0%	0%	0.2%	0.1%	0%	0%	0%
380 kV – D7BUER D7YPFU RIED W	0%	0%	0%	0.5%	0.6%	3.7%	0%	0%	0%
380 kV – D7BUER D7YWDL WONNEG O	0%	0%	0%	0%	0.2%	0.1%	0%	0%	0%
380 kV – D7DAHL D7ROMH SELHN O	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
380 kV – D7DAHL D7YDAH SELHN O	0%	0%	0%	0%	0%	0%	0.1%	0%	0%
380 kV – D7DAHL D7YDAH SELHN W	0%	0%	0%	0%	0%	0%	0.1%	0%	0%
380 kV – D7DETT D7URBE KARLST S	0%	0%	0%	0.5%	1.4%	2.2%	0%	0%	0%
380 kV – D7EBRU D7HUEL WESTFL W	0%	0%	0%	0%	0%	1.9%	0%	0%	0%
380 kV – D7EBRU D7MENG RECKLI N	0%	0%	0.2%	0%	0%	0.7%	0%	0%	0.1%
380 kV – D7EBRU D7MENG RECKLI S	0%	0%	0%	0%	0%	0.6%	0%	0%	0%
380 kV – D7EIBE D7HATT WEITMR W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7EIBE D7HUEL HUELLN W	0%	0.1%	0.1%	0%	0.4%	3.4%	0%	0%	0%
380 kV – D7EIBE D7KARN EIBERG N	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
380 kV – D7EIBE D7METT RUHRTL O	0%	0%	0%	0%	0.1%	0.7%	0%	0%	0%
380 kV – D7EIBE D7METT RUHRTL W	0%	0%	0%	0%	0%	1.1%	0%	0%	0%
380 kV – D7EIBE D7OHLI OERKHS W	0%	0%	0%	0%	0%	0%	0.4%	0%	0%
380 kV – D7EIBE D7YOHL OERKHS O	0%	0.1%	0.6%	0%	0%	0%	0%	0%	0%
380 kV – D7ENSD D7UCHT TAUBNT N	0%	0%	0%	0.1%	0.2%	2.9%	0%	0%	0%
380 kV – D7ENSD D7UCHT TAUBNT S	0%	0%	0%	0%	0.2%	1.6%	0%	0%	0%
380 kV – D7ENSD XEN_VI VIGY2 S	8.4%	1.3%	19.7%	2.2%	1.0%	11.3%	0.1%	0.2%	0.1%
380 kV – D7GERS D7LIPP WALTRO S	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – D7GERS D7MENG MENGED N	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – D7GERS D7YGER GERSTE O	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – D7GERS D7YGER UENTRO N	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – D7GRON D7GRON TR 441 E	1.5%	2.7%	1.6%	0.4%	0.7%	0.8%	0%	0%	0%
380 kV – D7GRON D7HANE GRONAU W	0.1%	0%	0%	4.4%	4.5%	3.2%	0%	0.1%	0.1%
380 kV – D7GRON D7KUSE HAMALD	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7GUET D7YGER GERSTE O	0%	0%	0%	0.1%	0%	1.1%	0%	0%	0%
380 kV – D7GUET D7YGUE GUETER S	0%	0%	0%	0%	0%	0.9%	0%	0%	0%
380 kV – D7GUND D7MEIT MEITGN N	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7GUND D7MEIT MEITGN S	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7GUND D7VOEH GUENZ N	0%	0%	0%	0.6%	0%	0%	0.3%	0%	0%
380 kV – D7GUND D7VOEH GUENZ S	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
380 kV – D7HANE D7MEPP MEPPEN	0%	0%	0%	22.5%	24.1%	16.2%	0%	0%	0%
380 kV – D7HANE D7WEHR NSACHS S	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – D7HANE D7YGER UENTRO N	0%	0%	0%	0.1%	0%	0.6%	0%	0%	0%
380 kV – D7HANE D7YHAN MUENST	0%	0%	0%	0.1%	0%	0.3%	0%	0%	0%
380 kV – D7HANE D7YOEC ROXEL O	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7HATT D7WITT KEMNAD S	0%	0%	0%	0%	0.1%	0.2%	0%	0%	0%
380 kV – D7HONE D7REIN KUGELB O	0%	0.1%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – D7HONE D7REIN KUGELB W	0%	0%	0%	0%	0.1%	0.3%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – D7HONE D7YHER HERBTG W	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – D7HUEL D7YHUE WESTFL W	0%	0%	0%	0%	0.6%	2.8%	0%	0%	0%
380 kV – D7HULF D7HULF DUEMM S1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – D7HULF D7WEHR OCHSMO O	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
380 kV – D7HULF D7WEHR OCHSMO W	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
380 kV – D7HULF D7YHUF DUEMM S1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – D7HULF D7YWES DUEMM S1	0%	0%	0%	0%	0%	0.6%	0%	0%	0%
380 kV – D7KARN D7YKAR BUESHR W	0%	0%	0%	0%	0.2%	0.1%	0%	0%	0%
380 kV – D7KELS D7KRIF TREBUR N	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7KNAP D7SECH WABERG W	0%	0.1%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – D7KOBL D7WTHU METTER	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7KRIF D7LIMB HESSEN O	0%	0.1%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – D7KUSE D7ROSE KUSENH	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7KUSE D7YHAN MUENST	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – D7KUSE D7YKUS LIPPE S	0%	0%	0%	0.5%	0.5%	0.4%	0%	0%	0%
380 kV – D7LAMB D7OTTE KAILAU S	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7LAMB D7WEIN LAMBSH W	0.2%	0.4%	0.1%	5.4%	9.1%	5.0%	0.2%	0.3%	0.3%
380 kV – D7LAMB D7YOTT KAILAU N	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7LEUP XWE LE FUESSN O	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7LIPP D7MENG MENGED S	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – D7MECK D7SECH BGEIST W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7MECK D7WTHU NETTE W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7MEIT D7OOTT AUGSBU O	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7MENG D7YHUE WESTFL W	0%	0.6%	0.1%	0.2%	0.5%	1.1%	0%	0%	0.1%
380 kV – D7METT D7YOHL OERKHS O	0%	0%	0%	0%	0%	1.0%	0%	0%	0%
380 kV – D7METT D7YOHL OERKHS W	0%	0%	0%	0%	0%	0.5%	0%	0%	0%
380 kV – D7MITB D7OTTE RAMSTE S	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7MITB D7UCHT BLIES N	0%	0%	0.5%	0%	0%	0.1%	0%	0%	0%
380 kV – D7MITB D7UCHT BLIES S	0%	0%	0.1%	0%	0%	0.1%	0%	0%	0%
380 kV – D7MITB D7YOTT KAILAU N	0%	0.1%	0.4%	0%	0%	0%	0%	0%	0%
380 kV – D7NRHE D7UTFO ZENSEN S	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
380 kV – D7NRHE D7WALS NRHEIN W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7NSTE D7OBZI SELHN O	0%	0%	0%	0%	0%	0%	0.1%	0%	0%
380 kV – D7NSTE D7OBZI SELHN W	0%	0%	0%	0%	0%	0%	0.2%	0%	0%
380 kV – D7NSTE D7OSBU GILZEM O	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – D7NSTE D7ROMH NIMSTA O	0%	0.2%	0%	0%	0.3%	0%	0%	0%	0%
380 kV – D7NSTE D7UCHT UCHTLF W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7NSTE D7YDAH SELHN O	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
380 kV – D7NSTE D7YDAH SELHN W	0%	0%	0%	0%	0.9%	0.3%	0%	0.1%	0%
380 kV – D7OBZI D7SECH SECHTM N	0%	0%	0%	0%	0%	0%	0.6%	0%	0.1%
380 kV – D7OBZI D7SECH SECHTM S	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7OBZI D7SIER KIRCHB S	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7OBZI D7YDAH SELHN O	0.1%	0%	0.1%	0.2%	0.4%	0.1%	0%	0%	0%
380 kV – D7OBZI D7YDAH SELHN W	0.5%	1.1%	0.1%	0%	0.4%	0.1%	0%	0%	0%
380 kV – D7OBZI D7YPAF SECHTM N	2.3%	3.2%	1.7%	1.1%	0.8%	1.6%	0%	0%	0%
380 kV – D7OBZI D7YPAF SECHTM S	0%	0%	0%	0.6%	1.0%	1.6%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – D7OHLI D7PETE PETER N	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – D7OHLI D7YOHL OERKHS O	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
380 kV – D7OPLA D7ROKI OPLADN N	0%	0%	0%	0.1%	0.1%	0%	0%	0%	0%
380 kV – D7OPLA D7YOHL OERKHS O	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
380 kV – D7OSBU D7UCHT UCHTLF O	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – D7PAFF D7ROKI PAFFEN N	1.2%	0.9%	0%	1.0%	0.2%	0%	0%	0%	0%
380 kV – D7PAFF D7ROKI PAFFEN S	0.6%	0.9%	0.3%	0%	0.3%	0.2%	0%	0%	0.1%
380 kV – D7PAFF D7YPAF SECHTM N	0%	0%	0%	0.6%	0.2%	0%	0%	0%	0%
380 kV – D7PAFF D7YPAF SECHTM S	1.9%	1.2%	2.0%	0%	0.2%	0.2%	0%	0%	0%
380 kV – D7PETE D7ROKI PETER S	0%	0%	0.3%	0%	0%	0.6%	0%	0%	0%
380 kV – D7PETE D7YOHL OERKHS W	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – D7PFUN D7URBE GRIESH O	0%	0.1%	0%	0.5%	1.3%	3.9%	0%	0%	0%
380 kV – D7ROKI D7SECH VILLE O	0%	0%	0%	0.1%	0.1%	0%	0%	0%	0%
380 kV – D7ROKI D7SECH VILLE W	0.2%	0%	0%	0.5%	0.1%	0%	0%	0%	0%
380 kV – D7ROMH D7YDAH SELHN O	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
380 kV – D7ROXE D7UENT UENTRO S	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7ROXE D7YOEC ROXEL O	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – D7SECH D7WTHU MITREI	0%	0.1%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – D7SECH D7YPAF SECHTM N	0%	0%	0%	0%	0%	0%	0.2%	0.1%	0%
380 kV – D7SECH D7YPAF SECHTM S	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
380 kV – D7UENT D7YGUE GUETER S	0%	0%	0%	0%	0%	0.7%	0%	0%	0%
380 kV – D7URBN D7URBE ERLENS W	0%	0%	0%	2.6%	7.5%	5.1%	0%	0%	0.1%
380 kV – D7UTFO D7WALS LOHHEI W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – D7VOEH D7YVOE DONAU O	0%	0%	0%	1.2%	0.1%	0.6%	0%	0%	0%
380 kV – D7WDLA D7WTHU SOONWD W	0%	0.1%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – D7WEHR D7WEHR DUEMM S1	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – D7WEHR D7YHUF DUEMM S1	0%	0%	0%	0.4%	0%	0.1%	0%	0%	0%
380 kV – D7WEHR D7YWES DUEMM S1	0%	0%	0%	0%	0%	1.0%	0%	0%	0%
380 kV – DDA_WE D7WEIN GERMHM S	0.1%	0.6%	0.2%	7.0%	10.5%	6.2%	1.1%	0.4%	0.5%
380 kV – DDE_HV D7YVOE DONAU O	0%	0%	0%	0%	0%	0%	0.4%	0%	0%
380 kV – DDE_VO D7VOEH DONAU W	0%	0%	0%	1.4%	0%	0.4%	0.4%	0%	0.1%
380 kV – DHR_TI D7TIEN TIENGN N	0%	0.1%	0%	0%	0%	0%	0.1%	0.1%	0%
380 kV – DPU_HO D7HONE HO PU WS	0%	0%	0%	2.4%	1.1%	1.2%	0.4%	0.2%	0%
380 kV – XEN VI D7ENSD VIGY1 N	0.8%	0.7%	2.8%	2.0%	0.9%	10.4%	0.3%	0.3%	0.4%
380 kV – XLA_TI D7TIEN ANDLSB	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
380 kV – XOB_MB D7OBZI SELFK WS	0.6%	3.0%	3.7%	0.1%	0.4%	0.6%	0%	0.3%	0.1%
380 kV – XSI_MB D7SIER SELFK SW	0.4%	0.8%	2.2%	0%	0.2%	0.3%	0%	0.1%	0%
380/220 kV – Conneforde/O T421	0%	0%	0%	0.1%	0.5%	0%	0.1%	0.4%	0%
380/220 kV – Conneforde/O T422	0%	0%	0%	1.0%	0.4%	0.1%	0%	0%	0%
380/220 kV – Etzenricht T421	0%	0%	0%	0.7%	0.9%	0%	0%	0%	0%
380/220 kV – Fedderwarden T421	0%	0%	0%	0.3%	4.9%	0%	0%	0%	0%
380/220 kV – Fedderwarden T422	0%	0%	0%	0%	4.9%	0%	0%	0%	0%
380/220 kV – Irsching T421	0%	0%	0%	0.1%	0.5%	0.3%	0%	0%	0%
380/220 kV – Landesbergen T421	0%	0%	0%	0%	0%	0.9%	0%	0%	0%
380/220 kV – Landesbergen T422	0%	0%	0%	0.1%	0.3%	4.5%	0%	0%	0%
380/220 kV – Landesbergen T423	0%	0%	0%	0.9%	2.3%	0.3%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380/220 kV – Pleinting T421	0 %	0 %	0 %	0.7 %	0 %	0.2 %	0 %	0 %	0 %
380/220 kV – Pleinting T422	0 %	0 %	0 %	0.3 %	0 %	0.2 %	0 %	0 %	0 %
380/220 kV – Raitersaich T421	0 %	0 %	0 %	0 %	0.6 %	0.2 %	0 %	0 %	0 %
380/220 kV – Sottrum T421	0 %	0 %	0 %	1.5 %	1.4 %	5.2 %	0 %	0 %	0.1 %
380/220 kV – Stade/W T421	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380/220 kV – Stade/W T422	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380/220 kV – Unterweser T421	0 %	0 %	0 %	0.9 %	0 %	0.6 %	0 %	0 %	0 %
380/220 kV – Würgassen T422	0 %	0 %	0 %	0.1 %	0.1 %	0 %	0 %	0.2 %	0 %
380/220 kV – Buers Transformer 37	0 %	0 %	0.1 %	4.0 %	3.0 %	1.9 %	0.1 %	0 %	0 %
380 kV – Bechterdissen – Ovenstädt/3	0 %	0 %	0 %	0 %	0 %	0 %	0.4 %	0 %	0 %
380 kV – Dillenburg – Dauersberg	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %
380 kV – Frankfurt Sued – Karben – Kriftel/Taunus	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %
380 kV – Ganderkesee – St. Huelfe/Hunte Schwarz	0 %	0 %	0 %	0 %	0 %	2.8 %	0 %	0 %	0 %
380 kV – Ganderkesee – St. Huelfe/Hunte Weiss	0 %	0 %	0 %	0 %	0 %	4.0 %	0 %	0 %	0.1 %
380 kV – Preilack – Ragow 540	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %
380 kV – Altenfeld – Redwitz 459	0 %	0.1 %	0 %	0.8 %	5.0 %	1.8 %	0.1 %	0.4 %	0 %
380 kV – Altenfeld – Redwitz 460	0 %	0 %	0 %	1.6 %	4.5 %	2.0 %	0.1 %	0.1 %	0.1 %
380 kV – Altenfeld – Vieselbach 467	0 %	0 %	0 %	0.1 %	0.1 %	0 %	0 %	0 %	0 %
380 kV – Altenfeld – Vieselbach 468	0 %	0 %	0 %	0.1 %	0.1 %	0 %	0 %	0 %	0 %
380 kV – Altentreptow Süd – Malchow/518	0 %	0 %	0 %	0 %	0 %	1.2 %	0 %	0 %	0.1 %
380 kV – Altentreptow-Süd – Gransee 479	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Bärwalde – Schmölln 551	0 %	0 %	0 %	0.8 %	1.5 %	0.6 %	0 %	0 %	0 %
380 kV – Bärwalde – Schmölln 552	0 %	0 %	0 %	0.8 %	1.6 %	0.6 %	0 %	0 %	0 %
380 kV – Brunsbüttel – Hamburg/Nord 951	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Buers – Obermooweiler blau	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Buers – Westtirol rot	0 %	0 %	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Charlottenburg – Mitte 906	0 %	0 %	0 %	0 %	1.6 %	2.5 %	0 %	0.2 %	0.1 %
380 kV – Daxlanden – Weingarten gelb	0.9 %	0.9 %	0.4 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Dellmensingen – Voehringen gruen (Donau W)	0.9 %	0.1 %	0.2 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Dellmensingen-Goldshöfe-Niederstotzingen weiss	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380 kV – Dellmensingen-Hoheneck-Voehringen – rt-Donau O	0 %	0 %	0 %	0 %	0 %	0 %	0.4 %	0 %	0 %
380 kV – Eichstetten – Muhlbach 1 rot	0.2 %	0.1 %	0.3 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Eisenach – Vieselbach 454	0 %	0 %	0 %	0.2 %	0.4 %	0.8 %	0 %	0 %	0 %
380 kV – Eisenhüttenstadt – Heinersdorf 548	0 %	0 %	0 %	0 %	0 %	0.5 %	0 %	0 %	0 %
380 kV – Eisenhüttenstadt – Preilack 547/1	0 %	0 %	0 %	0 %	0 %	0.5 %	0 %	0 %	0 %
380 kV – Eisenhüttenstadt 547/2	0 %	0 %	0 %	0 %	0 %	0.5 %	0 %	0 %	0 %
380 kV – Eisenhüttenstadt 548/2	0 %	0 %	0 %	0 %	0 %	0.5 %	0 %	0 %	0 %
380 kV – Endersbach-Großgartach-Mühlhausen grün	0.1 %	0.1 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380 kV – Engstlatt – Oberjettingen – Pulverdingen rot	0.1 %	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Engstlatt – Oberjettingen weiss	0.1 %	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Förderstedt – Jessen/Nord 533	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0 %	0 %
380 kV – Freiberg/Nord – Dresden/Süd 592	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
380 kV – Friedrichshain – Marzahn 921	0 %	0 %	0 %	0 %	0.2 %	0.6 %	0 %	0 %	0 %
380 kV – Friedrichshain – Marzahn 922	0 %	0 %	0 %	0 %	0.3 %	0.6 %	0 %	0.1 %	0 %
380 kV – Friedrichshain – Mitte 919	0 %	0 %	0 %	0 %	0 %	0.2 %	0 %	0 %	0 %
380 kV – Friedrichshain – Mitte 920	0 %	0 %	0 %	0.2 %	0 %	0.3 %	0 %	0 %	0 %

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – Goldshoefe-Kupferzell – gn	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Goldshoefe-Kupferzell-Stalldorf grün-rot	0%	0%	0%	0%	0.8%	0%	0%	0%	0%
380 kV – Görries – Güstrow 423	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
380 kV – Grafenrheinfeld – Stalldorf 416 rot	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Graustein – Bärwalde 565	0%	0%	0%	0.8%	0.1%	0.5%	0%	0.1%	0%
380 kV – Graustein – Bärwalde 566	0%	0%	0%	0.9%	0.1%	0.5%	0%	0.1%	0%
380 kV – Großgartach – Hueffenhardt blau	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Großgartach – Kupferzell weis	0%	0.1%	0%	0%	0.7%	1.5%	0%	0.1%	0%
380 kV – Grossgartach – Pulverdingen rot	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – Grossgartach – Pulverdingen weiss	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Gruenkraut – Obermooweiler blau	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Güstrow – Putlitz/Süd 514	0%	0%	0%	0%	0.3%	0.4%	0%	0%	0%
380 kV – Hagenwerder – Mikulowa 567	0.4%	0.1%	0%	0.1%	0%	0.1%	0%	0%	0%
380 kV – Hagenwerder – Mikulowa 568	0.1%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – Hagenwerder-Schmölln 553	7.1%	1.4%	0%	0.2%	0%	0%	0%	0%	0%
380 kV – Hagenwerder-Schmölln 554	6.7%	1.5%	0%	0.2%	0%	0%	0%	0%	0%
380 kV – Hamburg/Nord – Hamburg/Ost 961	0%	0%	0%	1.2%	0%	3.8%	0.1%	0%	0%
380 kV – Hamburg/Nord – Hamburg/Ost 962	0%	0%	0%	1.1%	0%	3.9%	0%	0%	0%
380 kV – Hamburg/Ost – Hamburg/Süd 991-972	0%	0%	0%	1.0%	1.1%	1.7%	0.1%	0%	0%
380 kV – Hamburg/Süd – Dollern 981	0%	0%	0%	0%	0%	0.1%	0.1%	0.1%	0%
380 kV – Hamburg/Süd – Dollern 982	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Helmstedt – Wolmirstedt 491-1	0%	0%	0%	0.2%	2.0%	0.7%	0.1%	0.5%	0.3%
380 kV – Helmstedt – Wolmirstedt 492-2	0%	0%	0%	0.2%	2.0%	0.5%	0%	0.3%	0%
380 kV – Hoepfingen – Hueffenhardt gelb	0%	0.1%	0%	0.3%	1.4%	0%	0%	0%	0.1%
380 kV – Hoheneck – Pulverdingen weiss	1.0%	2.0%	0.2%	0%	0%	0%	0%	0%	0%
380 kV – Hüffenhardt-Neurott-Wiesloch gelb	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Jessen/Nord – Marke 500	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
380 kV – Krümmel – Görries 419	0%	0%	0%	0%	0.5%	0.1%	0%	0.4%	0%
380 kV – Krümmel – Hamburg/Ost 992	0%	0%	0%	0.3%	0.8%	3.0%	0.2%	0.1%	0%
380 kV – Krümmel – Hamburg/Süd 991	0%	0%	0%	0%	0%	2.0%	0%	0%	0%
380 kV – Krümmel – Hamburg/Süd 991-972	0%	0%	0%	1.0%	1.1%	1.6%	0%	0%	0%
380 kV – Krümmel – Wessin 420	0%	0%	0%	0%	0.4%	0.1%	0%	0.3%	0%
380 kV – Krümmel (50 Hz) – Krümmel (TTG) 993	0%	0%	0%	0%	0%	3.2%	0%	0%	0%
380 kV – Krümmel (50 Hz) – Krümmel (TTG) 994	0%	0%	0%	2.5%	0%	3.5%	0%	0%	0%
380 kV – Kuehmoos – Laufenburg braun	0.3%	1.3%	0.3%	0.2%	0.1%	0%	0%	0%	0%
380 kV – Kuehmoos – Laufenburg gelb	0%	0%	0%	0.2%	0.1%	0%	0%	0%	0%
380 kV – Kuehmoos – Laufenburg rot	0%	0.1%	0%	0%	0%	0%	0.1%	0%	0%
380 kV – Kupferzell – Stalldorf rot	0%	0%	0%	1.8%	2.8%	0.8%	0%	0.1%	0%
380 kV – Lauchstädt – Jessen/Nord 499	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
380 kV – Lauchstädt – Klostermansfeld 538	0%	0%	0%	0%	0%	1.6%	0%	0%	0%
380 kV – Lauchstädt – Vieselbach 471	0%	0%	0%	4.5%	8.1%	8.3%	1.0%	2.0%	0.4%
380 kV – Lauchstädt – Vieselbach 472	0%	0%	0%	4.3%	8.3%	8.3%	0%	0.4%	0%
380 kV – Lauchstädt – Wolmirstedt 535	0%	0%	0%	0%	0%	0.5%	0%	0%	0%
380 kV – Marke – Lauchstädt 504	0%	0%	0%	0%	0%	0.7%	0%	0%	0.2%
380 kV – Mecklar – Eisenach 450-2	0%	0.1%	0%	0.3%	0.9%	1.1%	0.3%	0.3%	0.4%
380 kV – Mecklar – Vieselbach 449-1	0%	0%	0%	0.3%	1.5%	1.1%	0.1%	0.8%	0.5%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – Neuenhagen – Eisenhüttenstadt 547	0%	0%	0%	0%	0%	0.5%	0%	0%	0%
380 kV – Neuenhagen – Gransee 517	0%	0%	0%	0%	0.6%	0.4%	0%	0.2%	0.1%
380 kV – Neuenhagen – Heinersdorf 444	0%	0%	0%	0%	0%	0.4%	0%	0%	0%
380 kV – Neuenhagen – Malchow 520	0%	0%	0%	0%	0%	0.7%	0%	0%	0%
380 kV – Neuenhagen – Marzahn 495	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
380 kV – Neuenhagen – Marzahn 496	0%	0%	0%	0%	0%	0.3%	0%	0%	0%
380 kV – Oberjettingen-Pulverdingen weiss	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Perleberg – Stendal/West 516	0%	0%	0%	0.2%	1.5%	4.4%	0%	0.2%	0%
380 kV – Preilack – Graustein 541	0%	0%	0%	0.6%	0%	0.1%	0%	0%	0%
380 kV – Preilack – Graustein 542	0%	0%	0%	0.6%	0.1%	0%	0%	0%	0%
380 kV – Preilack – Streumen 559	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Preilack – Streumen 560	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Pulgar – Vieselbach 589	0%	0.1%	0%	3.3%	0.5%	1.4%	0%	0%	0.1%
380 kV – Pulgar – Vieselbach 590	0%	0%	0%	3.2%	0.6%	1.3%	0%	0%	0%
380 kV – Pulverdingen – Engstlatt – Oberjettingen rot	0%	0.2%	0%	0%	0%	0%	0%	0%	0%
380 kV – Putlitz/Süd – Putlitz/Süd 596	0%	0%	0%	0.1%	0.6%	1.1%	0%	0%	0%
380 kV – Putlitz/Süd – Stendal/West 515	0%	0%	0%	0.3%	2.3%	5.2%	0.7%	0.7%	0.4%
380 kV – Ragow – Preilack 539	0%	0%	0%	0%	0%	0.8%	0%	0%	0%
380 kV – Ragow – Streumen 561	0%	0%	0%	0.5%	0%	0%	0.2%	0%	0%
380 kV – Ragow – Streumen 562	0%	0%	0%	0.5%	0%	0.1%	0.1%	0%	0%
380 kV – Redwitz – Remptendorf 413	0%	0%	0%	1.4%	2.6%	1.4%	0.1%	0.3%	0.1%
380 kV – Redwitz – Remptendorf 414	0%	0%	0%	1.5%	2.5%	1.4%	0%	0.1%	0%
380 kV – Reuter – Charlottenburg 904	0%	0%	0%	0.1%	0.5%	0.9%	0.1%	0.1%	0%
380 kV – Reuter – Mitte 903	0%	0%	0%	4.7%	2.2%	7.3%	0.2%	0.1%	0.6%
380 kV – Röhrsdorf – Freiberg/Nord 594	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Röhrsdorf – Hradec 445	0.2%	1.7%	3.4%	0.2%	3.3%	8.7%	0%	0%	0%
380 kV – Röhrsdorf – Hradec 446	0.2%	2.4%	3.7%	0.2%	3.3%	8.7%	0%	0%	0%
380 kV – Röhrsdorf – Remptendorf 574	0%	0%	0%	0.5%	0%	0%	0%	0%	0%
380 kV – Röhrsdorf – Weida 573	0%	0%	0%	0.3%	0%	0%	0%	0%	0%
380 kV – Schmölln – Dresden/Süd 555	0%	0.2%	0.1%	0.1%	0%	0%	0%	0%	0%
380 kV – Schmölln – Dresden/Süd 556	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – Siedenbrünzow – Güstrow 512	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Siedenbrünzow – Putlitz/Süd 513	0%	0%	0%	0%	0.2%	0.4%	0%	0%	0%
380 kV – Stendal/West – Wolmirstedt 488	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Stendal/West – Wolmirstedt 489	0%	0%	0%	0.2%	0%	0.1%	0%	0%	0%
380 kV – Stendal/West – Wolmirstedt 490	0%	0%	0%	0.2%	0.1%	0.1%	0%	0%	0%
380 kV – Streumen – Röhrsdorf 571	0%	0%	0%	1.7%	1.0%	1.9%	0.1%	0%	0%
380 kV – Streumen – Röhrsdorf 572	0%	0%	0%	2.0%	1.0%	1.4%	0.1%	0%	0%
380 kV – Teufelsbruch – Reuter 907	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Teufelsbruch – Reuter 908	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Trossingen – Laufenburg rot	0.3%	1.0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Vieselbach – Remptendorf 415	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Weida – Remptendorf 575	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
380 kV – Wessin – Güstrow 424	0%	0%	0%	0%	0.3%	0.1%	0%	0%	0%
380 kV – Wolmirstedt – Förderstedt 437	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – Wolmirstedt – Förderstedt 438	0%	0%	0%	0%	0%	0.1%	0%	0%	0%

Germany (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – Wolmirstedt – Klostermansfeld 536	0%	0%	0%	0%	0%	1.1%	0%	0%	0%
380 kV – Wolmirstedt Parchim/Süd 332-322	0%	0%	0%	0.1%	0%	0%	0%	0.2%	0%
380 kV – Zwönitz 577/2	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Zwönitz 578/2	0%	0%	0%	0%	0.2%	0%	0%	0%	0%
Friedrichshain – Wulheide 706	0%	0%	0%	0%	0%	2.8%	0%	0%	0%
Friedrichshain – Wulheide 707	0%	0%	0%	0%	0%	2.8%	0%	0%	0%
Grid area D84 (voltage)	0%	0%	0%	0%	0%	0%	0.6%	0%	2.2%
Grid area D86 (voltage)	0%	0%	0%	0%	0%	0%	1.5%	0.2%	5.0%
Grid area D87 (voltage)	0%	0%	0%	0%	0%	0%	0.6%	0%	8.5%
KONTEK/KF CGS	36.6%	27.4%	38.0%	0%	0%	0%	11.7%	16.7%	19.7%
Profil DE – DK2 (Countertrading)	0%	0%	0%	0%	0%	0%	11.7%	16.7%	19.7%
PST-Röhrsdorf-Röhrsdorf 442	0%	0%	0%	0%	0%	0%	0%	0%	0%
Region Süd (voltage)	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transformer-Vierraden-Vierraden 402	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transformer-Vierraden-Vierraden 404	0%	0.2%	0%	0%	0%	0%	0%	0%	0%

Greece

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400 kV – Bitola-Meliti	0%	2.9%	8.8%	0%	0%	0%	0%	0%	0%
400 kV – Dubrovo-Thessaloniki	0%	1.7%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – Babaeski-Nea Santa	0%	0.7%	0%	0%	0%	0%	0%	0%	0%

Hungary

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220/132 kV – Dunamenti I. transformer	0%	0%	0%	0%	0%	1.5%	0%	0%	0%
220/132 kV – Dunamenti II. transformer	0%	0%	0%	0%	0%	2.2%	0%	0%	0%
220/132 kV – Győr I. transformer	0%	0%	0%	0%	0%	0%	0%	0%	0%
220/132 kV – Szolnok IV. transformer	0%	0%	0%	0%	0%	0.7%	0%	5.6%	1.4%
220 kV – DETK – Sajószöged	0%	0%	0%	0%	0%	0.5%	0%	0.8%	14.6%
220 kV – Dunamenti – Oroszlány	0%	0%	0%	0%	0%	0%	0%	0%	2.2%
220 kV – Göd – Zugló	0%	0%	0%	0%	0%	0.8%	0%	8.9%	0%
220 kV – Győr – Neusiedl	0%	0%	0%	0%	0%	0%	0%	0%	4.6%
220 kV – Győr – Oroszlány	0%	0%	0%	0%	0%	0%	0%	0%	2.7%
220 kV – Győr – Wien SO	9.9%	4.1%	0%	0%	0%	0%	0%	0%	0%
220 kV – Kisvárda – Mukachevo	0.4%	0%	0%	0%	0%	0.5%	0%	0%	0%
220 kV – Sajószöged – Mezőcsát	0%	0%	0%	0%	0%	4.9%	0%	0%	0%
400/132 kV – Bicske Dél I. transformer	0%	0%	0%	0%	0.5%	2.8%	0%	0%	0%

Hungary (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400/132 kV – Bicske Dél II. transformer	0%	0%	0%	0%	0.6%	2.0%	0%	0%	0%
400/132 kV – Bicske Dél III. transformer	0%	0%	0%	0%	0.8%	0.5%	0%	0%	0%
400/132 kV – Göd I. transformer	0%	0%	0%	0%	1.1%	9.5%	0%	0%	0%
400/132 kV – Göd II. transformer	0%	0%	0%	0%	0%	9.9%	0%	6.0%	0%
400/132 kV – Göd V. transformer	0%	0%	0%	0%	1.1%	11.3%	0%	0%	0%
400/132 kV – Győr IV. transformer	0%	0%	0%	0%	0%	0%	0%	0%	0%
400/132 kV – Kerepes I. transformer	0%	0%	0%	0%	0%	13.9%	0%	0%	0%
400/132 kV – Kerepes II. transformer	0%	0%	0%	0%	0%	9.2%	0%	0%	0%
400/132 kV – Litér B transformer	0%	0%	0%	0%	0%	13.0%	0%	0%	0%
400/132 kV – Paks II. transformer	0%	0%	0%	0%	0%	2.1%	0%	0%	0%
400/132 kV – Pécs II. transformer	0%	0%	0%	0%	0%	0%	0%	0%	0%
400/132 kV – Perkáta I. transformer	0%	0%	0%	0%	0.6%	0.5%	0%	0%	0%
400/132 kV – Perkáta II. transformer	0%	0%	0%	0%	0%	0.5%	0%	1.0%	0.5%
400/132 kV – Sándorfalva II. transformer	0%	0%	0%	0%	9.2%	0%	0%	0%	0%
400/132 kV – Szigetcsép I. transformer	0%	0%	0%	0%	5.0%	1.5%	0%	0%	0%
400/132 kV – Szigetcsép II. transformer	0%	0%	0%	0%	5.0%	1.5%	0%	0%	0%
400 kV – Albertirsa – Szolnok	9.2%	3.7%	0%	0%	0%	0%	0%	0%	0%
400 kV – Békécsaba – Nadab	0%	1.3%	0%	0%	0%	0%	0%	0%	0%
400 kV – Békéscsaba – Szolnok	0%	0%	0%	0%	0%	0%	0%	0%	1.1%
400 kV – Bicske Dél – Gönyű	0%	0%	0%	0%	0%	0%	0%	0%	0.6%
400 kV – Felsőzsolca – Sajóivánka	0%	0%	0%	0%	0%	0%	0%	0%	2.2%
400 kV – Felsőzsolca – Sajószöged 1	0%	0%	0%	0%	0%	0%	0%	0%	0.8%
400 kV – Göd – Levice	0.4%	0.1%	0.2%	0%	0%	0.5%	0%	0%	0%
400 kV – Gönyű – Gabcikovo	0.9%	0.1%	0.1%	0%	0%	0%	0%	11.5%	18.8%
400 kV – Győr – Gabcikovo	8.8%	4.4%	0%	0%	0%	0%	0%	0%	0%
400 kV – Győr – Gönyű	0%	0.1%	0.1%	0%	0%	0%	0%	0%	27.3%
400 kV – Győr – Litér	0%	0%	0%	0%	0%	0%	0%	0%	0.9%
400 kV – Győr – Zurndorf	0%	0.3%	0%	0%	0%	0%	0%	0.8%	12.4%
400 kV – Hévíz – Cirkovce	0%	0.1%	0.1%	0%	0%	0%	0%	0%	18.1%
400 kV – Hévíz – Zerjavinec	9.9%	4.4%	0%	0%	0%	0%	0%	0%	1.9%
400 kV – Litér – Martonvásár	0%	0%	0%	0%	0%	0%	0%	0%	0.5%
400 kV – Litér – Paks	0.1%	0%	0%	0%	0%	0%	0%	0%	14.3%
400 kV – Paks – Perkáta	0%	0%	0%	0%	0%	0%	0%	0%	0.5%
400 kV – Paks – Sándorfalva	0.1%	0%	0%	0%	0%	0%	0%	0%	3.1%
400 kV – Pécs – Ernestinovo	0.1%	0%	0%	0%	0%	0%	0%	0%	13.2%
400 kV – Sajóivánka – R.Sobota	4.8%	4.1%	0%	0%	0%	0%	0%	0%	1.2%
400 kV – Sándorfalva – Arad	9.8%	3.7%	0%	0%	0%	0%	0%	0%	0%
750/400 kV – Szabolcsbáka transformer	0%	0%	0%	0%	9.3%	29.0%	0%	7.7%	0%
750 kV – Szabolcsbáka – Zahidnoukrainska	0%	0%	0%	0%	0%	0.8%	0%	5.6%	1.4%

Ireland and Northern Ireland

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
250 kV – Moyle HVDC Interconnector	7.0%	28.3%	12.1%	0%	0%	0%	0%	0%	0%
400 kV – EWIC HVDC Interconnector	4.4%	25.4%	7.6%	0%	0%	0%	0%	0%	0%

Italy

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Baggio-Magenta	0.1%	0.4%	2.9%	0%	0%	0%	0%	0%	0%
220 kV – Bertola-Udine	0.2%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Leyni-Valpelline	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
220 kV – Lienz-Auronzo	0%	0%	0.8%	0%	0%	0%	0.1%	0.3%	0.2%
220 kV – Malgovert-Passy	0.2%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Montjovet-Leyni	0.3%	0.6%	1.1%	0%	0%	0%	2.5%	0%	0%
220 kV – Nauders-Glorenza	0%	0%	0.5%	0%	0%	0%	0.8%	0%	0%
220 kV – Passy-Pressy	0%	0%	0%	0%	0%	0%	0%	0%	0%
220/150 kV – PST TIRANO ST	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – A.PIAZZA DANTE-A.S.PAOLO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – A.PIAZZA DANTE-A.TIBURTINA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ABBADIA NK-CANDIA	1.9%	0.1%	0%	0%	0%	0%	0%	0%	0%
220 kV – ABBADIA NK-ROSARA NK	4.9%	3.5%	0.9%	0%	0%	0%	2.2%	0%	0%
220 kV – ACC.VALB.BZ NK-ACC.VALBRUNA BZ	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ACERRA SM-FRI-EL ACERRA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – AIRLIQUIDE VR-AIRLIQUIDE VR NK	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ALA-BUSSOLENGO S.S.	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – ALA-VICENZA MONTEVIALE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ALFA AVIO-ALFA A. UT	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ALFA AVIO-BRUSCIANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ALFA AVIO-CASALNUOVO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ARCO-S.MASSENZA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – AREZZO C-PIETRAFITTA 220	10.5%	2.2%	0.3%	0%	0%	0%	0%	0%	0%
220 kV – AREZZO C-S.BARBARA	12.5%	0.1%	0.7%	0%	0%	0%	0%	0.1%	0%
220 kV – AVENZA-SPEZIA STAZIONE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – AVERSA-FRATTA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – AVISE-RIDDES	0.2%	0.7%	0.7%	0%	0%	0%	0%	0%	0%
220 kV – BAGGIO-MUSOCCO ST	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BIELLA EST-RONDISSONE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BISTAGNO-CASANOVA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BISTAGNO-ERZELLI	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BORGO VALSUGANA-LAVIS	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BRUSCIANO-MADDALONI	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BRUSCIANO-NOLA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BUIA-UDINE NORD EST	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BUSACHI-MOGORELLA	0%	0%	0%	0%	0%	0%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – BUSACHI-OTTANA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BUSSOLENGO S.S.-S.MASSENZA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BUSSOLENGO S.S.-SANDRA'	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – BUSSOLENGO S.S.-VERONA BORGO MI	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CALENZANO-S.BENEDETTO QUERCETO	1.0%	0.2%	0.8%	0%	0%	0%	5.4%	0%	0.1%
220 kV – CAMPOCHIESA-CAMPOROSSO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CAMPOCHIESA-VADO LIGURE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CAMPOROSSO-MENTON ALL	1.9%	0%	0.1%	0%	0%	0%	0.1%	0.3%	0.6%
220 kV – CAPRIATI-POPOLI	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
220 kV – CARACOLI-SORGENTE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CASANOVA-MONCALIERI	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – CASANOVA-VIGNOLE BORBERA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CASORIA 2 -CASALNUOVO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CASORIA 2 -CASTELLUCCIA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CASTEGNERO-CITTADELLA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CASTELLUCCIA-S.SEBASTIANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CAVILLA NK-VELLAI	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CAVILLA NK-VICENZA NK	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CHIARAMONTE GULFI-FAVARA S.NE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CODRONGIANOS-ORISTANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CODRONGIANOS-OTTANA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – COLA'-SANDRA'	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – COLLI AMINEI-SECONDIGLIANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – COLORNO-AVENZA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – COLUNGA-BUSSOLENGO S.S.	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – COLUNGA-S.BENEDETTO QUERCETO	2.4%	0%	0.6%	0%	0%	0%	0.1%	0%	0%
220 kV – CORMANO-OSPIATE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CORRIOLO-CARACOLI	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – CORRIOLO-SORGENTE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – DALMINE ST-CISLAGO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – DELTACOGNE NK-DELTACOGNE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – DOLO-SCORZE'	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – DUGALE-CASTEGNERO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – DUGALE-SANDRA'	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – DUGALE-VICENZA MONTEVIALE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ENICHEM OTTANA-OTTANA	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ERCOLANO-S.SEBASTIANO	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ERCOLANO-TORRE N	3.2%	0.4%	0.5%	0%	0%	0%	0.6%	0%	0.1%
220 kV – FAVARA S.NE-CATTOLICA ERAC. S.NE	0%	0%	0%	0%	0%	0%	1.2%	0%	0%
220 kV – FAVARA S.NE-PARTANNA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – GARGNANO-NAVE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – GARGNANO-S.MASSENZA	0%	0%	0%	0%	0%	0%	0%	0.3%	0%
220 kV – GLORENZA NK-CASTELBELLO	0%	0%	0%	0%	0%	0%	9.1%	0%	0%
220 kV – GLORENZA-PREMADIO ALL	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – GRAGNANO-MONTECORVINO	0%	0%	0%	0%	0%	0%	0.5%	0%	0%
220 kV – GRAGNANO-TORRE N	3.2%	1.4%	0.8%	0%	0%	0%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – LAINO-TUSCIANO	1.0%	0%	0%	0%	0%	0%	0.1%	0.1%	0.3%
220 kV – LANA-S.MASSENZA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MAGENTA ST-PALLANZENO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MALCONTENTA-DOLO	0%	0%	0%	0%	0%	0%	0.1%	0%	0%
220 kV – MALCONTENTA-SCORZE'	0%	0%	0%	0%	0%	0%	0.1%	0.1%	0%
220 kV – MALCONTENTA-STAZ.5-259 NK	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MALCONTENTA-STAZIONE 1A	0%	0%	0%	0%	0%	0%	0%	0%	0.5%
220 kV – MASO PILL-CASTELBELLO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MELILLI-MISTERBIANCO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MELILLI-RAGUSA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MINCIO-AIRLIQUIDE VR NK	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – MISTERBIANCO-SORGENTE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MONCALIERI-SANGONE	0%	0%	0%	0%	0%	0%	1.1%	1.2%	1.0%
220 kV – MONTECORVINO-SALERNO N	0%	0.1%	0.1%	0%	0%	0%	0%	0%	0%
220 kV – MONTJOVET-CHATILLON SE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – MONTJOVET-LEYNI	0%	0%	0%	0%	0%	0%	0%	0.3%	0%
220 kV – MONTORIO V. SE-ROSARA NK	4.4%	3.7%	0.7%	0%	0%	0%	0%	0%	0%
220 kV – MONTORIO V. SE-VILLANOVA PE	1.9%	0%	0%	0%	0%	0%	1.8%	0%	0%
220 kV – MUSOCCO ST-PORTA VOLTA	0%	0%	0%	0%	0%	0%	0.1%	0.2%	0.2%
220 kV – NAVE-TORBOLE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – NOCERA-S.VALENTINO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – NOCERA-SALERNO N	3.2%	0%	0%	0%	0%	0%	0.1%	0%	0%
220 kV – NOLA-S.VALENTINO	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
220 kV – ORISTANO-SULCIS	0%	0%	0%	0%	0%	0%	0%	0.2%	0%
220 kV – PADRICIANO-DIVACA	0%	0%	0%	0%	0%	0%	0.5%	0.3%	0.6%
220 kV – PALLANZENO-SERRA	0.1%	0.5%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – PARTANNA-PARTINICO S.NE	0%	0%	0%	0%	0%	0%	0.4%	4.2%	2.3%
220 kV – PARTANNA-SAMBUCA S.NE	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – PIETRAFITTA 220-VILLAVALLE	9.0%	0.5%	0.7%	0%	0%	0%	0%	0%	0%
220 kV – PONTE V.F.-ALL'ACQUA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – POPOLI-S.GIACOMO NK	0%	0%	0%	0%	0%	0%	0%	0%	1.5%
220 kV – PORDENONE-SALGAREDA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – PORDENONE-SOMPLAGO	0%	0%	0%	0%	0%	0%	0.1%	0.5%	0.2%
220 kV – PREMADIO ALL-TIRANO ST	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – PROVVIDENZA AL2-S.GIACOMO SE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – PROVVIDENZA AL2-VILLAVALLE	0.1%	0.3%	0.1%	0%	0%	0%	0.1%	0%	0%
220 kV – PROVVIDENZA-PROVVIDENZA AL2	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – PROVVIDENZA-S.GIACOMO NK	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – RAGUSA CONSEGNA-MAGHTAB MALTA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – RAGUSA CONSEGNA-RAGUSA	0%	0%	0%	0%	0%	0%	0.1%	0.1%	0.1%
220 kV – REDIPUGLIA-PADRICIANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – RIC.SUD MI-TAVAZZ.220	0%	0%	0%	0%	0%	0%	0.6%	0%	0%
220 kV – ROMA NORD-A.TIBURTINA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ROMA NORD-VILLAVALLE	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ROMA SUD-A.S.PAOLO	0%	0%	0%	0%	0%	0%	0.8%	0.6%	0.2%
220 kV – RONDISSONE-TRINO 220	0%	0%	0%	0%	0%	0%	0%	0%	0.3%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – ROSARA-ROSARA NK	0%	0%	0%	0%	0%	0%	0%	0.3%	0.5%
220 kV – ROSONE-VILLA	0.1%	0%	0.6%	0%	0%	0%	0%	0%	0%
220 kV – RUMIANCA-VILLASOR	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – S.ANTONIO-S.MASSENZA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – S.COLOMBANO GE-TORRILE	0.9%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – S.COLOMBANO GE-VIGNOLE BORBERA	0%	0%	0%	0%	0%	0%	0%	0.6%	0.1%
220 kV – S.GIACOMO NK-S.GIACOMO SE	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
220 kV – S.VALENTINO-TORRE N	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – SAFAU NK-UDINE NORD EST	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – SAFAU NK-UDINE SUD	0%	0%	0%	0%	0%	0%	0.3%	0%	0.5%
220 kV – SALGAREDA-TREVISO SUD	0%	0%	0%	0%	0%	0%	0.9%	0.7%	0.3%
220 kV – SALIVOLI-SUVERETO	6.5%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – SAMBUCA S.NE-CATTOLICA ERAC. S.NE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – SANDRA'-TORBOLE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – SANGONE-TO SUD	0%	0%	0%	0%	0%	0%	0%	0%	1.7%
220 kV – SCAFATI SE-TORRE N	0.4%	0%	0%	0%	0%	0%	2.1%	1.8%	3.7%
220 kV – SCORZE'-SOVERZENE	0%	0%	0%	0%	0%	0%	0%	0%	0.6%
220 kV – SCORZE'-TREVISO SUD	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – SELARGIUS-VILLASOR	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – SOMPLAGO-BUIA	0%	0%	0%	0%	0%	0%	0.3%	0%	0%
220 kV – SOVERZENE-LIENZ	1.6%	0%	0%	0%	0%	0%	0.1%	0%	0%
220 kV – SPEZIA STAZIONE-TORRILE	0.9%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – STAZIONE 1A-CASTEGNERO	0%	0%	0%	0%	0%	0%	0.3%	0.7%	0%
220 kV – STAZIONE 4A-STAZ.5-213 NK	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – SULCIS-RUMIANCA	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – SULCIS-VILLASOR	0%	0%	0%	0%	0%	0%	0.7%	0%	0%
220 kV – TAIO-SANDRA'	0%	0%	0%	0%	0%	0%	0.4%	1.7%	2.6%
220 kV – TAVAZZ.220-COLA'	0%	0%	0%	0%	0%	0%	0.1%	0.5%	0.1%
220 kV – TORBOLE-S.MASSENZA	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – TORNOLO-S.COLOMBANO GE	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – TORNOLO-SPEZIA STAZIONE	0%	0%	0%	0%	0%	0%	0%	0.4%	7.3%
220 kV – TRINO 220-VERCELLI NORD	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – TURBIGO STAZIONE-BIELLA EST	0%	0%	0%	0%	0%	0%	0.5%	0.2%	1.4%
220 kV – VALPELLINE-RIDDES	2.3%	3.8%	7.0%	0%	0%	0%	0%	0.1%	0.3%
220 kV – VELLAI-SOVERZENE	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – VERDERIO-GROSIO	0%	0%	0%	0%	0%	0%	0%	0%	0.7%
220 kV – VERDERIO-RIC.NORD MI	0%	0%	0%	0%	0%	0%	0.1%	0.1%	0.2%
220 kV – VERONA BORGO MI-DUGALE	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – VICENZA MONTEVIALE-VICENZA NK	0%	0%	0%	0%	0%	0%	0%	0%	2.3%
220 kV – VILLASOR-MOGORELLA	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – VILLA-VILLENEUVE	0%	0%	0%	0%	0%	0%	0%	0%	0%
225 kV – Chavanod-Genissiat	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – Filisur-Robbia	1.2%	0%	0%	0%	0%	0%	0.1%	0%	0%
380 kV – Filisur-Sils	0.8%	0.3%	1.0%	0%	0%	0%	1.1%	0%	0%
380 kV – Lavorgo-Mettlen	0%	0.2%	0.1%	0%	0%	0%	0%	0%	0%
380 kV – Magliano-Piossasco	0%	0%	0.1%	0%	0%	0%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – Pradella-Robbia	0%	0%	1.1%	0%	0%	0%	0%	0%	0%
380 kV – Pradella-Sils	0%	0%	0.1%	0%	0%	0%	1.3%	0.2%	0%
380 kV – Pradella-Y/La Punt	0.1%	2.9%	0%	0%	0%	0%	0%	0%	0%
380 kV – PST DIVACA	0.8%	0%	0.3%	0%	0%	0%	0%	0%	2.0%
380 kV – PST FOGGIA	0%	0%	0%	4.1%	4.4%	0%	0%	0%	0%
380 kV – PST VILLANOVA	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – Robbia-Gorlago	0%	0.1%	0.8%	0%	0%	0%	0.7%	2.0%	1.3%
380 kV – Robbia-Sils	0%	0.8%	0%	0%	0%	0%	0.1%	0%	0%
380 kV – Robbia-Y/La Punt	0.3%	0.3%	0%	0%	0%	0%	0.2%	0.2%	0.4%
380 kV – Sils-Soazza	0.4%	4.9%	8.0%	0%	0%	0%	0%	0.3%	0%
380 kVFilisur-Robbia	0%	0.6%	1.2%	0%	0%	0%	0.1%	0%	0%
380 kV – ACCIAIOLO-SPEZIA STAZIONE	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – ALIANO-LAINO	0.1%	0.1%	0%	0.3%	0%	0%	0%	1.0%	0%
380 kV – ALTOMONTE-FEROLETO	0.1%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – ALTOMONTE-LAINO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – AVELLINO NORD-BISACCIA 380	0.9%	0.4%	0%	0%	0%	0.4%	0%	0%	0%
380 kV – AVELLINO NORD-S.SOFIA	0.9%	0.4%	0.1%	0%	0%	0.4%	0%	0%	0%
380 kV – BAGGIO-LACCHIARELLA	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
380 kV – BARGI-CALENZANO	4.2%	0.4%	1.9%	2.7%	0.1%	0.5%	0%	0%	0%
380 kV – BARGI-MARTIGNONE	1.5%	0%	0%	0.7%	0%	0.1%	0%	0%	0%
380 kV – BARI O-BRINDISI	0%	0%	0%	0.1%	0.1%	0%	0%	0%	0%
380 kV – BARI O-PALO DEL COLLE	0%	0%	0%	0.2%	0%	0%	0.2%	0%	0.3%
380 kV – BELCASTRO 380-SCANDALE	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – BENEVENTO 2-BENEVENTO 3	1.6%	2.2%	0.1%	3.8%	1.8%	0.1%	0.8%	2.5%	0.2%
380 kV – BENEVENTO 2-PRESENZANO	0%	0%	0%	0.2%	0%	0%	0%	0%	0.4%
380 kV – BENEVENTO 2-S.SOFIA	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – BENEVENTO 3-TROIA 380	1.3%	0%	0%	0.5%	0.1%	0%	0%	0%	0.5%
380 kV – BISACCIA 380-DELICETO	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – BOVISIO-BULCIAGO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – BOVISIO-VERDERIO	0%	0%	1.5%	0.9%	0%	0.2%	0%	0%	0%
380 kV – BRINDISI-BRIN.ALL.380	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – BRINDISI-BRINDISI ALL	0%	0%	0%	1.5%	0%	0%	0.3%	0%	0.1%
380 kV – BRINDISI-TARANTO N2	0%	0%	0%	0.2%	0%	0%	1.6%	0.8%	0.2%
380 kV – BULCIAGO-SOAZZA	9.3%	6.0%	8.4%	0.9%	0%	0.1%	0%	0%	0%
380 kV – CAGNO-MENDRISIO	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%
380 kV – CAGNO-MUSIGNANO	0.1%	0.1%	0.1%	0.1%	0%	0%	0.1%	0%	0%
380 kV – CALENZANO-CASELLINA	0.1%	0%	0%	0.8%	0%	0%	0%	0.2%	0.4%
380 kV – CALENZANO-SUVERETO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – CANDIA-FANO E.T.	0%	0%	0%	0.3%	0%	0%	0%	0%	0.3%
380 kV – CANDIA-ROSARA	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – CAORSO-MALEO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – CARPI FOSSOLI-CAORSO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – CARPI FOSSOLI-S.DAMASO	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – CASELLINA-POGGIO A CAIANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – CASTELNUOVO S-VIGNOLE BORBERA	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – CEPRANO380-LATINA NUC	0%	0%	0%	0.1%	0.1%	0%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – CHIARI ST-GORLAGO	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
380 kV – CHIARI ST-TRAVAGLIATO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – CHIGNOLO PO-LACCHIARELLA	0%	0%	0%	0.2%	0%	0.8%	0.1%	0%	0%
380 kV – CHIGNOLO PO-S.ROCCO PO	0%	0%	0%	0.4%	0%	0%	0%	0%	0.3%
380 kV – CHIVASSO STAZ.-RONDISSONE	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – COLUNGA-FORLI'	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – COLUNGA-MARTIGNONE	0%	0%	0%	0%	0%	0%	0%	0%	0.2%
380 kV – CORDIGNANO-UDINE OVEST	0%	0%	0%	0.1%	0%	0%	0%	0%	0.2%
380 kV – CREMONA-FLERO ST	0%	0%	0%	0.4%	0%	0%	2.6%	2.3%	4.4%
380 kV – FLERO ST-MANTOVA ST	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – FLERO ST-NAVE	0%	0%	0%	0.9%	0%	0%	0%	0%	0%
380 kV – FLERO ST-TRAVAGLIATO	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – FOGGIA PST-TROIA 380	1.3%	0.7%	0.2%	1.0%	0%	0%	0%	0%	0%
380 kV – FOGGIA-FOGGIA PST	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – FOGGIA-PALO DEL COLLE	0.3%	0%	0.2%	0.3%	0%	0%	0.1%	0%	0%
380 kV – FOGGIA-S.SEVERO 380	0.4%	0%	0%	0%	0%	0%	0%	0%	5.7%
380 kV – FORLI' -FANO E.T.	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – FORLI' -RAVENNA CANALA	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – FORLI' -S.MARTINO IN XX	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – GARAGUSO-ALIANO	0%	0%	0.1%	0.2%	0%	0%	0%	0%	0%
380 kV – GARAGUSO-MATERA	0%	0.1%	0%	0.2%	0%	0%	0%	0%	0.9%
380 kV – GARIGLIANO ST-CEPRANO380	0.1%	0.1%	0.4%	0.2%	0.1%	0%	0.1%	0.1%	0.1%
380 kV – GARIGLIANO ST-LATINA NUC	0%	0.3%	0%	0%	0.9%	0%	0%	0%	0%
380 kV – GARIGLIANO ST-PATRIA	0%	0.1%	0.1%	0.2%	0%	0%	8.9%	18.2%	27.8%
380 kV – GARIGLIANO ST-SPARANISE	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
380 kV – GENZANO 380-MATERA	0.9%	0%	0%	0%	0%	0%	0.2%	0%	0.1%
380 kV – GISSI-LARINO	1.2%	1.4%	0%	0.8%	0.1%	0%	0.2%	0%	0.3%
380 kV – GISSI-VILLANOVA NK	1.5%	0.1%	0%	1.5%	0%	0%	0%	0%	0%
380 kV – GISSI-VILLANOVA NK 1	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – GORLAGO-VERDERIO	0%	0%	0%	2.6%	0%	0.6%	0.4%	0.4%	0%
380 kV – LAINO-MONTECORVINO	0.9%	0%	0%	1.7%	0%	0%	0%	0%	0%
380 kV – LAINO-MONTECORVINO 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – LAINO-MONTECORVINO 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – LARINO-ROTELLO380	0.4%	0%	0%	0%	0%	0%	2.7%	0%	0.5%
380 kV – LATINA NUC-APRILIA CP	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – LATINA NUC-APRILIA380	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – LATINA NUC-VALMONTONE	0%	0%	0%	0.4%	0%	0.1%	0.2%	0%	0%
380 kV – LONATO-NAVE	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – MAGISANO-MAIDA	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – MAGLIANO-VADO LIGURE	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – MAIDA-RIZZICONI	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – MALEO-CREMONA	0%	0%	0%	3.0%	0.4%	0.1%	0.2%	0.3%	0.6%
380 kV – MALEO-S.ROCCO PO	0%	0%	0%	5.4%	0%	0.2%	0.2%	0%	0.1%
380 kV – MARGINONE-CALENZANO	1.5%	0%	0%	0%	0%	0%	0.2%	0%	0%
380 kV – MARGINONE-POGGIO A CAIANO	0%	0%	0%	0.5%	0%	0%	0.1%	0%	0%
380 kV – MARGINONE-SPEZIA STAZIONE	0%	0%	0%	0.5%	0%	0%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – MARTIGNONE-S.DAMASO	0%	0%	0%	1.3%	0%	0%	0.1%	0.5%	0.5%
380 kV – MATERA-CASTELLANETA 380	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – MELFI 380-BISACCIA 380	0.9%	0%	0%	0%	0%	0%	0.1%	0%	0%
380 kV – MELFI 380-GENZANO 380	0.9%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – MONTECORVINO-S.SOFIA	0%	0%	0.1%	0.1%	0.1%	0%	12.2%	10.8%	4.7%
380 kV – MUSIGNANO-LAVORGO	8.5%	6.5%	7.7%	1.2%	0%	0.1%	0%	0%	0%
380 kV – NAVE-S.FIORANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – OSTIGLIA ST-DUGALE	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – OSTIGLIA ST-MANTOVA ST	0%	0%	0%	0.4%	0%	0%	0.1%	0%	0.3%
380 kV – PARADISO-BOLANO	0.8%	0.8%	6.4%	2.1%	0%	0.9%	0%	0%	0%
380 kV – PARMA VIGHEFFIO-S.ROCCO PO	0%	0%	0%	6.5%	0%	0%	0%	0%	0%
380 kV – PARMA VIGHEFFIO-SPEZIA STAZIONE	0%	0%	0%	0.3%	0%	0%	0%	0%	1.0%
380 kV – PATERNO' SE-SORGENTE	1.3%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – PATRIA-S.SOFIA	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – PIAN DELLA SPERANZA-POGGIO A CAIANO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – PIAN DELLA SPERANZA-ROMA NORD	0.3%	0%	0.1%	0.1%	0%	0%	1.3%	4.8%	3.2%
380 kV – PIOSSASCO-VENAUS	0%	0%	0.1%	0%	0%	9.5%	0.8%	1.1%	5.0%
380 kV – PLANAIS-SALGAREDA	0.1%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – POGGIO A CAIANO-SUVERETO	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – POGLIANO-RHO	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
380 kV – PRESENZANO-VALMONTONE	0%	0%	0%	0%	0.1%	0%	0%	0%	0.1%
380 kV – REDIPUGLIA-DIVACA	2.9%	1.2%	0%	0.1%	0.2%	0.1%	3.3%	1.3%	14.6%
380 kV – RIZZICONI-BOLANO	17.2%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – ROMA EST-ROMA NORD	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – ROMA EST-VALMONTONE	0%	0.2%	0.4%	0.2%	0%	0%	1.0%	3.2%	1.5%
380 kV – ROMA SUD-APRILIA CP	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
380 kV – ROMA SUD-APRILIA380	0%	0%	0%	0.3%	0%	0%	0%	0%	0.2%
380 kV – ROSSANO TE-SCANDALE	0.1%	0%	0%	0.2%	0%	0%	1.0%	0%	0%
380 kV – ROTELLO380-S.SEVERO 380	0.4%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – ROTELLO380-SAN SEVERO SUD	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – S.FIORANO-ROBBIA	0.6%	1.9%	3.4%	0.1%	0%	6.7%	0%	0%	0%
380 kV – S.MARIA CAPUA V.-S.SOFIA	0%	0%	0%	0.1%	0.1%	0%	0%	0%	0.2%
380 kV – S.MARIA CAPUA V.-SET TEVEROLA	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – S.MARIA CAPUA V.-SPARANISE	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – SORGENTE-PARADISO	12.9%	0%	0%	2.4%	0%	0.9%	0%	0%	0%
380 kV – SPEZIA STAZIONE-VIGNOLE BORBERA	0%	0%	0%	0.3%	0%	0%	0%	0%	0.2%
380 kV – SUVERETO-MONTALTO	0%	0%	0%	0.3%	0%	0%	0%	0%	0.2%
380 kV – SUVERETO-MONTALTO 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – SUVERETO-MONTALTO 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – SUVERETO-SUVERETO	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – TURANO-S.ROCCO PO	0%	0%	0%	0.4%	0%	0.2%	0.1%	0%	0%
380 kV – TURANO-TAVAZZANO ST	0%	0%	0%	0.1%	0%	0.1%	0%	0%	0%
380 kV – TURBIGO STAZIONE-RONDISSONE	0%	0%	0%	1.1%	0%	0.1%	0%	0%	0%
380 kV – TURBIGO STAZIONE-TURBIGO	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – VENAUS-VILLARODIN	0%	0.1%	0.1%	0%	0%	9.8%	0%	0%	0%
380 kV – VILLAFRANCA TIRRENA-SCILLA	0.3%	0%	0%	0%	0%	0%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – VILLANOVA NK-VILLANOVA NK 1	0%	0%	0%	0%	1.6%	0%	0%	0%	0%
380 kV – VILLANOVA NK-VILLANOVA NK 2	0%	0%	0%	0%	1.0%	0%	0%	0%	0.1%
380 kV – VILLANOVA PE-VILLANOVA NK	0%	0%	0%	1.6%	0%	0%	0.1%	0%	0%
380 kV – VILLANOVA PST-GISSI	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
400 kV – Albertville-Coche	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Albertville-Grande Ile 1	0.1%	0.1%	0.3%	0%	0%	0%	0.2%	0.4%	0%
400 kV – Albertville-Grande Ile 2	0.1%	0%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – Albertville-Grande Ile 3	0.4%	0.2%	0%	0%	0%	0%	0.1%	0.1%	0.6%
400 kV – La Coche-Praz	0.4%	0%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – La Praz-Villarodin	0%	0%	0.6%	0%	0%	0%	0.2%	0%	0%
400 kV – PST La Praz	1.3%	0.1%	2.7%	0%	0%	0%	0.1%	0%	0%
400 kV – RONDISSONE-ALBERTVILLE 1	1.0%	0%	0.4%	0%	0%	0.3%	0.3%	0.8%	0.3%
400 kV – RONDISSONE-ALBERTVILLE 2	1.6%	0.2%	0.4%	0.5%	0%	0.3%	0%	0%	0.2%
500 kV – FIUMESANTO CR-FIUMESANTO CR	2.6%	0%	0%	0%	0%	0%	0%	0%	0%
500 kV – FIUMESANTO CR-FIUMESANTO CR 1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
500 kV – FIUMESANTO CR-FIUMESANTO CR 2	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
AdditionalConstraint	0%	10.8%	7.2%	0%	0%	0%	0%	0%	0%
adriatica	0.7%	1.1%	0.6%	0%	0%	0%	0%	0%	0%
area sud	0.4%	0.1%	0.2%	0%	0%	0%	0%	0%	0%
ATR 220/115 kV – Divaca	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 220/132 kV – NAVE	0%	0%	0%	0.8%	0.5%	0%	0%	0%	0%
ATR 220/132 kV – PADRICIANO	0%	0%	0%	0%	0%	0%	0%	0%	0.5%
ATR 220/132 kV – ROSARA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 220/132 kV – S.LUCIA	0%	0%	0%	0.2%	0%	0%	0%	0%	0%
ATR 220/132 kV – SALGAREDA	0%	0%	0%	0.4%	0.2%	0%	0.2%	0.4%	0%
ATR 220/132 kV – VILLABONA	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
ATR 220/150 kV – MELILLI	0%	0%	0%	0%	0%	0%	0%	0%	0.2%
ATR 220/150 kV – MISTERBIANCO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 220/150 kV – RAGUSA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 220/150 kV – VILLASOR	0%	0%	0%	0%	0%	0%	0%	1.5%	0.6%
ATR 220/220 kV – CAMPOROSSO	0%	0%	0%	0%	0%	0%	0%	0%	0.2%
ATR 380/120 kV – VILLAVALLE	0%	0%	0%	1.8%	1.2%	0%	0%	0%	0.3%
ATR 380/132 kV – ACCIAIOLO	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
ATR 380/132 kV – BAGGIO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – BRUGHERIO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – BULCIAGO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – CALENZANO	0%	0%	0%	0.1%	0%	0%	0%	0%	0.1%
ATR 380/132 kV – CAMIN	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – CANDIA	0%	0%	0%	1.3%	0.4%	0%	0%	0.1%	0%
ATR 380/132 kV – CARPI FOSSOLI	0%	0%	0%	0%	0%	0%	1.5%	0.6%	0.4%
ATR 380/132 kV – CASELLINA	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
ATR 380/132 kV – CISERANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – CISLAGO	0%	0%	0%	0%	0%	0%	0%	0.2%	0%
ATR 380/132 kV – COLUNGA	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
ATR 380/132 kV – CORDIGNANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – DOLO	0%	0%	0%	0.1%	0.4%	0%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
ATR 380/132 kV – DUGALE	0%	0%	0%	2.0%	7.2%	0%	0%	0%	0.1%
ATR 380/132 kV – FANO E.T.	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – FERRARA FOCOMORTO	0%	0%	0%	0%	0%	0%	0%	0.3%	0%
ATR 380/132 kV – FLERO ST	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
ATR 380/132 kV – FORLI'	0%	0%	0%	0%	0%	0%	0%	0%	0.5%
ATR 380/132 kV – GORLAGO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – LACCHIARELLA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – MARGINONE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – MARTIGNONE	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
ATR 380/132 kV – MERCALLO	0%	0%	0%	0%	0%	0%	0.5%	1.6%	2.1%
ATR 380/132 kV – OSTIGLIA ST	0%	0%	0%	0%	0%	0%	0.1%	0.5%	0%
ATR 380/132 kV – PARMA VIGHEFFIO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – PORTO TOLLE	0%	0%	0%	0%	0%	0%	0%	0%	0.2%
ATR 380/132 kV – REDIPUGLIA	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
ATR 380/132 kV – RONDISSONE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – ROSARA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – S.BARBARA	0%	0%	0%	0%	0%	0%	0%	0.1%	0.8%
ATR 380/132 kV – S.DAMASO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – S.MARTINO IN XX	0%	0%	0%	0%	0%	0%	0.1%	0%	0.7%
ATR 380/132 kV – S.ROCCO PO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – SANDRIGO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – SPEZIA STAZIONE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – TAVARNUZZE	0%	0%	0%	0%	0%	0%	0%	0%	0.8%
ATR 380/132 kV – UDINE OVEST	0%	0%	0%	0%	0%	0%	0%	3.0%	0%
ATR 380/132 kV – VENEZIA NORD	0%	0%	0%	0%	0%	0%	0%	0.1%	0.2%
ATR 380/132 kV – VERDERIO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/132 kV – VIGNOLE BORBERA	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
ATR 380/132 kV – VILLANOVA PE	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
ATR 380/132 kV – VILLAVALLE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – ALIANO	0%	0%	0%	0%	0%	0%	0.9%	0.8%	0%
ATR 380/150 kV – ANDRIA	0%	0%	0%	0%	0%	0%	0%	0%	0.9%
ATR 380/150 kV – BARI O	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – BENEVENTO 2	0%	0%	0%	0%	0%	0%	0%	0%	0.3%
ATR 380/150 kV – BRINDISI	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – BRINDISI SUD	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
ATR 380/150 kV – CAGLIARI SUD	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – FOGGIA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – GALATINA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – GARIGLIANO ST	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – GENZANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – LARINO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – LATINA NUC	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – MELFI 380	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – PATERNO' SE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – RIZZICONI	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – ROMA EST	0%	0%	0%	0%	0%	0%	0.4%	0.2%	0.1%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
ATR 380/150 kV – ROMA OVEST	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – ROSSANO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – RUMIANCA	0%	0%	0%	0.8%	0%	0%	1.1%	0%	0%
ATR 380/150 kV – S.MARIA CAPUA V.	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – S.SOFIA	0%	0%	0%	0.9%	0.1%	0%	4.3%	0.6%	1.7%
ATR 380/150 kV – SCANDALE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – TARANTO N2	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
ATR 380/150 kV – TROIA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/150 kV – VILLANOVA PE	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
ATR 380/150 kV – VILLAVALLE	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
ATR 380/220 kV – BAGGIO	0%	0%	0%	0.5%	0.3%	0.1%	0%	0%	0.1%
ATR 380/220 kV – CAMIN	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – CANDIA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – CASANOVA	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
ATR 380/220 kV – CHIARAMONTE GULFI	0%	0%	0%	0.3%	0%	0%	0.2%	0%	0%
ATR 380/220 kV – CODRONGIANOS	0%	0%	0%	1.6%	0.9%	0%	0%	0.3%	0.1%
ATR 380/220 kV – DOLO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – DUGALE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – Lavorgo	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – LEYNI	0%	0%	0%	0.1%	0%	23.1%	0%	0%	0%
ATR 380/220 kV – MELILLI	0%	0%	0%	0%	0%	0.1%	0%	0%	0.1%
ATR 380/220 kV – MONTECORVINO	0.1%	0.6%	0.1%	6.3%	5.4%	0.4%	0.6%	1.6%	1.2%
ATR 380/220 kV – NAVE	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – PIOSSASCO	0%	0%	0%	0%	0%	4.3%	1.8%	1.0%	0.3%
ATR 380/220 kV – REDIPUGLIA	0%	0%	0%	0%	0%	0.4%	1.2%	0%	1.1%
ATR 380/220 kV – ROMA NORD	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – ROMA SUD	0%	0%	0%	0.3%	0%	0%	0%	0%	0%
ATR 380/220 kV – RONDISSONE	0%	0%	0.1%	0%	0%	32.2%	0%	0%	1.0%
ATR 380/220 kV – RUMIANCA	0%	0%	0%	0%	0.5%	0.4%	0%	0%	0%
ATR 380/220 kV – S. BARBARA	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
ATR 380/220 kV – S.BARBARA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – S.GIACOMO SE	1.2%	0%	0.9%	3.6%	1.7%	1.3%	0%	0%	0%
ATR 380/220 kV – S.MARIA CAPUA V.	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
ATR 380/220 kV – S.SOFIA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – SALGAREDA	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – SELARGIUS	0%	0%	0%	0.5%	0%	0.1%	0%	0%	0%
ATR 380/220 kV – SORGENTE	26.6%	0.1%	3.3%	0.1%	0%	0%	0%	0%	0%
ATR 380/220 kV – SPEZIA STAZIONE	0%	0%	0%	0.8%	0%	0%	1.5%	1.3%	1.6%
ATR 380/220 kV – TAVAZZANO ST	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – TURBIGO	0%	0%	0%	0%	0%	0%	0%	0%	0%
ATR 380/220 kV – TURBIGO STAZIONE	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
ATR 380/220 kV – UDINE SUD	0%	0%	0%	0.7%	0.1%	0%	0%	0%	0%
ATR 380/220 kV – VADO LIGURE	0%	0%	0%	0.4%	0.3%	0%	5.0%	7.8%	7.5%
ATR 380/220 kV – VIGNOLE BORBERA	0%	0%	0%	0%	0.1%	0.2%	0.1%	0.1%	0%
ATR 380/220 kV – VILLANOVA	0%	0%	0%	3.1%	1.4%	0%	1.8%	1.0%	0.3%
ATR 380/220 kV – VILLANOVA PE	0.1%	1.4%	1.2%	0%	0%	0.1%	0%	0%	0%

Italy (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
ATR 380/220 kV – VILLAVALLE	0.5%	0.2%	0%	0%	0%	0.1%	0%	0%	0%
ATR 380/380 kV – FOGGIA	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
ATR 380/380 kV – RONDISSONE	0%	0%	0%	0%	0%	0.6%	0%	0%	0.6%
calabria	0.6%	0%	0.1%	0%	0%	0%	0.5%	0%	0.1%
campania	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
CEPAGATTI_TRCONV1	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
Failed_Calculation	0%	5.4%	0%	0%	0%	0%	0%	0%	0%
Failure Convergence	0%	0.1%	0.1%	0%	0%	0%	0%	0%	0%
GRITA link	0%	0%	0%	0%	0%	0%	0%	0%	0%
lazio	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
PST 220 kV – Camporosso	0%	0%	0%	0%	0%	0%	0%	0%	0%
SACOI link	28.7%	0%	0%	0%	0%	0%	0%	0%	0%
SAPEI link	1.1%	0%	0%	0.3%	0%	0%	0%	0.1%	0.1%
sicilia	0%	0%	0%	0%	0%	0%	0%	0%	0%
toscana	0.2%	0.4%	0.6%	0%	0%	0%	0.8%	0%	0%
TTC_Planned	0%	1.0%	1.4%	0%	0%	0%	1.7%	0.5%	0.4%

Lithuania

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
330/400 kV – LitPol Link	20.8%	20.9%	12.8%	0%	0%	0%	0%	0%	0%
330/400 kV – NordBalt	30.9%	49.9%	61.2%	0%	0%	0%	0%	0%	0%
Kruonis-Sovietskas-447	0%	4.3%	0%	0%	0%	0%	0%	0%	0%

Luxemburg

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Flebour S – xnode Bauler	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – Flebour N – xnode Bauler	0%	0%	0%	0%	0%	0.1%	0%	0%	0%

Netherlands

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – BGM-RBB Z	0%	0%	0%	0%	0%	0%	0%	0%	0.2%
220 kV – BGM-VVL Z	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – HSW-ENS Z	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – LSM-BGM W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – OHK-ENS W	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – OHK-ENS Z	0%	0%	0%	0%	0%	0.2%	0%	0%	0.4%
220 kV – RBB-VVL W	0%	0%	0%	0.6%	0%	0%	0%	0%	0.1%
220 kV – RBB-WEW P	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – VVL-EEM G	0%	0%	0%	0.3%	0%	0%	0%	0%	0.1%
220 kV – VVL-ZYV W	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – ZKL-BSA W	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
220 kV – ZKL-BSA Z	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
220 kV – ZYV-HSW Z	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – BKK-DIM W	0%	0%	0%	0.1%	0.7%	0.1%	0%	0%	0%
380 kV – BSL-RLL G	0%	0.1%	0.1%	1.1%	0.1%	0.2%	0%	0%	1.5%
380 kV – BSL-RLL Z	0.1%	0%	0%	1.1%	0.1%	0.2%	0%	0%	1.6%
380 kV – BVW-VHZ Z	0%	0%	0%	0.3%	0%	0%	0%	0%	0%
380 kV – BWK-VHZ P	0%	0%	0%	0%	0%	0.1%	0%	0%	0.2%
380 kV – CST-GT Z	0%	0.3%	0.1%	0%	0%	0%	0%	0%	0.1%
380 kV – CST-KIJ W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – CST-KIJ Z	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – DIM-LLS W	0.6%	4.6%	4.2%	1.8%	6.6%	6.4%	0%	0%	4.5%
380 kV – DIM-LLS Z	3.9%	0.7%	0.3%	8.8%	2.9%	6.4%	0%	0%	5.1%
380 kV – DOD-DTC W	0%	0%	0.1%	0.1%	0%	0%	0%	0%	0%
380 kV – DOD-DTC Z	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
380 kV – DTC-HGL W	0%	0%	0.2%	0.3%	0.3%	0.4%	0%	0%	0.4%
380 kV – DTC-HGL Z	0%	0%	0%	0.2%	0%	0.4%	0%	0%	0.4%
380 kV – EEM-EHH Z	0.3%	0.2%	0%	9.3%	7.3%	4.8%	0%	0%	5.2%
380 kV – EEM-EOS W	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – EEM-EOS Z	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
380 kV – EEM-MEE W	0.7%	0.3%	0.4%	0.1%	0%	0.4%	0%	0%	0%
380 kV – EEM-MEE Z	0%	0%	0%	0.2%	0%	0.2%	0%	0%	0%
380 kV – EHH-MEE Z	0%	0%	0%	9.3%	7.3%	4.8%	0%	0%	5.2%
380 kV – EMT-MEE W	0%	0%	0%	9.4%	7.4%	4.7%	0%	0%	2.0%
380 kV – ENS-ZL W	0%	0%	0%	1.0%	0.3%	0.5%	0%	0%	0.4%
380 kV – ENS-ZL Z	0%	0%	0%	1.0%	0.3%	0.5%	0%	0%	0.4%
380 kV – EOS-EEM W	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – EOS-EEM Z	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
380 kV – EOS-EMT W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – GT-EHV G	0%	0%	0%	0%	0%	0%	0%	0%	0.3%
380 kV – GT-EHV W	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
380 kV – GT-EHV Z	0%	0%	0%	0%	0%	0%	0%	0%	0.3%
380 kV – GT-RLL W	0%	0.3%	0.1%	0%	0%	0.2%	0.2%	0.1%	0.7%
380 kV – GT-RLL Z	0.2%	0.1%	0%	0%	0%	0.2%	0%	0.1%	0.9%
380 kV – KIJ-BKK W	0%	0.4%	0%	0.1%	0.8%	0.1%	0%	0%	0%
380 kV – KIJ-BWK W	0%	0%	0%	0%	0%	0%	0%	0%	0%

Netherlands (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
380 kV – KIJ-DIM Z	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
380 kV – KIJ-GT W	0.3%	0.2%	1.0%	1.2%	0.1%	0.7%	0%	0%	2.4%
380 kV – KIJ-GT Z	2.3%	0.3%	0%	1.2%	0.1%	0.3%	0%	0%	0.7%
380 kV – LLS-ENS W	0%	0.2%	0%	0.7%	0.8%	3.6%	0%	0%	2.3%
380 kV – LLS-ENS Z	0%	0%	0%	0.7%	0.8%	3.4%	0%	0%	2.2%
380 kV – MBT-EHV W	0%	0%	0.4%	0%	0%	0.2%	0%	0%	0.4%
380 kV – MBT-EHV Z	0%	0%	0.1%	0%	0%	0.3%	0%	0%	0.4%
380 kV – MBT-OBZ W	0.7%	0.9%	0.6%	0.3%	0.3%	0.5%	0%	0%	1.2%
380 kV – MBT-SDF Z	0.1%	0.3%	0.3%	0.1%	0.2%	0.3%	0%	0%	0.6%
380 kV – MBT-VYK W	0%	0%	0%	0.3%	1.1%	0.1%	0%	0%	0%
380 kV – MBT-VYK Z	0%	0%	0%	0.1%	0.2%	0.2%	0%	0%	0.1%
380 kV – MEE-DIL W	3.6%	13.2%	4.9%	16.7%	15.3%	25.6%	0%	0%	24.4%
380 kV – MEE-DIL Z	0.8%	0.8%	11.6%	14.7%	20.6%	25.6%	0%	0%	24.7%
380 kV – OZN-DIM G	0%	0.1%	0%	0%	0%	0%	0%	0%	0.1%
380 kV – OZN-DIM Z	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – RLL-GT W	0%	0%	0%	0.6%	0.2%	0%	0%	0%	0.1%
380 kV – RLL-GT Z	0%	0%	0%	0.6%	0.2%	0%	0%	0%	0.1%
380 kV – RLL-ZVL G	0.2%	0.2%	0.4%	0%	0%	0.2%	0%	0%	0.8%
380 kV – RLL-ZVL W	0.1%	0.3%	1.1%	0%	0%	0%	0%	0%	0.5%
380 kV – SMH-CST W	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – SMH-CST Z	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – VHZ-BWK P	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
380 kV – VYK-MBT W	0.1%	0.3%	0.1%	0%	0%	0.1%	0%	0%	0%
380 kV – VYK-MBT Z	0.1%	0%	0.1%	0%	0%	0.2%	0%	0%	0.1%
380 kV – WTR-BWK Z	0%	0%	0%	0%	0%	0%	0%	0%	0%
380 kV – ZL-HGL W	0%	0.2%	0.4%	0.2%	0.2%	0.6%	0%	0%	1.7%
380 kV – ZL-HGL Z	0.2%	0.1%	0%	0.2%	0.2%	0.6%	0%	0%	1.5%
380 kV – ZL-MEE W	0%	0%	0%	1.1%	0.7%	2.1%	0%	0%	1.1%
380 kV – ZL-MEE Z	0%	0%	0%	1.1%	0.7%	2.0%	0%	0%	1.2%

Poland

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Bujakow – Byczyna	0%	0%	0%	0.1%	0.4%	1.1%	0%	0%	0%
220 kV – Bujakow – Komorowice	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Bujakow – Liskovec	0%	0%	0.1%	0%	0%	0%	0%	0.6%	0.2%
220 kV – Cieplice – Mikulowa	0%	0%	0%	0.2%	0.4%	0.4%	0%	0%	0%
220 kV – Dunowo-Zydowo	0.3%	0%	0%	0%	0%	0%	0%	0.6%	0.2%
220 kV – Gorzow – Lesniow	0%	0%	0%	0%	0.1%	0.1%	0%	0%	0%
220 kV – Kopanina – Katowice	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Kopanina – Liskovec	0.8%	0.7%	2.0%	0.3%	0.1%	0%	0%	0%	0%
220 kV – Krajnik – Gorzow	0.1%	0.1%	0%	0%	2.3%	6.1%	0%	0%	0%

Poland (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – Lesniow – Mikulowa	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Lesniow – Zukowice	0%	0%	0%	0%	0.3%	1.0%	0%	0%	0%
220 kV – Leszno – Polkowice	0.5%	0%	0%	1.0%	0%	0.1%	0%	0%	0%
220 kV – Mikulowa – Polkowice 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Mikulowa – Polkowice 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Mikulowa – Swiebodzice 1	0%	0%	0%	0.8%	2.4%	1.7%	0%	0%	0%
220 kV – Mikulowa – Swiebodzice 2	0%	0%	0%	0.9%	2.3%	1.4%	0%	0%	0%
220 kV – Plewiska – Polkowice	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – Polaniec – Klikowa	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Polkowice – Zukowice	0%	0%	0%	0.4%	0.3%	0.8%	0%	0%	0%
220 kV – Wielopole – Kopanina	0%	0%	0%	0%	0%	0%	0%	0%	0%
400/220 kV – Mikulowa AT1	3.0%	0%	1.8%	1.2%	0.4%	0.7%	0%	0%	0%
400/220 kV – Polkowice AT3	0%	0%	0%	0.3%	0.1%	0%	0%	0%	0%
400/220 kV – Dunowo-AT1	0.2%	0%	0%	0%	0%	0%	0%	0%	0%
400/220 kV – Krajnik AT2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400/220 kV – Krajnik AT3	0%	0%	0.1%	0.1%	0%	0.1%	0%	0%	0%
400/220 kV – Mikulowa AT2	0.2%	0.1%	0.1%	1.9%	0.5%	0.6%	0%	0%	0%
400/220 kV – Polaniec AT2	0%	0%	0%	1.6%	0.3%	0.8%	0%	0%	0%
400/220 kV – Swiebodzice AT3	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
400 kV – Morzyczyn – Dunowo	0.1%	0%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – Polaniec – Rzeszow	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Czarna – Mikulowa	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Czarna – Pasikurowice	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Czarna – Polkowice 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Czarna – Polkowice 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Dobrzen – Albrechtice	0%	0%	0%	0.4%	0%	0%	0%	0%	0%
400 kV – Krajnik – Plewiska 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Krajnik – Plewiska 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Krajnik – Vierraden 1	0.2%	0%	3.7%	1.5%	0%	0%	0%	0%	0.2%
400 kV – Krajnik – Vierraden 2	0.3%	0%	0.3%	2.2%	0.3%	0%	0%	0%	0%
400 kV – Kromolice – Ostrow 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Kromolice – Ostrow 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Krosno Iskrzynia – Rzeszow	0.1%	3.5%	3.5%	0.2%	1.7%	0%	0%	0%	0%
400 kV – Krosno Iskrzynia – Tarnow	0%	0.2%	2.0%	0%	0%	0%	0%	0%	0%
400 kV – Lemesany – Krosno Iskrz 1	2.2%	5.7%	0%	1.1%	2.0%	0%	0%	0%	0%
400 kV – Lemesany – Krosno Iskrz 2	0.1%	1.1%	0.1%	1.2%	2.0%	0%	0%	0%	0%
400 kV – Mikulowa – Hagenwerder 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Mikulowa – Hagenwerder 2	0.1%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Mikulowa – Pasikurowice	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Mikulowa PST1	0.1%	0%	13.0%	0.1%	0%	0.1%	0%	0%	0%
400 kV – Mikulowa PST2	2.5%	0.3%	0%	0.1%	0%	0.1%	0%	0%	0%
400 kV – Mikulowa PST3	0.1%	0.1%	1.6%	0.1%	0%	0.1%	0%	0%	0%
400 kV – Mikulowa PST4	2.9%	0.4%	0%	0.1%	0%	0.1%	0%	0%	0%
400 kV – Plewiska – Kromolice 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Plewiska – Kromolice 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Polaniec – Tarnow	1.6%	0.7%	0.5%	0.3%	0.5%	0%	0%	0%	0%

Poland (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400 kV – Rzeszow – Khmelnytskyi	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Swiebodzice – Wroclaw	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Wielopole – Nosovice	7.8%	9.6%	3.2%	0.1%	0%	0%	0%	0%	0%
400 kV – Wroclaw – Dobrzen	0%	0%	0%	2.4%	0.6%	0.2%	0%	0%	0%
BtB-Elk-Alytus	12.9%	1.6%	1.4%	0%	0%	0%	0%	0%	0%
DC-LINK-Slupsk-Starno	2.8%	11.1%	8.6%	0%	0%	0%	0%	0%	0%

Portugal

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
150 kV – Bouçã – Zêzere 2	0%	0%	0%	5.5%	0%	0%	0%	0%	0%
150 kV – Monte da Pedra – Sines	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
150 kV – Palmela – Évora – Pegões	0%	0%	0.4%	0%	0%	0%	0%	0%	0%
150 kV – Vilarinho das Frunas – Caniçada	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Aguieira – Pereiros – Mortágua	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Cabril – Bouçã	0%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – Picote – Mogadouro	0%	0%	0%	0.5%	0%	0%	0%	0%	0%
220 kV – Pocinho – Armamar 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Alqueva – Brovales	0%	0%	0.8%	0%	0%	0%	0%	0%	0%
400 kV – Alto Lindoso – Cartelle 1 e 2	1.1%	0.3%	0.4%	0%	0%	0%	0%	0%	0%
400 kV – Armamar – Lagoaça	0%	0.2%	0.3%	0%	0%	0%	0%	0%	0%
400 kV – Falagueria – Cedillo	0%	0%	0.4%	0%	0%	0%	0%	0%	1.2%
400 kV – Lagoaça – Aldeadávilla 1	0%	0.2%	0.8%	0%	0%	0%	0%	0%	0%
400 kV – Palmela – Pegões	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Pego – Falagueira	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Riba d'Ave – Recarei 1	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Riba d'Ave – Recarei 2	0%	0%	0%	0%	0%	0%	0%	0%	0%
400 kV – Rio Maior – Alto Mira	0%	0%	0%	0%	0%	0%	0%	0%	0%

Romania

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
OHL 220 kV – Barbosi – Filesti	0%	0%	0%	2.1%	0.6%	0%	0%	0%	0%
OHL 220 kV – Bucuresti Sud – Fundeni c.1 (2)	0%	0%	0%	0.7%	0.8%	0.9%	0%	0%	0%
OHL 220 kV – Pestis – Hasdat	0%	0%	0.9%	0.7%	0%	2.5%	0%	0%	0%
OHL 220 kV – Portile de Fier – Resita c. 1 (2)	1.0%	1.2%	2.8%	21.2%	8.6%	17.8%	4.5%	1.5%	3.5%
OHL 220 kV – Resita – Timisoara c.1 (2)	0%	2.8%	6.2%	17.0%	6.8%	11.7%	4.0%	1.2%	3.1%
OHL 220 kV – Sibiu Sud – Lotru c.1 (2)	0%	0%	0%	1.3%	0%	1.7%	0%	0%	0%
OHL 400 kV – Gura Ialomitei – Lacu Sarat	0%	0%	0%	0%	0%	2.0%	0%	0%	0%

Romania (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
OHL 400 kV – Hasdat – Mintia	0%	0%	0%	0%	0%	2.2%	0%	0%	0%
OHL 400 kV – Isaccea – Vulcanesti	0%	0.7%	0.1%	0%	5.7%	1.8%	0%	1.2%	0.5%
OHL 400 kV – Tulcea Vest – Isaccea	0%	0%	0%	0%	0%	1.9%	0%	0%	0.5%
OHLs 220 kV – Urechesti – Targu Jiu Nord – Paroseni – Baru Mare – Hasdat	0%	8.4%	2.7%	1.1%	2.9%	4.9%	0%	0%	1.5%
TIE 400 kV – Portile de Fier – Djerdap	22.0%	11.4%	3.9%	0%	0%	0%	0%	0%	0%
TIE 400 kV – Tantareni – Kozlodui c.1 (2)	0%	5.6%	1.0%	0%	0%	3.0%	0%	0%	0%
TR 400/220 kV – Arad	0%	0.4%	0.5%	0%	0%	0%	0%	0%	0%
TR 400/220 kV – Brazi Vest 3	0%	0%	0%	1.8%	2.1%	1.9%	0%	0%	0%
TR 400/220 kV – Bucuresti Sud 3 (4)	0%	0%	0%	16.3%	6.4%	2.4%	0%	0%	0%
TR 400/220 kV – Gutinas 5.6	0%	0%	0%	0%	1.9%	0%	0%	0%	0%
TR 400/220 kV – Iernut 1 (2)	0%	0%	0%	11.3%	2.7%	2.6%	0%	0%	0%
TR 400/220 kV – Portile de Fier 1 (2, 3)	0%	0.7%	1.7%	1.1%	0%	0%	0%	0%	0%
TR 400/220 kV – Rosiori 1	9.0%	6.0%	8.8%	1.3%	1.0%	1.4%	0%	0%	0%

Slovakia

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400 kV – SK_L1	0%	1.1%	6.8%	0.1%	0.2%	2.2%	0.1%	0.3%	6.5%
400 kV – SK_L2	0%	1.1%	0.1%	0.3%	0.2%	2.0%	0.3%	0.3%	4.3%
400 kV – SK_L3	0%	1.4%	1.6%	0%	0.1%	0%	0.5%	0.8%	0%
400 kV – SK_L4	0%	0.5%	1.4%	0%	0.1%	0.3%	0%	0.1%	0.4%
400 kV – SK_L5	0%	0.2%	0.6%	0%	0%	0.2%	0.1%	0%	0.7%
400 kV – SK_L6	0%	0%	0.1%	0%	0%	0.2%	0%	0%	0.2%
400 kV – SK_L7	0%	0%	0%	0.2%	0%	0%	0.3%	0%	0%
400 kV – SK_L8	0%	0%	0%	0.1%	0%	0%	0.7%	0.4%	0%
400 kV – SK_L9	0%	0%	0%	0.1%	0.1%	0%	0.7%	0.4%	0%
400 kV – SK_L10	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – SK_L11	0%	0%	0%	0%	0%	0%	0%	0%	0%

Slovenia

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
[AT-SI] Kainachtal – Maribor 473 [AT]	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
[AT-SI] Obersielach – Podlog 247 [AT]	0%	8.1%	8.8%	0%	2.9%	2.4%	0%	0%	0%
[HR-SI] 220 kV – Pehlin – Divaca [HR]	0%	3.3%	4.0%	0%	2.5%	2.0%	0%	0%	0%
[HR-SI] 400 kV – Melina – Divaca [HR]	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
[HR-SI] 400 kV – Tumbri – Krsko 1 [HR]	0%	0.5%	0.1%	0%	0.2%	0%	0%	0%	0%
[SI-AT] 220 kV – Podlog – Obersielach [SI]	0%	2.3%	1.5%	0%	0.7%	1.2%	0%	0%	0%

Slovenia (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
[SI-AT] 400 kV – Maribor – Kainachtal 1 [SI]	0%	0.7%	0.3%	0%	0.3%	0%	0%	0%	0%
[SI-HR] 220 kV – Podlog – Zerjavinec [SI]	0%	0%	0%	0%	0%	0%	0%	0%	0%
[SI-HU] 400 kV – Cirkovce – Heviz [SI]	0%	0.2%	0.9%	0%	0.1%	0.4%	0%	0%	0%
[SI-IT] Divača – Redipuglia [SI]	8.4%	0%	0%	0%	0%	0%	0%	0%	0%
[SI-IT] PST Divaca [SI]	7.8%	0.6%	0.2%	0%	0%	0%	0%	0%	0%
[SI-SI] Divaca TR212 transformer	0.1%	0.2%	0%	0%	0%	0%	0%	0%	0%

Spain

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – ES_L10	0%	0%	0%	0.2%	3.7%	7.7%	0.7%	0.8%	1.2%
220 kV – ES_L100	0%	0%	0%	0%	0%	0.1%	0%	0%	0.1%
220 kV – ES_L101	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
220 kV – ES_L106	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – ES_L107	0%	0%	0%	0.1%	0%	0%	0.1%	0%	0%
220 kV – ES_L108	0%	0%	0%	0%	0.1%	0%	0%	0%	0.1%
220 kV – ES_L109	0%	0%	0%	0%	0.1%	0%	0.1%	0%	0.8%
220 kV – ES_L11	0%	0%	0%	0.3%	5.0%	5.9%	0%	1.1%	0.7%
220 kV – ES_L111	0%	0%	0%	0%	0.1%	0%	0%	0%	0.1%
220 kV – ES_L112	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – ES_L114	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – ES_L115	0%	0%	0%	0%	0%	0%	0.1%	2.0%	0.2%
220 kV – ES_L116	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ES_L117	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ES_L12	0%	0%	0%	0.6%	0.9%	6.7%	2.5%	0.4%	3.1%
220 kV – ES_L124	0%	0%	0%	0%	0%	0%	0%	0%	0.7%
220 kV – ES_L125	0%	0%	0%	0%	0%	0%	0%	0%	0.3%
220 kV – ES_L126	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ES_L127	0%	0%	0%	0%	0%	0%	0.1%	0.2%	0%
220 kV – ES_L128	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ES_L13	0%	0%	0%	1.0%	4.6%	4.6%	1.7%	2.8%	4.7%
220 kV – ES_L130	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ES_L131	0%	0%	0%	0%	0%	0%	0%	0%	0.3%
220 kV – ES_L132	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
220 kV – ES_L135	0%	0%	0%	0%	0%	0%	0%	0.1%	0.3%
220 kV – ES_L136	0%	0%	0%	0%	0%	0%	0%	0.2%	0%
220 kV – ES_L138	0%	0%	0%	0%	0%	0%	0%	0.1%	0.1%
220 kV – ES_L14	0%	0%	0%	0.1%	1.0%	7.3%	1.2%	0.8%	4.2%
220 kV – ES_L140	0%	0%	0%	0%	0%	0%	0.1%	0%	0%
220 kV – ES_L141	0%	0%	0%	0%	0%	0%	0%	0.3%	0.1%
220 kV – ES_L143	0%	0%	0%	0%	0%	0%	0.1%	0%	0.1%
220 kV – ES_L144	0%	0%	0%	0%	0%	0%	0%	0%	0.6%

Spain (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – ES_L145	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – ES_L147	0%	0%	0%	0%	0%	0%	0%	0.2%	0%
220 kV – ES_L148	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – ES_L149	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
220 kV – ES_L17	0%	0%	0%	0.3%	2.6%	3.4%	0%	0.2%	0.2%
220 kV – ES_L18	0%	0%	0%	0%	4.1%	1.9%	0.3%	0.7%	2.0%
220 kV – ES_L19	0%	0%	0%	0%	5.3%	0.6%	1.5%	1.7%	0%
220 kV – ES_L2	16.1%	22.4%	16.8%	0%	0%	0%	2.6%	5.5%	2.7%
220 kV – ES_L20	0%	0%	0%	4.6%	1.2%	0%	0.4%	0%	0%
220 kV – ES_L21	0%	0%	0%	0%	3.0%	2.7%	0%	0%	0%
220 kV – ES_L22	0%	0%	0%	0.7%	0%	4.1%	0%	0%	0.1%
220 kV – ES_L23	0%	0%	0%	0.2%	1.2%	3.4%	0.1%	0.4%	1.0%
220 kV – ES_L25	0%	0%	0%	0%	0%	3.9%	0%	0%	0%
220 kV – ES_L27	0%	0%	0%	0.9%	0%	2.8%	0%	0%	0%
220 kV – ES_L28	0%	0%	0%	0%	0.9%	2.2%	0.1%	0%	1.0%
220 kV – ES_L29	0%	0%	0%	1.3%	1.4%	0.4%	0%	0.1%	0%
220 kV – ES_L3	8.1%	15.9%	12.0%	0%	0%	0%	0%	0.4%	1.1%
220 kV – ES_L30	0%	0%	0%	0.3%	0.4%	2.2%	0%	0%	0.1%
220 kV – ES_L31	0%	0%	0%	0.1%	0%	2.8%	0%	0%	0.4%
220 kV – ES_L32	0%	0%	0%	1.2%	0.4%	1.2%	0.2%	0%	0%
220 kV – ES_L35	0%	0%	0%	0%	1.5%	1.2%	0%	0.1%	0%
220 kV – ES_L37	0%	0%	0%	0.5%	0%	2.0%	0.1%	0.1%	0.3%
220 kV – ES_L38	0%	0%	0%	0.3%	0.1%	2.0%	0%	0%	0%
220 kV – ES_L39	1.6%	0.1%	0.5%	0%	0%	0.2%	0%	0%	0.2%
220 kV – ES_L4	3.9%	1.6%	1.8%	0%	0%	0%	0%	0%	0%
220 kV – ES_L40	0%	0%	0%	0%	0%	2.4%	0.3%	0%	0%
220 kV – ES_L41	0%	0%	0%	2.1%	0%	0%	0%	0%	0%
220 kV – ES_L42	0%	0%	0%	0%	0%	2.0%	0%	0%	0%
220 kV – ES_L44	0%	0%	0%	0%	1.2%	0.7%	0%	0%	0.1%
220 kV – ES_L45	0%	0%	0%	0%	1.7%	0%	0%	0%	0%
220 kV – ES_L48	0%	0%	0%	0.3%	1.2%	0%	0%	0.4%	0%
220 kV – ES_L49	0%	0%	0%	0%	0.1%	1.3%	0%	0.5%	0.1%
220 kV – ES_L5	0%	0%	0%	0%	5.6%	15.7%	0.9%	1.0%	5.6%
220 kV – ES_L50	0%	0%	0%	0.2%	1.1%	0%	0%	0.3%	0%
220 kV – ES_L51	0%	0%	0%	0.2%	1.0%	0%	0%	0%	0%
220 kV – ES_L52	0%	0%	0%	0.1%	1.1%	0%	0%	0.2%	0%
220 kV – ES_L55	0%	0%	0%	0%	0%	1.0%	0.1%	0%	0%
220 kV – ES_L57	0%	0%	0%	0%	0%	0.9%	0%	0%	0.1%
220 kV – ES_L59	0%	0%	0%	0.8%	0%	0%	0%	0%	0%
220 kV – ES_L6	0%	0%	0%	0%	0.3%	0%	0%	0%	0%
220 kV – ES_L60	0.2%	0%	0%	0.4%	0.2%	0%	0.1%	0%	0%
220 kV – ES_L62	0%	0%	0%	0.7%	0%	0%	0%	0%	0%
220 kV – ES_L64	0.2%	0.4%	0%	0.1%	0%	0%	0%	0.1%	0%
220 kV – ES_L66	0%	0%	0%	0%	0.3%	0.3%	0%	0%	0.1%
220 kV – ES_L7	0%	0%	0%	0%	3.9%	16.5%	0.1%	1.6%	5.4%
220 kV – ES_L70	0%	0%	0%	0%	0%	0.5%	0%	0%	0%

Spain (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
220 kV – ES_L72	0%	0%	0%	0%	0.5%	0%	0%	0%	0%
220 kV – ES_L73	0%	0%	0%	0%	0.5%	0%	0%	0.1%	0%
220 kV – ES_L74	0%	0%	0%	0%	0.4%	0.1%	0%	0%	0%
220 kV – ES_L75	0%	0%	0%	0.2%	0.1%	0.1%	0%	0.1%	0%
220 kV – ES_L77	0%	0%	0%	0.1%	0%	0.3%	0%	0%	0%
220 kV – ES_L80	0%	0%	0%	0.3%	0%	0%	0%	0%	0%
220 kV – ES_L81	0%	0.2%	0.1%	0%	0%	0%	0%	0%	0%
220 kV – ES_L82	0%	0%	0%	0%	0.1%	0.2%	0%	0%	0%
220 kV – ES_L85	0%	0%	0%	0%	0.2%	0%	0%	0.1%	0%
220 kV – ES_L86	0%	0%	0%	0%	0.2%	0%	0%	0%	0.1%
220 kV – ES_L87	0.2%	0%	0%	0%	0%	0%	0%	0%	0%
220 kV – ES_L9	0%	0%	0%	0%	4.7%	7.4%	0%	0.1%	0.3%
220 kV – ES_L92	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – ES_L93	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
220 kV – ES_L94	0%	0%	0%	0%	0%	0.1%	0.3%	0%	0%
220 kV – ES_L96	0%	0%	0%	0.1%	0%	0%	0%	0%	0%
220 kV – ES_L97	0%	0%	0%	0%	0%	0.1%	0%	0%	0.2%
220 kV – ES_L98	0%	0%	0%	0.1%	0%	0%	0%	1.3%	0.3%
220 kV – ES_L99	0%	0%	0%	0%	0%	0.1%	0%	0.5%	0.8%
400/132 kV – ES_L91	0%	0%	0%	0%	0%	0.1%	2.7%	2.0%	3.7%
400/220 kV – ES_L118	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
400/220 kV – ES_L122	0%	0%	0%	0%	0%	0%	0%	0.1%	0%
400/220 kV – ES_L123	0%	0%	0%	0%	0%	0%	0.3%	0%	0%
400/220 kV – ES_L128	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
400/220 kV – ES_L133	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
400/220 kV – ES_L134	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
400/220 kV – ES_L137	0%	0%	0%	0%	0%	0%	0.2%	0%	0%
400/220 kV – ES_L139	0%	0%	0%	0%	0%	0%	0%	0%	0.2%
400/220 kV – ES_L142	0%	0%	0%	0%	0%	0%	0%	0%	0.1%
400/220 kV – ES_L15	0%	0%	0%	0%	0.8%	6.0%	5.2%	3.8%	4.2%
400/220 kV – ES_L26	0%	0%	0%	0%	0.6%	3.3%	1.1%	0.1%	2.5%
400/220 kV – ES_L61	0%	0%	0%	0%	0.5%	0.2%	0%	0.1%	0%
400/220 kV – ES_L68	0.6%	0%	0%	0%	0%	0%	0%	0%	0%
400/220 kV – ES_L74	0%	0%	0%	0%	0%	0.2%	0%	0%	0%
400/220 kV – ES_L76	0%	0%	0%	0.4%	0%	0%	0.2%	1.0%	0%
400/220 kV – ES_L79	0.3%	0%	0%	0%	0%	0%	0%	0%	0%
400/220 kV – ES_L83	0%	0%	0%	0%	0.3%	0%	0%	0.2%	0%
400/220 kV – ES_L95	0%	0%	0%	0%	0.1%	0%	0%	2.0%	3.0%
400 kV – ES_L1	6.1%	10.5%	8.7%	0%	0%	0%	1.0%	1.3%	1.7%
400 kV – ES_L102	0%	0%	0.1%	0%	0%	0%	0%	0%	0%
400 kV – ES_L103	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
400 kV – ES_L104	0%	0.1%	0%	0%	0%	0%	0%	0%	0%
400 kV – ES_L105	0%	0%	0%	0%	0.1%	0%	0%	0%	0%
400 kV – ES_L110	0%	0%	0%	0%	0%	0.1%	0%	0%	0%
400 kV – ES_L113	0%	0%	0%	0%	0%	0%	0%	0.3%	0%
400 kV – ES_L119	0%	0%	0%	0%	0%	0%	0%	0%	0.1%

Spain (continued)

Grid Element	CCDA 2021	CCDA 2022	CCDA 2023	D-1 2021	D-1 2022	D-1 2023	CTRT 2021	CTRT 2022	CTRT 2023
400 kV – ES_L120	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.2 %
400 kV – ES_L121	0 %	0 %	0 %	0 %	0 %	0 %	0.1 %	0 %	0.1 %
400 kV – ES_L146	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0.1 %
400 kV – ES_L16	0 %	0 %	0.1 %	1.7 %	1.0 %	4.5 %	0 %	0.4 %	5.2 %
400 kV – ES_L24	0 %	0 %	0 %	0 %	3.3 %	1.2 %	0 %	0.2 %	0 %
400 kV – ES_L33	0 %	0 %	0 %	1.6 %	0.4 %	0.8 %	1.4 %	0.1 %	0.4 %
400 kV – ES_L34	0 %	0 %	0.1 %	0.1 %	0 %	2.5 %	0 %	0 %	2.6 %
400 kV – ES_L36	0.3 %	0.9 %	1.4 %	0 %	0 %	0 %	0 %	0.2 %	0 %
400 kV – ES_L43	0 %	0 %	0 %	0.3 %	0.8 %	0.8 %	0 %	0 %	0.1 %
400 kV – ES_L46	0 %	0 %	1.7 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – ES_L47	0.3 %	0.4 %	0.9 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – ES_L53	0.4 %	0.5 %	0.2 %	0 %	0 %	0 %	0 %	0.6 %	0.4 %
400 kV – ES_L54	0 %	0.7 %	0.2 %	0 %	0.1 %	0 %	0 %	0 %	0 %
400 kV – ES_L56	0.1 %	0.8 %	0 %	0 %	0 %	0 %	0 %	0.2 %	0.8 %
400 kV – ES_L58	0 %	0 %	0.8 %	0 %	0 %	0 %	0 %	0 %	0.4 %
400 kV – ES_L63	0 %	0 %	0 %	0 %	0 %	0.7 %	0 %	0 %	0 %
400 kV – ES_L65	0 %	0 %	0 %	0 %	0 %	0.7 %	0.2 %	0.4 %	0.9 %
400 kV – ES_L67	0 %	0 %	0 %	0 %	0 %	0.6 %	0 %	0 %	0 %
400 kV – ES_L69	0 %	0 %	0 %	0 %	0.3 %	0.3 %	0 %	0 %	0.1 %
400 kV – ES_L71	0 %	0.3 %	0.2 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – ES_L78	0 %	0 %	0 %	0.3 %	0 %	0 %	0 %	0 %	0 %
400 kV – ES_L8	0 %	0 %	0 %	7.8 %	1.5 %	4.8 %	1.3 %	0.2 %	0.9 %
400 kV – ES_L88	0 %	0 %	0.2 %	0 %	0 %	0 %	0 %	0 %	0.3 %
400 kV – ES_L89	0 %	0.1 %	0.1 %	0 %	0 %	0 %	0 %	0 %	0 %
400 kV – ES_L90	0 %	0 %	0 %	0 %	0 %	0.2 %	0.1 %	0.1 %	0.2 %

Appendix 3

Overview of the fulfilment of minimum capacity targets (considering derogations and action plans) 2021–2023 by region/border

The following table provides an overview of the status of the CEP70 provisions for 2021–2023. Like in the Technical Report 2020, the central performance indicator in this table is the share of MTUs during which the respective TSO fulfilled the CEP70 provisions considering potential derogations and action plans.

Country	TSO	Border/CCR	% of MTUs in which minimum target was reached (considering		
			2021	2022 (for No Core TSOs)	2022 (pre Core go live)**
Austria	APG	CWE (AT↔DE)	99.99 % CNEC compliance reached		99.99 % CNEC compliance reached
		cNTC (AT↔CZ/HU/SI)	99.92 % CNEC compliance reached		98.32 % CNEC compliance reached
		Core (AT↔DE/CZ/HU/SI)			
		Italy North (AT↔IT)	100 % CNEC compliance reached	100 % CNEC compliance reached	
Belgium	Elia	CWE (BE↔DE/FR/NL)	99.25 % CNEC compliance reached		92.48 % CNEC compliance reached
		Core (BE↔DE/FR/NL)			
Bulgaria	ESO	BG→GR/SEE region	Since there was a derogation for 2021 without minimum target capacity, ESO has been 100 % compliant.	For BG→GR and GR→BG over 99 % of the time there is no limiting CNEC in our control area. Derogation until 22.10.2022 to be considered as well.	
		GR→BG/SEE region	Since there was a derogation for 2021 without minimum target capacity, ESO has been 100 % compliant.		
		BG→RO/SEE region	Since there was a derogation for 2021 without minimum target capacity, ESO has been 100 % compliant.	For BG→RO over 25 % of the time relative MACZT between 50 % and 70 %, 36 % of the time no limiting CNEC in our control area. Derogation until 22.10.2022 to be considered as well.	
		RO→BG/SEE region	Since there was a derogation for 2021 without minimum target capacity, ESO has been 100 % compliant.	For RO→BG 94 % of the time no limiting CNEC in our control area. Derogation until 22.10.2022 to be considered as well.	
Croatia	HOPS	HR–SI, HR–HU/Core borders	N/A (derogation)		N/A (derogation)

* Svenska kraftnät published a methodology to minimise the need for a derogation in March of 2021
** relevant only for Core TSOs
*** A minimum capacity of 70 % has already been applied from 2020 onwards.

action plans and/or derogations)		derogation/action plan applied		
2022 (post Core go live)**	2023	2021	2022	2023
		Full derogation (no target until 27.07 %), Then Derogation and action plan	Derogation and action plan (until Core Go-live)	N/A
		Full derogation (no target until 30.06 %), Then Derogation and action plan	Derogation and action plan (until Core Go-live)	N/A
100 % CNEC compliance reached	100 % CNEC compliance reached	N/A	Derogation and action plan (as of Core Go-live)	Derogation and action plan
	100 % CNEC compliance reached	Full derogation (no target until 28.10 %), Then action plan	Action plan	Action plan
		Derogation	Derogation	Derogation
99.81 % CNEC compliance reached	99.66 % CNEC compliance reached	Derogation	Derogation	Derogation
	For BG→GR and GR→BG over 99 % of the time there is no limiting CNEC in our control area.	Derogation	Derogation until 28.10.2022.	
		Derogation	Derogation until 28.10.2022.	
	For BG→RO 10.3 % of the time relative MACZT between 50 % and 70 %, 77 % of the time no limiting CNEC in our control area.	Derogation	Derogation until 28.10.2022.	
	For RO→BG 15.5 % of the time relative MACZT between 50 % and 70 %, over 71 % of the time no limiting CNEC in our control area.	Derogation	Derogation until 28.10.2022.	
100 %	100 %	Derogation	Derogation and Action plan	Action plan

Country	TSO	Border/CCR	% of MTUs in which minimum target was reached (considering		
			2021	2022 (for No Core TSOs)	2022 (pre Core go live)**
Czech Republic	ČEPS – ČEPS, a.s.	CZ→(AT+DE+PL+SK)	100 %		100 %
		(AT+DE+PL+SK)→CZ	100 %		100 %
		CZ→CORE			
		CORE→CZ			
Denmark	ENERGINET	SE3→DK1	81 %	98 %	
		DK1→SE3	81 %	99 %	
		DE→DK2	99 %	100 %	
		DK2→DE	99 %	100 %	
		DK1→DK2	98 %	99 %	
		DK2→DK1	100 %	99 %	
		DK1→NL	95 %	100 %	
		NL–DK1	88 %	100 %	
		DK1→NO2	99 %	99 %	
		NO2→DK1	100 %	100 %	
		DK2→SE4	100 %	83 %	
		SE4→DK2	100 %	83 %	
		DK1→DE	99 %	73 %	
		DE→DK1	98 %	73 %	
Estonia	Elering – Elering AS	LV–EE, FI–EE	100 %	100 %	
Finland	Fingrid – Fingrid OyJ	FI–EE	100 %	100 %	
		FI–SE1	100 %	100 %	
		FI–SE3	100 %	100 %	
France	RTE	FR–CWE	81 %		64 %
		FR–Core			
		FR–Italy North	87 %	99.7 %	
		SWE FR⇔ES	80 %	90 %	
Germany	Amprion	CWE	100 %		99.98 %
		Core			
		Alegro	100 %		97.04 %
	TransnetBW	CWE	100 %		100 %
		Core			
	TenneT GER & 50Hertz	DE→PL/CZ	100 %		100 %
		PL/CZ→DE	100 %		100 %
	TenneT GER	DE→SE4	98.973 %	98.002 %	
		SE4→DE	100 %	99.943 %	
		DE→DK1	100 %	100 %	
		DK1→DE	100 %	100 %	
		DE→NO2	100 %	100 %	
		NO2→DE	100 %	100 %	
		CWE	100 %		99.960 %
		Core			
	50Hertz	DK2→DE	100 %	100 %	
		DE→DK2	100 %	100 %	
Greece	IPTO	SEE	77 %	97 %	
		GRIT	99.85 %	100 %	

* Svenska kraftnät published a methodology to minimise the need for a derogation in March of 2021
** relevant only for Core TSOs
*** A minimum capacity of 70 % has already been applied from 2020 onwards.

action plans and/or derogations)		derogation/action plan applied		
2022 (post Core go live)**	2023	2021	2022	2023
		Derogation	Derogation until 8.6.2022	
		Derogation	Derogation until 8.6.2022	
100 %	99.84 %			
100 %	100 %			
	95 %	No	No	No
	85 %	No	No	No
	99 %	No	No	No
	99 %	No	No	No
	98 %	No	No	No
	99 %	No	No	No
	98 %	No	No	No
	98 %	No	No	No
	99 %	No	No	No
	99 %	No	No	No
	99 %	No	No	No
	100 %	No	No	No
	100 %	No	No	No
	100 %	No	No	No
	100 %	No	No	No’
	100 %	no	no	no
	97.01 %	no	no	no
	100 %	no	no	no
		No	No	No
88 %	81 %	No	No	No
	99 %	No	No	No
	94 %	Derogation on FR⇔ES border	No	No
		Action plan	Action plan	Action plan
99.51 %	99.72 %	Action plan	Action plan	Action plan
100 %	100 %	Action plan	Action plan	Action plan
		Action plan	Action plan	Action plan
100 %	100 %	Action plan	Action plan	Action plan
N/A	N/A	Action plan	Action plan	Action plan
N/A	N/A	Action plan	Action plan	Action plan
	97.272 %	Action plan	Action plan	Action plan
	99.144 %	Action plan	Action plan	Action plan
	100 %	Action plan	Action plan	Action plan
	99.988 %	Action plan	Action plan	Action plan
	100 %	Action plan	Action plan	Action plan
	100 %	Action plan	Action plan	Action plan
		Action plan	Action plan	Action plan
99.493 %	99.886 %	Action plan	Action plan	Action plan
	100 %	Action plan***	Action plan***	Action plan***
	100 %	Action plan***	Action plan***	Action plan***
	92 %	Derogation	Derogation	Derogation
	100 %			

Country	TSO	Border/CCR	% of MTUs in which minimum target was reached (considering		
			2021	2022 (for No Core TSOs)	2022 (pre Core go live)**
Hungary	MAVIR ZRt.	NTC (HU↔AT/HR/SK)	N/A (derogation)	100 %	82.30 %
		Core (HU↔AT/HR/RO/SI/SK)	N/A (derogation)	100 %	
Ireland	EirGrid – EirGrid plc	The SEM market is currently not physically interconnected to other Member states nor other third countries that apply EU VO 2019/943. Hence, SEM runs as an isolated market. The assessment on cross-zonal trade capacity will become relevant when the SEM reconnects to the European IEM with the commissioning of the Celtic interconnector.			
Italy	Terna – Terna SpA	Italy North	88 %	56 %	
		GRIT	100 %	100 %	
Latvia	Augstsprieguma	LV↔LT, LV↔EE	100 %	100 %	
Lithuania	LITGRID AB	LT→SE4	100 %	97.74 %	
		SE4→LT	100 %	97.75 %	
		LT↔PL, LT↔LV	100 %	100 %	
Luxembourg	CREOS Luxembourg	Creos does not have commercialised borders.			
Netherlands	TenneT TSO	CORE	38.72 %		94.31 %
Norway	Statnett	The minimum trade requirement pursuant to Art. 16 of Regulation (EU) 2019/943 is not fully applicable in Norway due to that Regulation (EU) 2019/943 is not implemented in the EEA-agreement			
Poland	PSE	CZ–DE–SK→PL	100 %		100 %
		PL→CZ–DE–SK	100 %		100 %
		PL – CORE			N/A
		PL→LT	100 %		100 %
		LT→PL	100 %		100 %
		PL→SE4	100 %		100 %
		SE4→PL	100 %		100 %
Portugal	REN	PT – ES	100 %	100 %	
Romania	Transelectrica S.A.	Core borders	100 %		100 %
		SEE	100 %		100 %
Slovak Republic	SEPS –	SK→(CZ+PL+HU)	82 %		100 %
		(CZ+PL+HU)→SK	95 %		100 %
		Core borders			
Slovenia	ELES	SI↔AT, SI↔HR	100 %		100 %
		CORE			
		Italy North	100 %	100 %	
Spain	REE	SWE borders	100 %	100 %	

* Svenska kraftnät published a methodology to minimise the need for a derogation in March of 2021
** relevant only for Core TSOs
*** A minimum capacity of 70 % has already been applied from 2020 onwards.

action plans and/or derogations)		derogation/action plan applied		
2022 (post Core go live)**	2023	2021	2022	2023
		Derogation	Action plan	Action plan
98.69 %	94.25 %	Derogation	Action plan	Action plan
	79 %	Derogation	Derogation	Derogation
	100 %			
	100 %	N/A	N/A	N/A
	100 %	N/A	N/A	N/A
	100 %	N/A	N/A	N/A
	100 %	N/A	N/A	N/A
42.37 %	98.54 %	Derogation+Action Plan	Derogation+Action Plan	Derogation+Action Plan
N/A		Derogation+Action Plan	Derogation+Action Plan	N/A
N/A		Derogation+Action Plan	Derogation+Action Plan	N/A
100 %	100 %	N/A	Derogation+Action Plan	Derogation+Action Plan
100 %	100 %	Action Plan	Action Plan	Action Plan
100 %	100 %	Action Plan	Action Plan	Action Plan
100 %	100 %	Action Plan	Action Plan	Action Plan
100 %	100 %	Action Plan	Action Plan	Action Plan
	100 %	Derogation	Derogation	Derogation
100 %	86 %	Action plan	Derogation+Action Plan	Derogation+Action Plan
100 %	export – 52 % import – 38 %	Action plan	Action plan	Action plan
		Derogation	Derogation	Derogation
96 %	92 %			
		No	No	No
0.966 %	97 %	No	No	No
	100 %	No	No	No
	95 %	Derogation	Derogation	N/A

Country	TSO	Border/CCR	% of MTUs in which minimum target was reached (considering		
			2021	2022 (for No Core TSOs)	2022 (pre Core go live)**
Sweden	Svenska Kraftnät	DE→SE4	100 %	100 %	
		DK1→SE3	100 %	100 %	
		DK2→SE4	100 %	100 %	
		FI→SE1	92 %	100 %	
		FI→SE3	100 %	98 %	
		LT→SE4	100 %	100 %	
		PL→SE4	100 %	100 %	
		SE1→FI	94 %	100 %	
		SE1→SE2	100 %	100 %	
		SE2→SE1	100 %	100 %	
		SE2→SE3	100 %	100 %	
		SE3→DK1	100 %	99 %	
		SE3→FI	100 %	100 %	
		SE3→SE2	100 %	100 %	
		SE3→SE4	100 %	100 %	
		SE4→DE	100 %	100 %	
		SE4→DK2	100 %	100 %	
		SE4→LT	100 %	100 %	
		SE4→PL	100 %	100 %	
		SE4→SE3	100 %	100 %	

* Svenska kraftnät published a methodology to minimise the need for a derogation in March of 2021
** relevant only for Core TSOs
*** A minimum capacity of 70 % has already been applied from 2020 onwards.

action plans and/or derogations)		derogation/action plan applied		
2022 (post Core go live)**	2023	2021	2022	2023
	100 %	Derogation*		
	100 %	Derogation*		
	100 %	Derogation*		
	100 %			
	99 %			
	100 %	Derogation*		
	100 %	Derogation*		
	100 %			
	100 %			
	100 %			
	99 %			
	99 %	Derogation*		
	99 %			
	100 %			
	99 %			
	100 %	Derogation*		
	99 %	Derogation*		
	100 %	Derogation*		
	100 %	Derogation*		
	100 %			

Abbreviations

ACER	Agency for the Cooperation of Energy Regulators
AL	Albania
AT	Austria
BA	Bosnia and Herzegovina
BE	Belgium
BG	Bulgaria
BZ	Bidding zone
CACM	Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management
CCDA	Capacity calculation for the purpose of day-ahead allocation
CCP	Central Counterparty Clearinghouse
CCR	Capacity Calculation Region
CEP	Clean Energy Package
CGM	Common Grid Model
CH	Switzerland
CI	Congestion income
CID	Congestion income distribution
CNE	Critical Network Element
CORE	Capacity Calculation Region in Central Europe
CSE	Continental South-East
CT	Counter-trading
CWE	Central Western Europe
CZ	Czech Republic
D-1	One day prior to real time
DA	Day Ahead
DACF	Day Ahead Congestion Forecast
DC	Direct Current
DE	Germany
DK	Denmark
EE	Estonia
ENTSO-E	European Network of Transmission System Operators for Electricity
EPAD	Electricity Price Area Differential
ES	Spain
ETYS	Electricity Ten Year Statement
FAV	Final Adjustment Value
FB	Flow Based
FI	Finland
FR	France
GB	Great Britain
GR	Greece
GSK	Generation Shift Key
HAR	Harmonised Allocation Rules
HR	Croatia
HU	Hungary
HVDC	High-Voltage Direct Current
ICS	Incidents Classification Scale
IDCF	Intra Day Congestion Forecast
IE	Ireland
IN CCR	Italy North Capacity Calculation Region
ISP	Integrated Scheduling Process
IT	Italy
LFC	Load Frequency Control
LU	Luxembourg
LT	Lithuania
LTTR	Long-term transmission right
LV	Latvia
ME	Montenegro
MACZT	Margin available for cross-zonal trading
MK	North Macedonia

MMR	Market Monitoring Report
NI	Northern Ireland
MNCC	Margin not coming from the capacity calculation
NL	Netherlands
NO	Norway
NOA	Network Options Assessment
NRA	National Regulatory Authorities
NTC	Net Transfer Capacity
OHL	Overhead Line
PL	Poland
PST	Phase Shifting Transformer
PT	Portugal
PTDF	Power Transfer Distribution Factor
RC	Renewable Curtailment
RCC	Regional Coordination Centre
RD	Redispatch
RES	Renewable Energy Sources
RO	Romania
RS	Serbia
SA	Synchronous area
SE	Sweden
SEE	South-East Europe
SHB	Control block of Slovenia, Croatia, and Bosnia Herzegovina
SI	Slovenia
SK	Slovakia
SO	System Operator
TSO	Transmission System Operator
TTG	TenneT Germany
TR	Turkey
TYNDP	Ten-Year Network Development Plan
UA	Ukraine

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