# ENTSO-E Bidding Zone Configuration Technical Report 2021

Regular Reporting on Bidding Zone Configuration

# 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 42 member TSOs, representing 35 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 use 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 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), bidding zone borders shall be based on long-term, structural congestions in the transmission network. Bidding zones shall not contain such structural congestions unless they have no impact on neighbouring bidding zones, or unless as a temporary exemption, their impact on neighbouring bidding zones 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 bidding zones 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 the periodic (every 3 years) assessment of the efficiency of the current bidding zone configuration. This Technical Report was prepared by ENTSO-E for the years 2018–2020 upon the request of ACER, which was received on 18 February 2021. Since the assessment of the efficiency of bidding zone configurations is the task of ACER, this Technical Report serves only a fact-collection purpose and provides no recommendations in that regard.

The Technical Report consists of four main sections. The first three sections correspond to major CACM requirements, i. e. Chapter 2 deals with congestions, Chapter 3 deals with flows not resulting from capacity allocation (PTDFs), Chapter 4 deals with congestion income and firmness costs. The last section, 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 gives an overview of congestions for the following time stages: Capacity calculation for the purpose of DA capacity allocation, D-1 (operational planning after DA market closure) and (close to) real-time. The location and frequency of congestions is also reported. In the timeframe 'Capacity calculation for the purpose of DA capacity allocation', reported congestions are generally on BZ borders or in their direct vicinity. Relatively few grid elements show congestions, for relative high frequency. In D-1 and close-to-real-time timeframes, reported congestions are either on tie lines or internal lines.

A relatively high number of grid elements show congestions, most of them for relatively low frequencies compared to those of capacity calculation for the purpose of DA capacity allocation.

Chapter 3 illustrates the PTDF flow deviation indicator, which is 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 the years 2018, 2019 and 2020. As for the results, the overall magnitude of the PDTF flow indicator decreased both during the three observed years and compared with the last technical report.

Chapter 4 provides information on collected congestion income, volumes of congestion management measures and the respective costs incurred to ensure firmness of cross-border capacities.

For years 2018 and 2019 the highest total amounts of congestion income are collected by France, Italy and Germany. The main factors that influence the amount of congestion income are described in the respective section. In 2020, the highest amounts of congestion incomes are collected by France, followed by Sweden and Norway, only then Germany, Denmark and Finland. Please note that congestion income by the Great Britain is not always reported.

The financial firmness costs incurred by TSOs to ensure firmness of cross-border capacities are dominated in all reported years by curtailments caused by emergency grid security or safety issues, followed by other reasons not specified by


TSOs. Italy and France had the highest costs over all three displayed years. In the Netherlands, financial firmness costs almost doubled year to year. Please note that the financial firmness cost is not always reported by Great Britain.

The highest costs for physical firmness measures are incurred by Germany, followed by Austria and Poland, whereas the highest volumes of measures are reported by Poland, Germany, and Denmark. In Germany the costs of renewables curtailment compensation constitute the majority of the total physical firmness costs. These costs are influenced by the adequate compensation RES producers receive due to underlying political decisions. This effect can be clearly discovered when considering the cost-volume relation. The values in Poland are overestimated. There is no general trend visible. It seems that countries with high installed RES production capacities tend to manage higher volumes to handle congestions. It should be highlighted that any comparison between the absolute values of the countries must be interpreted carefully. An analysis of the physics must carefully consider the volume of each measure and relate it to relevant factors, including but not limited to country size.

Chapter 5 shows that for the year 2020, the vast majority of TSOs acted in accordance with the CEP70 rules 100 % of the time when considering action plans and/or derogations. Moreover, even when the minimum target was not reached, very often the TSO still considered itself compliant since Art. 16 of EU Electricity Regulation allows – as a measure of last resort – the reduction of the offered cross-zonal capacity below the minimum targets, if the TSOs or RCCs, respectively, can justify that their application would endanger system security.

# 1 Introduction


Figure 1: Bidding zone configuration.
According to Annex 1 to ACER Decision No 06/2016 from 17 November 2016, the bidding zone 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. For Italy, virtual bidding zones are not represented on the map.

## 1.1 Background and the 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[1], a bidding zone 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 TSOs. According to Commission Regulation (EU) 2015/1222 (CACM), bidding zones reflecting supply and demand distribution are a cornerstone of market-based electricity trading and are a prerequisite for reaching the full potential of capacity allocation methods including the flow-based method. Bidding zones therefore should be defined in such a manner as to ensure efficient congestion management and overall market efficiency. In the current bidding zone configuration, there are multiple bidding zones in Italy and the Nordic countries one bidding zone covering two countries (DE/LU) following the DE/AT/LU split, and bidding zones based on a historical context corresponding to Member States (see Figure 1). CACM details how the efficiency of the current bidding zone 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 bidding zone configuration. This process shall consist of:

- The Technical Report, prepared every three years by ENTSOE according to Article 34 of CACM and sent to ACER; and
- A market report evaluating the impact of the current bidding zone 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 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.
- 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 18 February 2021 requests:

- That the Technical Report shall include the time frame in which the congestions are seen, e. g., real-time, intraday, day-ahead etc.
- That the evolution of the congestions should consider the short to mid-term time frames.
- For 2020 only, an assessment of whether the cross-zonal trade capacity reached the linear trajectory pursuant to Article 15 of Electricity Regulation or the minimum capacity pursuant to Article 16 of that Regulation.

## 1.3 Structure of the Technical Report

The present Technical Report is subdivided into four main sections:

- Executive summary and introduction
- 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)

1 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.

# 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 or removal 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 capacity calculation and methodological descriptions. Afterward, congestions in 2018, 2019 and 2020 and their future evolution patterns are presented.

## 2.1 Methodology and general descriptions

For this Technical Report, the following have been investigated and analysed:

- Grid elements limiting cross-zonal capacity that appeared as active market constraints in the Day Ahead (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 a period of up to one hour before the time of operation.

All three processes are briefly described in the following chapters.

As explained in chapter 1.2 above and in accordance with CACM Regulation, Regulation 2019/943, only structural congestions and major physical congestions are relevant in order to assess the bidding zone configuration. Hence, although this Technical Report includes an exhaustive list of all historical congestions in the different timeframes during the period 2018–2020 as required by CACM Regulation and Regulation 2019/943, only those congestions that were structural should be taken into consideration when assessing the bidding zone configuration as also recognised both by CACM Regulation and Regulation 2019/943. Given that the definition of a structural congestion in Article 2 of CACM does not 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 period of the study with a view to facilitating the differentiation of structural congestions. The frequency of a congestion is one of the key factors; however, it appears that the frequency of a congestion of a single element alone is insufficient to identify a structural congestion. Other elements, such as the causes of the identified congestions, geographical stability over time and predictability are also relevant. Indeed, if a group of elements in the same area with very low frequency is considered separately, on occasion they can form a single structural congestion if they occur during normal operation (e.g., without any planned or unplanned outage motivating the congestion).

Congestions in ES, SK, BG and CH are presented as bubbles (not line based) as these are considered 'sensitive critical infrastructure protection related information' according to the CACM Regulation and the national laws of the respective countries. For some of these countries, the colour of the bubble perimeter corresponds to the congestion frequency (hours per year).

### 2.1.1 Capacity calculation for the purpose of day-ahead allocation

Within the capacity calculation process, TSOs calculate cross-zonal capacities which 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 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 done for a given timeframe and bidding zone borders (including the so-called technical profiles, which encompass several bidding zone borders). Operational security limits cover permissible loading of grid elements[2], 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 **critical network elements (CNEs)**. The CNEs limiting cross-zonal exchanges appear not only on bidding zone borders, but also within the grid of a bidding zone. 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 critical network elements, TSOs include remedial actions in the capacity calculation process to provide maximum cross-zonal capacity to market participants and ensure the secure operation of the system. This, together with reliability margin and applied risk policies, ensures that cross-zonal capacities are offered to the market whilst ensuring operational security. Before available capacities are provided to the market, they are also subject to mutual coordination between neighbouring TSOs. Other congestions, fully internal to the BZ, are managed by the TSO via remedial actions, e. g., redispatching, topological changes, and so forth.

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 currently has only been implemented in the Central Western Europe [CWE] area. In the NTC approach, the capacity to be provided to the market is determined by the TSOs for each bidding zone 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 bidding-zone borders in highly meshed and interdependent systems, and the market 'decides' within the allocation process how the available cross-zonal capacity is to be used. 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 amongst bidding zone 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 the purpose of this Report.

The active constraints are determined after the application of remedial actions, per the agreed methodologies for capacity calculation.

### 2.1.2 Day-ahead operational planning (D-1)

Day-ahead congestion forecasts (DACF), which comprise the results of the day-ahead allocation, represent the basis for the short-term operational planning process (e. g., DACF and Intra-Day Congestion Forecast [IDCF]). 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, congestions which occur during these D-1 processes are mainly caused by deviations from forecasts such as unexpected changes in the grid topology or the generation or load pattern. The deviations may also be a consequence of inefficiencies in the current configuration of the market (e. g., uncoordinated capacity calculation) resulting in unscheduled transit flows, loop flows, et cetera. During this phase, congested network elements which 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 day-ahead operational security assessment or in 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. Due to the local structural conditions of the network, several TSOs do not perform a DA security assessment . In their case, congestions in the DA timeframe could not be evaluated.

2 lines, transformers, breakers etc.

### 2.1.3 Close to real-time system operation

The aim of all previous congestion management procedures 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 ICS data. This means that for these TSOs, congestions seen within one hour of real time and which were resolved by control room actions, e. g., re-dispatch 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.

## 2.2 Congested areas and their future evolution

In this section, congestions reported by TSOs are presented on maps for the different years and timeframes under investigation. A list of all congestions is provided in Annex 1. In compliance with CACM, in the current Technical Report, congestions are reflected only by their frequency, i. e., the percentage of hours per year where the congestion appeared. However, this is only one indicator of a congestion, and therefore should always be complemented by further indicators and contextualised by expert assessments. Further indicators might include the overload volume and the simultaneity of congested lines.

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

It is of note that not all congestions appear at the same time (the maps show full years). This means, that if, for instance, there are three neighbouring grid elements that all impact cross-zonal capacity and each of these is congested 5 % of the time, these may lead to a maximum reduction of cross-zonal capacity of 15 % of the time (in the case of total non-simultaneity). Furthermore, the frequency does not provide any information about how much this congestion impacts the volume of cross-zonal capacity.

The below maps and scale should be understood as follows:

- The colour scale represents the percentage of total hours of the year and reflects the range of congestion frequency for most of the reported lines. Congestions with frequency below 0.5 % are not represented (see Annex 1 for further detail maps). Congestions with a frequency above 35 % are represented in dark red.
- A dot represents a transformer or substation or transmission line with length less than 10 kilometres.
- 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 represent reported congestions with no frequency available.
- If a country is shown in purple, this represents that the data is not available.
- Countries in light blue represent that the data available uses a different standard than shown in the map (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 the full list of congestions is provided in Annex 1.

The shape of the grid elements on the maps (straight lines) does not correspond to their real geographical layout; only the coordinates of the substations at both extremities are used.

Annex 1 shows the detailed maps, including congestions with a frequency lower than 0.5 %.

## 2.2.1 Capacity calculation for the purpose of capacity allocation

### 2018 – Capacity calculation for the purpose of DA allocation

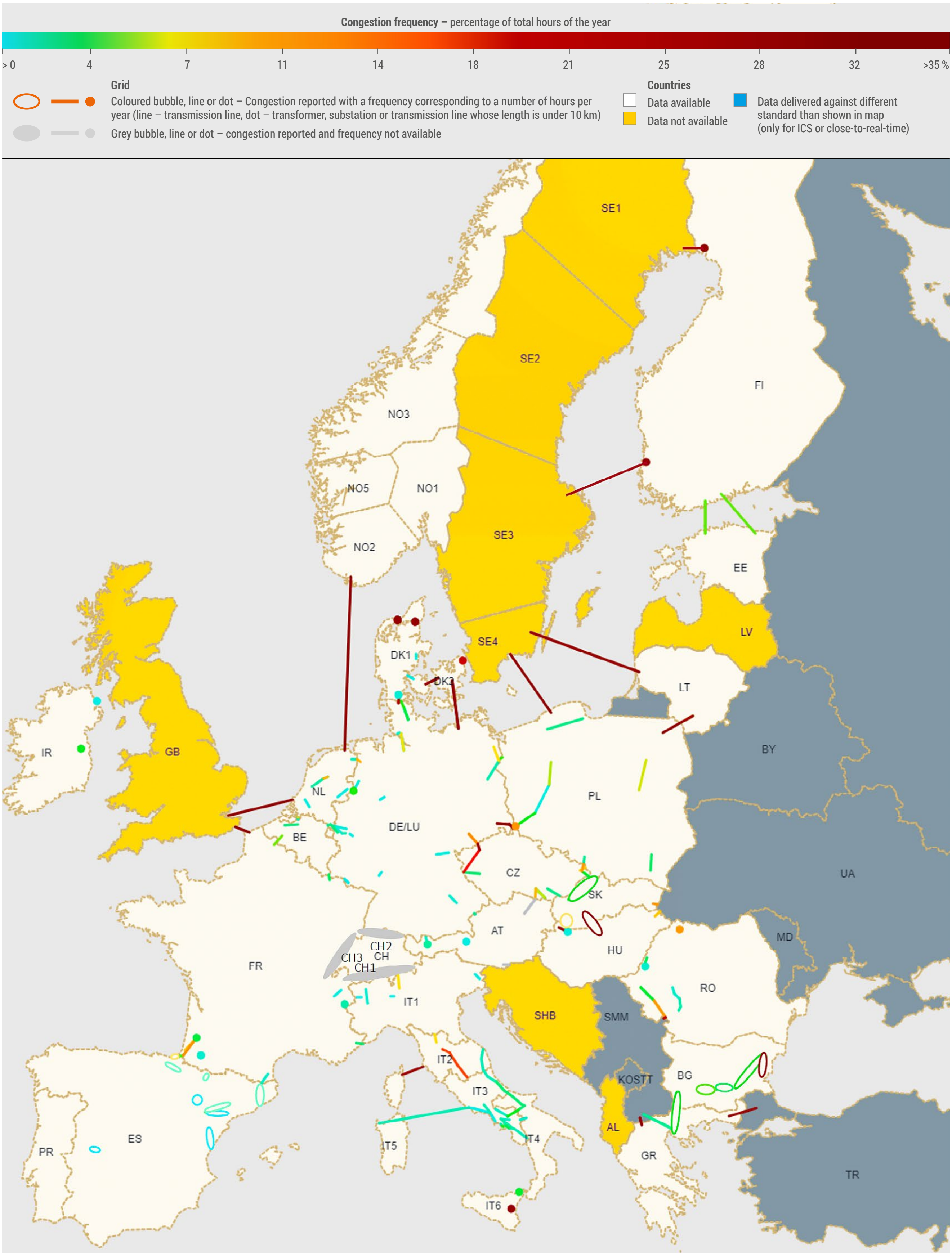



Figure 2: CCDA for 2018 – Europe

## Zoomed images

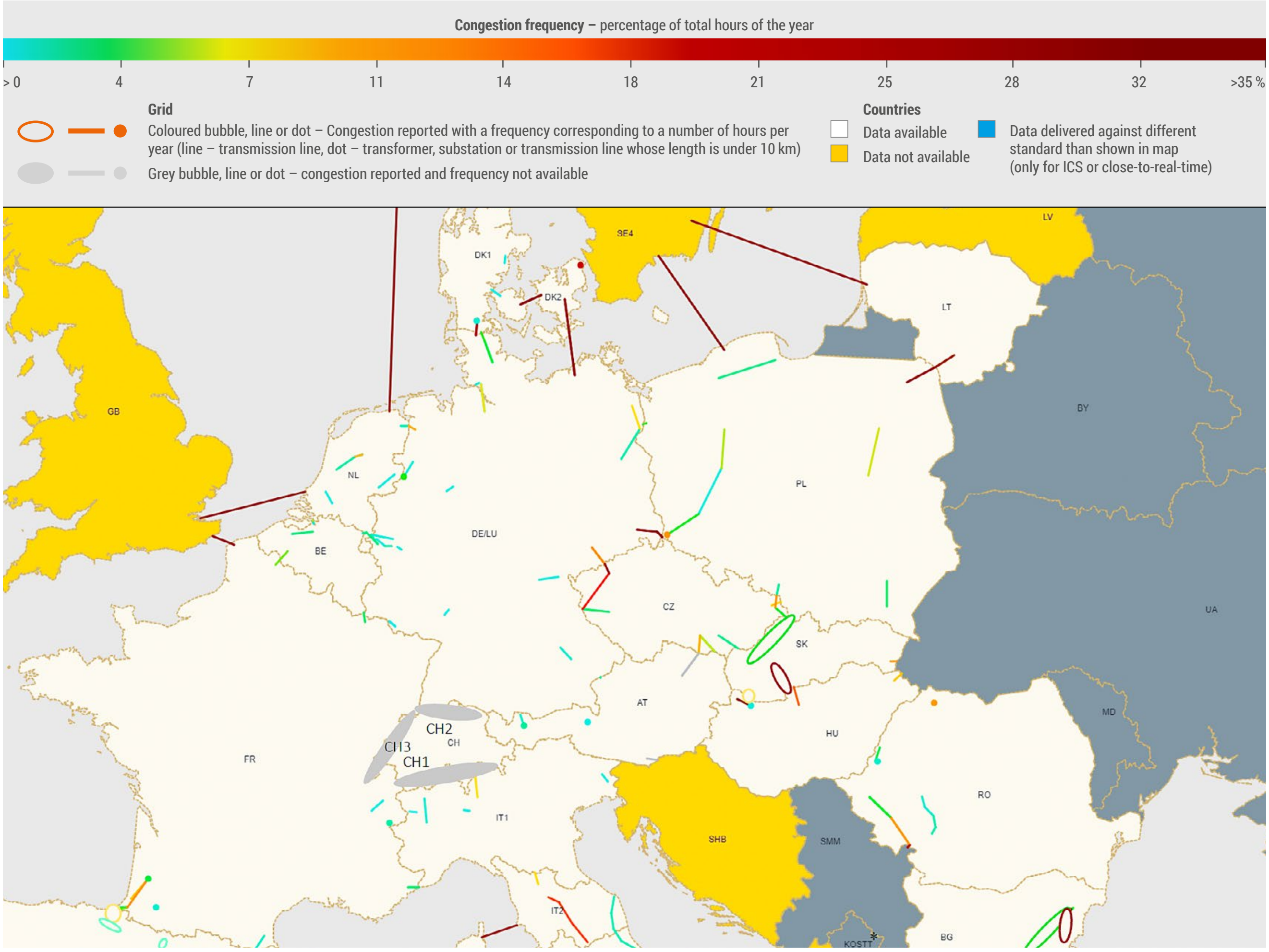



Figure 3: CCDA for 2018 – Central Europe

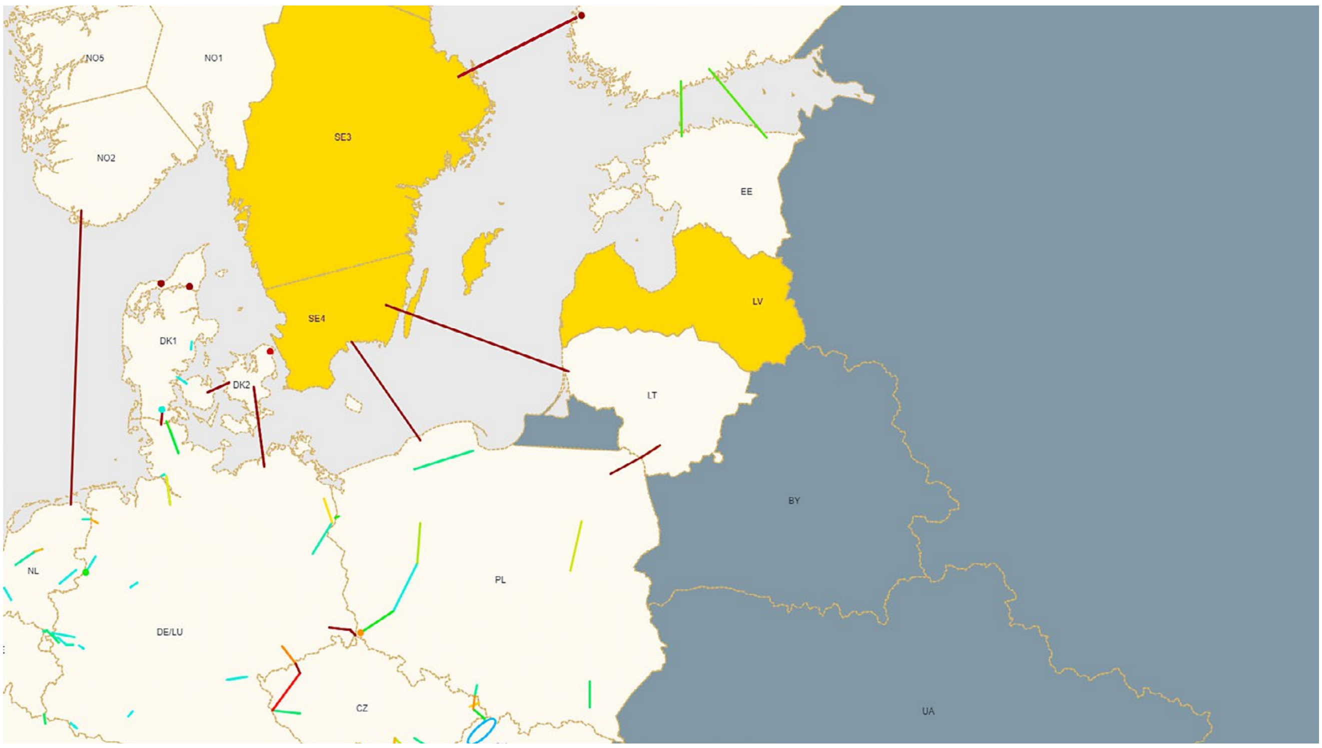



Figure 4: CCDA for 2018 – Baltic countries and Denmark/Sweden

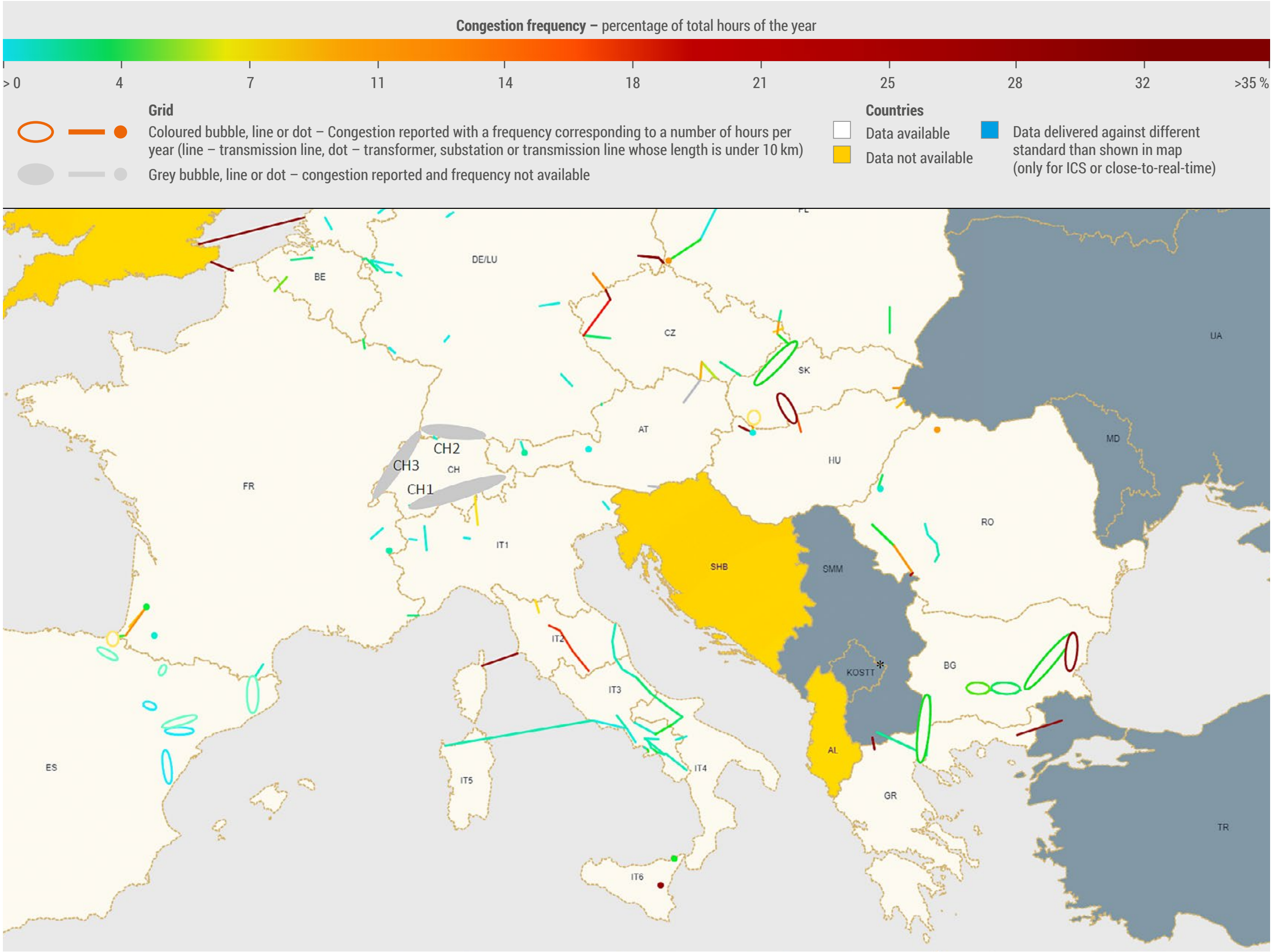



Figure 5: CCDA for 2018 – Balkans and Italy

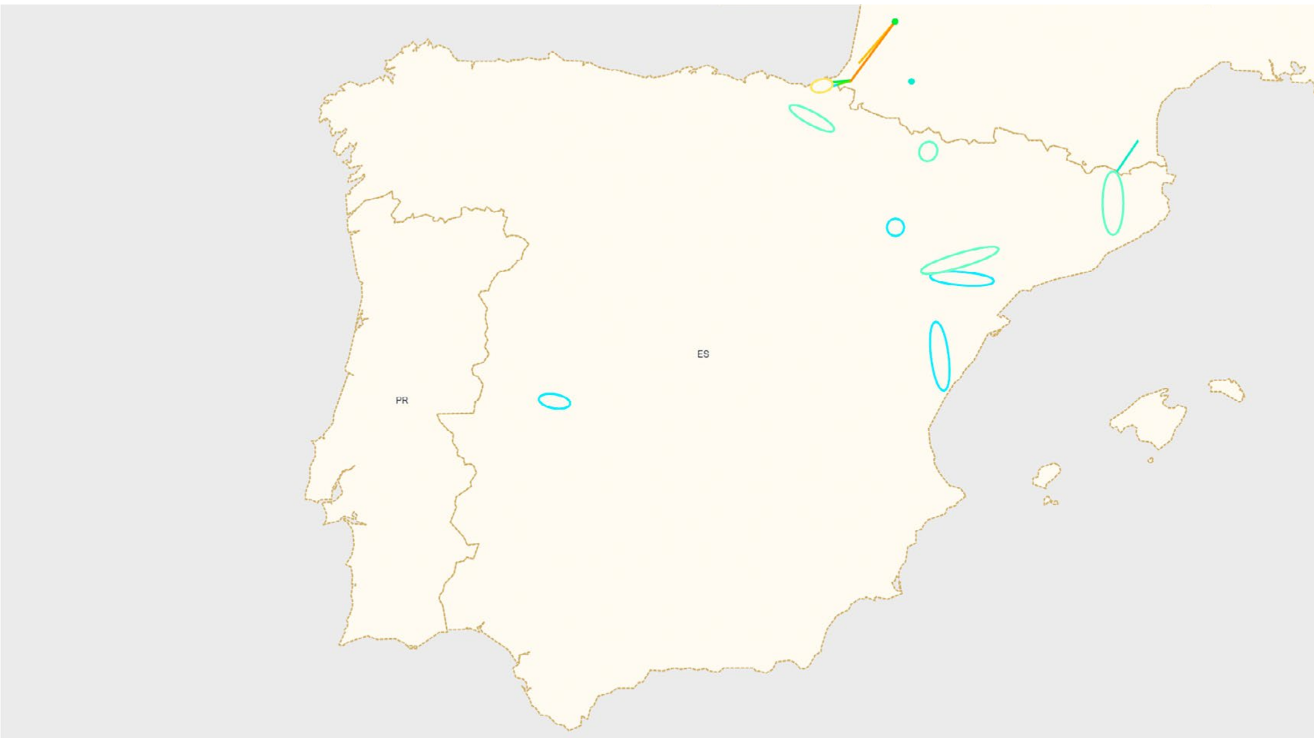



Figure 6: CCDA for 2018 – Spain/Portugal

## 2019 – Capacity calculation for the purpose of DA allocation

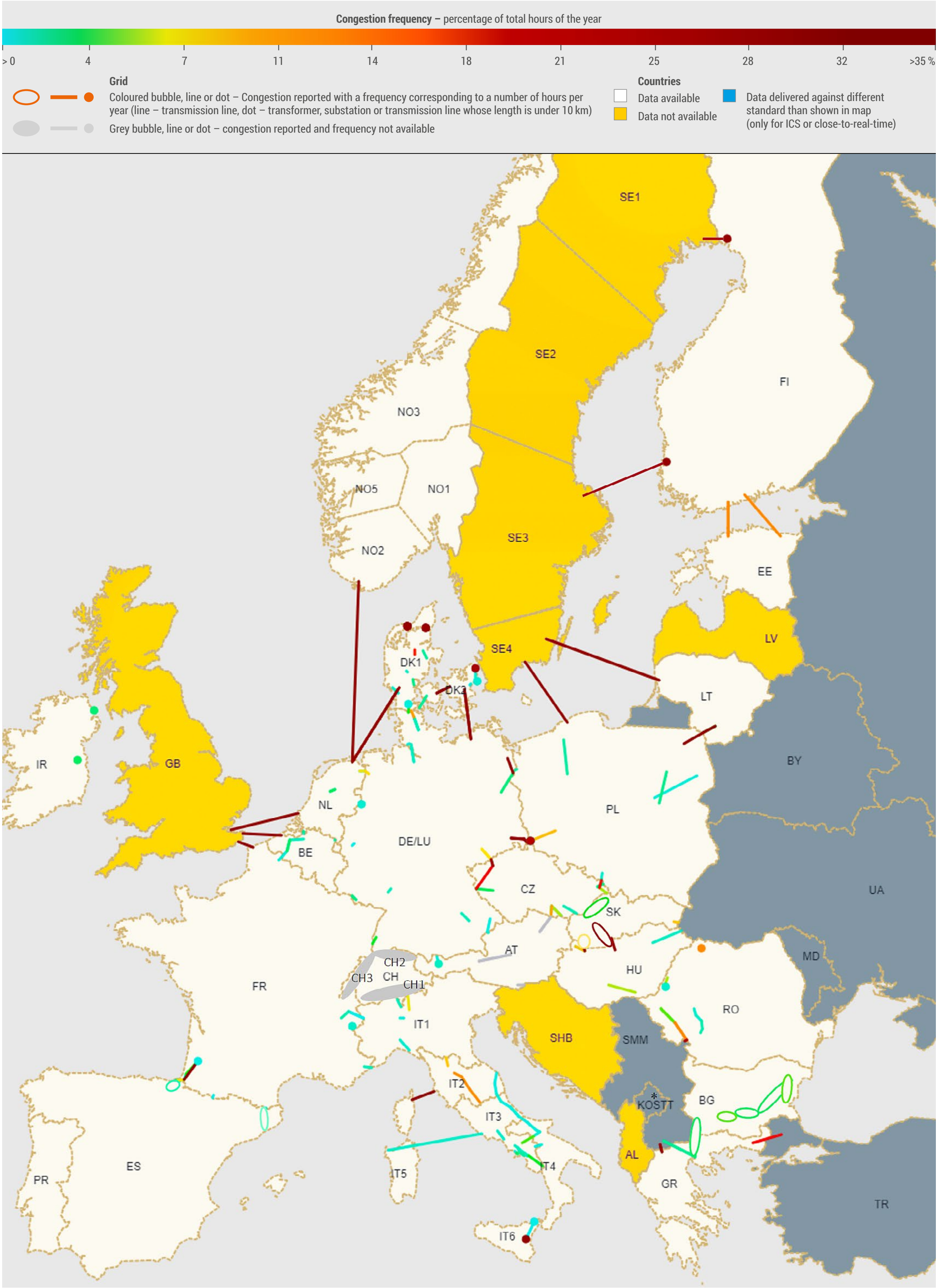



Figure 7: CCDA for 2019 – Europe

## Zooms

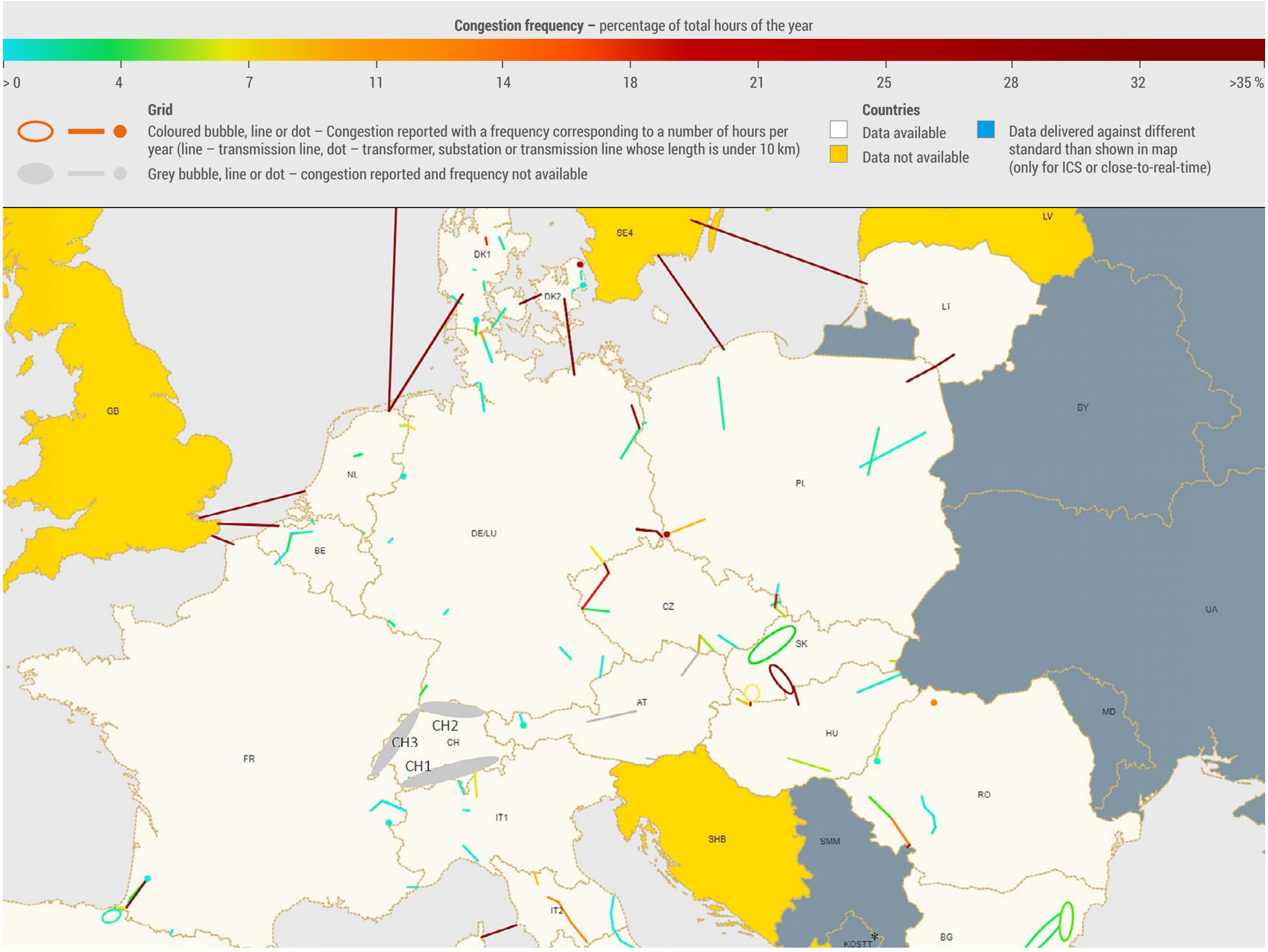



Figure 8. CCDA for 2019 – Central Europe

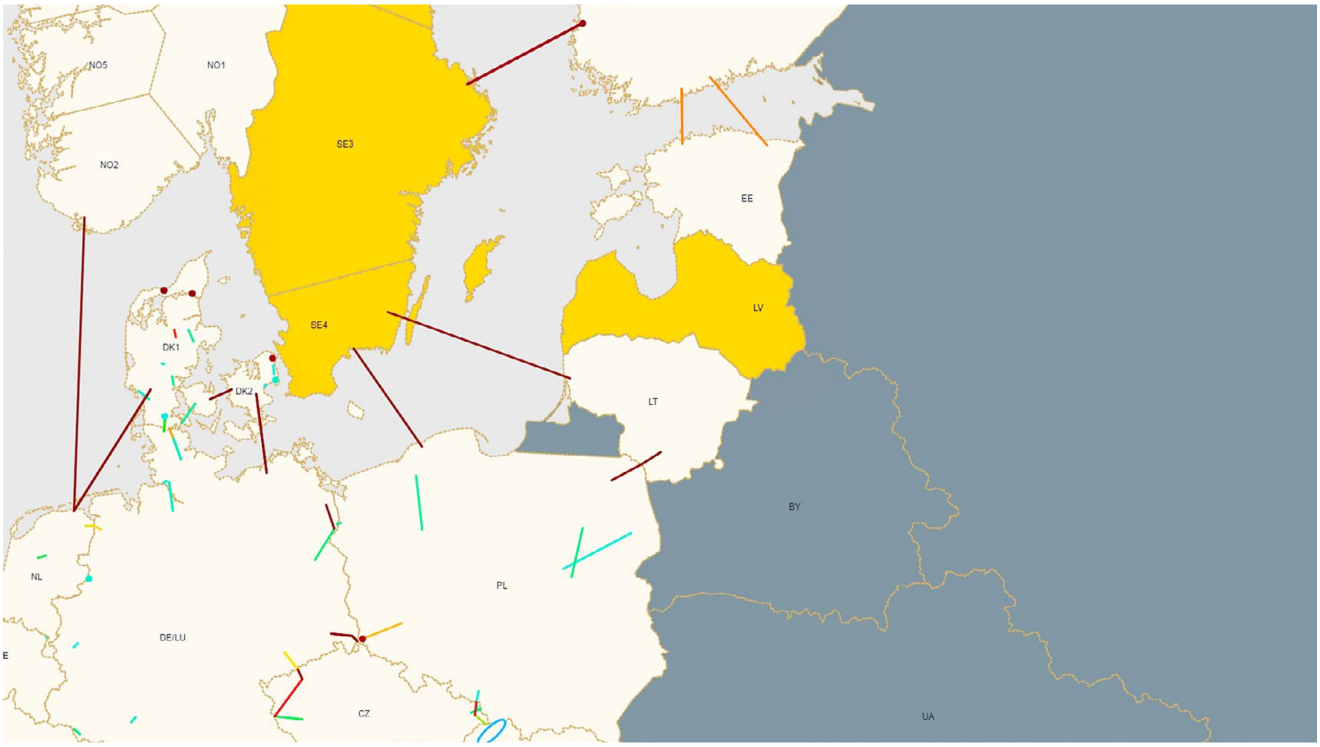



Figure 9. CCDA for 2019 – Baltic countries and Denmark/Sweden

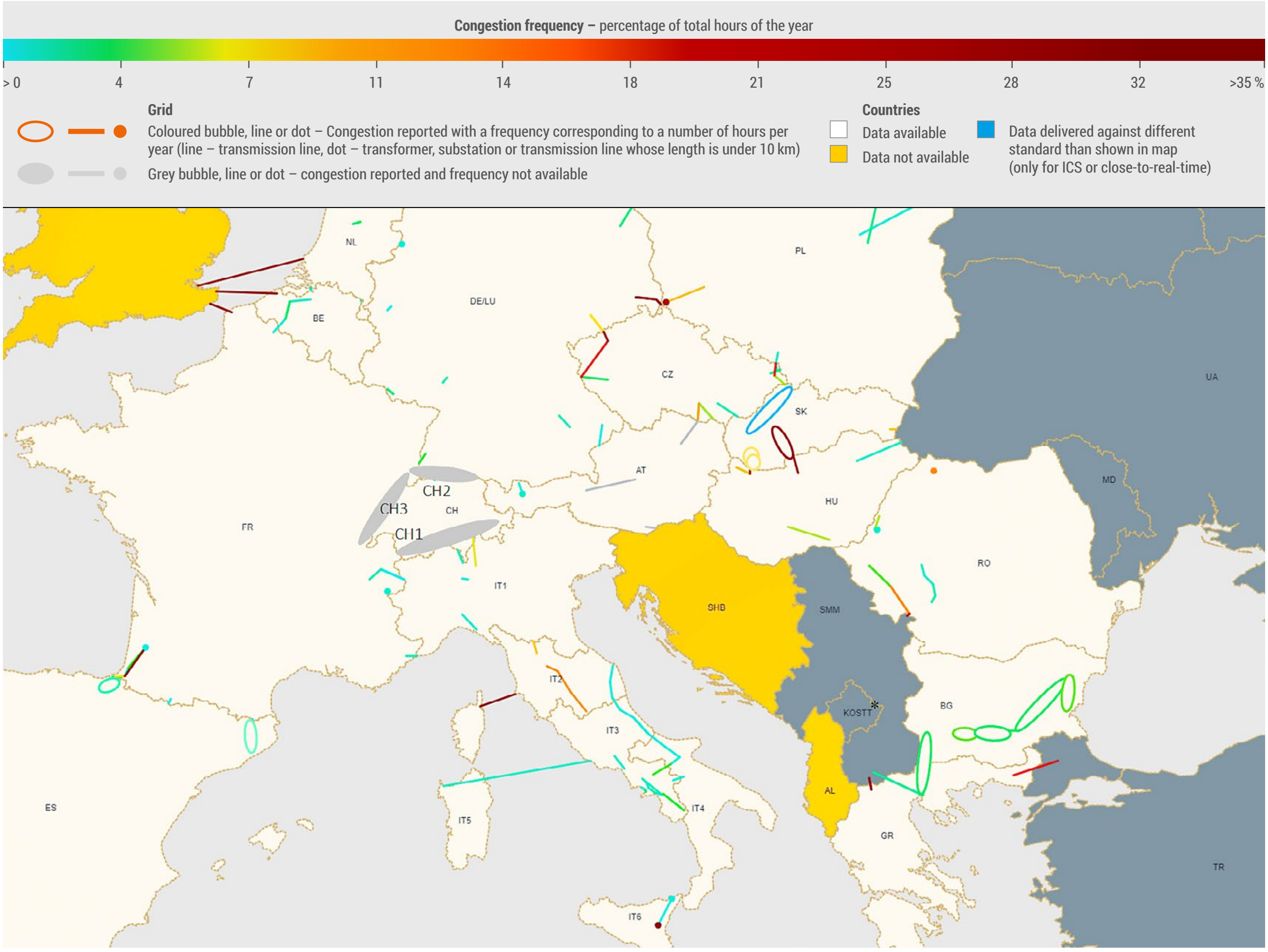



Figure 10. CCDA for 2019 – Balkans and Italy

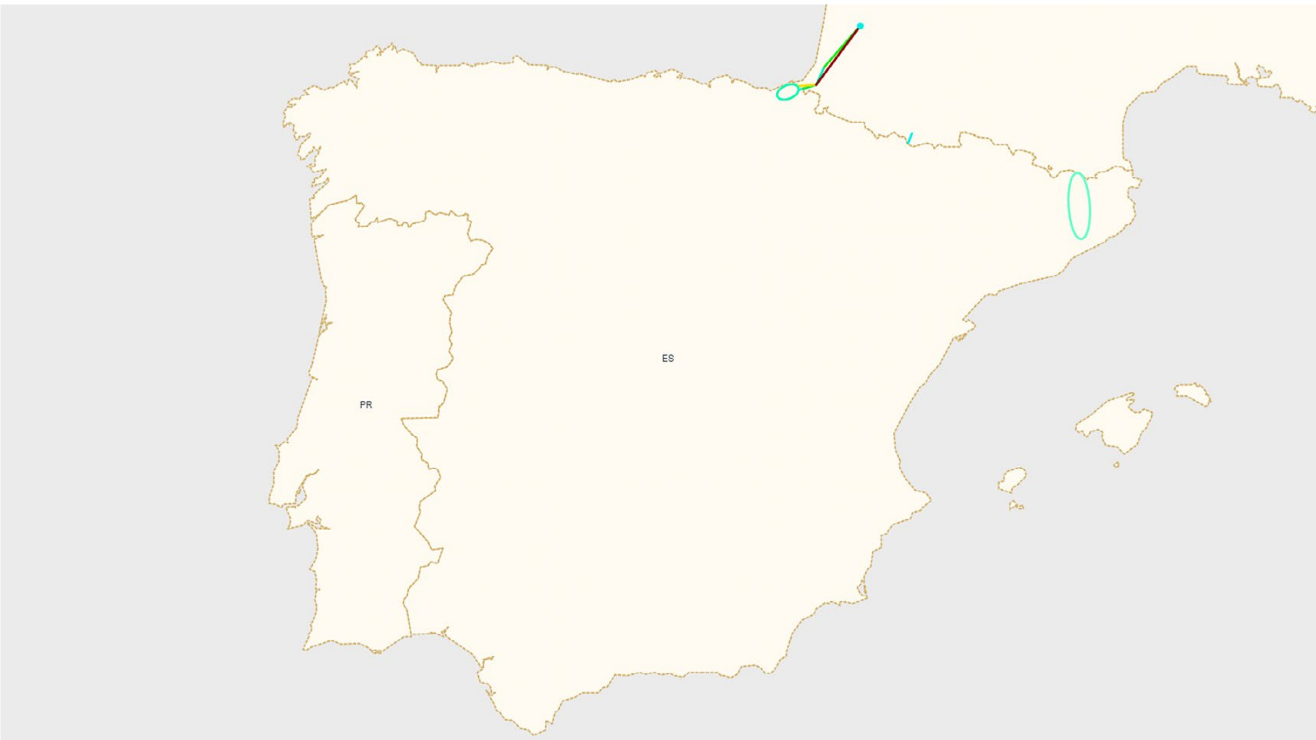



Figure 11: CCDA for 2019 – Spain/Portugal

## 2020 – Capacity calculation for the purpose of DA allocation

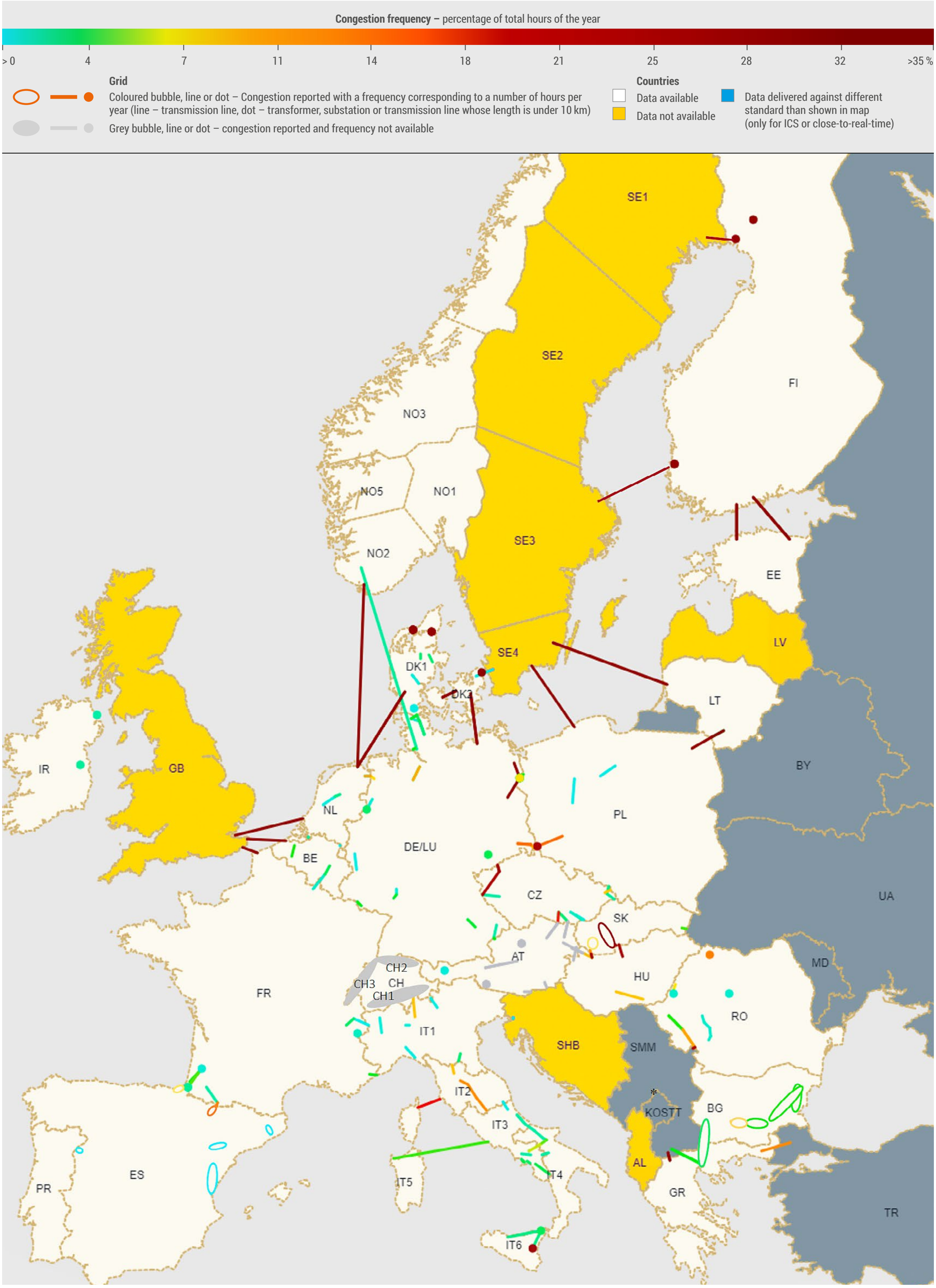



Figure 12: CCDA for 2020 – Europe

## Zooms

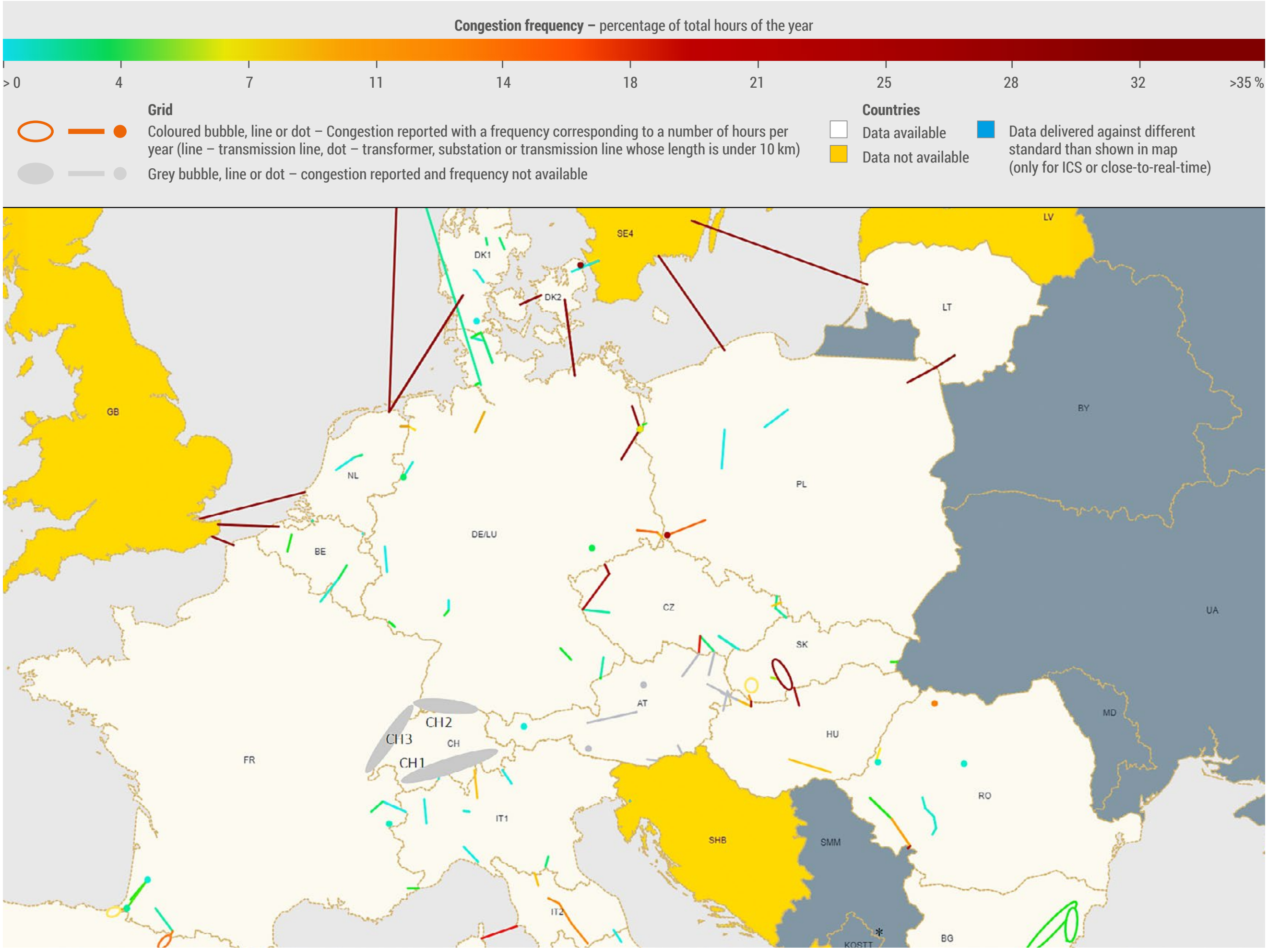



Figure 13: CCDA for 2020 – Central Europe

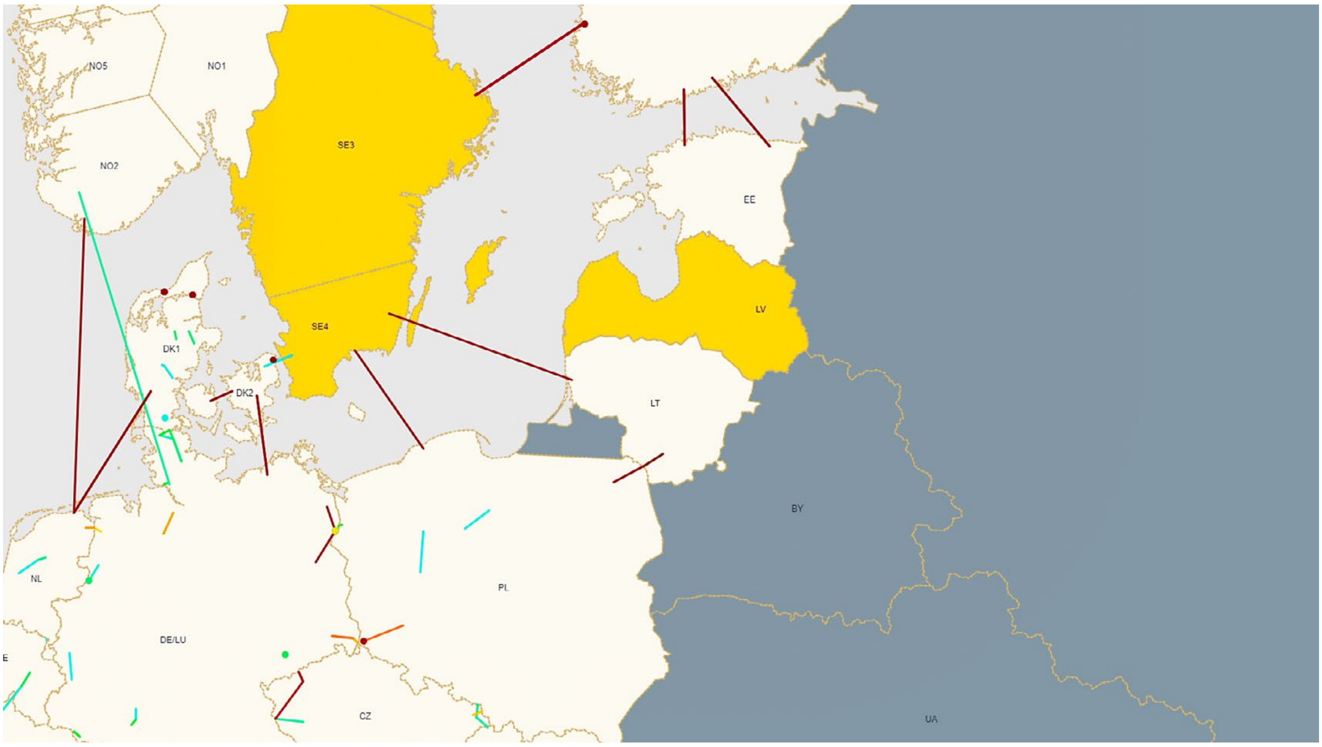



Figure 14: CCDA for 2020 – Baltic countries and Denmark/Sweden

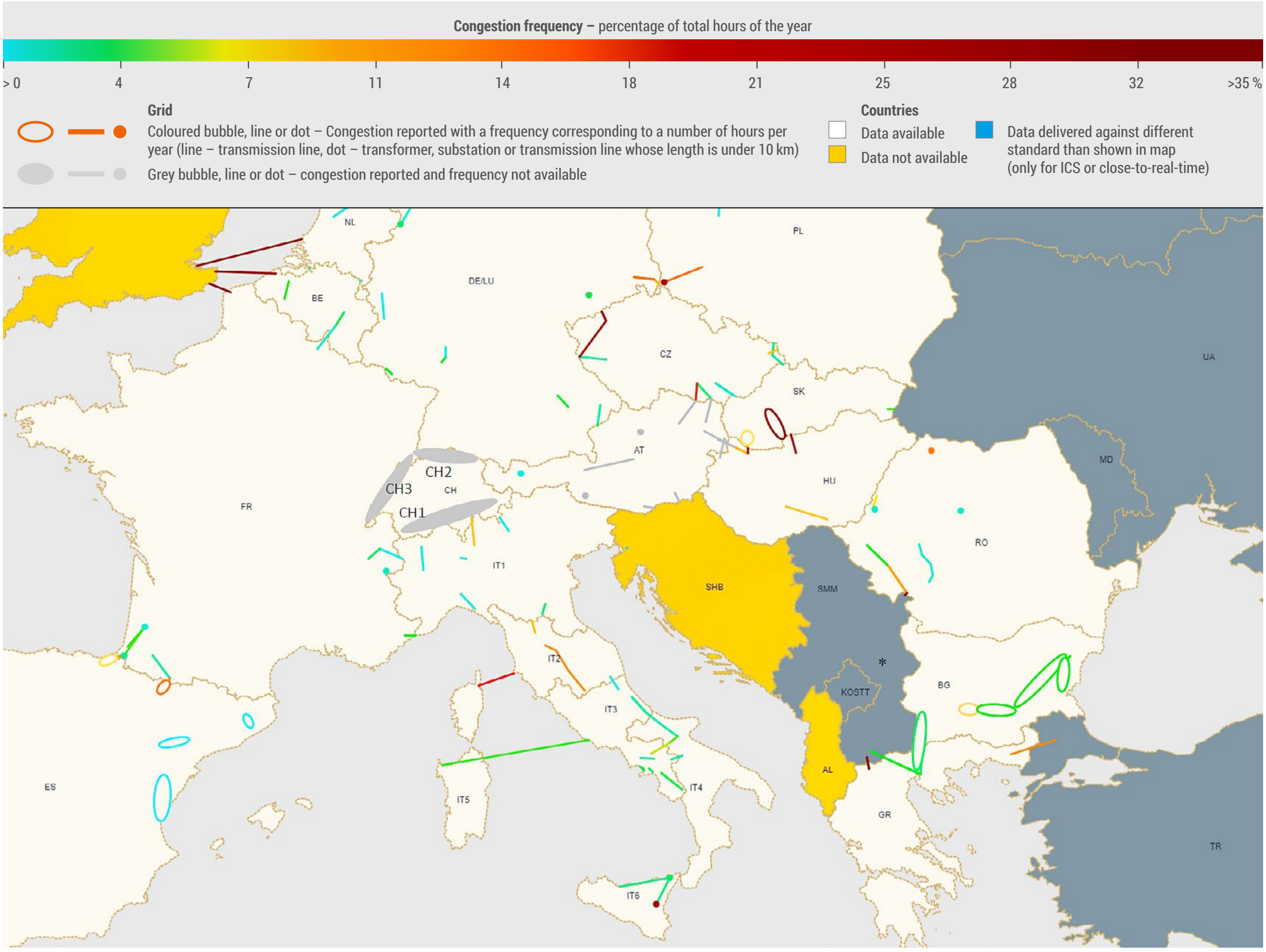



Figure 15: CCDA for 2020 – Balkans and Italy

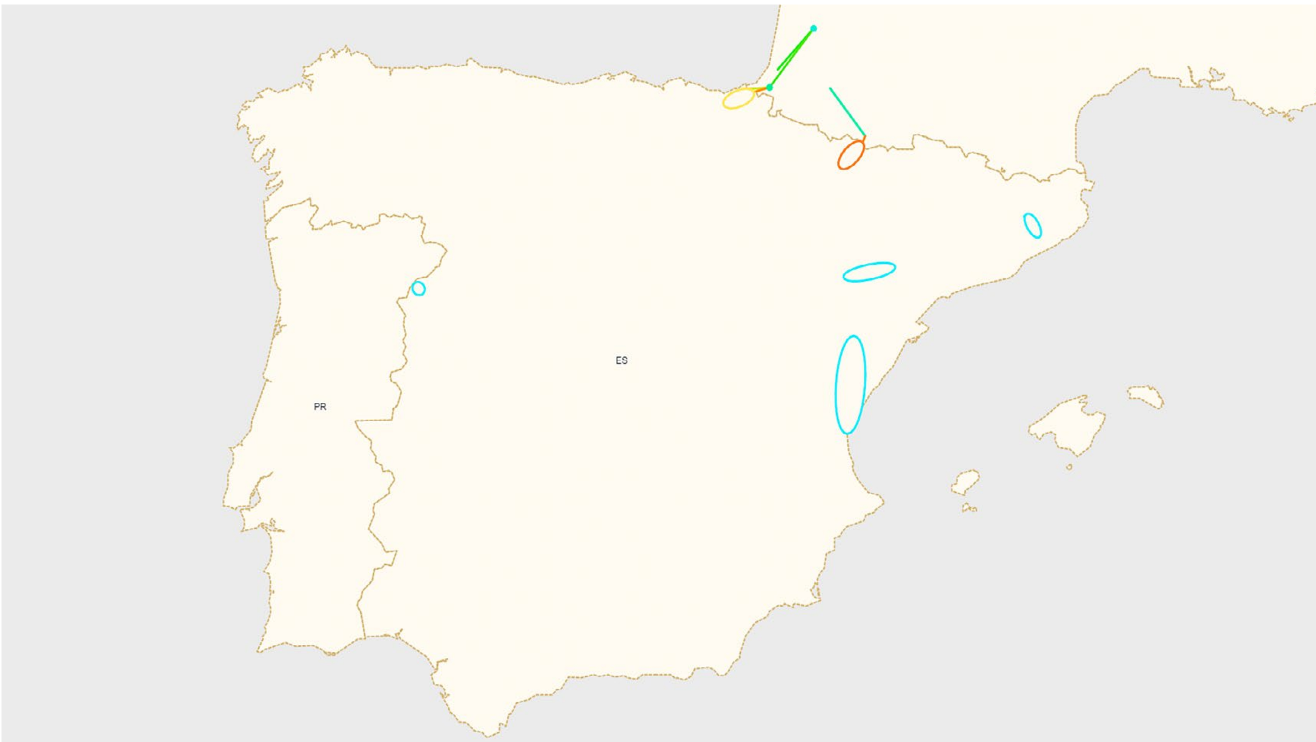



Figure 16: CCDA for 2020 – Spain/Portugal

### 2.2.2 Expert assessment of congestions for capacity calculation for the purpose of capacity allocation for the day-ahead market

The primary objective of Section 2 is to report on the location of congestions that occurred in the grid over the reported years 2018, 2019 and 2020. In this subsection, each TSO provides an expert assessment of how these congestions have evolved over the reported years for the stage 'capacity calculation for the purpose of capacity allocation'. This includes an expert assessment of the causes of the congestions and the interdependencies of congested lines.

The assessments below were provided by the TSOs of the respective countries:

#### Albania

In its operational planning processes and month-ahead capacity calculation, OST strives to provide the maximum possible transmission capacity for capacity allocation to market participants. The most frequent congestion is observed on 220 kV lines with Montenegro (Koplik - Podgorica1) and Kosovo (Fierze - Prizren). The main reason behind the congestion is the close proximity to generation sources of 220 kV and 110 kV nodes combined with the high growth of 110 kV hydrogeneration sources in Albania.

#### Austria

For the given period of time, cross-zonal capacities for the day-ahead market between Austria and its neighbours were allocated to the market according to the following processes:

- AT-DE: Central Western Europe Flow-Based Capacity Allocation
- AT-IT: Coordinated D-2 capacity allocation in the CCR North Italy
- AT-SI/HU/CZ/CH: NTC-based capacity allocation

Between 2018 and 2020, most of the reasons for limiting cross-zonal capacity in Austria were either cross-border lines or situations on network elements due to planned disconnections for grid reinforcement. The frequency of Austrian active market constraints within CWE FB CC mostly varied between 1 % and 2 % during this period.

As the transmission system of Austria is centrally located in Continental Europe, it is strongly affected by the different export/import patterns in Europe. As such, different load flow directions have been observed in the past, of which the most dominant were the North-South and West-East directions.

#### Belgium

In day-ahead capacity allocation, Elia looks at all 380 kV lines in the corridors which pass through Belgium with respect to both critical grid elements and critical outages.

Elia provides as much capacity as possible while considering operational security. The grid does not have structural congestions, so any limitation of capacity is usually related to required maintenance work that reduces the available capacity

#### Bulgaria

ESO EAD does its utmost to provide maximum capacity to the market. The network elements provided are considered critical network elements in the process of DA capacity calculation only during maintenance conditions in the transmission network.

#### 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 in accordance with the Operation Handbook, the minimum values calculated by the TSOs within the bilateral area (HR-SI, HR-HU, HR-BA, HR-RS) have been selected. This means that certain NTC values may reflect the network constraints of the neighbouring TSO (limiting elements are present outside the HOPS transmission network).

#### Czech Republic

The critical network elements provided are with the Regulation 2019/943 Article 16(8) and with the Recommendation No 01/2019 of ACER on the implementation of the minimum margin available for cross-zonal trade, which monitors the utilisation of individual elements.

For each hour, one element was determined in each direction (export and import), which limited the further increase of NTCs.

However, the fact that an element is marked as critical does not mean it does not comply with the regulation or the respective derogation. Moreover, it does not mean it limits the market.

Rather, it only limits further increases of NTCs because of the way NTC capacity calculation behaves – increasing NTCs until one element has zero capacity.

## Denmark

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

## Estonia

Elering does its utmost to provide maximum capacity to the market. The connection between Finland and Estonia was limited mostly due to the technical limits of the HVDC links. Cross-zonal congestions are caused due to lower electricity prices in the Nordics.

## Finland

Full capacity has been given during all normal operational conditions, and market coupling allocates all given capacity. Cross-zonal congestions are due to Finnish bidding zone dependence on the import electricity and transit flow from Sweden (SE1-FI and SE3-FI) to Baltics via FI-EE for all years from 2018 to 2020. Increased congestions during 2018 and 2020 are due to the Baltic States' increased dependence on relatively inexpensive electricity.

Generally, transmission within the Finnish bidding zone is adequate, with no internal congestions noticed before day-ahead 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 few years. The fifth line will be commissioned 2022 to prepare for the increase in north-to-south transmission.

## France

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

The France-Spain area can be qualified as congested. RTE and REE committed themselves to a high level of grid investments, with such projects as the PST of Arkale in 2017. The Biscay Gulf project, whose commissioning is planned in 2027, should almost double the cross-zonal capacity between France and Spain.

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

On the French-Italian border, a few active constraints can be noted, which are created by PST optimisation. A new HVDC line between France and Italy (the 'Savoie-Piémont' project) is ongoing in order to increase the cross-zonal capacity of the North Italian border. Its commissioning is planned for the end of 2021 at the earliest.

The French-British border is traversed by DC interconnections only. There is no capacity calculation for this border, i.e. the full physical transmission capacity of the DC cables is always provided to the market. Therefore, the frequency of the active constraint corresponds to the price divergence between France and Great Britain, adjusted for losses. The new DC interconnection IFA2 was commissioned at the beginning of 2021. Several new DC interconnection projects are ongoing, the most advanced being Eleclink, planned for 2022.

The occurrence of all other active constraints in France is very low (under 0.5 %). Therefore, they can't be qualified as structural or as major. Nevertheless, RTE maintains its investment in the whole territory in anticipation of potential future congestions.

RTE uses mainly preventive and curative topological remedial actions in order to maximise the cross-border capacities and solve congestions.

This model allows:

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

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

## Germany

Due to its central location in the European electricity system, Germany is an important transit country in the east-west and north-south directions. Moreover, its current transit is influenced by several factors. In the last three years, exchanges with foreign countries have changed and are highly affected by load patterns and the development of generation capacities. The highest exports are still towards Austria, but these exports have decreased. On 1 October 2018, the German-Austrian border became part of the CWE flow-based capacity mechanism. At the borders with France and the Netherlands, average exports have also decreased. In contrast, average imports from Denmark have increased. In addition, exchanges at the other borders were fairly stable. Furthermore, the generation landscape has changed in the last three years and is now characterised by a significantly lower feed-in from lignite and hard coal and an increasing feed-in from wind and gas-fired power plants. In addition, 2020 was marked by the emergence of the COVID-19 crisis, and in particular its impact on load patterns.

Nevertheless, most of the congestions in the German grid appear when renewable infeed is high in the northern part (50Hertz and TenneT) and Germany exports electricity in a southbound direction (France, Switzerland, Austria). In these situations, congestions in the north-to-south and in the north-east to south-west directions appear.

Other factors that influence congestions include the further development of the grid as well as its more 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 conjunction with innovative measures that help to increase grid utilisation efficiency, such as dynamic line rating.

The congestion situation is also affected by given minimum capacities. In the area of the CWE flow-based mechanism, a minimum capacity of 20 % was introduced in April 2018. After European Regulation (EU) 2019/943 entered into force in the summer of 2019, Germany drafted an action plan to increase capacity at its external borders in order to achieve the 70 % capacity target. As of 2020, Germany's rising minimum capacities have had an enormous impact on the congestion situation and the active constraints. As a result, there are fewer German active constraints during capacity calculation and allocation, but congestions closer to real time have increased (most notably in the D-1 stage).

### Capacity calculation for the purpose of capacity allocation

The active constraints in Germany at the CCDA stage have decreased over the observed time period (2018–2020) due to a number of factors, such as targeted grid expansions and more efficient grid use (e. g., dynamic line rating) and because of the introduction of minimum capacities in accordance with both Regulation (EU) 2019/943 and the German action plan since the beginning of 2020, which have led to a disregard of congestions in the day-ahead capacity calculation, which in return has resulted in fewer German grid elements actively limiting the market. The application of minimum capacities has therefore shifted congestions from the CCDA stage closer to real time – most notably to the D-1 stage.

The active constraints observed during the CCDA stage are either close to or on the border. Therefore, very few internal German grid elements actively constrain the market for a limited number of hours. The most prominent constraints are further explained below.

#### Border area DE-Nordics

Since mid-2017, TenneT has applied minimum NTC values on the DE-DK1 border, which were gradually increasing up to 1,300 MW until the beginning of 2020. When the minimum NTC applies, no congested element is depicted. The determining element is only taken into account if the NTC was above the minimum NTC. The elements that satisfy this condition are mainly cross-border lines. Since the commissioning of the east coast line in Schleswig-Holstein, elements south of the river Elbe more often determine the NTC.

#### Border area DE-CZ

The capacities in the region of CZ are determined between 50Hertz, CEPS and TenneT Germany. The formerly active constraints around Mechlenreuth, Etzenricht and Redwitz have vanished completely. The interconnector Röhrsdorf-Hradec is still congested, but congestions are less frequent since the commissioning of the PSTs in Röhrsdorf and Hradec.

#### Border area DE-PL

The often-congested lines are the feeding lines of the two interconnectors between 50Hertz and PSE. Neuenhagen-Vierraden, Pasewalk-Vierraden and the transformers in Vierraden in the north, Schmölln-Hagenwerder, as well as the interconnector Hagenwerder-Mikulowa in the south. In 2018, the interconnector Vierraden-Krajnik was partly disconnected due a line upgrade. This led to less-congested feeding lines in 2018. The interconnector itself has not been congested since the upgrade and the congestions on the lines Schmölln-Hagenwerder and Hagenwerder-Mikulowa have decreased considerably over the years.

## Greece

The Greece-Italy border is a DC interconnection. The full physical transmission capacity of the DC cable is always available to the market (except for maintenance periods).

For AC interconnections, the NTC approach is used, and the status per year is as follows:

### 2018

For the total amount of Greek imports, the critical element is mainly a tie line between Greece and North Macedonia (the 400 kV line Bitola-Meliti), while the 400 kV tie line between Greece and Turkey (Nea Santa-Babaeski) has also a relative considerable share.

For the total amount of Greek exports, the main critical element is a tie line between Greece and North Macedonia, (the 400 kV line Bitola-Meliti), additionally, the other tie line between IPTO – MEPSO, Dubrovo-Thessaloniki has a relative very small share. No internal lines appear to be critical regarding the capacity allocation.

### 2019

As in 2018, for 2019 for the total amount of Greek imports, the critical element is mainly a tie line between Greece and North Macedonia (the 400 kV line Bitola-Meliti), while the 400 kV tie line between Greece and Turkey (Nea Santa-Babaeski) has also a relative considerable share.

For the total amount of Greek exports, the main critical element is a tie line between Greece and North Macedonia, (the 400 kV line Bitola-Meliti), additionally, the other tie line between IPTO – MEPSO, Dubrovo-Thessaloniki has a relative very small share. No internal lines appear to be critical regarding the capacity allocation.

### 2020

As in the previous two years, for 2020, for the total amount of Greek imports, the critical element is mainly a tie line between Greece and North Macedonia (the 400 kV line Bitola-Meliti),while the 400 kV tie line between Greece and Turkey (Nea Santa-Babaeski) has also a relative considerable share.

For the total amount of Greek exports, the main critical element is a tie line between Greece and North Macedonia, (the 400 kV line Bitola-Meliti) , additionally, the other tie line between IPTO – MEPSO, Dubrovo-Thessaloniki has a relative very small share. No internal lines appear to be critical regarding the capacity allocation.

## Hungary

The congestions of the Hungarian system in this timeframe are concentrated in the Northern part of the network. This congestion area consists cross-border lines and to those directly connected internal lines at the Austrian, Slovak and Ukrainian border. 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 consists of 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 Austrian-Hungarian and Slovak-Hungarian borders, and are that way 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, partly double-circuit running over several substations form the center 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 in the 2018-2020 time period (very similar to the previous period), no constraints have gained or lost importance in a significant manner, except the reduction of constraints in substation Győr with the commissioning of an additional 400/132 kV transformer. In 2021, we expect the reduction of congestions in the Northern part of the network with the commissioning of the new Hungarian-Slovak tie-lines.

## Ireland

–

## Italy

Active critical branches in the Italian power system are presented for all existing bidding zone borders, including internal Italian bidding zones.

The frequencies of critical branches activation 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 that between IT2 (Italy Central North) and IT3 (Italy Central South), where there are congestions for some 220kV 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.

### Latvia

Due to the capacity calculation methodology used in the Baltics, AST does not use CGM models to distinguish critical network elements and congestions per element.

### Lithuania

The connection between Lithuania and Sweden was limited by the technical capabilities of the HVDC link. The connection between Lithuania and Poland was mostly limited by the LitPol Link technical capabilities.

### Luxembourg

No congestions were identified in the Luxembourgish Grid.

### Netherlands

The results of the CCDA process for the period 2018–2020 show that some internal Dutch CNEs, as well as cross-border CNEs, have limited cross-zonal exchanges.

When looking at the cross-border CNEs, we see that the HVDC interconnectors with the UK, Norway and Denmark are consistently congested, on the basis that there is a persistent price spread between the Netherlands and these countries. Also, we see that the AC interconnector Meeden – Diele between the Netherlands and Germany was a network element which often limited cross-zonal exchanges.

When looking at internal CNEs, we see that in particular the lines Lelystad-Ens (LLS-ENS) and Diemen-Lelystad (DIM-LLS) - which together form a corridor from northeast to southwest – have limited cross-zonal exchanges in the day-ahead timeframe. These flows are caused by a predominant flow from northeast to southwest in the Netherlands, caused by a combination of internal flows, commercial flows from outside NL to the UK and Belgium and loop flows.

Both lines are included in TenneT's investment program ('Beter Benutten') for a capacity upgrade from 2.5 kA to 4 kA per circuit. The first results can already be observed, as the upgrade of both circuits of LLS-ENS W in Q4 2019 and Q1 2020 has led to a significant decrease in the number of congestions on this line (from ~12 % in 2018 to ~1 % in 2020).

### Norway

In Q1 202,1 a 1,400 MW HVDC from Norway to Germany came online and in Q4 2021 the North Sea Link, also with a capacity of 1,400 MW, will connect Norway and Great Britain. To allow power to be transported to both these HVDCs and the other interconnector, the transmission grid in almost all of Norway has seen a significant upgrade from 300 kV to 420 kV over these years. During the construction of these new or upgraded lines, a substantial amount of planned outages were needed, which affected the cross-border capacity substantially in this period.

### Poland

There are a few active market constraints in the CCDA reporting over the past three years. The relevant constraints are found at cross-border connections (Poland-Sweden and Poland-Lithuania) and at the Mikułowa substation, which is located next to the DE-PL border (connection to 50Hertz). It should be underlined that the lines and transformers at the Mikułowa substation are highly burden by loop flows in the DE > PL direction.

### Portugal

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.

During 4.1 % of the hours in 2020, the Portuguese and Spanish bidding zones presented different day-ahead prices. The commissioning of the new Spain-Portugal interconnection line will solve the detected congestion.

### Romania

The maps show the critical network elements identified in the framework of capacity calculation and day-ahead allocation on all Romanian borders.

The main active constraints are located in the west and south-west area of the country due to the 220 kV network with limited transport capacity and concentration of the cross-border exchanges in this area, since there are no interconnections in the North and East of Romania.

Critical network elements are mostly 220 kV OHL and 400/220 kV transformer units that shall be relieved through the measures taken in the Action Plan developed according to Article 15 of the EU Regulation 2019/943.

### Slovakia

The congested lines, three in total, are mainly cross-border. The main reason for their congestion is overloading caused by high transfer from the northern part of Europe (north of Germany) with high production to the southern part of Europe (Hungary and the Balkan states) with a higher load. Most of the transfer is transmitted by three interconnectors on the SK-HU and SK-UA profile. The congestion on the internal line is primarily due to high transfer flow from north to south through the Slovak transmission system.

## Slovenia

A few active constraints can be noted around the Divača substation, which are for most of the time intentionally created by the PST located in the substation with the goal of maximising overall IN CCR cross-zonal capacities.

## Spain

There are no relevant active market constraints on the REE network elements monitored in the Spain-Portugal CCDA, as demonstrated by the high rate of price convergence between both bidding zones in the day-ahead timeframe (e. g., only in 4,1 % of the total hours in 2020 did the Spanish and Portuguese bidding zones present different day-ahead prices). For 2020, REE observed only one active market constraint on the Spain-Portugal border, which was located on the Duero interconnection line and represented a frequency of 1 %. The commissioning of the new Spain-Portugal interconnection line will solve the detected congestion.

There are more active market constraints on the network elements monitored in the Spain-France CCDA, limiting cross-zonal trade through the Spain-France bidding zone border. For instance, for 60.6 % of the total hours in 2020, the Spanish and French bidding zones presented different day-ahead prices due to limited cross-zonal capacity at the Spain-France bidding zone border. As can be seen in Figure 16, the active market constraints present in the Spanish bidding zone that impact the Spain-France CCDA are mostly placed on the western interconnection lines. These active market constraints on the western interconnection lines reached frequency values between 6 % and 12 % for 2020. Therefore, in the day-ahead capacity calculation timeframe, the western interconnection lines on the Spain-France border can be qualified as the only congested area inside the Spanish bidding zone. It is planned that the relevant congestion in the western zone of the Spain-France bidding zone 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.

Apart from the market constraints located in the western interconnection lines of the Spain-France bidding zone border, there are no additional relevant congestions in the Spanish bidding zone that affect cross-zonal capacity. The frequency of other, non-relevant congestions identified in the Spanish bidding zones for the Spain-France CCDA stayed below 1 % in 2020; these elements were associated with network element outages or unusual operational situations related to RES or demand. On top of this, the number and frequency of these non-relevant active market congestions are currently being reduced through the reinforcement and uprating of the Spanish transmission network in the area.

It can therefore be concluded that the most relevant congestion is at the Spain-France bidding zone border and that there exist no structural congestions inside the Spanish bidding zone that affect cross-zonal capacity calculations.

## Sweden

Due to national legislation, data on congestions in the timeframe 'capacity calculation for the purpose of DA allocation' cannot be provided for Swedish network elements, and consequently no expert assessment is provided.

## Switzerland

### Congested area No. 1 (CH-IT)

Following the start of the coordinated CCDA in 2016, which maximises cross-zonal capacities at the North Italian border, limiting CNEs have been determined more accurately. The Italian-Swiss 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 renders it the most congested of the Northern Italian borders in the CCDA process.

### Congested area No. 2 (DE/AT-CH)

The grid in Northern Switzerland is highly meshed and the appearance of congestions is dependent on maintenance activities around the bidding zone 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. Between 2018 and 2020, a transformer malfunction near the border of Switzerland and France led to higher loads on PSTs in the Northern Swiss grid.

### Congested area No. 3 (FR-CH)

Congestions on the Swiss-French border are primarily due to high exports from France. The degree of congestion is often dependent on weather conditions, since France experiences a high level of production but less demand in the event of early, warmer winters. The main congestions in 2018 and 2019 occurred due to a transformer malfunction near the border between Switzerland and France. The transformer was replaced in spring 2020.

### 2.2.3 D-1 timeframe

#### 2018 – D-1

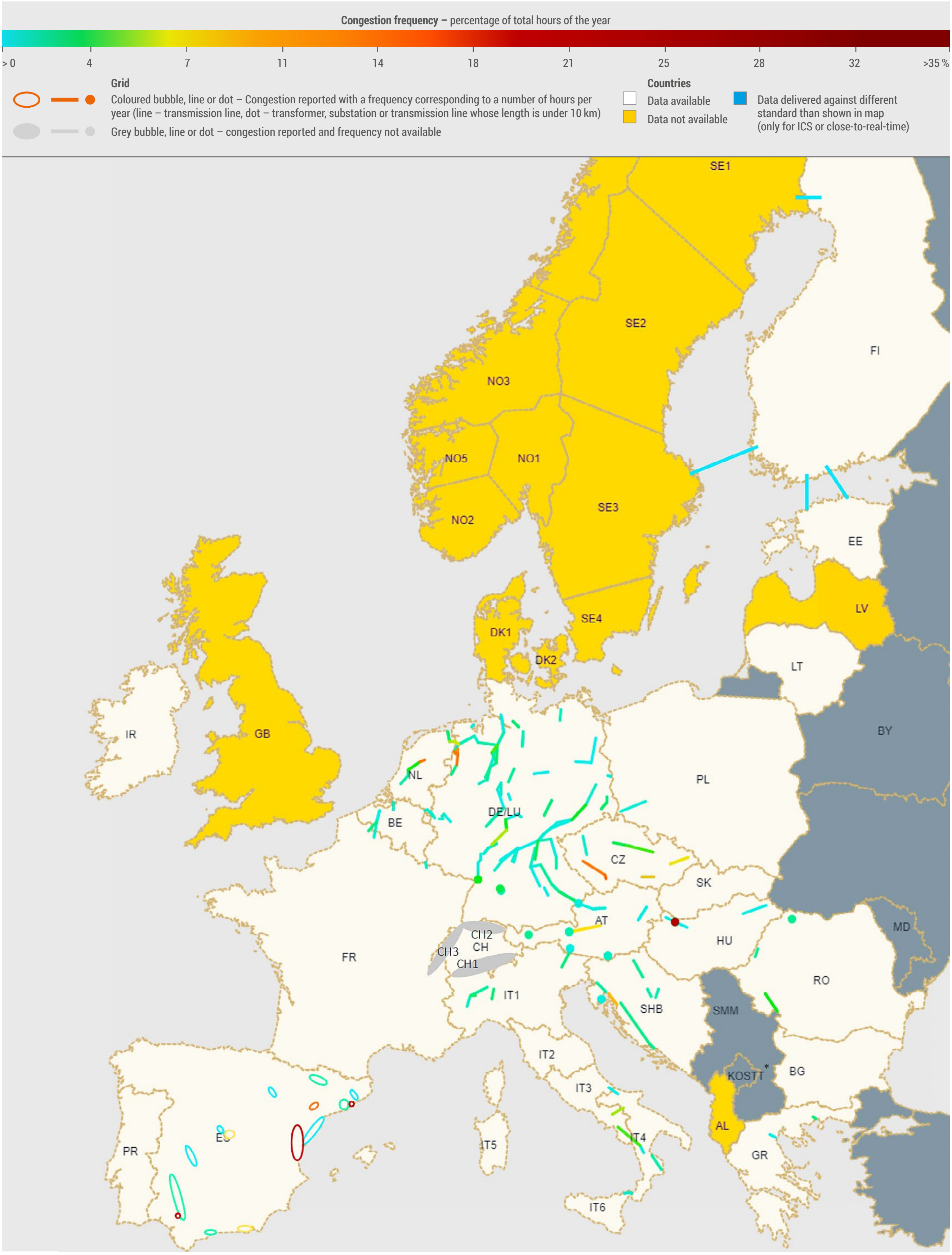



Figure 17: D-1 for 2018 – Europe

## Zooms

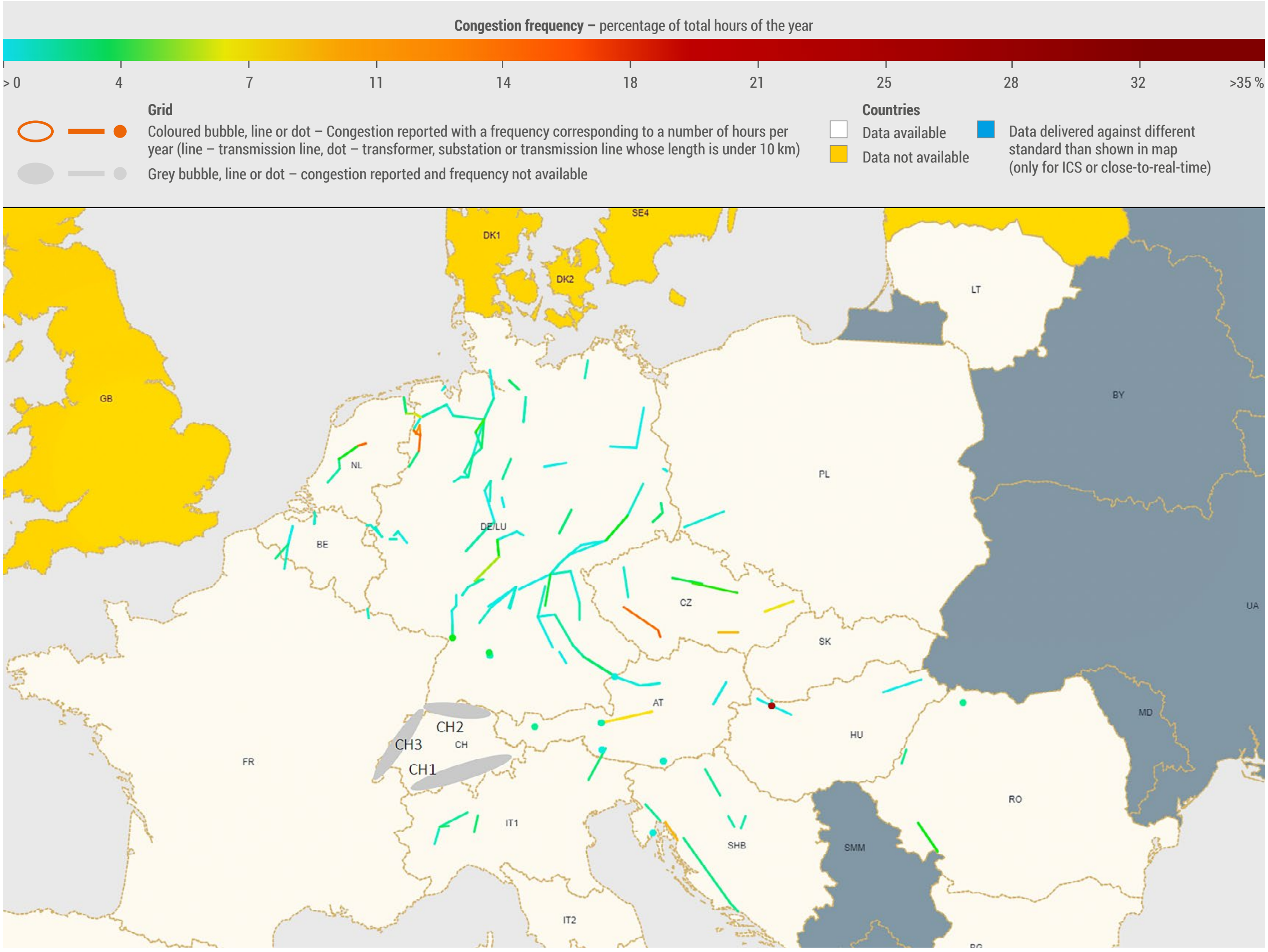



Figure 18: D-1 for 2018 – Central Europe

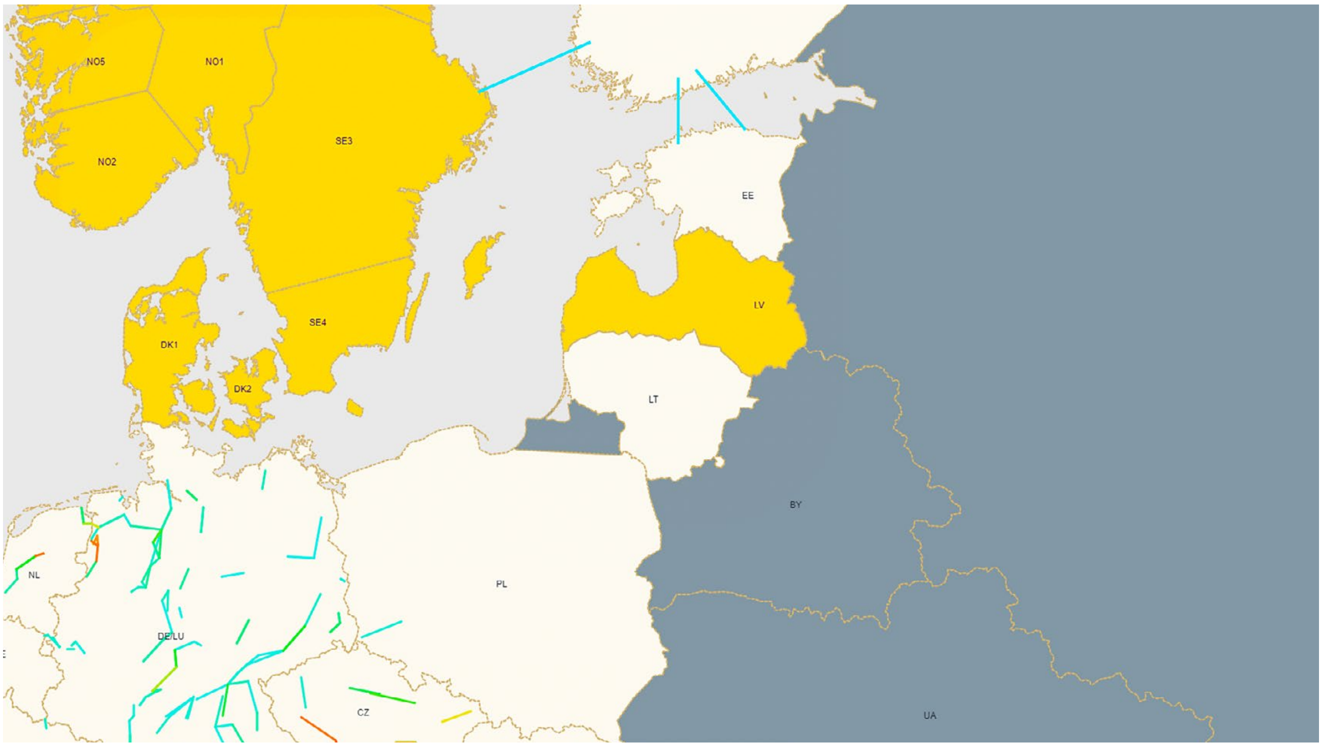



Figure 19: D-1 for 2018 – Baltic countries and Denmark/Sweden

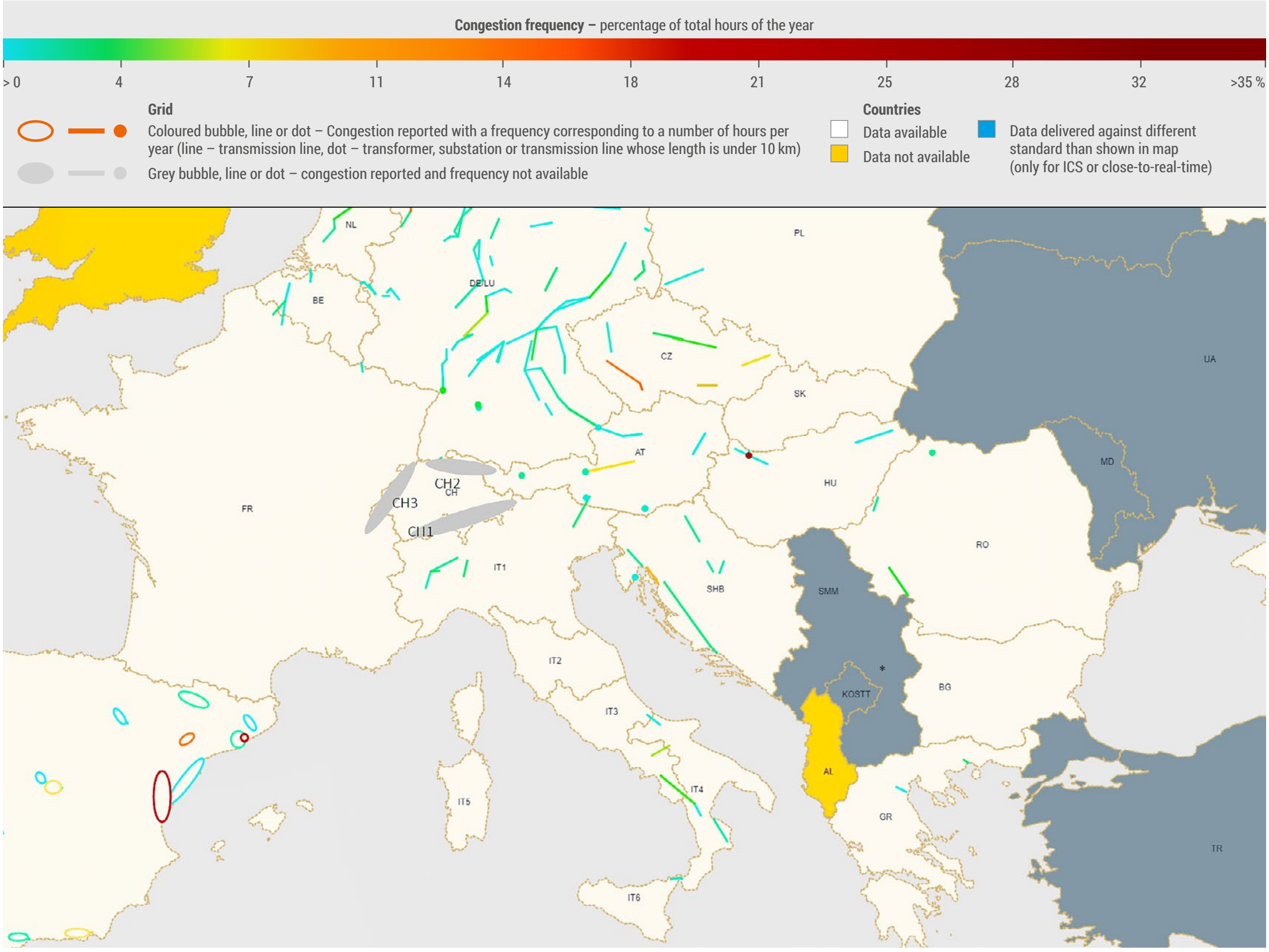



Figure 20: D-1 for 2018 – Balkans and Italy

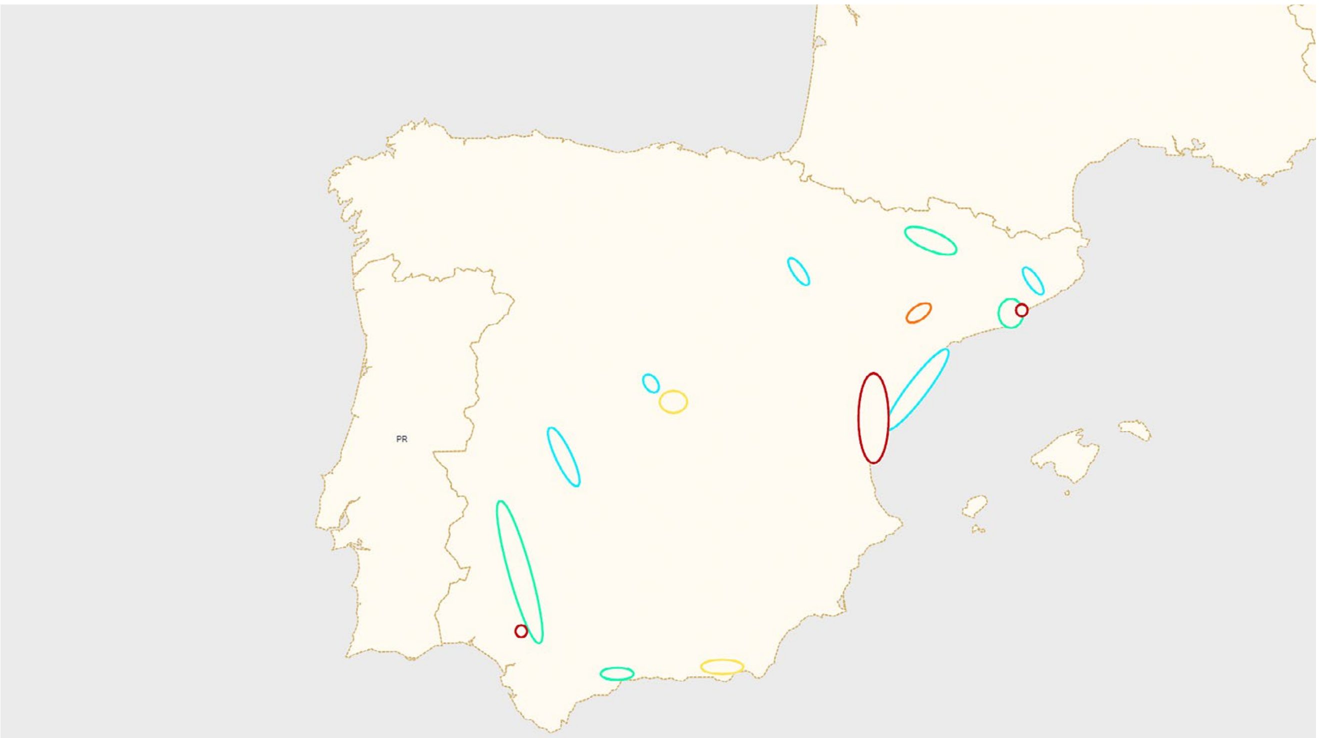



Figure 21: D-1 for 2018 – Spain/Portugal

## 2019 – D-1

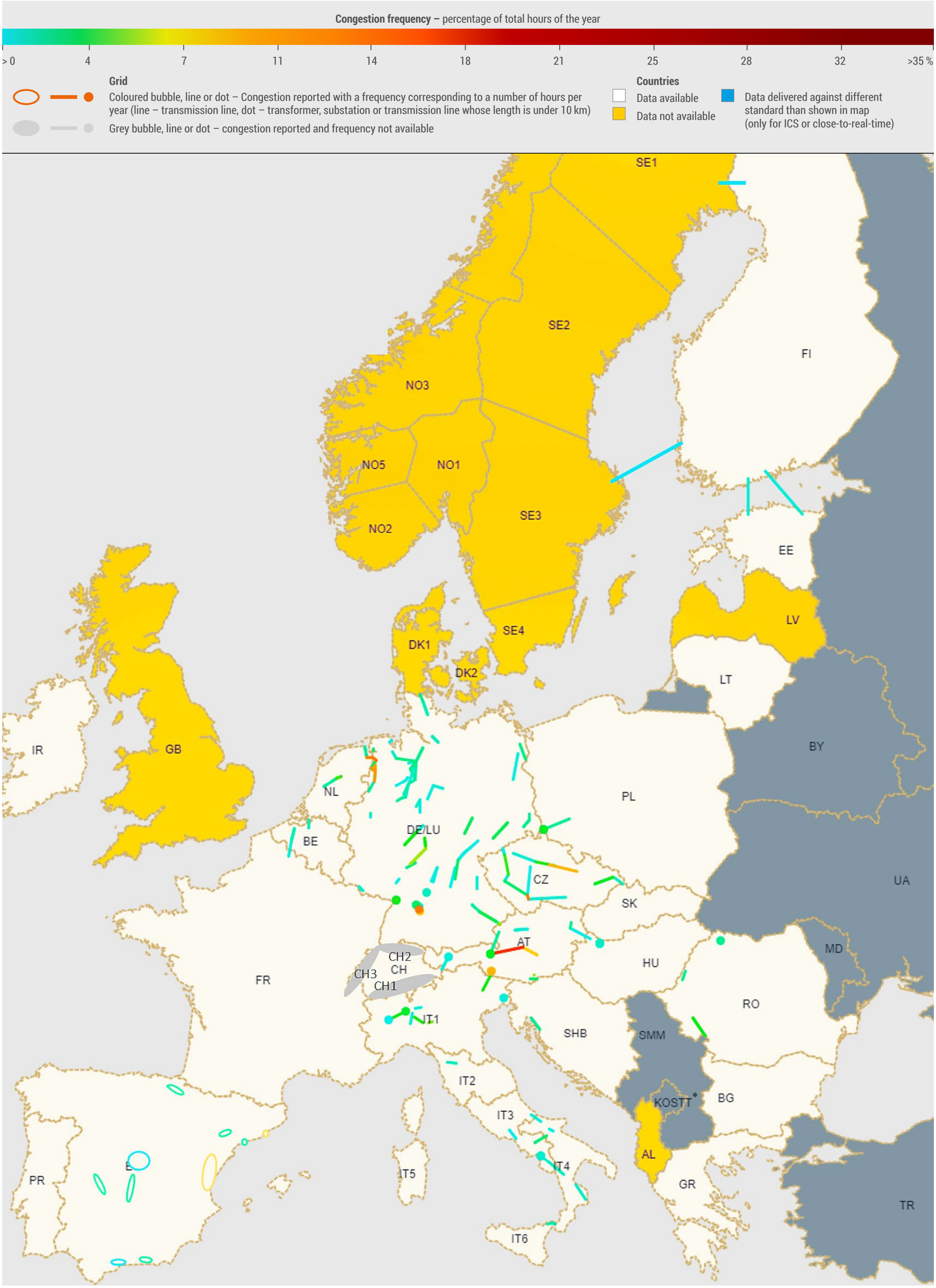



Figure 22. D-1 for 2019. Europe

## Zooms

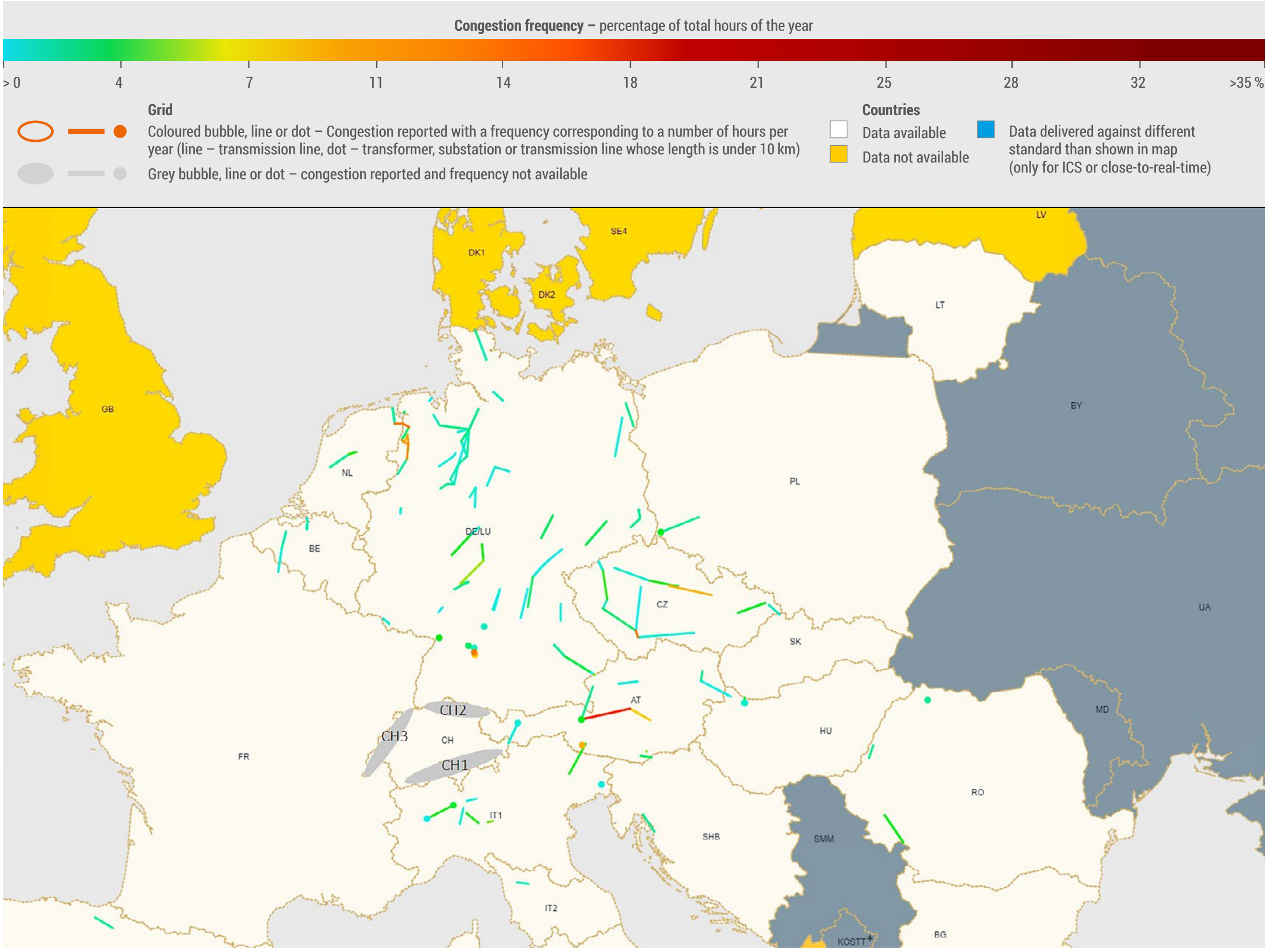



Figure 23: D-1 for 2019 – Central Europe

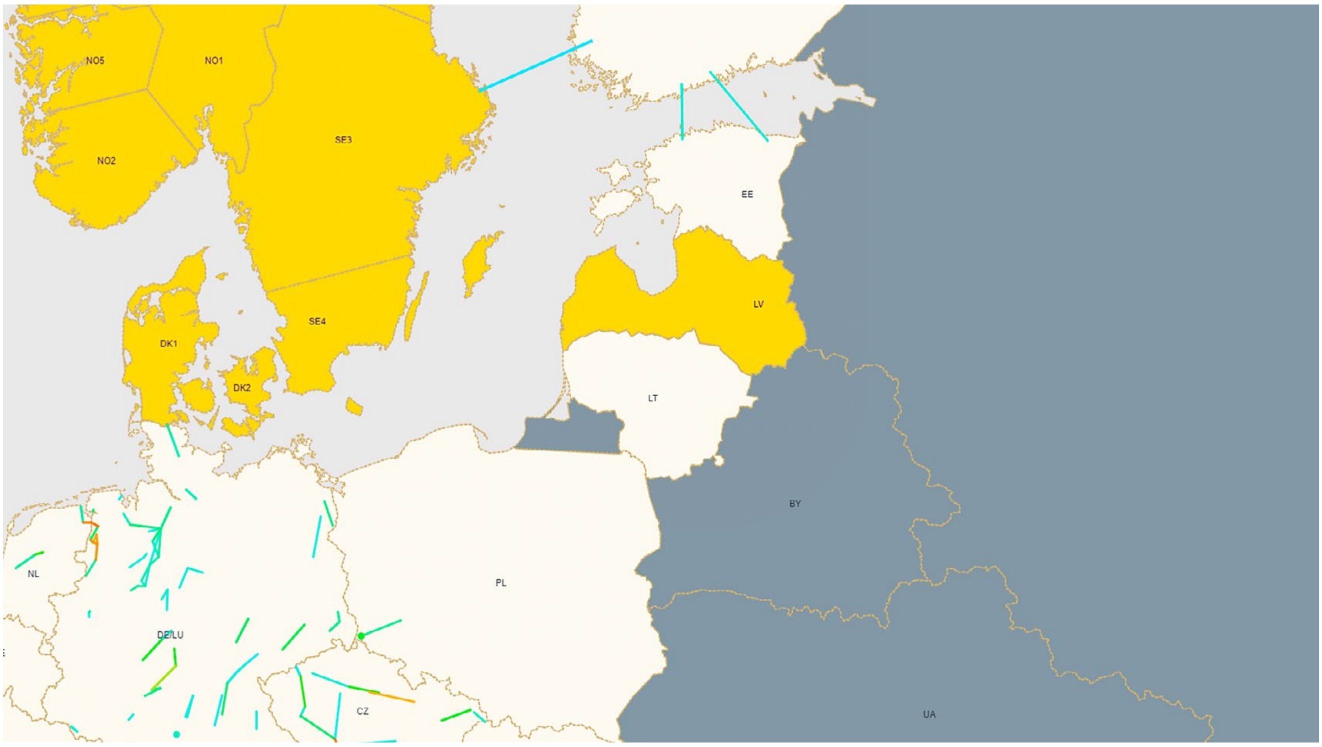



Figure 24: D-1 for 2019 – Baltic countries and Denmark/Sweden

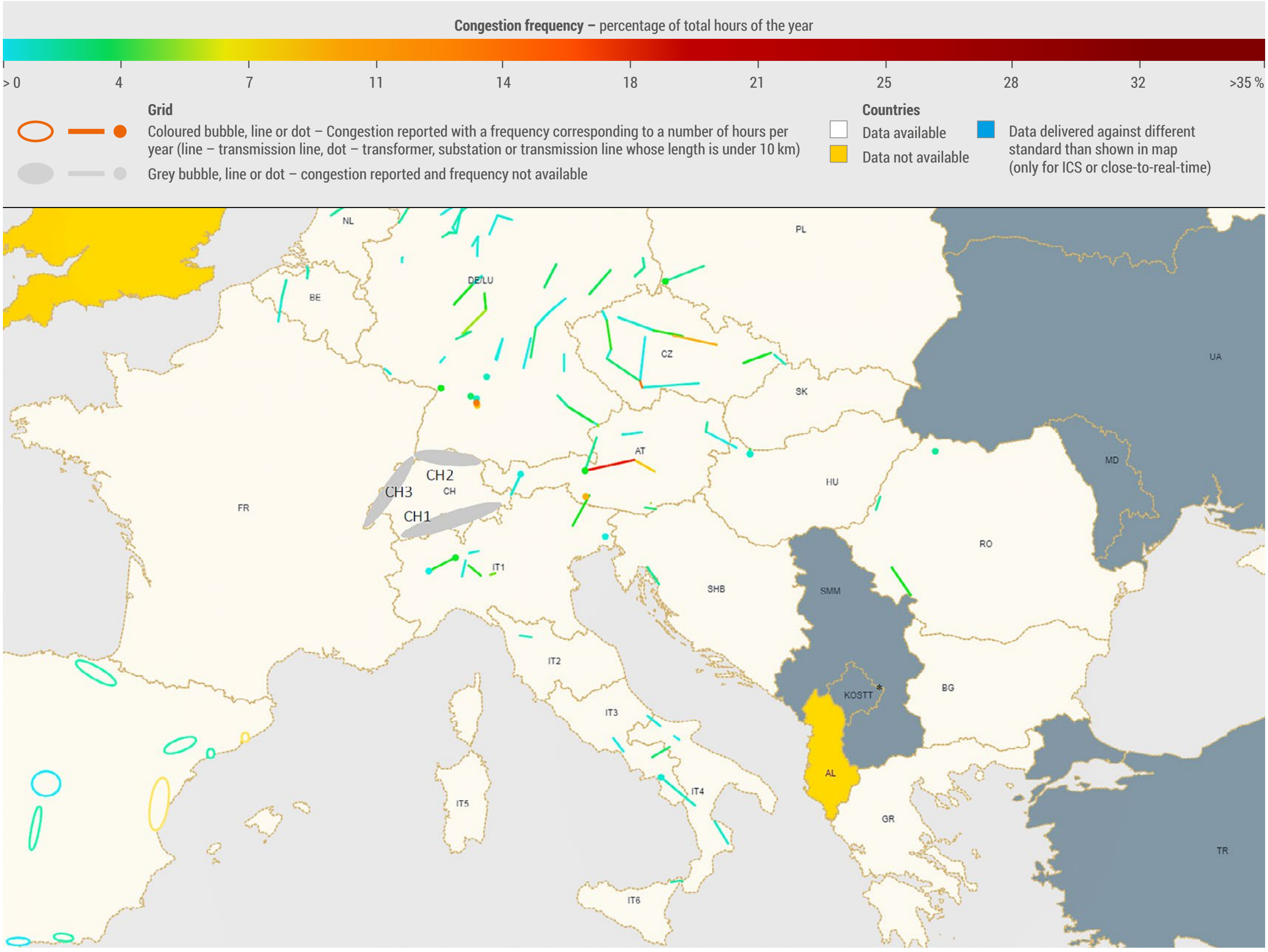



Figure 25: D-1 for 2019 – Balkans and Italy

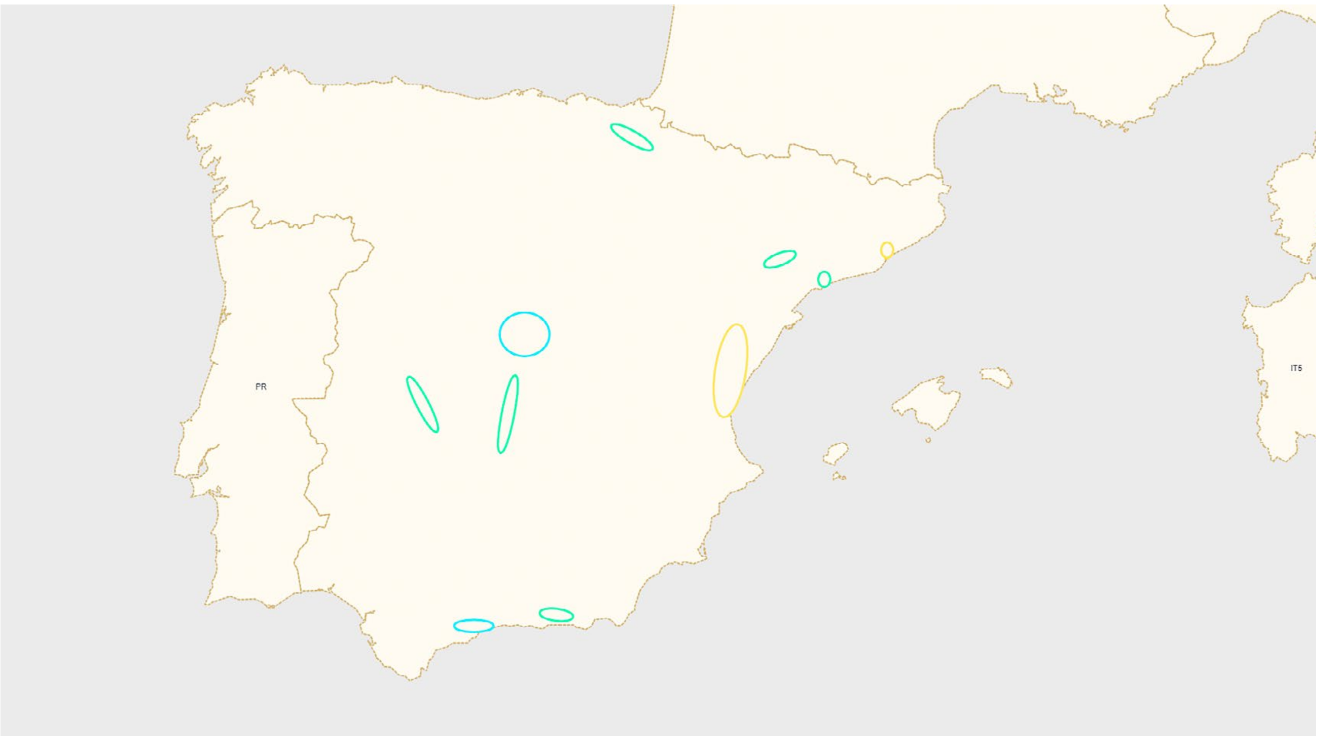



Figure 26: D-1 for 2019 – Spain/Portugal

## 2020 – D-1

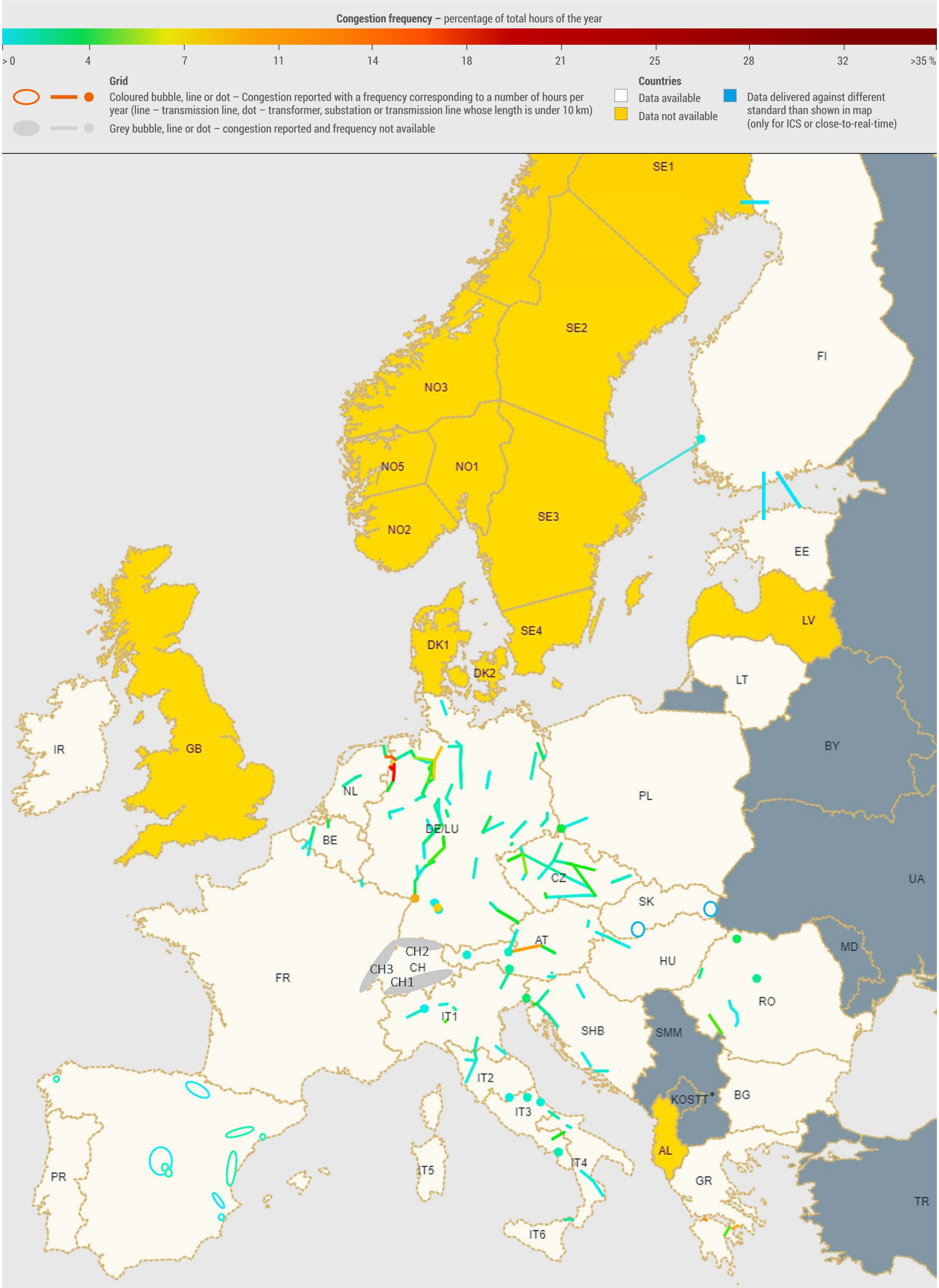



Figure 27: D-1 for 2020. Europe

## Zooms

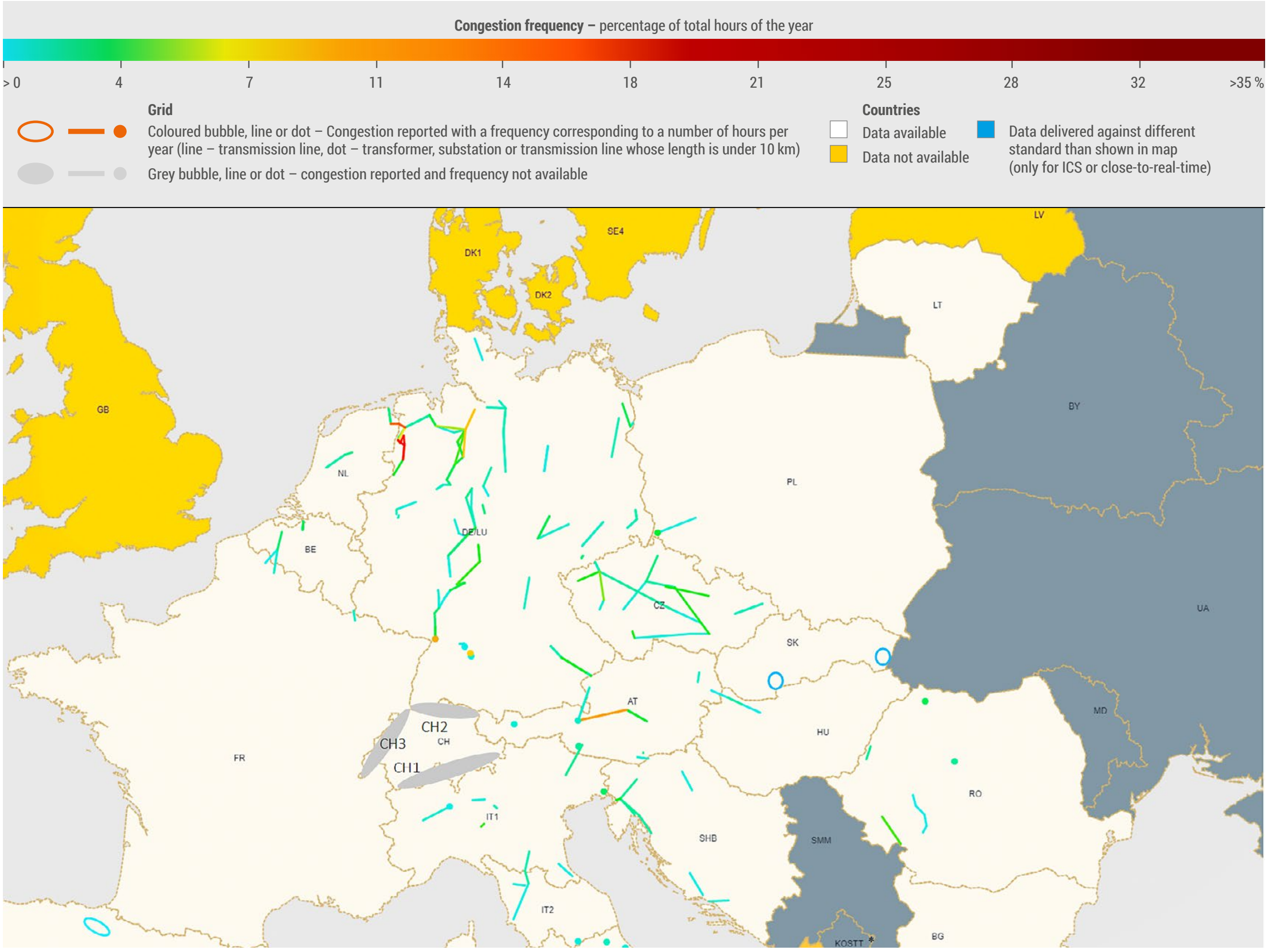



Figure 28: D-1 for 2020 – Central Europe

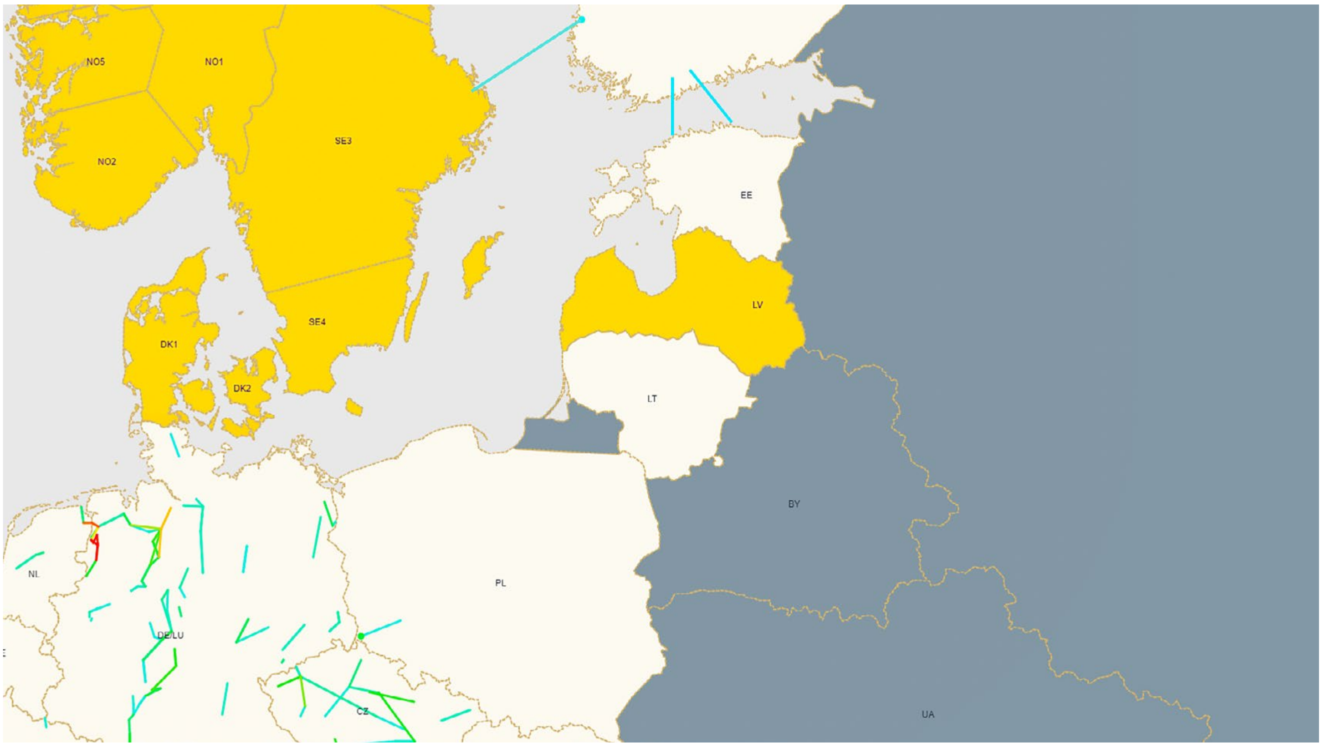



Figure 29: D-1 for 2020 – Baltic countries and Denmark/Sweden

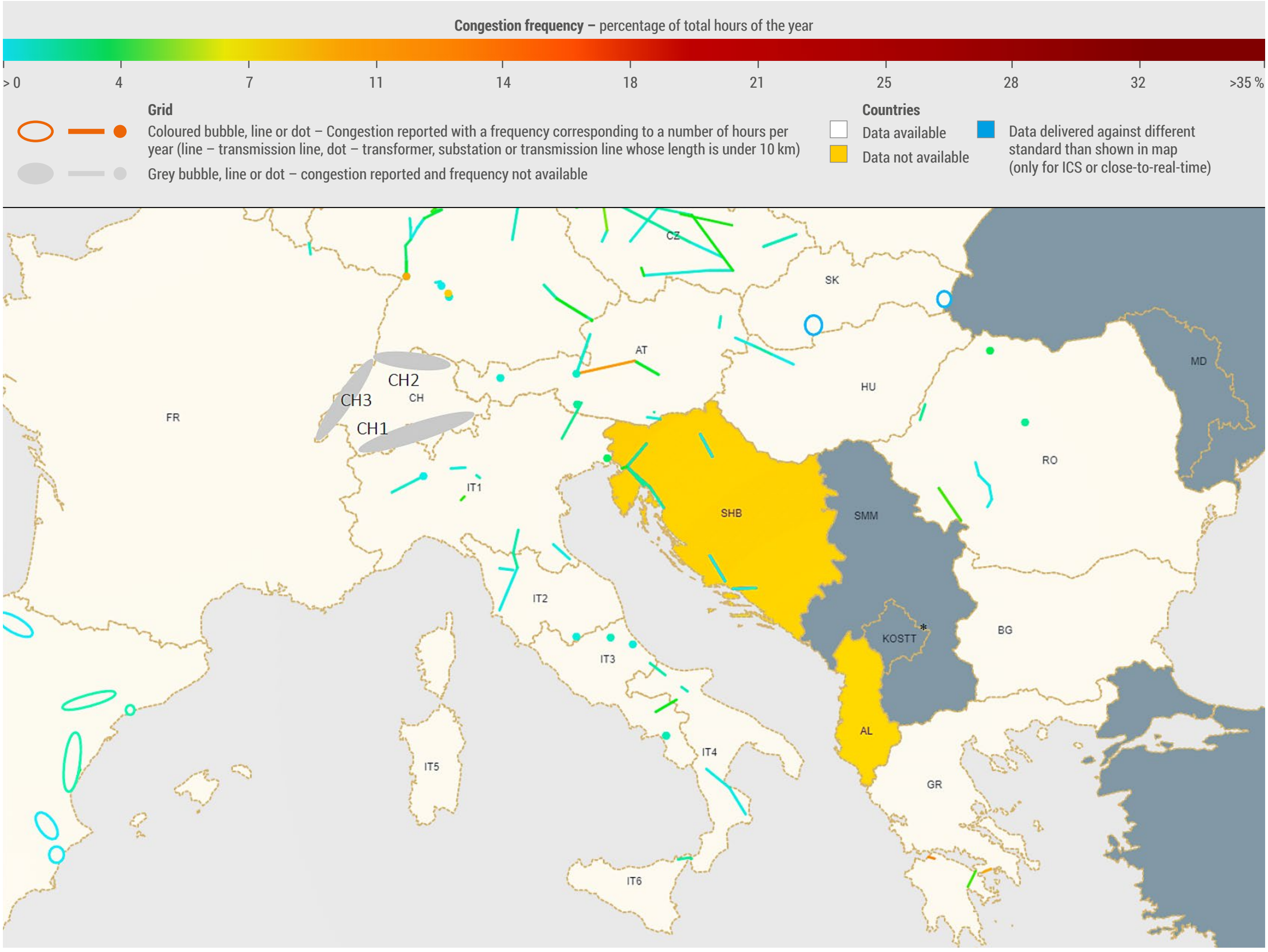



Figure 30: D-1 for 2020 – Balkans and Italy

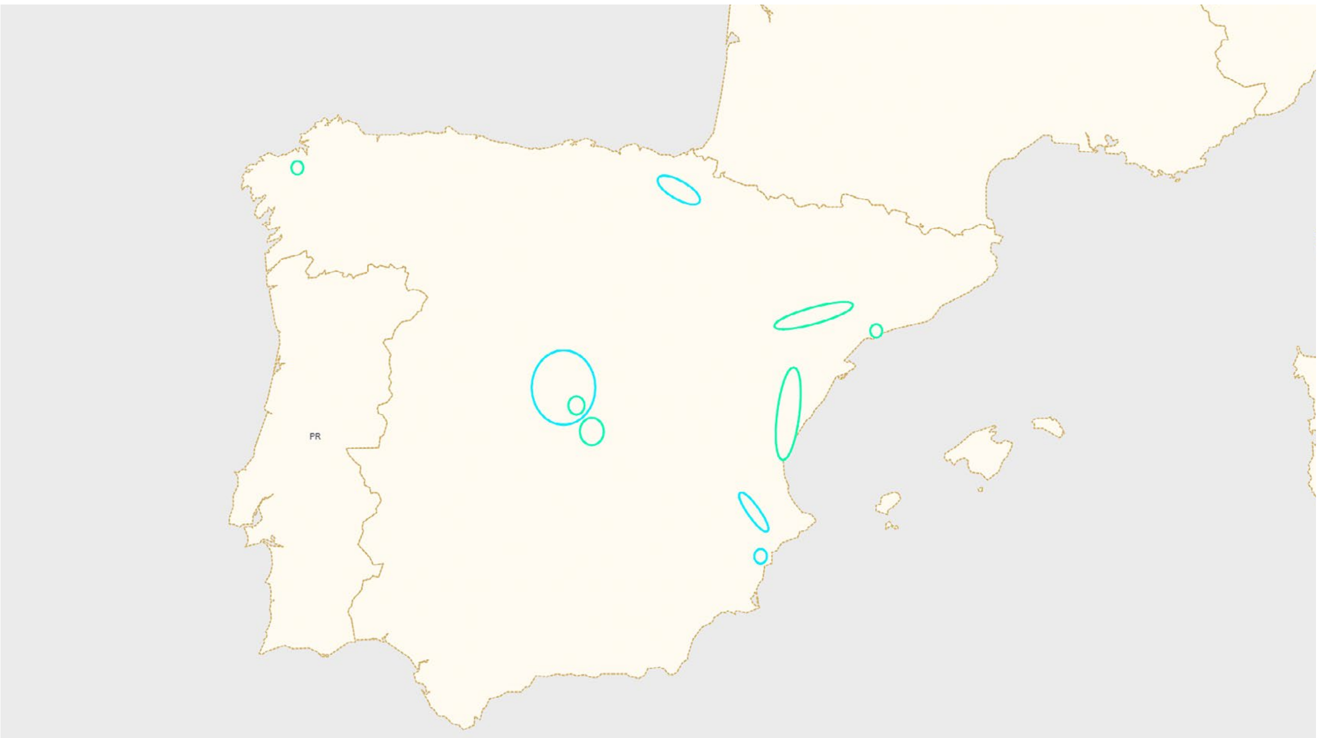



Figure 31: D-1 for 2020 – Spain/Portugal

## 2.2.4 Expert assessment of congestions for the D-1 timeframe

The assessments below were provided by the TSOs of each of the named countries:

### Albania

The most frequent congestion is observed on 220 kV lines with Montenegro (Koplik-Podgorica1) and Kosovo (Fierze-Prizren), and is solved in day-ahead time frames by applying redispatching or topological changes.

### Austria

Since the transmission system of Austria is located centrally in Continental Europe, it is strongly affected by the various European export and import patterns. As such, different load flow directions have been observed in the past, of which the most dominant have been north-south and west-east.

Congestions in the area of St. Peter and Tauern are currently relieved by PST tapping, special switching states and thermal rating, as well as redispatching. To relieve congestions in the area of St. Peter, two new 380 kV double-circuit OHLs are planned, St. Peter – National Border (2024: Isar/Otten-hofen/DE) and St. Peter – National Border (2028: Pleinting/DE). Furthermore, a reconstruction of the existing 220 kV line St. Peter – Hausruck – Ernsthofen was finished in 2021 (a new switching station, SW Weibern, is planned for 2023). To relieve congestions around Tauern, a new internal double-circuit 380 kV line connecting the substations Salzburg and Tauern is under construction (replacement of existing 220 kV lines on optimised routes). To remedy congestions in area of Lienz, PST tapping is the primary method applied. In August 2021, the installation of a third 380/220 kV transformer in Lienz was commissioned to relieve congestions. Furthermore, an additional cross-border line between Austria and Italy (Nauders – Glorenza) is planned (projected commission year: 2023) and a reinforcement of the existing 220 kV line Lienz – Soverzene is planned in 2027. These projects will have a relieving effect in this area.

### Belgium

In day-ahead security assessments, Elia considers all 380 kV lines in the corridors which pass through Belgium regarding both critical grid elements and critical outages.

Given the market result of the day-ahead capacity allocation, Elia will prepare all remedial actions required to ensure operational security in collaboration with Coreso and TSCNet.

### Bulgaria

ESO EAD does its utmost to provide maximum capacity to the market. During the target years 2018, 2019 and 2020, there were no congestions identified in the D-1 timeframe. If there was a security violation identified it was eliminated by applying non-costly RA.

### Croatia

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

- 220 kV transmission line from the south to the north of Croatia, exactly on the route BA-HR-SI towards Central Europe,
- 400/x kV, 220/x kV substations in the eastern, southern and north-western part of Croatia (e. g. Ernestinovo, Đakovo and Konjsko, Zakučac and Melina, Tumbri) located next to the HR-RS, HR-BA, HR-SI borders.

### Czech Republic

Constraints detected in the short-term planning stage correspond to the high utilisation of the grid by international trading/transiting flows during the period of intensive reconstruction of the transmission grid. Nevertheless, most constraints are solved by either preventive or curative measures during the next run of the DACF and IDCF processes by applying agreed-upon measures in our and/or in neighbouring grids. Some internal elements reported have no cross-border relevance.

### Denmark

D-1 timeframe after market allocation but before use of remedial actions:

In Denmark, there is no structured congestion management process for this timeframe. The market result from the allocation phase is directly useable if there are no unplanned outages in the grid between the time where capacity is given to the market and real time. The use of bidding zones to handle significant congestions ensures that the market outcome can be directly applied regardless of the schedules that market participants submit to the TSO.

## Estonia

D-1 congestions are mainly due to unexpected outages when day-ahead capacity has been given to the market.

## Finland

There are only a small number of observed congestions 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 are used in a few planned outages. Unexpected congestions are managed by remedial actions close to real time.

During the D-1 timeframe, intraday trade generally relieves D-2 congestions to the reverse direction providing a market-based method for congestion management. In Finnish cross-border settings, this has meant around 10 % fewer congestions for each year from 2018 through 2020.

Generally, capacity within the Finnish bidding zone is adequate and there are no internal congestions noticed in D-1 timeframe.

## France

Network congestion data during short-term operational planning (or D-1 congestion) are partial data and correspond to the constraints detected in D-1 and for which costly preventive measures have been implemented in order 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 0.32 % and is low over the years, so they cannot be considered as structural or as major physical congestions.

Nevertheless, we noticed that from such constraints managed in D-1, a majority are influenced by cross-border energy exchange zones such as the Spanish border, CWE and CSE.

## Germany

Due to its central location in the European electricity system, Germany is an important transit country in the east-west and north-south directions. Moreover, the current transit is influenced by several factors. In the last three years, exchanges with foreign countries have changed and are highly affected by load pattern and development of generation capacities. The highest exports are still towards Austria, but they have decreased. On the 1st of October 2018, the German Austrian border became a part of the CWE flow-based capacity mechanism. At the borders with France and the Netherlands, average exports have also decreased. In contrast, average imports from Denmark have increased. Furthermore, the exchanges at the other borders were rather stable. Furthermore, the generation landscape has changed in the last three years and is now characterised by a significantly lower feed-in from lignite and hard coal and an increasing feed-in from wind and gas-fired power plants. In addition, 2020 has been marked by the emergence of the COVID-19 crisis and particularly its impact on load patterns.

Nevertheless, most of the congestions in the German grid appear when renewable infeed is high in the northern part (50Hertz and TenneT) and Germany exports electricity in the southbound direction (France, Switzerland, Austria). In these situations, congestions in the north to south and in the north-east to south-west directions appear.

Further influencing factors are 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).

The congestion situation is also impacted by given minimum capacities. In the area of the CWE flow-based mechanism, a minimum capacity of 20 % was introduced in April 2018. After European Regulation (EU) 2019/943 entered into force in the summer of 2019, Germany drafted an action plan for increasing capacity at the external borders to achieve the 70 % capacity target. The rising minimum capacities have had a huge impact on the congestion situation and the active constraints as of 2020. As a result, there are fewer German active constraints during capacity calculation and allocation, but congestions closer to real time have increased (most notably in the D-1 stage).

### D-1

Overall congestions at the D-1 stage in Germany decreased slightly from 2018 to 2019, but increased in 2020 due to the introduction of minimum capacities in accordance with the German action plan put into place following the Regulation

(EU) 2019/943. The application of the minimum capacities has led to a shift of congestions from the DA CC stage to the D-1 stage and has offset the positive effects of the targeted grid expansions and more efficient grid utilisation.

#### Border area DE-Nordics

In the Schleswig-Holstein area, a grid extension project for the East Coast Line from Denmark to Dollern was commissioned from 2018 to 2020, with the last section between Hamburg/Nord and Dollern being put into operation near the middle of 2020. This led to a significant reduction in congestions in this region, but moved the congestions south of the river Elbe, particularly into the area Sottrum-Dollern. The increasing minimum capacity obligations are further aggravating the congestion, which will however be resolved by the upcoming grid extension.

#### Border area DE-NL

An often-congested line is the so called 'Emslandleitung' between TenneT Germany and Amprion (Dörpen/West (TTG)-Hanekenfähr – Meppen – Niederlangen). The load at these lines is especially impacted by the increase in the installed offshore production capacity during these years. The introduction of a common dynamic line rating in March 2019 has resulted in a significant reduction in the number of remedial actions required. However, due to the increase in completed offshore connections, congestions are increasing again.

#### Border area DE-AT

This border is mainly impacted by the transit across Germany and Austria. In particular, in conjunction with high solar feed-in in Bavaria, the lines Pirach-Simbach-Altheim-Pleinting-St. Peter were congested.

#### Border area DE-PL and DE(50Hertz)-CZ

As in the DACC stage there are congested lines near the border with PSE and CEPS. Compared to the last Technical Report, there are only a few congested lines left. On most of these lines, the congestions have been further reduced over the years under review due to the commissioning of PSTs in Röhrsdorf and Hradec.

#### Area 'Mittlerer Neckarraum'

Due to the decommissioning of nuclear power plants in Germany, the nuclear power plant Philippsburg, connected to the grid of TransnetBW in the southwest of Germany, was shut down in 2019. This resulted in an increase in voltage dependent redispatch to keep the voltage level below the operational limits. This effect appeared mostly in the centre 'Mittlerer Neckarraum', the northern part of the TransnetBW's control area.

### Greece

The congestions observed in D-1 do not appear in the CCDA stage since they are not included in the critical elements that are monitored in the CCDA, because they do not present any relevant sensitivity to cross-border exchanges. In most cases these relate to internal lines for which preventive and/or curative measures are taken but have no effect in the cross-border exchanges.

D-1 congestions that were corrected by remedial actions are linked to single contingencies for which their occurrences are relatively low for 2018, zero for 2019, and higher in 2020 than in 2018.

### Hungary

Based on the situation of the capacity calculation timeframe, 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. In the northwestern part of the Hungarian network, where the tie-lines to Austria and Slovakia are concentrated and interdependent, these flows cause overloads in various situations. Overloads in this region have been relatively stable in the period from 2018 to 2020, with the reduction in congestions around substation Győr as a result of a commissioning of a new 400/132 kV transformer. Managing these overloads was mainly rendered possible by conservative bilaterally offered capacities on these borders, since the difference between scheduled exchange and real-time flow on SK-HU border occasionally reaches maximum values of 1,000 MW, which is caused by difficult-to-predict transit flows.

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

In the above-mentioned cases, there were topological measures available to decrease the loading of the affected lines.

### Ireland

–


## Italy

In D-1 timeframe, the congestion level in the Italian power system is stable during the period, 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 bidding zones, expected to exceed the NTC value. This expectation is related to the application of improved load and RES infeed forecasts in D-1 stage from the Terna side.
- Local congestions inside bidding zones and close to metropolitan areas.
- Different load and generation distribution compared to the capacity calculation process.

## Latvia

Due to the capacity calculation methodology used in the Baltics, AST does not use CGM models to distinguish critical network elements and congestions per element.

## Lithuania

No congestions were detected in the Lithuanian grid.

## Luxembourg

No congestions were identified in the Luxembourgish grid.

## Netherlands

When comparing congestions between the D-1 timeframe and the CCDA timeframe, we generally see congestions on the same network elements for both timeframes, but the congestions in the D-1 timeframe are less frequent than in the CCDA timeframe. This consistency is a positive sign, since it shows that these network elements correctly limit cross-zonal exchanges in the CCDA timeframe, as otherwise more significant/frequent physical congestions in the D-1 timeframe would have occurred. The remaining congestions are resolved with both topological measures and internal redispatch measures, resulting to a N-1 operational planning.

A notable distinction between the D-1 and CCDA timeframe is that in the D-1 timeframe there are no congestions on the HVDC interconnectors whereas in the DA timeframe they are almost always congested. This is because of the HVDC technology, which enables TenneT (and its TSO counterparts) to fully control the power flow across these interconnectors, which in ensures that there are no congestions on the interconnectors in operational security assessments.

## Norway

Correction of D-1 congestions is mainly due to unexpected outages after the day-ahead capacity has been provided to the market.

## Poland

After the day-ahead market, the only relevant congestions are found at the Mikułowa substation, which is located next to the DE-PL border (connection to 50Hertz). All the congestions detected at this stage are solved by changing the PST settings, topology measures or if still needed, by implementing redispatching.

### Portugal

In the Portuguese system, the D-1 congestions are mainly due to outages.

### Romania

The D-1 timeframe uses the results of day-ahead allocation and is dedicated to operational security analysis. The congestions in the framework of capacity calculation and day-ahead allocation are reduced due to the application of topological remedial actions to fulfil security (N-1) criteria in real time.

### Slovakia

The congested lines are cross-border lines, and the main cause of the congestion is very high transfer flows from the northern part of Europe, with high production to the southern part of Europe, with a higher load.

### Slovenia

The D-1 congestion in IN CCR is typically handled by PST Divača and therefore virtually is non-existent. The congestion on the 220 kV grid between SI-AT is stable, which means that it can be handled with the application of effective topological remedial actions. It is foreseen that the application of active devices (SSSC) will improve network operation security.

### Spain

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

From 2018 to 2020, most of the congestions observed by REE in D-1 have shown a decreasing pattern both in number and frequency due to progressive commissioning of uprates, run-back automatisms or new network elements. As shown in Figures 21, 26 and 31, the congestions observed by REE are generally placed in the REE control area. These are caused by unusual operational situations related to RES, demand or REE network element outages, both planned and unplanned. These congestions are managed by REE with non-costly topological measures and when this is not possible, through redispatching measures. In 2020, the frequency of these congestions stayed below 5 %.

As such, for this timeframe, it can be concluded that there do not exist any structural congestions inside the Spanish bidding zone.

### Sweden

Due to national legislation, data on congestions in the D-1 timeframe cannot be provided for Swedish network elements, and consequently no expert assessment is provided.

### Switzerland

**Congested area No. 1 (CH-IT)**

The constraints on the IT-CH border are mainly the same in D-1 as in the CCDA timeframe. Congested elements are 380 kV internal and tie lines in case of high Italian imports.

**Congested area No. 2 (DE/AT-CH)**

The constraints on the DE/AT–CH border are the same in the D-1 as in the CCDA timeframe. Depending on the scenario, the main congested elements are the PSTs and 380 kV transit lines. The situation worsened due to the introduction of the CWE Market coupling, which induces high unscheduled flows inside the Swiss system.

**Congested area No. 3 (FR-CH)**

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

## 2.2.5 Close-to-real-time

For the close-to-real-time stage, it is especially challenging to provide comparable data, since congestion management approaches and the data processing and reporting differ among TSOs. Therefore, for real time, two different sets of maps are shown. One set of maps displays all the TSOs that used ICS reports as their source. These TSOs typically have very few congestions since ICS reports only include (N-1) grid violations appearing in real time. The other set of maps presents all the TSOs that provided data up to one hour before real time. However, even for these TSOs, sources differ, and the resulting reported congestions are not necessarily comparable. Further details can be found in the individual TSO descriptions below. It is important to highlight that only Switzerland reported congestions in a close to real-time timeframe over a five-minute time interval; all other countries reported over a one-hour time interval.

### 2.2.5.1 Close-to-real-time maps of the TSOs which used up to 1 hour real-time data

## 2018 – real-time, 1 hour

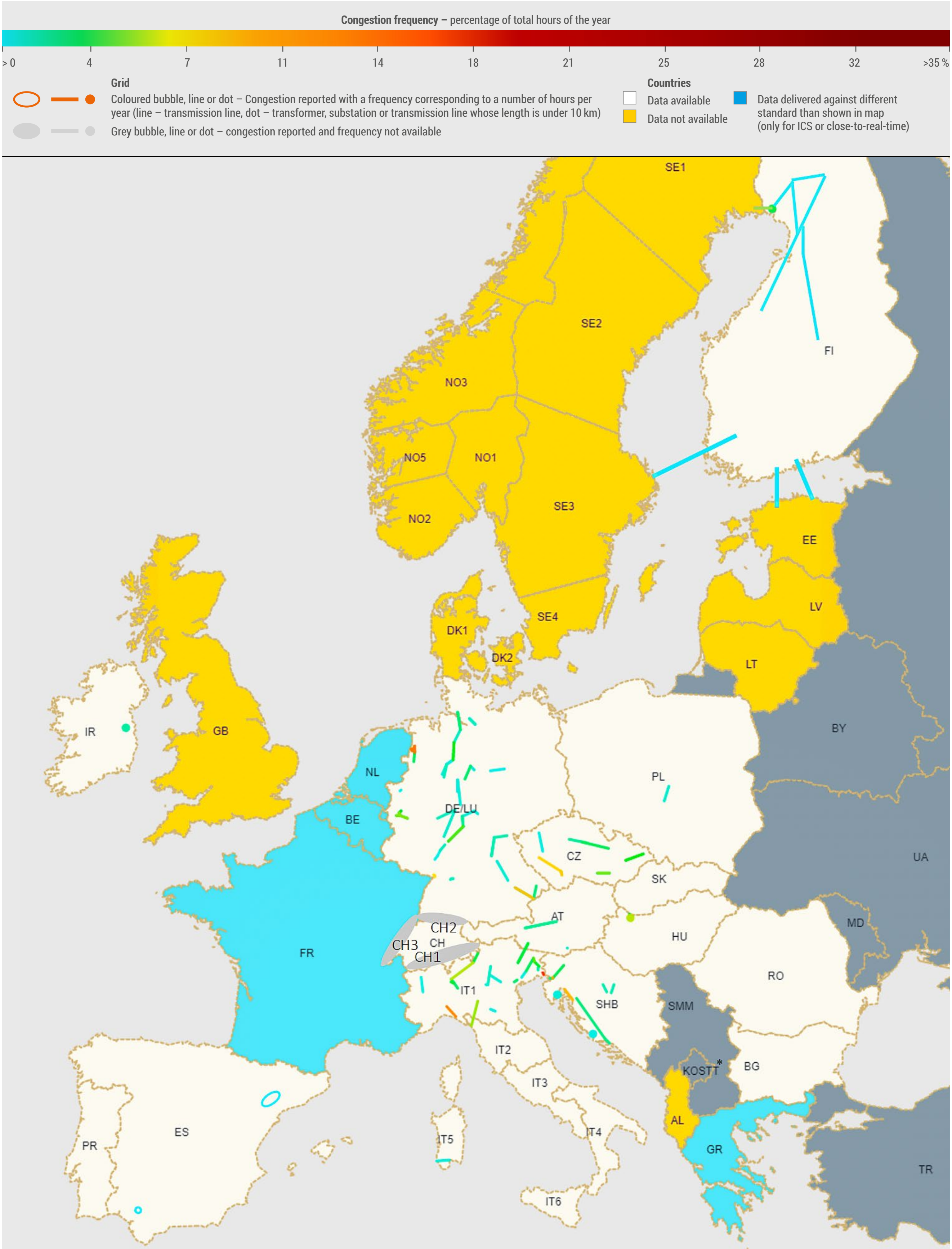



Figure 32: real-time for 2018 – Europe

## Zooms

**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)

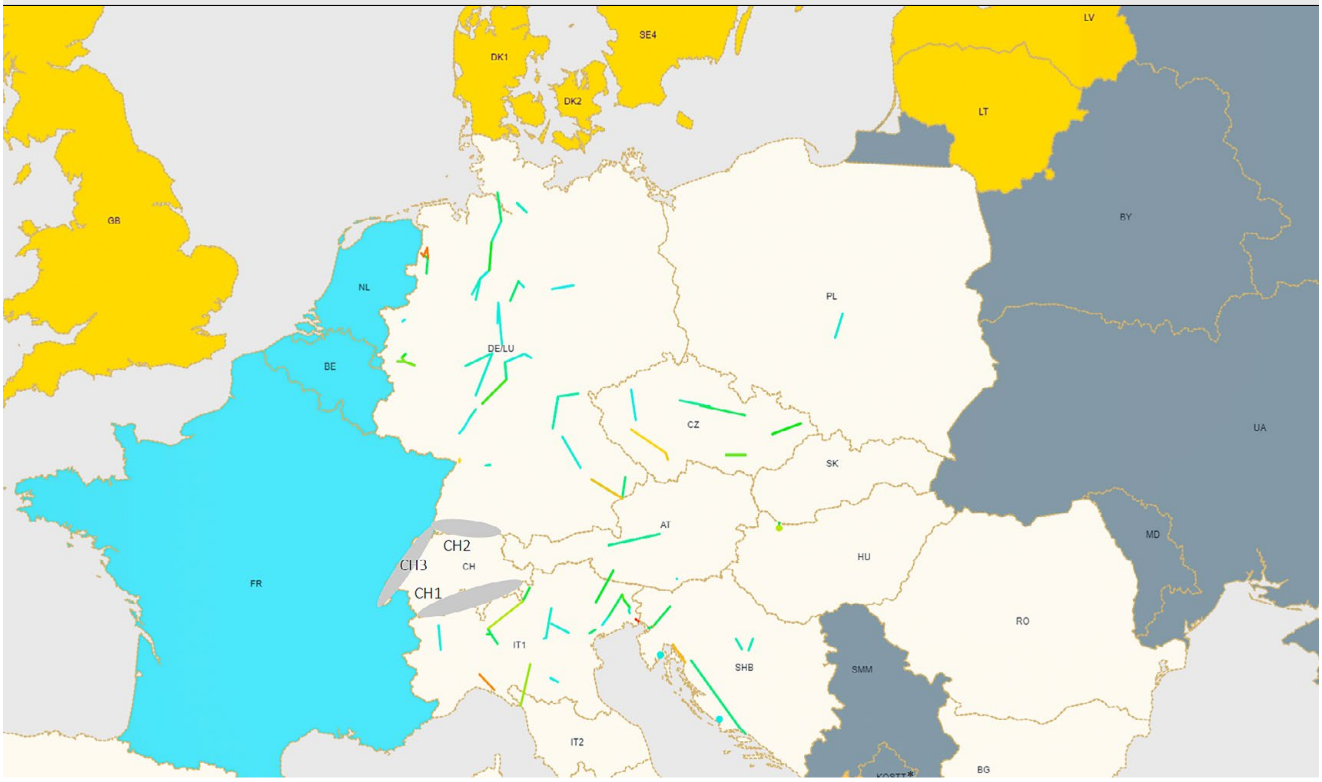



Figure 33: real-time for 2018 – Central Europe

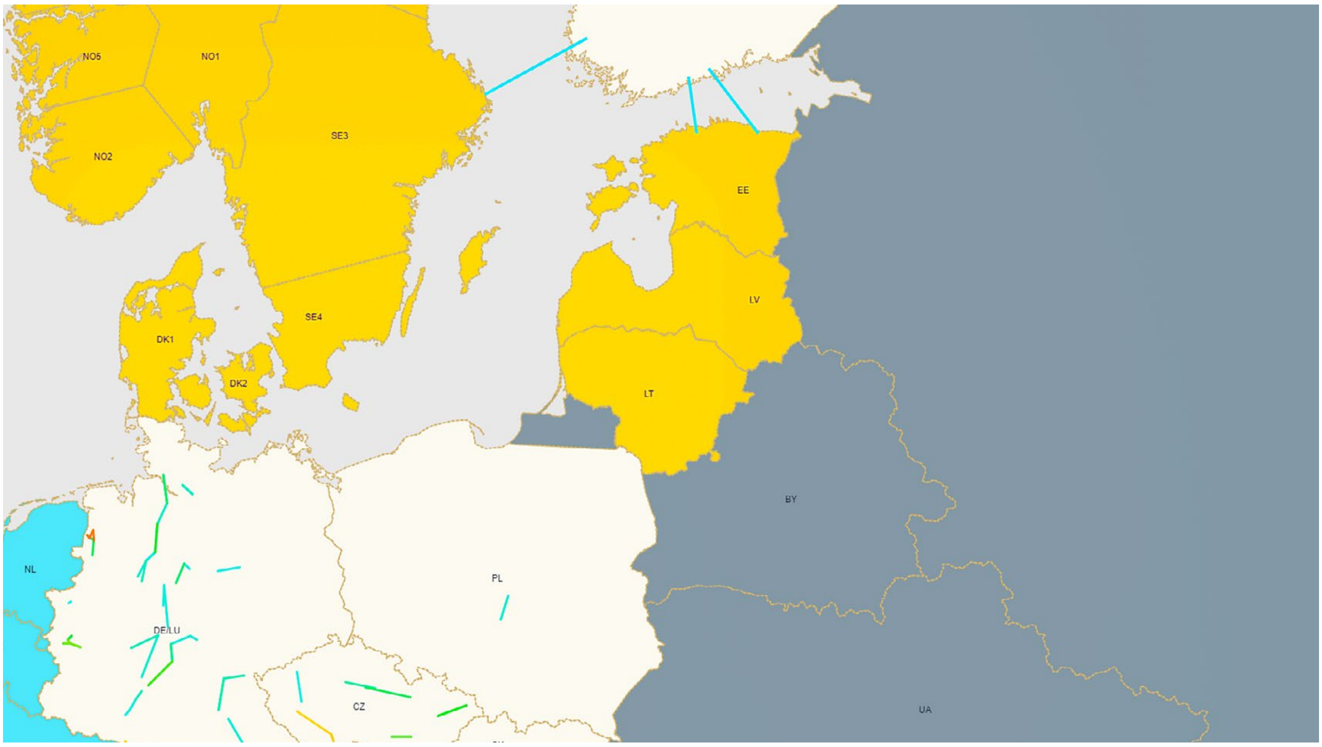



Figure 34: real-time for 2018 – Baltic countries and Denmark/Sweden

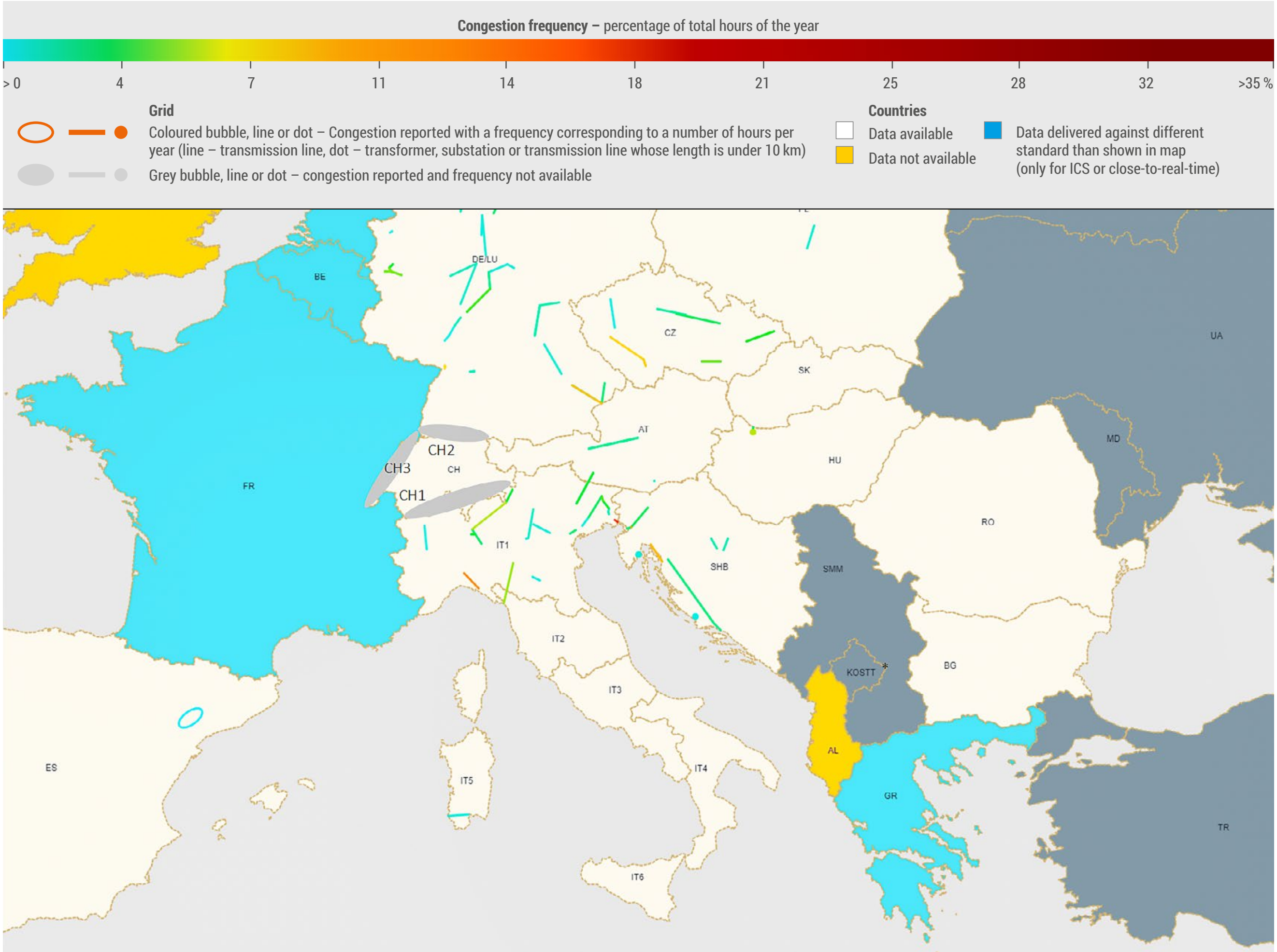



Figure 35: real-time for 2018 – Balkans and Italy


Figure 36: real-time for 2018 – Spain/Portugal

## 2019 – real-time, 1 hour

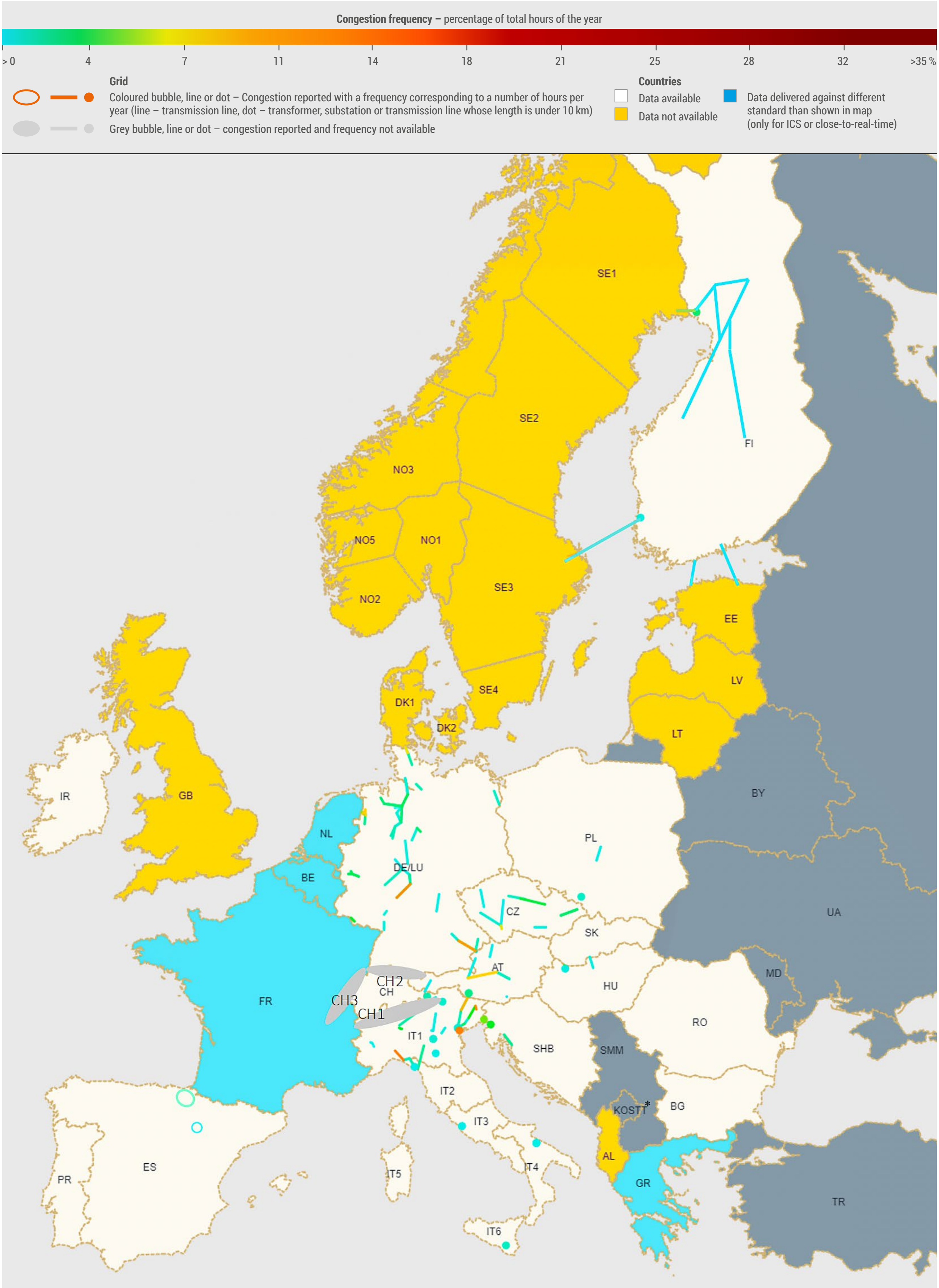



Figure 37: real-time for 2019 – Europe

## Zooms

**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)

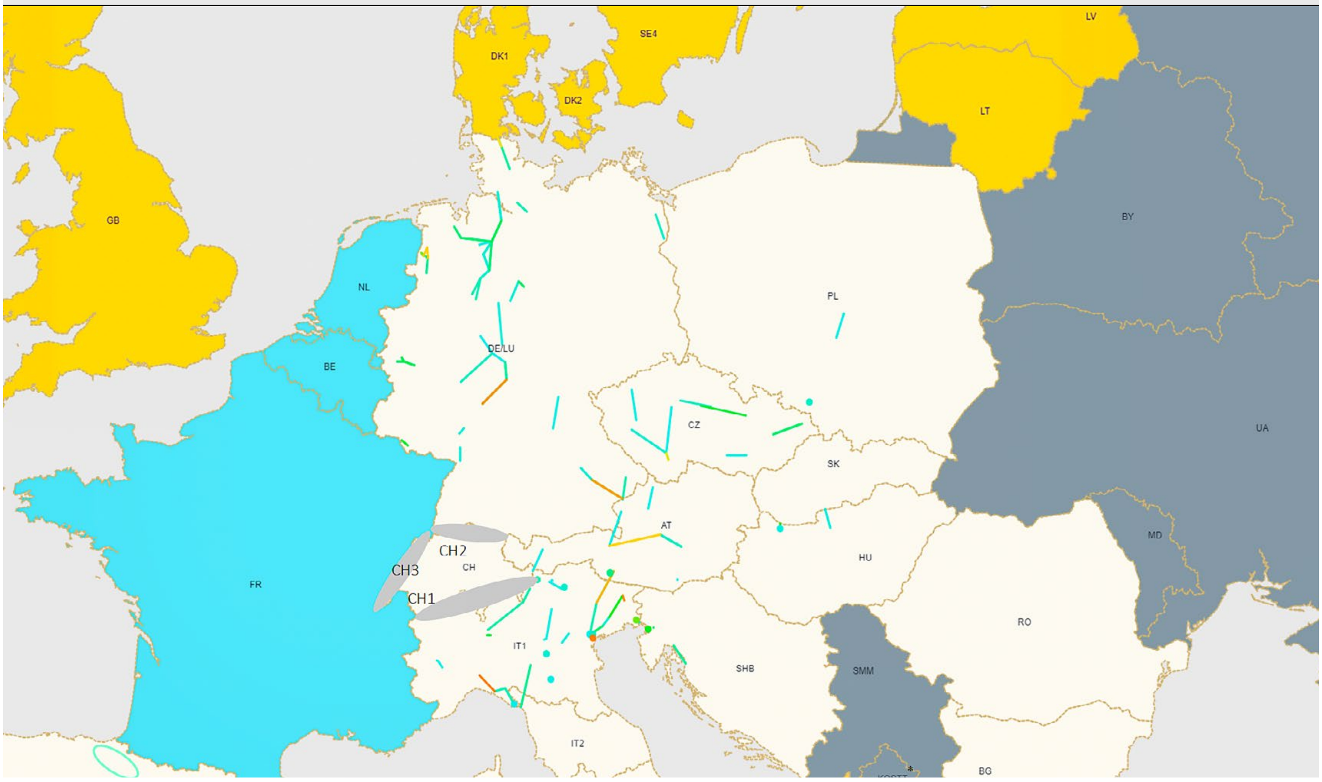



Figure 38: real-time for 2019 – Central Europe

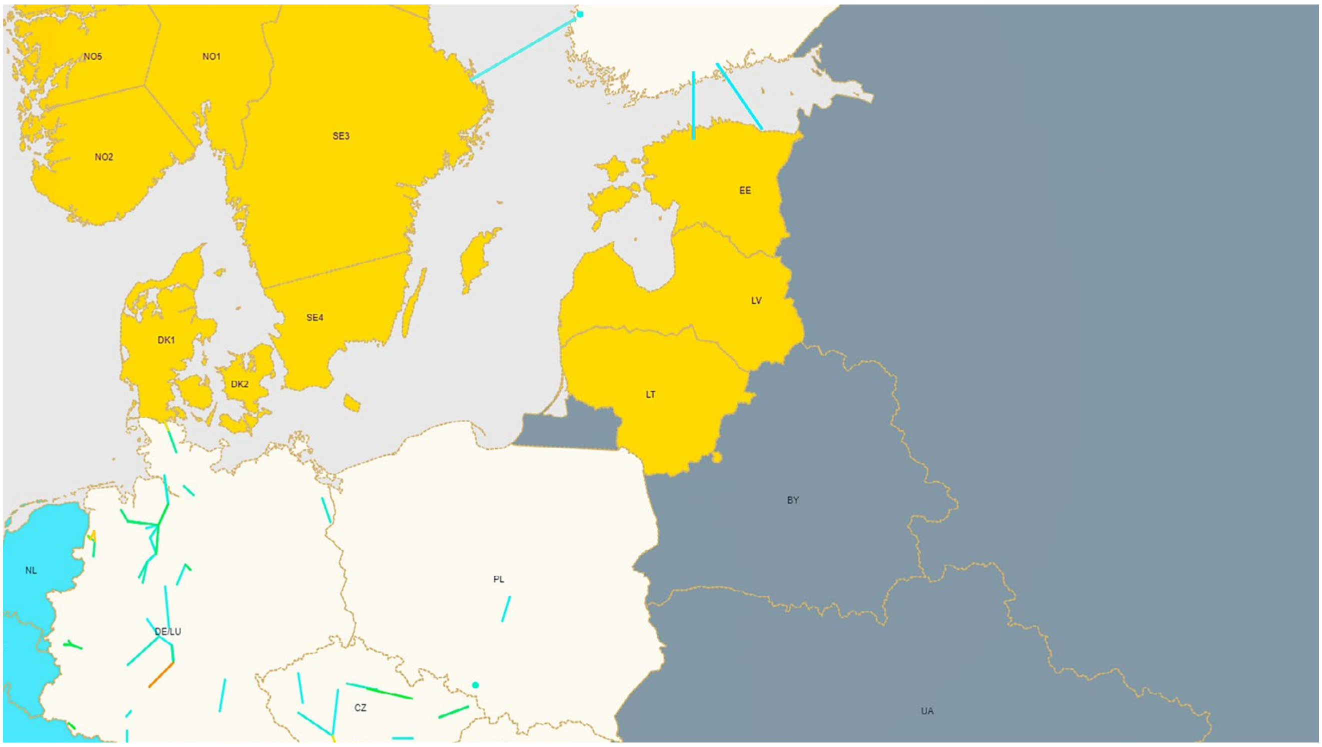



Figure 39: real-time for 2019 – Baltic countries and Denmark/Sweden

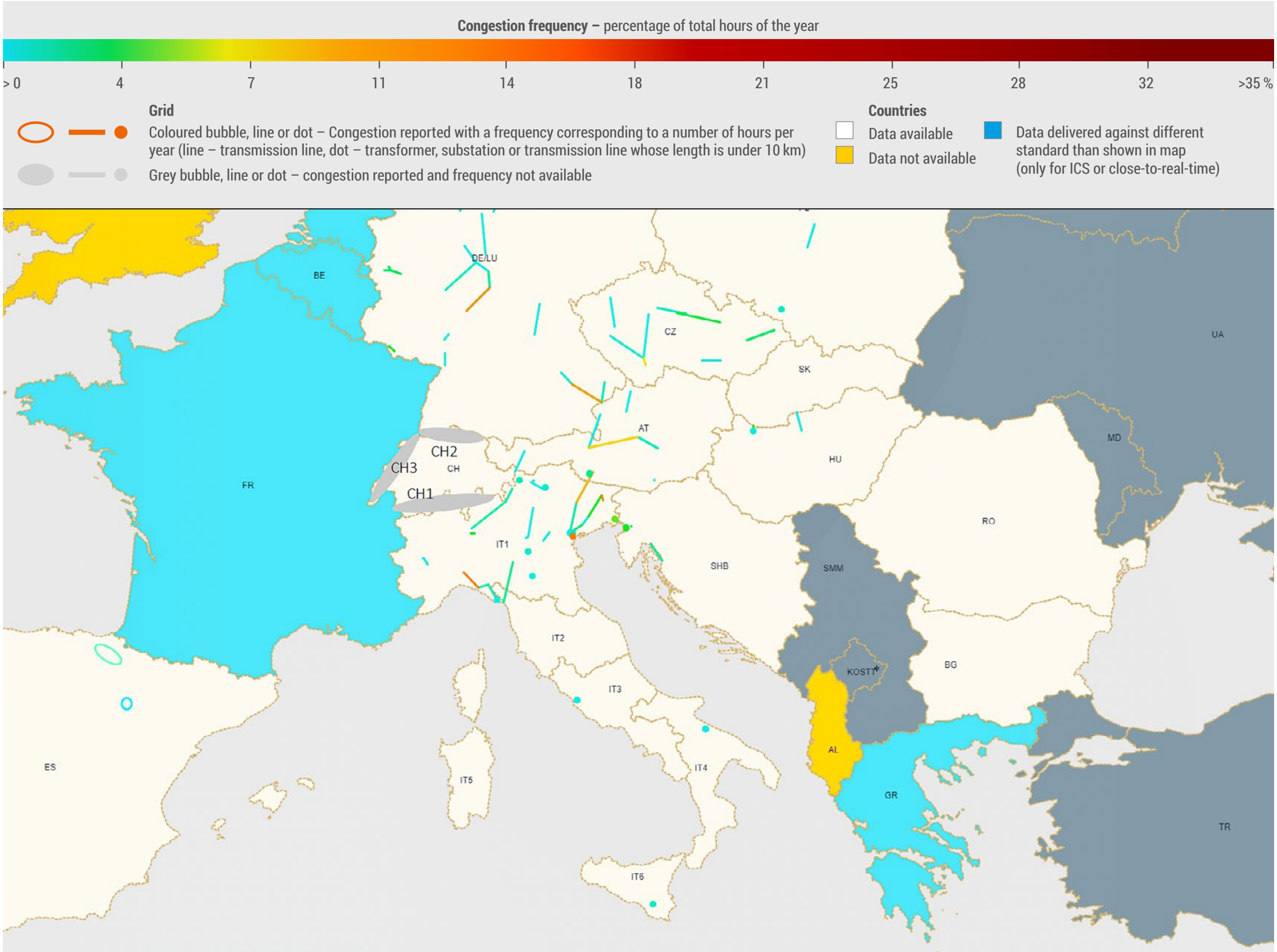



Figure 40: real-time for 2019 – Balkans and Italy


Figure 41: real-time for 2019 – Spain/Portugal

## 2020 – real-time, 1 hour

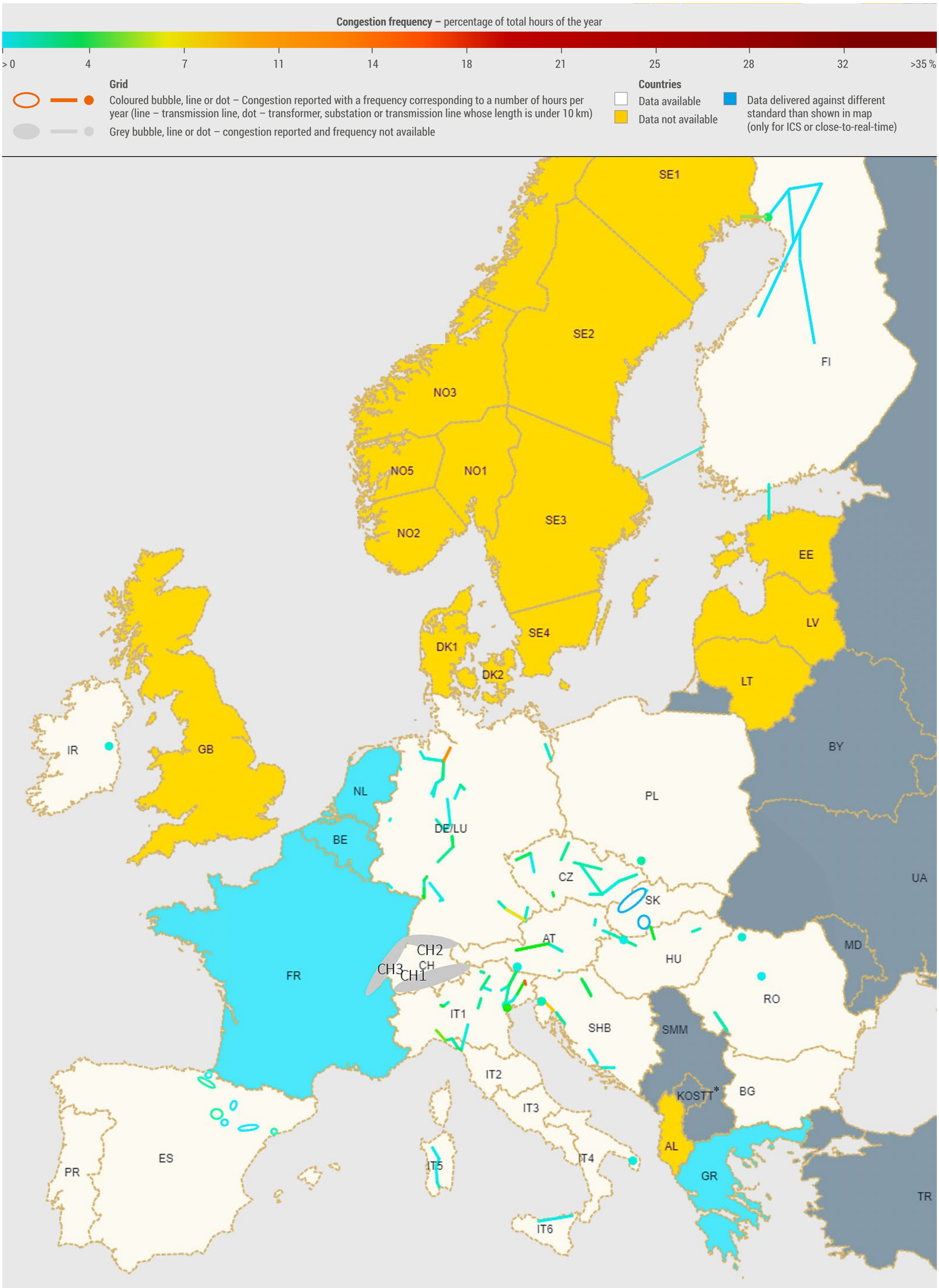



Figure 42: real-time for 2020. Europe

## Zooms

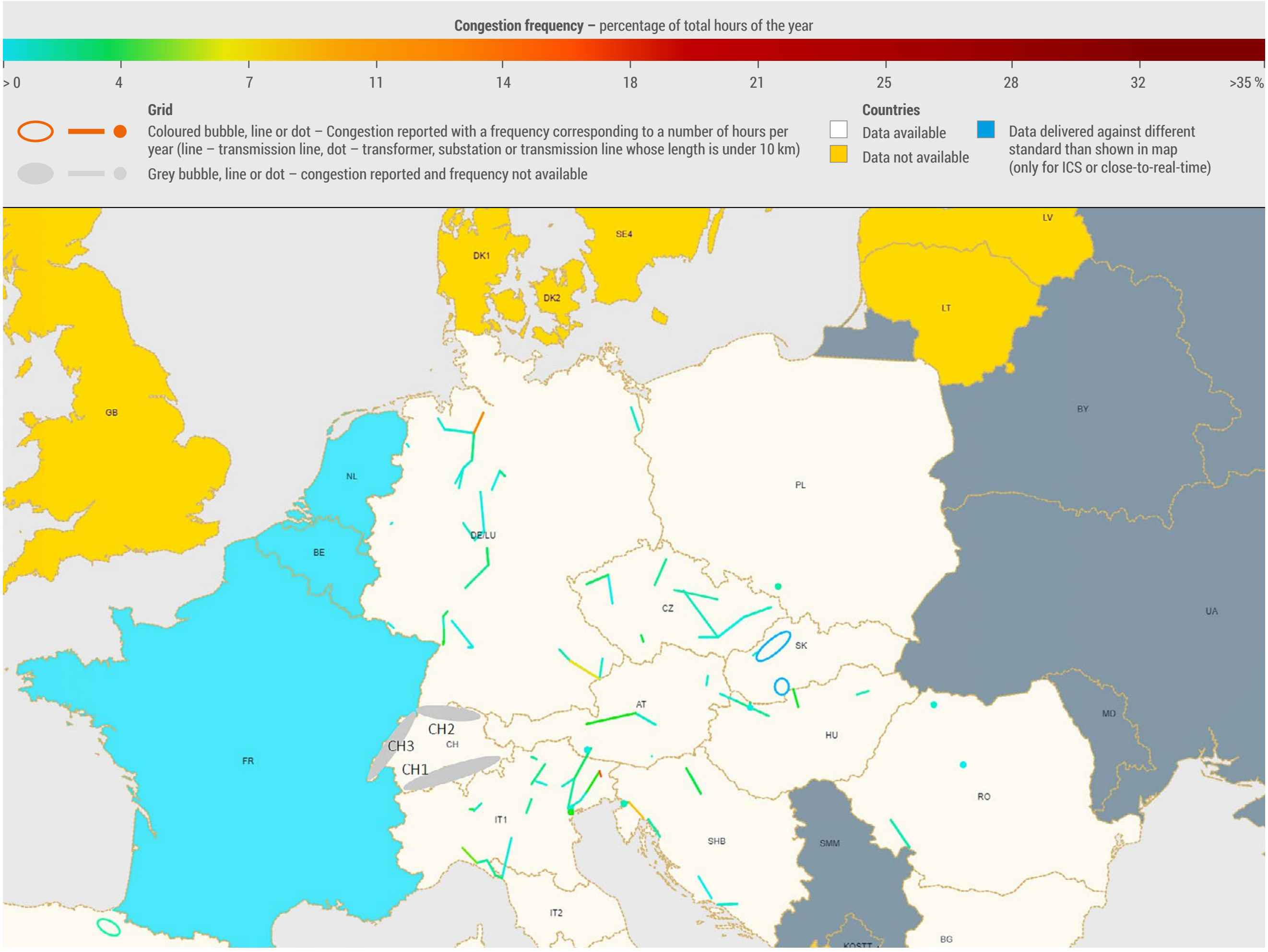



Figure 43: real-time for 2020 – Central Europe

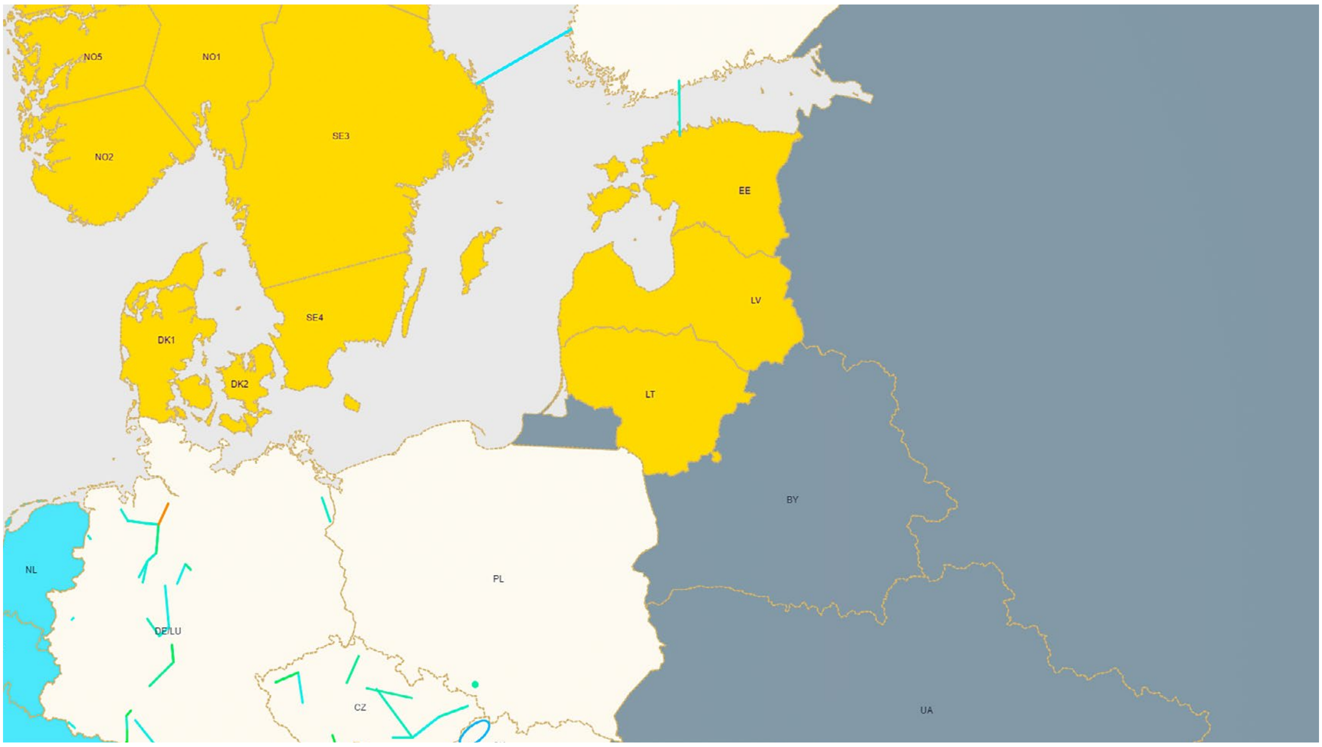



Figure 44: real-time for 2020 – Baltic countries and Denmark/Sweden

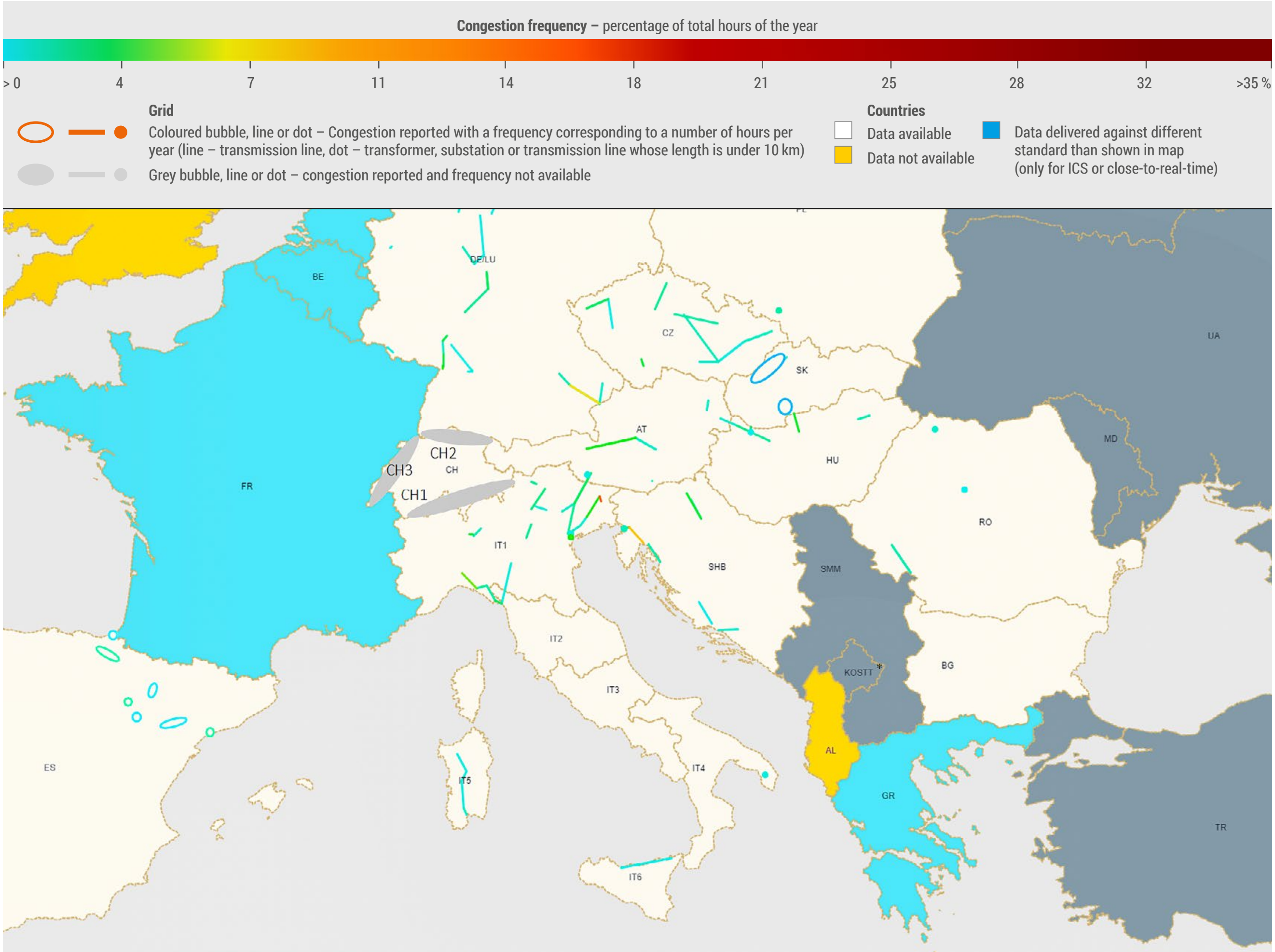



Figure 45: real-time for 2020 – Balkans and Italy

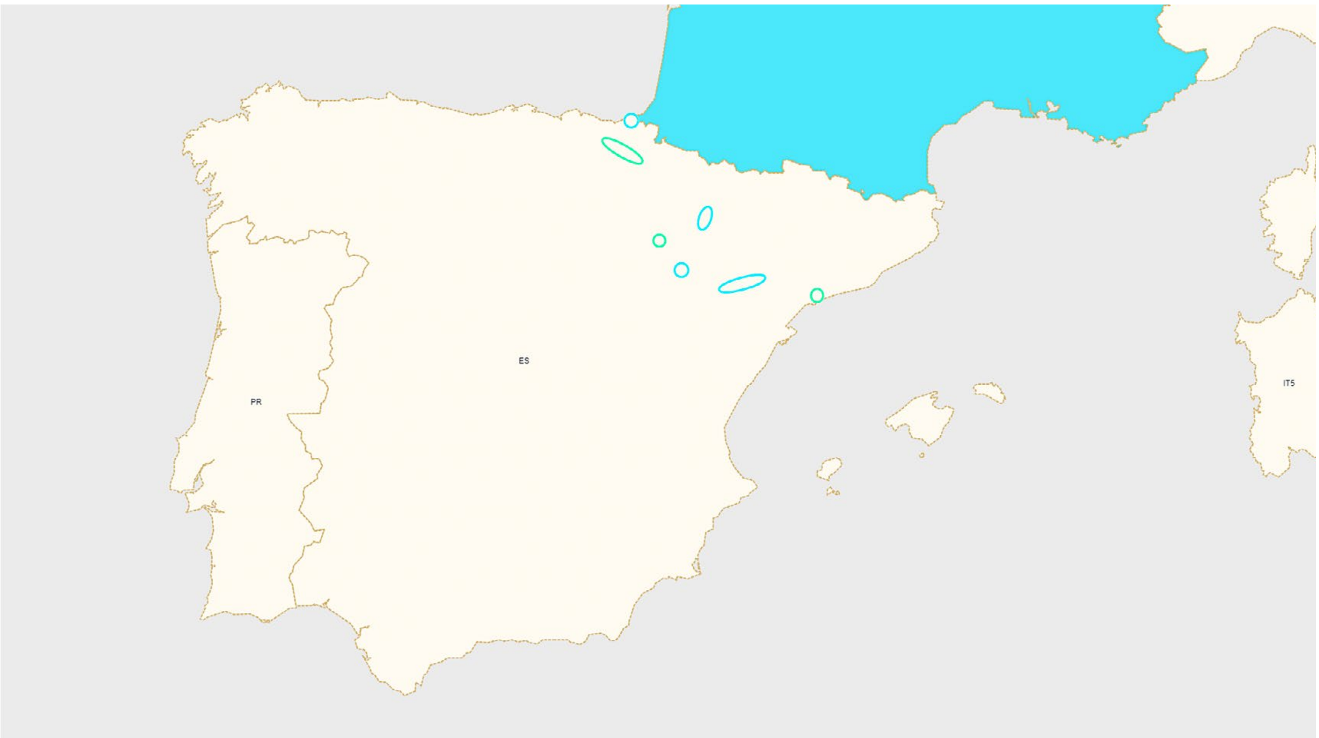



Figure 46: real-time for 2020 – Spain/Portugal

## 2.2.5.2 Real-time maps of the TSOs which used ICS data

### 2018 – ICS:

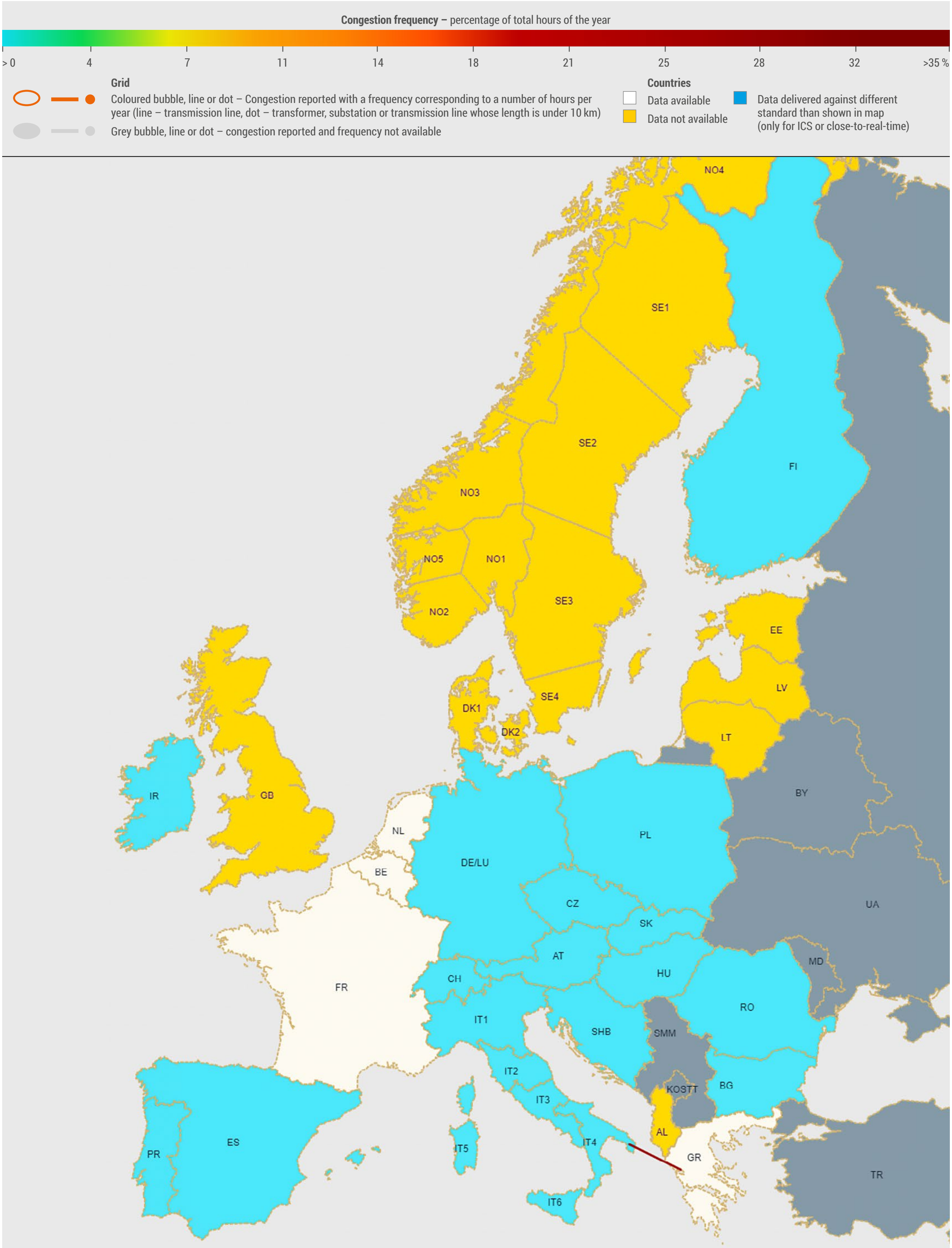



Figure 47: ICS for 2018. Europe

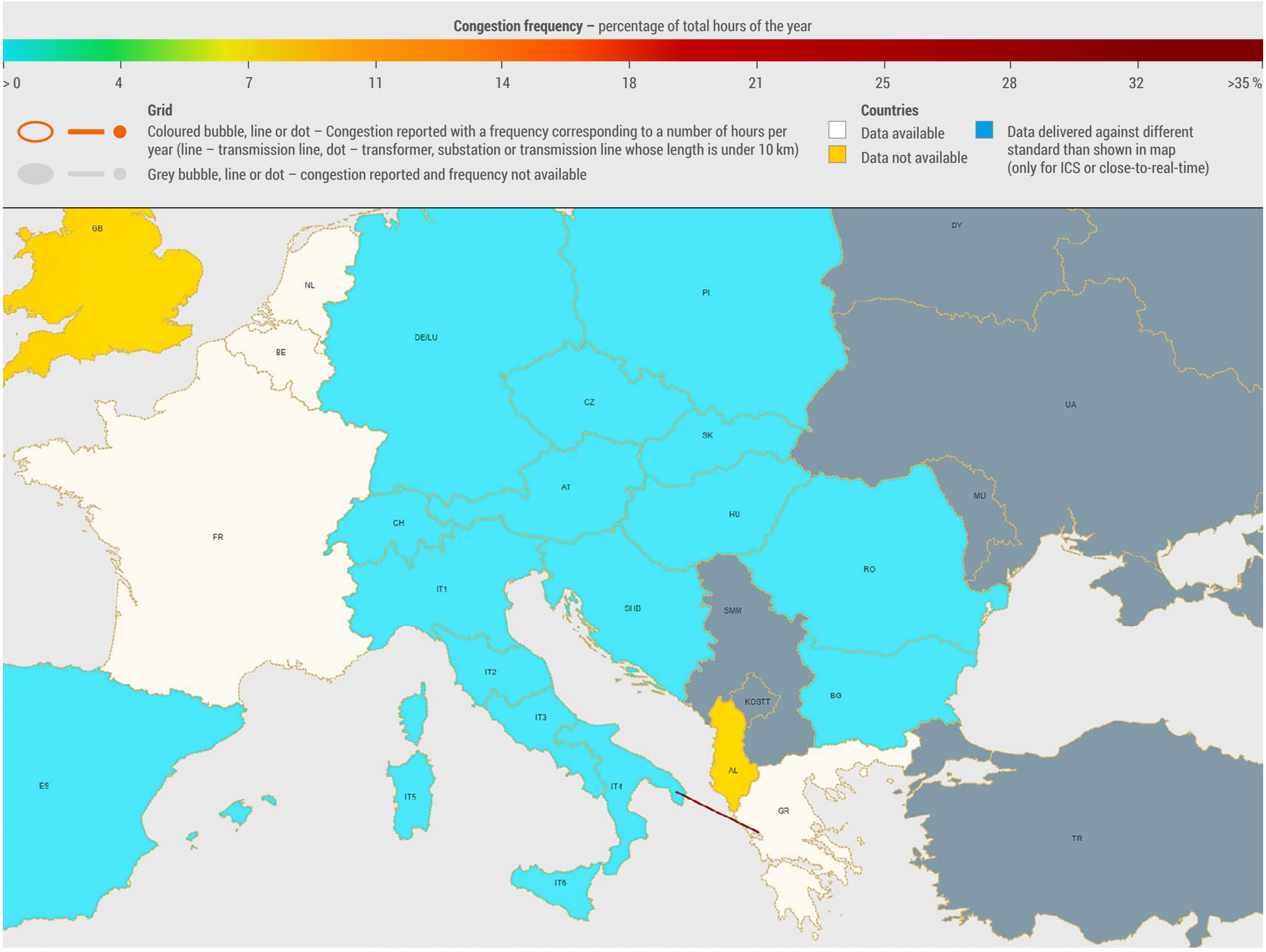



Figure 48: ICS maps for 2018 – Balkans and Italy

## 2019 & 2020 – ICS:

For 2019 and 2020, the reported congestions based on the ICS standard delivered by BE, GR, FR and NL have a frequency lower than 0.5 % per year; therefore, no maps are included here. The expert assessment for the reported congestions can be found in Section 2.2.6. Maps without a frequency threshold for all three years can be found in Annex 1.

## 2.2.6 Expert assessment of congestions for close to real-time

### 2.2.6.1 Close-to-real-time (1 hour)

The assessments below were provided by the TSOs of each of the named countries:

#### Albania

Congestions are solved during day-ahead planning; we usually do not observe congestions close to real time.

#### Austria

In comparison to the D-1 timeframe, fewer grid elements in the Austrian control area appear congested and the frequency of (N-1) grid violations also is lower close to real time. This is the result of the effective application of the agreed-upon remedial actions in the D-1 timeframe. Most of the congestions which are forecasted one hour before real time are in the Tauern and Lienz area. These congestions are mostly relieved by non-costly remedial actions, such as PST tapping. As mentioned in chapter 2.2.4, a reinforcement of the grid is currently either planned or already ongoing around Tauern and Lienz.

#### Bulgaria

ESO EAD does its utmost to provide maximum capacity to the market. During the target years 2018, 2019 and 2020, there were no congestions identified in the close-to-RT timeframe. When a security violation was identified, it was eliminated by applying non-costly RA.

#### Croatia

In general, there are congestions that have already been recognised during the D-1 timeframe (almost the same elements appear for the same reasons explained for the 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.

#### Czech Republic

Reported constraints are very rare and mostly solved in real time by corrective measures, especially for elements with temporary overloading. These results documented high utilisation of the grid by international trading/transiting flows during the period of intensive reconstruction of the transmission grid.

#### Denmark

In general, as with the CCDA stage, there are no internal congestions in the Danish bidding zones when all grid elements are in operation. This means that most of the congestion management during real-time is to handle faults in the grid.

#### Estonia

There are no congestions reported.

#### Finland

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 allowed transmission 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 bidding zone.

#### Germany

Due to its central location in the European electricity system, Germany is an important transit country in the east-west and north-south directions. Moreover, the current transit is influenced by several factors. In the last three years, exchanges with foreign countries have changed and are highly impacted by load patterns and the development of generation capacities. The highest exports are still towards Austria, but they have decreased. On 1st of October 2018, the German-Austrian border became a part of the CWE flow-based capacity mechanism. At the borders with France and the Netherlands, average exports have also decreased. In contrast, average imports from Denmark have increased. In addition, exchanges at the other borders were relatively stable. Furthermore, the generation landscape has changed in the last three years and is now characterised by a significantly lower feed-in from lignite and hard coal and an increasing feed-in from wind and gas-fired power plants. In addition, 2020 has been marked by the emergence of the COVID-19 crisis and in particular its impact on load patterns.

Nevertheless, most congestions in the German grid appear when renewable infeed is high in the northern part (50Hertz and TenneT) and Germany is exporting electricity in the southbound direction (France, Switzerland, Austria). In these situations, congestions appear in the north to south and in the north-east to south-west directions.

These congestions are further influenced by the continued development of the grid as well as its more 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 conjunction with innovative measures which help to increase the grid utilisation efficiency (e. g., dynamic line rating).

The congestion situation is also affected by the minimum capacities. In the area of the CWE flow-based mechanism, a minimum capacity of 20 % was introduced in April 2018. After European Regulation (EU) 2019/943 entered into force in summer 2019, Germany drafted an action plan for increasing capacity at the external borders to achieve the 70 % capacity target. As of 2020, these rising minimum capacities have had a enormous impact on the congestion situation and the active constraints. As a result, there are fewer German active constraints during capacity calculation and allocation, but increased congestions closer to real time (most notably in the D-1 stage).

#### Close-to-real-time

Overall congestions in Germany in the close-to-real-time stage have decreased over the observed period (2018–2020) for several reasons, such as targeted grid expansions and more efficient grid use (e. g. dynamic line rating).

#### Border area DE-Nordics

In the Schleswig-Holstein and Sottrum Doller areas, the congestion situation is primarily influenced by the given transit from Scandinavia and the wind feed-in offshore and onshore. Any congestions remaining or appearing close to real time are principally handled by feed-in management, which can only be activated very close to real time.

#### Border area DE-NL

The so called 'Emslandleitung' between TenneT Germany and Amprion (Dörpen/West (TTG)- Hanekenfähr – Meppen – Niederlangen) is especially affected by offshore wind feed-in, as well as by the onshore wind and solar feed-in in the north-west area of Lower Saxony. 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.

#### Border area DE-AT

This border is mainly impacted by the transit across Germany and Austria. In particular, in conjunction with high solar feed-in in Bavaria, the lines Pirach-Simbach-Altheim-Pleinting-St. Peter 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.

### Hungary

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. This corresponds 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 decrease the loading of the overloaded lines. These measures are considered curative actions, which means they are activated only if the contingency situation actually occurs. In the 2018–20 time period, 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 but they had a very limited frequency, at only few hours per year.

### Ireland

–

### Italy

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 (having at least one element with a frequency higher than 10 %) are the following:

- Congestions close to the Austria–Italy and Slovenia–Italy border. They appear when high import flows are observed from the eastern countries. These congestions can be solved by managing the PSTs' tap positions; they are also mitigated by special protection schemes at the border.
- Congestions on the 220 kV grid close to the IT1-IT2 border. They 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.

### Latvia

Due to the capacity calculation methodology used in the Baltics, AST does not use CGM models to distinguish critical network elements and congestions per element.

### Luxembourg

No congestions were identified in the Luxembourgish grid.

### Lithuania

No congestions were detected in the Lithuanian grid.

### Norway

Costly remedial actions (bids from the real-time market) are used to correct internal congestions in the Norwegian grid. Since there is no regular D-1 process to correct overloaded lines, such actions are standard procedure close to real time.

### Poland

There are a few congestions found at the close-to-real-time stage. They are located at the generation unit where unloading automation is installed. Furthermore, they are solved by implementing countermeasures: network switching or generation schedule changes.

### Portugal

In the Portuguese system the real-time congestions are mainly due to unexpected outages.

### Romania

Congestions close to real time occur rarely. When they do, measures are taken in the form of remedial actions so that thermal limits are not exceeded. Close-to-real-time violations correlate with the congestions identified in the D-1 timeframe.

### Slovakia

Most congestions can be solved with a combination of several remedial actions, which was indeed the case for the years in question.

### Slovenia

There are no frequent congestions in real-time operation. Some congestions close to the IN CCR area are present; however, this is due to near-maximum optimised PST operation in line with coordinated CCDA. Due to the nature of this congestion, effective remedial action (PST adjustment) is always available. Congestion on the SI – AT CORE CCR border is handled with topological remedial actions.

### Spain

There are no relevant congestions in real-time operation. In general, the frequency of congestions, which typically were caused by unexpected events or operational situations, in real-time operation stayed below 5 %. These congestions are managed using topological measures and either countertrading or redispatching measures, depending on the affected elements.

It can therefore be concluded that for this timeframe there did not exist any structural congestions inside the Spanish bidding zone.

### Sweden

Due to national legislation, data on congestions in the close-to-real-time timeframe cannot be provided for Swedish network elements, and consequently no expert assessment is provided.

### Switzerland

#### Congested area No. 1 (CH-IT)

The constraints at the IT–CH border are mainly the same in real time as in the D-1 timeframe. Congested elements are 380 kV internal and tie lines in case of high Italian imports. Additionally, the occurrence of high unscheduled flows are increasing.

#### Congested area No. 2 (DE/AT-CH)

The constraints on the DE/AT–CH border are the same in real time as in the D-1 timeframe. Depending on the scenario, the main congested elements are the PSTs and the 380 kV transit lines. The situation worsened due to the introduction of the CWE Market coupling, which induces high unscheduled flows inside the Swiss system.

#### Congested area No. 3 (FR-CH)

The constraints on the FR–CH border are the same in real time as in the D-1 timeframe. Additionally, as was the case on the DE/AT-CH border, the situation worsened due to the CWE Market coupling, which induces high unscheduled flows inside the Swiss system, particularly in the north to southwest flow direction.

### 2.2.6.2 ICS

#### Belgium

As foreseen by its operational rules, Elia will manage any congestions which occur close to real time or in 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.

Curative measures are those which 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.

#### Greece

Greece reported ICS data. Violations were very rare, apart from the DC link between GR and IT in 2018, which was out of operation 25 % of the time. These violations refer to the tripping of individual tie lines caused by faults or maintenance, not by violations of the N-1 criteria.

#### France

RTE reported ICS data together with the violations reported in accordance with the French classification scale, Evènements Système Significatifs, or significant system events (ESS).

Such violations are very rare and are resolved within a few minutes using topological modifications as remedial actions, since it is almost impossible to solve these types of violations in less than 15 minutes through costly remedial actions with generation redispatching. Therefore, they are not relevant for the consideration of this Technical Report and cannot be considered either as structural or as major physical congestions.

#### Netherlands

The congestions shown are measured against the ICS standard, meaning they are measured very close to real time. In this timeframe, operators should have taken all measures possible to relieve congestions, meaning few to no congestions are left. In general, congestions from real-time operation do not exceed 0.1 % of the time and are caused by unexpected events or operational situations.

## 2.2.7 Expert assessment of the future evolution of congestions

Grid reinforcement and expansion may relieve or completely remove an existing congestion or shift it to other locations in the grid. Another important driver of congestions is the development of generation and demand patterns. Changes in these patterns may also relieve or worsen existing congestions or create new ones. Thus, assessment of congestion evolution for the future horizon is subject to uncertainties. Furthermore, congestions can move on an hourly resolution that cannot be reflected in the bidding zone configuration.

In this subsection, each TSO provides a brief assessment of how investment plans by TSOs are expected to impact the identified congestions by the years 2023, 2025 and 2030. This future assessment also considers anticipated changes to generation and demand patterns.

### Albania

**2023**

–

**2025**

By 2025, the new 400 kV interconnector Albania–North Macedonia will be in operation, which will significantly improve supply security for the Albanian power system and the region.

**2030**

–

### Austria

**2023**

**380/220 kV Transformer Lienz**

The NDP project 15-3 foresees the erection of a third 380/220 kV transformer in Lienz to reduce the congestion of the existing transformers. Expected Commissioning Date: 2021

**220 kV line Bisamberg - (Kledering) - Wien Südost**

Due to the erection of the APG-Weinviertelleitung (NDP Project 11-8/TYNDP 2020 Project 186), the interaction with the wind infeed and the exchange with CZ will be done via 380 kV (Austria internal transformation) and will therefore affect the powerful 380 kV systems around Vienna. The direct sensitivity to the given 220 kV line will be significantly reduced and therefore the flows will be lower. Expected Commissioning Date: 2022.

**380 kV line St.-Peter - Kronstorf**
**220 kV line St.-Peter - Ernsthofen**

The NDP Project 14-2 (Reconstruction of the existing 220 kV line St. Peter - Hausruck - Ernsthofen) has already been put in operation, except for the new switching station SW Weibern. The erection of SW Weibern will lead to a load flow symmetrisation and therefore to a reduction in line loadings.Expected Commissioning Date SW Weibern: 2023.

**2025**

**220 kV line Lienz - Soverzene**
**Erection of additional cross border line AT-IT: Nauders - Glorenza**

The NDP project 11-12/TYNDP 2020 Project 26 foresees a new 220 kV interconnector between the substations Nauders (AT) and Glorenza (IT). The expected effect of this project is to increase the security of supply and the Austria-Italy interconnection capacity. Moreover, the Lienz-Soverzene (IT) congestion will be relieved. Expected Commissioning Date: 2023.

Another Project is the reinforcement of the existing 220 kV interconnection line "Lienz - Soverzene" with a high temperature conductor in combination with a more powerful phase-shifter in Lienz (NDP Project 19-3). The expected effect is to increase the interconnection capacity to Italy and the congestions "Lienz – Soverzene" will be relieved. Expected Commissioning Date: 2027.

**220 kV line St. Peter - Simbach (D)/Pleinting (D)/Pirach (D)/ Altheim (D):**

New 380 kV double circuit OHL St. Peter - National Border (Isar/Ottenhofen/DE) and St. Peter - National Border (Pleinting/DE) (NDP project 11-7). This Project is also part of the German NDP and TYNDP 2020 (Project 313 and Project 187). The expected effect is that the congestions "St. Peter – Simbach/Altheim" and "St. Peter – Pleinting/Pirach" will be relieved. Expected Commissioning Date St. Peter - Isar/ Ottenhofen: 2024. Expected Commissioning Date St. Peter - Pleinting: 2028

**220 kV line Tauern-Salzburg**

220 kV double line Salzburg - Tauern 231A/232A completion of the 380 kV line St. Peter - Tauern (NDP 11-10). This contains a new internal double-circuit 380kV line connecting the substations Salzburg and Tauern (replacement of existing 220 kV lines on optimised routes). This project supports the interaction between the RES in northern Europe (mainly DE) with the pump storage in the Austrian Alps. This project is also part of TYNDP 2020 (Project 312). After the commissioning of the NEP project 11-10, the 380/220 kV transformers in Tauern will be decommissioned.

**Important:** The NDP Project 11-10 also is expected to relieve the congestions on the Tauern - Weißenbach and Weißenbach - Hessenberg lines. In addition, further projects are planned for a later date (NDP Projects 19-2 and 19-4). Expected Commissioning Date: 2025.

### 220 kV line Obersielach - Podlog (SI)

Erection of a 600 MVA PST in Obersielach or Hessenberg to control the flows on the 220 kV lines in southeast Austria. Expected Commissioning Date: 2025.

### 2030

### 380/220 kV Transformer Westtirol

The TYNDP 2020 Project 1054 foresees an upgrade of the existing 220kV line Westtirol - Zell-Ziller (NDP project 14-3) and the erection of additional 380/220kV transformers (NDP project 11-9). The expected effect is a connection to the 380 kV ring and a related increase in supply security. Moreover, the west-east connection will be enforced and transformer congestion in Westtirol will be relieved. Expected Commissioning Date – second 380/220 kV transformer Westtirol: 2024. Expected Commissioning Date – line upgrade West Tirol – Zell/Ziller: 2027.

### 220 kV line Tauern - Weißenbach

The NDP Project 19-2 foresees a two-step approach to reduce congestions on the Tauern - Weißenbach line.
Stage 1: 1:1 Replacement of the present conductors (Expected Commissioning Date 2021)
Stage 2: Exchange for modern conductors (Expected Commissioning Date 2027)

### 220 kV line Weißenbach - Hessenberg

The NDP Project 19-4 foresees N-1 and operational optimisation of the Weißenbach - Hessenberg line to reduce line loadings. Expected Commissioning Date: 2028.

## Belgium

A principal area of congestion is on the French-Belgian border, which results 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 day-ahead flow-based 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 highly influenced by both the France-Belgium and France-Germany cross border flows, electrically speaking. Given the expected increase in power flows, these axes would become structural bottlenecks.

Increasing the interconnection capacity between France and Belgium creates synergies between the export position of France during favourable meteorological conditions and the import position of Belgium, with higher flows from south (France) to north (Belgium) appearing more frequently at the French-Belgium 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 the development of approximately 6 GW transport capacity from the coast to the centre of Belgium. This corridor is envisioned to be implemented with AC technology per the example of the Stevin project. Timing, routing, scope, et cetera are subject to feasibility studies and subsequent spatial planning procedures.

A second area of congestion is on the Dutch-Belgian border. During TYNDP16 and TYNDP18, a need for the development of additional interconnection capacity between Belgium and The Netherlands was identified. Several projects effectively increase the degree of interconnectivity between the Belgian and Dutch bidding zones. The possibility of higher market exchanges between these two bidding zones leads to higher price convergence in more hours of the year and therefore reduces the price differentials. These projects have an important adequacy contribution due to decreasing installed conventional generation capacity (bad market conditions), and especially considering the nuclear phase-out required by 2025. RES integration implies higher flows in the meshed AC grid and thus increases the need for cross-border transmission capacity.

Third, the existing central and eastern part of the internal Belgian 380 kV backbone will be upgraded with HTLS. This upgrade will be key to sustaining price convergence whilst power flows become increasingly more volatile and international. While in the past the locations of generation and load centres were quite stable over time, this will be much less the case with the future energy mix characterised by RES geographically spread out over Europe. Depending on climatic conditions, flows can come from the north, east, south, or west, and even change several times per day as wind fronts and clouds move on an hourly basis. Upgrading the existing internal corridors also ensures the potential to integrate new large power plants domestically. RES integration implies higher flows in the meshed AC grid and thus increases the need for internal transmission capacity.

**2023**
**FR-BE:** Installation of two phase-shifting transformers in Aubange, one on each of the 225 kV circuits of the Moulaine (FR)-Aubange (BE) interconnector (2021).

**FR-BE:** Completion of the 380 kV HTLS upgrade from Avelin/Mastaing (France) to Avelgem (Belgium) and Horta (2022/2023). The reinforcement of the section between Avelgem & Horta was completed in 2020 to i) facilitate higher flows from France to Belgium and ii) to evacuate energy in case of high infeed from offshore wind or imports from the UK.

**NL-BE:** Reinforcement of the Rilland (NL)-Zandvliet (BE) interconnection by upgrading the existing line to use high-capacity conductors and the installation of two additional PSTs in Zandvliet (2022/2023). This will also help to balance the flows over the different cross-border lines of the Belgian Dutch interconnection.

**2025**
**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 consisting of 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 on the internal backbone upgrade starts with the upgrade of the Massenhoven-Van-Eyck section by 2024, since this is the weakest link, currently having only 1 conductor. A second upgrade, along the Mercator-Bruegel section, is planned to be built by 2025/2026.

**2030**
**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 with Horta-Mercator (2028).

**Internal:** The HTLS reinforcement of the internal backbone continues with the rest of the 380 kV ring Massenhoven-Van-Eyck-Gramme-Courcelles-Bruegel-Mercator-Massenhoven and is 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.

## Bulgaria

**2023**
Active market constraints and possible congestions in Bulgarian EPS will be completely removed by the construction of the following new lines: the 400 kV Martisa East – Plovdiv OHL, parallel to the existing line (over 60 % already built), the 400 kV Maritsa East - Maritsa East 3 OHL, parallel to the existing line (in operation since the end of 2020), the 400 kV Maritsa East - Burgas OHL (in operation since the end of 2020) and the 400 kV Maritsa East – Burgas OHL (over 95 % already built). After the construction of the above lines, we expect net transfer capacities between Bulgaria and neighbouring EU countries to be limited from network elements outside of our control area. A new interconnection line between Bulgaria and Greece is also currently under construction. Once the new 400 kV Maritza East - Nea Santa

(Greece) OHL is in operation, we expect a significant increase in net transfer capacities. The Bulgarian part of the power line (80 % of the total length) will be built by the end of 2021. This power line is expected to be put into operation in 2022. More information about the evaluation and the technical data of these projects can be found in the ENTSO-E TYNDP and on our TSO web site.

### 2025

Active market constraints and possible congestions in Bulgarian EPS will be completely removed by the construction of the following new lines: the 400 kV Martisa East – Plovdiv OHL, parallel to the existing line (over 60 % already built), the 400 kV Maritsa East - Maritsa East 3 OHL, parallel to the existing line (in operation since the end of 2020), the 400 kV Maritsa East – Burgas OHL (in operation since the end of 2020) and the 400 kV Maritsa East – Burgas OHL (over 95 % already built). After the construction of the above lines, we expect net transfer capacities between Bulgaria and neighbouring EU countries to be limited from network elements outside of our control area. A new interconnection line between Bulgaria and Greece is also currently under construction. Once the new 400 kV Maritza East - Nea Santa (Greece) OHL is in operation, we expect a significant increase in net transfer capacities. The Bulgarian part of the power line (80 % of the total length) will be built by the end of 2021. This power line is expected to be put into operation in 2022. More information about the evaluation and the technical data of these projects can be found in the ENTSO-E TYNDP and on our TSO web site.

### 2030

Active market constraints and possible congestions in Bulgarian EPS will be completely removed by the construction of the following new lines: the 400 kV Martisa East – Plovdiv OHL, parallel to the existing line (over 60 % already built), the 400 kV Maritsa East - Maritsa East 3 OHL, parallel to the existing line (in operation since the end of 2020), the 400 kV Maritsa East – Burgas OHL (in operation since the end of 2020) and the 400 kV Maritsa East – Burgas OHL (over 95 % already built). After the construction of the above lines, we expect net transfer capacities between Bulgaria and neighbouring EU countries to be limited from network elements outside of our control area. A new interconnection line between Bulgaria and Greece is also currently under construction. Once the new 400 kV Maritza East - Nea Santa (Greece) OHL is in operation, we expect a significant increase in net transfer capacities. The Bulgarian part of the power line (80 % of the total length) will be built by the end of 2021. This power line is expected to be put into operation in 2022. More information about the evaluation and the technical data of these projects can be found in the ENTSO-E TYNDP and on our TSO web site.

## Croatia

### 2023

Construction of a new 400 kV Cirkovce – Pince double OHL will be finished by the end of 2022. Construction of a new 400 kV double-circuit OHL, which will be connected to one circuit of the existing Hévíz (HU) - Žerjavinec (HR) double-circuit 400 kV OHL by erecting a new 80 km AC double circuit 400 kV OHL with a capacity of 2 x 1330 MVA in Slovenia. The project will result in two new cross-border circuits: Hévíz (HU) - Cirkovce (SI) and Cirkovce (SI) - Žerjavinec (HR). The new line will be connected in a new 400 kV substation of Cirkovce (SI). Reduction of load flows from direction of HR to HU is expected, and redirection in direction of SI.

In terms of increasing transmission capacity, HTLS conductors will be installed on the existing 220 kV Zakučac – Konjsko OHL.

### 2025

In terms of increasing transmission capacity, HTLS conductors will be installed on existing the 220 kV Konjsko – Krš Pađene – Brinje OHL and the 220 kV Senj – Melina OHL, to prevent overloading of the mentioned OHLs. In Konjsko substation, two existing transformers will be replaced and a new one will be installed (expected transformation capacity 3 x 400 MVA). Also, in substation Velebit, existing transformers will be replaced and a new one will be installed (expected transformation capacity 2 x 400 MVA). Considering the increased integration of new RES on the southern part of network, the above-mentioned investments in 2025 should facilitate congestions in the 110 kV, 220 kV and 400 kV south corridors.

### 2030

By the end of 2026, the construction of a new double 400 kV Tumbri – (location) Veleševec OHL with a connection to existing 400 kV OHLs in the direction of SS Žerjavinec and SS Ernestinovo is expected.

Also, by the end of 2030, the following projects is expected: the construction of a new 400/110 kV Lika, new OHL 400 kV substation, Lika – Melina 2 and a new 400 kV OHL, Lika – Konjsko. The project will contribute in strengthening the Croatian transmission grid along its main north-south axis (in parallel with the eastern Adriatic coast) allowing for additional long-distance power transfers (including cross-border) from existing and new planned power plants (RES/wind/conventional/hydro and thermal) in Croatia (coastal parts) and BiH to major consumption areas in Italy (through Slovenia) and north Croatia. The increased transfer capacity will support market integration (particularly between Croatia and Bosnia-Herzegovina) by improving supply security (also for emergency situations), achieving higher diversity of supply and generation sources and routes, increasing resilience and flexibility of the transmission network. In later phase (after 2030), the project also implies increasing transfer capacity between HR and BA by the construction of a new 400 kV OHL, Lika (HR) – Banja Luka (BA).

## Czech Republic

In accordance with the newly approved NDP 2021-2030, a number of investments are foreseen which will have a positive effect on the cross-border transmission capacity. The full list of investments can be found in the NDP; the most relevant among them are:

### 2023

- Modernisation of the tie-line V424 (Sokolnice–SK) (2021-2023)
- Upgrading the existing 220 kV double-circuit V223/224 (Vernerov - Vitkov) to 400 kV V487/488 (22-23)
- Upgrading the single circuit V450 (Výškov-Babylon) into a double-circuit V450/428 (21-23)

### 2025

- Upgrading the single-circuit V431 (Chrást–Přeštice) into a double-circuit V431/831 (24-25)
- Upgrading the single-circuit V403 (Prosenice-Nošovice) into a double-circuit V403/803 (23-25)
- Upgrading the single-circuit V451 (Babylon-Bezděčín) into a double-circuit V451/448 (23-25)

### 2030

- Modernisation of the tie-lines V445 and V446 (Hradec East–Röhrsdorf) (27-28)
- Upgrading the single-circuit V430 (Hradec–Chrást) into a double-circuit V430/830 (28-30)
- ding the single-circuit V432 (Kočín–Přeštice) into a double-circuit V432/429 (26-28)
- Upgrading the single-circuit V411 (Hradec–Výškov) into a double-circuit V411/811 (26-27)
- New double-circuit V406/407 (Kočín-Mírovka) (23-27)

## Denmark

### 2023

Over the next few years, before 2025, Denmark will initiate and complete the following projects. These are just a few of the most important 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 - Klixbüll 400 kV and Flensborg - Kassø
- A new interconnector between Denmark and England, the 400 kV Bicker Fen – Revsing (2024)
- A 400 kV extension between Endrup and Idomlund.
- Establishing dynamic line rating components on overhead lines.

### 2025

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 2025 onwards, but system development needs will continuously be addressed as they are identified with a reasonable amount of certainty. The colour indicates how often an element is loaded more than 100 %. There are also plans in place to handle a number of these overloadings. These include the use of dynamic line rating as well as new reinforcements being planned when more is known about the development of the generation portfolio and the location of loads, both of which are changing significantly in Denmark over the coming 10 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 which projects will be realised from 2025 and onwards, except for reinvestment, but system development needs will continuously be addressed as they are identified with a reasonably amount of certainty. The political system in Denmark is highly focused on increasing the wind infeed into the Danish transmission system, thus it is expected that significant investments will be needed over the coming years.

## Estonia

### 2023

The cross-border capacity on the Estonian-Latvian border will change slightly due to the reconstruction of the 330 kV OHL between Balti and Tartu and the 330 kV OHL between Tartu and Valmiera.

### 2025

Cross-border capacity between Estonia and Latvia will change due to reconstruction of the 330 kV OHL between Viru, Tsirguliina and Valmiera. By the end of 2025, the Baltic power systems will disconnect from the Russian power system and connect to the Continental European power system.

### 2030

Baltic States will operate in synchronous mode with Continental Europe.

## Finland

The transmission needs within the Finnish bidding zone are expected to increase significantly, but at the same time grid reinforcements are planned to be built to answer those needs. Fingrid will invest about EUR 2 billion in the main grid between the years 2021–2030.

**2023**

There will be no new cross-border transmission lines built before 2025. The commissioning of the Olkiluoto 3 nuclear unit will reduce the cross-border capacity from SE1 to Finland by 300 MW until the expected commissioning of a third transmission line between FI and SE1 by the end of 2025.

The direction of congestion may change since a significant increase is expected in the installed wind power capacity in Finland. As such, on windy days congestion may increasingly occur in the export direction.

By the year 2023, significant reinforcements to the Finnish internal transmission grid (e. g., the 400 kV Forest line and the Oulujoki region), will be completed. These reinforcements are expected to help to avoid internal congestions, as well as responding to the growing need for electricity transmission from north to south, since in the near future wind power generation will increase significantly, especially on the northwest coast, and the consumption will mainly be in the south, while at the same time conventional CHP electricity generation is expected to decrease.

**2025**

The third transmission line between FI and SE1 (the Aurora Line), with an expected commission date prior to the end of 2025, will increase the transmission capacity from Sweden to Finland by 800 megawatts and from Finland to Sweden by 900 megawatts, which corresponds to around 30 % of the current capacity. This will reduce congestions in the FI-SE1 border. Within the Finnish bidding zone, reinforcements will be made in the southern part of Finland (Huittinen-Forssa and Helsinki region network) and other grid strengthening strategies will be implemented in order to maintain Finland as a single bidding zone, since transmission needs from production sites (from the north-west coast) to consumption site (to south) are expected to grow.

**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. Previously, Fenno-Skan 1 HVDC (FI-SE3) was expected to reach the end of its service life by the end of 2020, but after investigations by Fingrid and Svenska kraftnät, it has been decided that the link's service time shall be extended until the year 2040. Until 2030, it is not anticipated that there will be any need to strengthen the links between Finland and Estonia. 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. These connections will likely be needed during the 2030s. Fingrid plans to further investigate its options in the ENTSO-E TYNDP process.

## France

Three areas of major physical congestion have been identified: the borders between France and England, France and Spain, and France and Italy. As previously described in chapter 2.2.2, several grid investments are ongoing in these areas to increase the available cross-zonal capacities.

Furthermore, RTE continues to invest in the whole territory in anticipation of potential future congestions.

**2023**

The commissioning of a new line between Lille and Arras will prevent congestion from north to south (RES integration) and enforce the supply security of the region Hauts de France.

The reconductoring of the existing 400 kV OHL Eguzon-Marmagne for maintenance reasons will help to anticipate the expected increase in north-south flows and to improve the RES integration in the area.

**2025**

–

**2030**

Four zones could require reinforcements:

**The 'Massif central-Centre' zone:** it might be necessary to upgrade some 400 kV corridors, depending on the development of RES, the location of nuclear decommissioning and the development of pump-storage in the Massif central area.

**The 'façade Atlantique' zone:** it might be necessary to upgrade the 400 kV corridor between Nouvelle Aquitaine and the Loire valley, depending on the development of solar in the southwest and offshore on the Atlantic coast, the location of nuclear decommissioning and the evolution of exchanges with Spain.

**Zone 'Normandie-Manche-Paris':** a reinforcement between Normandie and Paris area might be necessary in some scenarios to deal with increasing flows in the north-west of France (development of renewable marine energies on the Channel coast, decommissioning of nuclear plants in the Loire Valley, evolution of exchanges with the UK).

**Zone 'Rhône-Bourgogne':** the 400 kV corridors around the Rhone valley might need to be upgraded in some scenarios to face increasing north to south and south to north flows (solar in the south, decommissioning of nuclear in the Rhone valley, evolution of exchanges with Italy and Switzerland).

## Germany

The German TSOs continually review and optimise the planned grid expansion in the framework of the national grid development plan (Netzentwicklungsplan). The following presents a selection of the most important investments, those that are projected to have the greatest positive effects on current and predicted congestions. They include different internal and cross border projects, from new lines to reinforcements, and in conjunction with all other planned investments are foreseen to solve all relevant identified internal congestions in the future.

All investments are approved by the German Regulatory Authority in the framework of the national grid development plan (Netzentwicklungsplan) and most are also enacted in German law (Bundesbedarfsplan or Energieleitungsausbaugesetz). Nevertheless, there exists a risk of delay of investments, which is reflected in two commissioning years (best-case scenario/base case). If only one commissioning year is provided, it is the base case.

Among the important planned grid expansion projects in Germany are several internal HVDC links, which will be built and commissioned during the underlying planning period. These HVDCs are built to transport the wind energy generated in the North and Baltic Seas to the consumption centres in the western and southern parts of Germany and should therefore solve the main observed historical congestions.

- The western HVDC, a DC line with a capacity of 2 GW, consists of two parts, A-Nord and Ultranet. A-Nord starts in the northwest of Germany in Emden/Ost near the North Sea and ends in the west in Osterath, in the densely populated Rhein-Ruhr Area. Ultranet connects Osterath with Philippsburg in the southwest of Germany. While the former is planned to be commissioned in 2024/2026, the latter will be commissioned in 2025/2027.

- In the centre of Germany, the two 525 kV HVDC lines of SuedLink will connect the north and south of Germany as of 2026/2028 with a capacity of 2 GW each. In the north, there will be two starting points: Brunsbüttel and Wilster in Schleswig-Holstein. From there, both will go south in parallel to Großgartach in Baden-Württemberg and Bergrheinfeld in Bavaria.

- In the east of Germany, there is another planned HVDC (SuedOstlink), connecting Wolmirstedt in Saxony-Anhalt with Isar in Bavaria. The 525 kV DC line is planned to be commissioned in 2025/2027 and will have a capacity of about 2 GW.

- In the northwestern part of Germany, two HVDC lines are planned with a capacity of 2 GW each. The HVDC lines will transport onshore and offshore energy from Northern Germany to the Ruhr Area, which is characterised by large conventional generation capacity that must be substituted by renewable energy due to the German coal phase-out. The 525 kV DC lines are planned to be commissioned in 2031.

Apart from the mentioned internal HVDC lines, another DC line, the Hansa PowerBridge, is planned to connect Germany and Sweden. This line, with a capacity of 700 MW, is planned to be operational in 2026.

Besides these HVDC links, there are several other planned grid reinforcements and expansions, of which only the most important are mentioned here:

**Border area DE-PL:** In the control area of 50Hertz there is one major internal project which is delayed due to ongoing court procedures, called Uckermarkleitung. It will replace a 115 km long 220 kV line near the border to Poland, has a capacity around five times higher than the line it will replace, and will solve many of the congestions mentioned in this area in the DACC, D-1 and close-to-RT timeframe.

**Border area DE-AT:** Successive grid enforcement on the axis Altheim-Simbach-St. Peter by replacing the current 220 kV line by a 380 kV line (e. g., Altheim – St. Peter 2024/2026 and Pleinting – St. Peter 2028/2030)

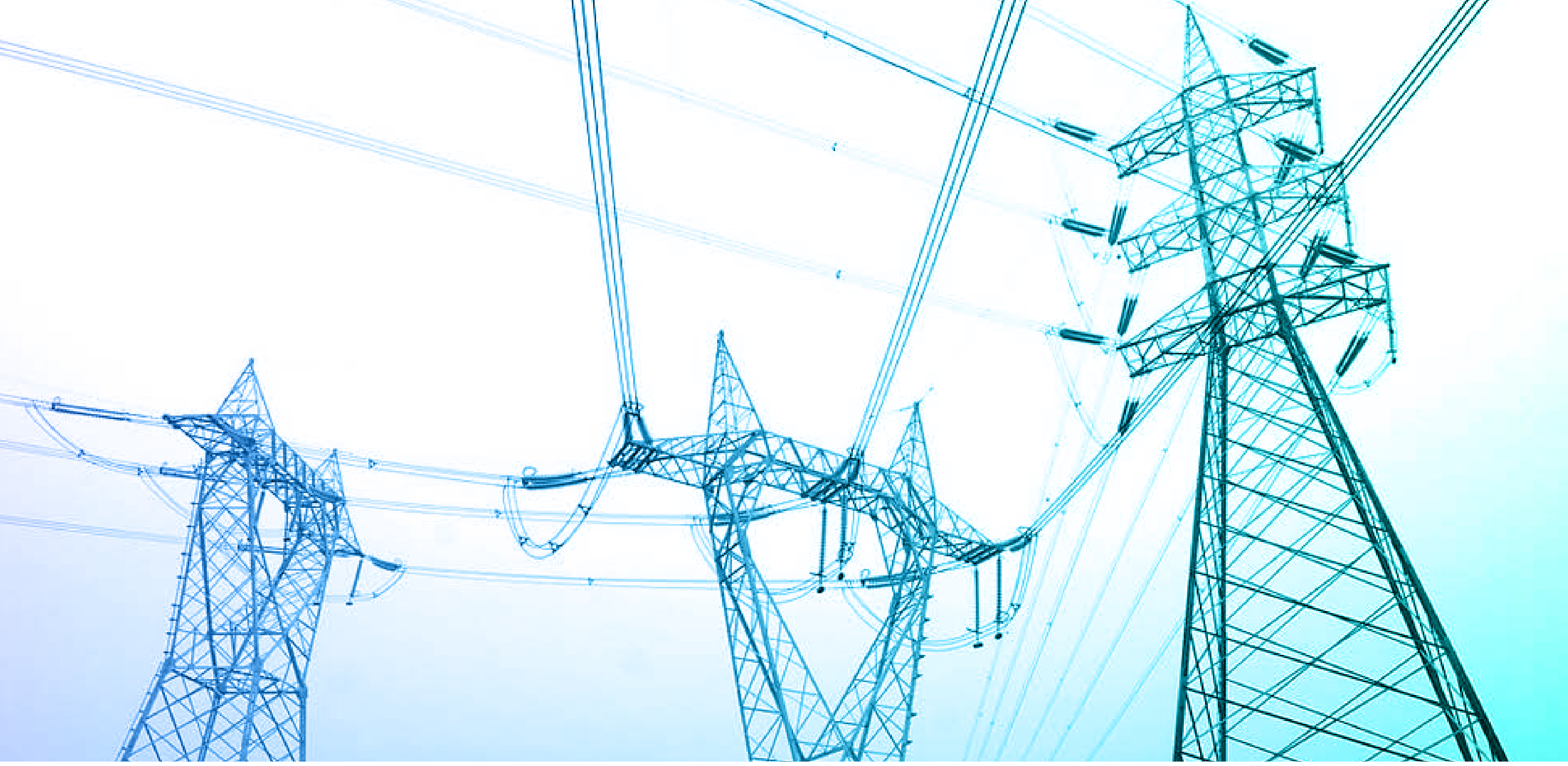
**Border area DE-NL:** Emslandleitung: Dörpen/West – Niederrhein (2025/27), Conneforde-Garrel/Ost-Cappeln/West Merzen (2026/2027)

**Center of Germany/border area DE-Nordics:** Stade-Sottrum-Landesbergen (2026), Wahle – Mecklar (2024), Mecklar – Bergrheinfeld/West (2031)

**Border area DE-FR - Control Area TransnetBW:** Reinforcement of the interconnection to France around Freiburg and Colmar (P176, Eichstetten – Muhlbach). Commissioning in 2026.

**South-West - Control Area TransnetBW:**

- Reinforcement of the connection to Amprion around Mannheim and Karlsruhe and further south to Freiburg (P47, Weinheim – Daxlanden and P49, Daxlanden - Eichstetten). Commissioning in 2028/2031 resp. 2028/2029.
- Reinforcement of the connection to TenneT in the area of Würzburg and Heilbronn (P48, Grafenrheinfeld – Kupferzell – Großgartach). Commissioning in 2025.



## Greece

**2023**

Tie lines:

- The operation of the new 400 kV tie-line between Maritsa (BG) and Nea Santa (GR) will relieve the loading of the Nea Santa (GR) - Babaeski (TR) tie-line indicated when tie-line Blagoevgrad (BG) – Thessaloniki (GR) is out of order (considering the same level of exchanges).
- The operation of a new 400 kV tie-line among neighboring countries AL - NMK will also reduce the loading of the Meliti (GR) - Bitola (NMK) tie-line.
- A DC connection of 1,000 MW among Israel, Cyprus, and Crete (Greece) is planned.

The new tie-line between Maritsa (BG) and Nea Santa (GR) has been approved by the Greek regulator in the framework of the 10-year national grid development plan and is also a Project of Common Interest (PCI). Information on the abovementioned planned projects in the Continental South-east Region is included in the ENTSO-E TYNDP and regional investment plan for the SEE region.

**2025**

Tie lines:

- The operation of the new 400 kV tie line among GR and BG, the Maritsa (BG) - Nea Santa (GR) line will relieve the loading of the Nea Santa (GR) - Babaeski (TR) tie-line, indicated when the Blagoevgrad (BG) – Thessaloniki (GR) tie-line is out of order (considering the same level of exchanges).
- The operation of a new 400 kV tie-line between the neighbouring countries, AL – NMK, will also reduce the loading of the Meliti (GR) - Bitola (NMK) tie-line.
- A DC connection of 1,000 MW among Israel, Cyprus, and Crete (Greece) is planned.

The new tie-line between Maritsa (BG) and Nea Santa (GR) has been approved by the Greek regulator in the framework of the 10-year national grid development plan and is also a Project of Common Interest (PCI). Information on the above-mentioned planned projects in the Continental Southeast Region is included in the ENTSO-E TYNDP and the regional investment plan for the SEE region.

**2030**

Tie lines:

- The operation of the new 400 kV tie line among GR and BG, the Maritsa (BG) - Nea Santa (GR) line, will relieve the loading of the tie-line Nea Santa (GR) - Babaeski (TR) indicated when tie-line Blagoevgrad (BG) – Thessaloniki (GR) is out of order (while considering an increase in exchanges on the GR-TR border).
- The operation of a new 400 kV tie-line among the neighbouring countries, AL – NMK, will also reduce the loading of the tie-line Meliti (GR) - Bitola (NMK).
- A DC connection of 1,000 MW among Israel, Cyprus, and Crete (Greece) is planned.

The new tie line between Maritsa (BG) and Nea Santa (GR) has been approved by the Greek regulator in the framework of the 10-year national grid development plan and is a Project of Common Interest (PCI). Information on the abovementioned planned projects in the Continental Southeast Region is included in the ENTSO-E TYNDP and regional investment plan for the SEE region.

## Hungary

**2023**

Based on the Hungarian NDP and the TYNDP, no congestions are expected on the transmission level in 2023. Three new 400 kV cross-border lines are to be commissioned in 2021 on the SK-HU border (Gabcíkovo-Gönyű, Velky Dur-Gönyű, Rimavska Sobotá-Sajóivánka), and upratings are planned on the 220 kV AT-HU cross-border lines (Győr-Wien/Neusiedl) by the end of 2022.

**2025**

No remaining congestions are expected. High import flows are still expected on the SK-HU border.

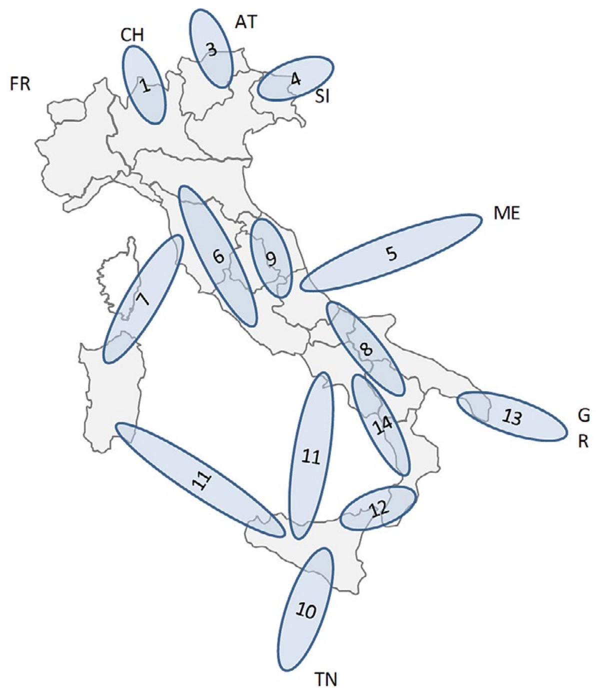
**2030**

No remaining congestions are expected, but 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 in a high number of hours.

## Ireland

–

## Italy




**2023**

An increase in the available transmission capacity at the northern Italian border is expected due to the enhancement of the interconnection with Austria (Area 3, new 132 kV Prati di Vizze – Steinach tie line and 220 kV line from Nauders to Glorenza).

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.

**2025**

–

**2030**

A further increase in the available transmission capacity at the northern Italian border is expected due to the new Salgareda – Divaca (area 4) HVDC link.

The repowering of the existing HVDC link between the Italian mainland, Corsica and Sardinia will also enhance the interconnection between Sardinia and Continental Italy (Area 11).

A new HVDC link (Area 8) between Villanova (or Villavalle) and Fano (or Portotolle) is planned to increase the transmission capacity on the relevant network critical section and will improve the stability of voltage and frequency between Italy Central South (IT3) and Italy Central North (IT2).

A new HVDC link is also planned between Italy and Tunisia (Area 10).

## Latvia

**2023**

–

**2025**

By the end of the 2025 is planned that Baltic States will desynchronize from IPS/UPS power system and operate in synchronous mode with Continental Europe. According to synchronization with Continental Europe it is relevant to strengthening internal grid in Baltic States and many internal reinforcements are planned. Regarding to Latvia and Estonia cross-border there is planned existing line reconstruction works which have to be done up to 2025 therefore by the end of the 2025 no congestions and overloads are forecasted.

**2030**

Until 2030 it is planned that Baltic States will operate in synchronous mode with Continental Europe. According to synchronization with Continental Europe it is relevant to strengthening the internal grid in Baltic States and many internal reinforcements should be already implemented until 2025. After 2025 some internal grid reinforcements are planned to connect rapid increase of RES generation, but currently the plan is being scheduled. Up to 2030 it is planned to instal up to 500 MW of off-shore wind near the coast line of Latvia and in this case the cross-border line Grobina (LV) - Derbenai (LT) must be strengthened.

## Lithuania

**2023**

- Congestions in mid-term timeframe might occur occasionally on LT-LV crossborder due to existing loop flows in IPS/UPS system.
- Structural congestions between LT-PL occur due to high price differences between market zones in North and South.
- Structural congestions between LT-SE4 occur due to high price differences between market Baltic and Nordic markets zones.

**2025**

- Congestions in mid-term timeframe might occur occasionally on LT-LV crossborder due to existing loop flows in IPS/UPS system.
- Structural congestions between LT-PL occur due to high price differences between market zones in North and South.
- Structural congestions between LT-SE4 occur due to high price differences between market Baltic and Nordic markets zones.

**2030**

- Structural congestions between LT-PL occur due to high price differences between market zones in North and South.
- Structural congestions between LT-SE4 occur due to high price differences between market Baltic and Nordic markets zones.

## Luxembourg

**2023**

A future expected increase in the vertical load of Luxembourg with additional transit flows may limit the exchanges on the DE-LU and BE-LU borders.

**2025**

A new infrastructure project between Germany and Luxembourg (IC DeLux) is currently under development (TYNDP 2020). The project comprises the construction of two new 380kVsubstations in Germany (Aach) and Luxemburg (Bofferdange). The new substations will be connected via a new AClink to allow a higher cross border capacity between Germany and Luxembourg. This new infrastructure will reduce possible future congestions due to a future load increase of Luxembourg on the DE-LU border. The commissioning date of the project is projected for 2026.

A new internal 380 kV reinforcement in Luxembourg between Bofferdange and Bertrange is expected in 2027.

**2030**

Upgrade of the 220 kV Heisdorf- Bauler OH lines to HTLS.

## Netherlands

Reference is made to TenneTs Investeringsplan 2020 for the most accurate and up-to-date information on the expected expansions on the grid, including expectation of future congestions.

**2023–2025**

Upgrade on Eemshaven Oudeschip – Vierverlaten is scheduled, which is foreseen to fix most of the current congestions on EEM380 – MEE 380 (on D-1 timeframe).

Upgrade on Diemen – Lelystad – Ens – Zwolle is scheduled, which is foreseen to fix most (but probably not all) congestion on this line (DIM380 – LLS380 & LLS 380 – ENS380). Some congestions on this line is still to be expected.

Upgrade on the interconnector Meede-Dielen is currently nearing completion, which is expected to fix the current congestion on this interconnector (MEE380 – DIL380).

**2030**

Grid-upgades are scheduled on grid connection Zwolle – Hengelo – Doetinchem - Dodewaard and stations upgrades on Wijchen, Almere, Graetheide, Europoort.

The grid connection Diemen – Lelystad – Ens acts as corridor between the North and the West of the country. Due to rapid development of solar PV, congestions are to be expected on this grid connection, despite the already foreseen grid extensions.

Other congestions are foreseen on Rilland – Geertruidenberg – Krimpen, Krimpen – Breukelen – Diemen – Beverwijk – Oostzaan, and Eindhoven – Maastbracht.

## Norway

**2023**

Ofoten–Balsfjord–Skillemoen-Skaidi (NO4): New 420 kV-line (ca.450 km) will increase the capacity in the north of Norway, mainly to serve increased petroleum-related consumption, as well as increase the security of supply. In addition, the project will prepare for some new wind power production. A line further east (Skaidi-Varangerbotn) is planned. The first part, Skaidi–Lebesby, has applied for a permit. Adamselv-Varangerbotn is under consideration.

**2025**

Lyse – Fagrafjell (NO2): New 420 kV-line (ca. 70 km) will increase the capacity in the Southwestern part of Norway. The project will increase the North-South capacity as well as facilitate high utilisation of the interconnectors.

**2030**
Greater Oslo (NO1): Voltage upgrades in the Oslo region. The project will serve increased consumption in the Oslo region, as well as increase the capacity North-South in Norway and facilitate high utilisation of the interconnectors. A new 420 kV-line (Fåberg-Oslo) is under consideration.

## Poland

**2023**
Development plans anticipate the completion of the following new investments by 2023:

- Construction of a new 400 kV line, Krajnik-Baczyna-Plewiska,
- Construction of a new 400 kV line, Mikułowa-Czarna-Pasikurowice,
- Construction of a new 400 kV line, Pątnów-Jasiniec-Grudziądz (Jasiniec-Grudziądz is already implemented).

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

**2025**
Implementation of the following development projects:

- Reinforcement of a chain of 400 kV lines, from Krajnik to Gdańsk Błonia in the northern part of Poland,
- Construction of a new 400 kV line, Dunowo-Żydowo Kierzkowo-Piła Krzewina-Plewiska,
- Construction of a new 400 kV line, Ostrołęka-Stanisławów.
- Construction of a new 400 kV line, Mikułowa- Świebodzice,
- Reinforcement of 220 kV line Świebodzice-Ząbkowice.

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

**2030**
The following development targets will be reached:

- Construction of a 400 kV line from Dobrzeń to Pasikurowice-Ostrów.
- Construction of a 400 kV Trębaczew-Joachimów (Rokitnica)-Wielopole line,
- Construction of the Podborze-Kopanina-Liskovec, Podborze-Bujaków-Liskovec, Podborze-Bieruń-Komorowice, Podborze-Czeczott-Moszczenica 220 kV lines together with the construction of a 220 kV Podborze substation,
- Upgrade of the 400 kV Rzeszów-Krosno Iskrzynia line,
- Construction of a Poland-Lithuania HVDC cable interconnector,
- Upgrade of the AC/DC Słupsk converter station.

All investments reduce the number of limiting internal lines active constraints in DA capacity allocation, as well as internal line congestion frequency in DA and close to RT timeframes. In addition, the abovementioned grid reinforcements will increase the transfer capacity toward Lithuania after the synchronisation of the Baltic States with CE.

## Portugal

**2023**
There are some internal reinforcements foreseen in the northwest Portugal region in order to solve some internal constrains caused by the increase of installed power in this area.

**2025**
It is expected that the future new interconnection between Portugal and Spain in the northwest part of Portugal, foreseen

to 2024, solve the current angle deviation restrictions that occurs in that area. This reinforcement will increase the NTC with Spain to higher values, mainly in the Spain to Portugal direction, and so achieving the MIBEL objective of an NTC for commercial purpose of at least 3,000 MW in both directions (ES > PT and PT > ES).

In the northern region of Portugal there is already a high volume of hydro power plants installed and a significant amount of new hydro power plant is foreseen to appear in 2023. Therefore, in wet conditions some constrains could occur in the internal Portuguese network and in northeast Portugal-Spain interconnection. Although, these constraints shouldn't affect too much the market operation as it's expected that, at least, the commercial NTC will be higher than the MIBEL target of 3,000 MW.

## Romania

According to our ten year development plan and our Action plan developed in accordance with Regulation (EU) 2019/943 the future evolution of the congested elements on the Romanian grid will be relieved with the following measures:

### 2023

By December 2020 the 400 kV OHL Nădab – Oradea Sud was already in operation and a new 400 MVA 400/220 kV Autotransformer in Iernut substation will be comissioned in the second semester of 2021.

### 2025

For the 2025 horizon the investments covered by the Development Plan and Action Plan consist of the following:

- 400 kV OHL Por ile de Fier – Reși a with a deadline 2024 and 400 kV OHL Reși a (RO) – Pancevo (RS) double circuit in operation;
- 400 kV OHL Reși a – Timișoara – Săcălaz double circuit with a deadline in 2025;
- 400 kV OHL Cernavodă – Gura Ialomi ei – Stâlpu double circuit with a deadline in 2023 and upgrate to 400 kV of the Brazi Vest – Teleajen – Stâlpu with a deadline in 2025;
- 400 kV OHL double circuit Smârdan – Gutinaș (one circuit equipped) with a deadline in 2024.

### 2030

With a deadline in 2027, the project for further relieving structural congestions is comissioning 400 kV OHL Timișoara – Săcălaz – Arad.

## Slovakia

The information in accordance with TYNDP 2020–2029:

### 2023

Modernisation of the tie-line V424 Križovany (Slovakia) – Sokolnice (Czech Republic) (2021–2023)

### 2025

Reconstruction of the cross-border line V404 Varín (Slovakia) – Nošovice (Czech Republic) (2024–2025)

### 2030

For now SEPS does not plan to strengthen other cross-border profiles with new lines.

## Slovenia

### 2023

- Upgrade RTP Cirkovce from 220 kV to 400 kV.
- New 400 kV connection from Slovenia to Hungary and Croatia.
- Installation of smart device SSSC in series with line 220 kV Podlog-Obersielach.

### 2030

–

### 2030

- New 400 kV connection Hrenza-Kozjak and connection of HSPP ČHE Kozjak
- New connection 220 kV Zagrad-Ravne

## Spain

### 2023

Most of the congestions identified over the period covered by this report will be solved by the commissioning of the new reinforcements included in the current 2015–2020 National Network Development Plan for the Transmission Grid and will relieve overloads thanks to uprating of lines, which will mostly occur by 2023 and in the east and south of Spain. Delays in the commissioning of reinforcements in other areas may cause some of the identified congestions to remain.

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

### 2025

Most of the congestions reported will be solved by 2025, since the reinforcements included in the current 2015–2020 Network Development Plan will already have been commissioned. A few of the reinforcements identified that are linked to the development of new solar and wind installations will require further reinforcements that are still not included in the current National Network Development Plan. However, a new version of the plan is being developed, which will solve these remaining congestions. It includes line uprates and construction of new transmission lines in new or existing corridors.

Some new developments in the north of Spain will be necessary to solve congestions associated with the ES-FR border and strengthen the grid before the commissioning of the new Bay of Biscay interconnection.

**2030**

Commissioning of the new HVDC interconnections with France (Bay of Biscay), Navarra-Landes and Aragón-Atlantic Pyrenees will increase the ES-FR cross-zonal capacity up to 8 GW and change flow patterns at the ES-FR border. These interconnections are considered method of achieving the NECP in Spain. The internal reinforcements needed for the Bay of Biscay will be included in the new 2021–2026 Network Development Plan. The planning process is already ongoing, with the public consultation phase having been completed. Further internal reinforcements 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 in ES-FR border will still be substantial even after the commissioning of the abovementioned projects to achieve the energy and climate goals set for Spain and Portugal.

## Sweden

To meet increasing electricity demand, relieve congestions, and allow for connection of new generation capabilities, in the coming years the Swedish transmission grid will be expanded, renewed and reinforced at both internal and external borders.

**2023**

- An additional HVDC line between SE3 and SE4, commissioned in 2021.
- An upgrade to internal power lines in SE2, a new AC line established to meet demand in an area that has limited the connection of new generation capabilities.
- Due to increasing electricity demand in the Stockholm area, 220 kV lines are replaced with 400 kV lines. Commission date from 2022 to 2030.

**2025**

- A third AC line that provides an additional 800 MW will be built between SE1 and FI, to reduce congestion and increase robustness. Expected commission near the end of 2025.
- A new power line will be built between SE3 and SE4 to ensure operation of the NordBalt-line and meet regional demand.
- Reinforcement and renewal of existing power lines between SE2 and SE3 will be carried out during 2024.
- Reinforcement with a 400 kV power line in SE3 to relieve internal congestions (West Coast corridor).
- A new AC power line will be built in SE4 to increase transmission capacity and enable the connection of wind power.

**2030**

- A new 700 MW HVDC line between Sweden (SE4) and Germany, commission in 2026.
- Old power lines and new connections call for reinforcement and renewal of multiple power lines at 220 kV and 400 kV in SE2.

## Switzerland

The realisation of the Strategic Grid 2025 should enable the elimination of current congestions and accommodate new large 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.

**2023**

- Pradella – La Punt, Commissioning 2022: Reinforcement of the existing route
- Chamoson – Chippis, Commissioning 2022: Reinforcement by construction of a 380 kV route and new 380/220 kV transformer in Chippis
- Bassecourt – Mühleberg, Commissioning 2023: Reinforcement of the existing route by voltage conversion to 380 kV including a new 380/220 kV transformer in Mühleberg
- Transformer Lachmatt, Commissioning 2023

**2025**

- Transformer Riddes, Commissioning 2024
- Transformer Mettlen, Commissioning 2024

**2030**

- Bickigen – Chippis, Commissioning 2028: Optimisation of the existing route by voltage conversion to 380 kV
- Chippis – Lavorgo, Commissioning 2029: Reinforcement by construction of a new 380 kV route including a new 380/220 kV transformer in Mörel

## 2.3 Conclusions

This chapter provides an overview of congestions for the following time stages: Capacity calculation for the purpose of DA capacity allocation, D-1 (operational planning after DA market closure) and (close to) real-time. The location and frequency of congestions are also reported.

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

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 timeframe 'real time' 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, whilst others reported all congestions identified up to one hour before real time. Since both types of data refer to different situations, two sets of real-time maps have been provided.

The first set of maps shows congestions reported by TSOs using data from up to one hour before real time. In general, these congestions result from changes to generation dispatch resulting from intra-day market activities, weather changes, forced outages (generation and/or transmission) and/or applied remedial actions which are activated very close to real time (e. g., PSTs). In most cases, TSOs were able to manage these close-to-real-time congestions using operational congestion management procedures. The second set of maps shows congestions reported by TSOs using ICS data (see Annex 1), corresponding to actual security violations that occurred. These were usually the result of unexpected situations such as forced outages. The reported congestions in this timeframe have quite low frequency rates and a relatively low number of congestions is reported.

Both sets of maps for this 'real-time' timeframe indicate the number of operational challenges faced by TSOs very close to real time.

With respect to the future evolution of reported congestions, TSOs' expert assessments have been provided in the report. It is to be emphasized that TSOs have extensive investment plans in place to address the congestions identified in the short-to-medium timeframe.

Finally, it is important to highlight that 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, et cetera. 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

Within this chapter, an assessment of flows not resulting from capacity allocation is carried out based on the PTDF Flow Indicator. Section 3.1 provides the calculation methodologies and general descriptions. Section 3.2 gives an overview of the data used. Section 3.3 presents and comments upon the results.

## 3.1 Methodology

This chapter provides a description of 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 MMR report is used and is described in this section. This PTDF indicator is widely accepted as being an approximation to loop flows.

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

- Market transactions within each bidding zone are not limited (the zone is considered to operate as a 'copper plate').
- Market transactions between all bidding zones are limited through cross-zonal capacity calculation and allocation procedures.

Flows not resulting from capacity allocation are computed as the difference between the measured physical flow and the computed flows at the bidding zone borders. In most cases the bidding zone border and member state border are the same thing. However, for the CZ borders with AT and DE, the borders are calculated on a member state basis (until 1 October 2018), DE and AT being in the same bidding zone until 1 October 2018[3], from the net positions of each bidding zone for each hour of the year.

The equation is as follows:

**PTDF flow deviation$_b$ (h) = PF$_b$ (h) - CF$_b$ (h)**

- PF$_b$ (h): Measured cross-border physical flow over given bidding zone border (b).
- CF$_b$ (h): Calculated flow induced by all cross-border exchanges between all European bidding zones, 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), the net position per bidding zone will have to be transformed (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 measured physical flows on cross-border tie-lines.

Hence, the indicator focuses on loop flows (which are a subset of unscheduled flows) and neither evaluates who is responsible for the PTDF Flow deviations nor whether the identified PTDF flow deviations induce security issues.

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

Sum of the flows created by all exchanges between bidding zones in the synchronous area at all bidding zone borders

PTDF matrix (resolution)

Net positions of the relevant bidding zones

3 Until 01.10.2018 DE/LU/AT consisted in a single bidding zone. During this period there was no CZ-(DE+AT) bidding zone border. The cross border allocation did exist for yearly, monthly, DA and intra-day timeframes on CZ-AT, CZ-DE(50HzT) and CZ-DE (TTG) cross-border interfaces.

For each hour, the flows resulting from capacity allocation are computed using a power transfer distribution factor (PTDF) matrix and the net positions of the relevant bidding zones from the synchronous area.

The measured hourly physical flow minus the above vector CFb (h) is the indicator for each hour.

The PTDF indicator is not computed for some areas of Continental Europe which are radially structured (e. g., internal Italian bidding zone borders).

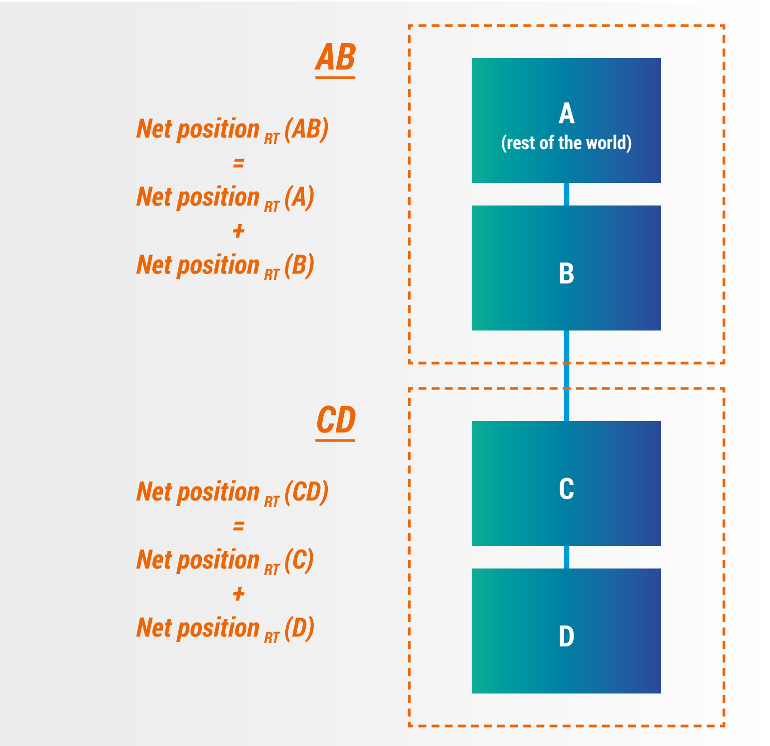



Figure 49: Radially structured network

In fact, in a radially structured network, such as that shown in Figure 49:

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 Bidding Zone $i$ to Bidding Zone $j$

$NP_{RT,z}$ is the net position (in real-time) of the Bidding Zone $z$

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 the link $l$ to a variation of the net position of the Bidding Zone $b$

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

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

And hence:

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

The difference between the hourly real-time net position and the hourly realised net position (control program) is equal to the hourly bidding zone imbalance $(IMB_D(h))$:

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

Since it is out of 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 bidding zone, the PTDF indicator can be assumed negligible for the bidding zones border in a radially structured part of the system.

This conclusion is also supported by the very low values obtained in the SWE region from the computation for the FR-ES and ES-PT borders (less than 20 MW per year).

# 3.2 Data Sources

This chapter provides a description of the data used for the calculation of 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 Chapter 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 Programs (Net Position)**

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

Data sources for the three SAs previously mentioned:

**Continental Europe**

The data source 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 and Nordic Areas**

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

## 3.2.2 Computation of the PTDF matrix

A power transfer distribution factor (PTDF) is an influence (sensitivity) factor in the modification of 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. More detailed information on the CWE flow-based methodology is available on the JAO website.

The PTDF matrix (resolution per bidding zone) 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 Energinet Associated Activities for the years 2018 and 2019 and between ENTSO-E and Amprion GmbH for 2020.

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

| Interval | CGM |
|---|---|
| 01/01/2018–28/02/2018 | DACF model for 20 January 2018 10:30 CET |
| 01/03/2018–30/04/2018 | DACF model for 16 March 2018 10:30 CET |
| 01/05/2018–30/06/2018 | DACF model for 18 May 2018 10:30 CET |
| 01/07/2018–31/08/2018 | DACF model for 20 July 2018 10:30 CET |
| 01/09/2018–31/10/2018 | DACF model for 21 September 2018 10:30 CET |
| 01/11/2018–31/12/2018 | DACF model for 16 November 2018 10:30 CET |
| 01/01/2019–28/02/2019 | DACF model for 16 January 2019 10:30 CET |
| 01/03/2019–30/04/2019 | DACF model for 20 March 2019 10:30 CET |
| 01/05/2019–30/06/2019 | DACF model for 15 May 2019 10:30 CET |
| 01/07/2019–31/08/2019 | DACF model for 17 July 2019 10:30 CET |
| 01/09/2019–31/10/2019 | DACF model for 18 September 2019 10:30 CET |
| 01/11/2019–31/12/2019 | DACF model for 20 November 2019 10:30 CET |
| 01/01/2020–29/02/2020 | D2CF model for 15 January 2020 10:30 CET |
| 01/03/2020–30/04/2020 | D2CF model for 18 March 2020 10:30 CET |
| 01/05/2020–30/06/2020 | D2CF model for 20 May 2020 10:30 CET |
| 01/07/2020–31/08/2020 | D2CF model for 15 July 2020 10:30 CET |
| 01/09/2020–31/10/2020 | D2CF model for 16 September 2020 10:30 CET |
| 01/11/2020–31/12/2020 | D2CF model for 18 November 2020 10:30 CET |

Table 1: CGM and intervals used

It is not possible to perfectly represent the grid topology over the entire year with just a few snapshots; some aspects will not be considered with this approach (e.g., maintenance, modification of topology, new lines, generation and load patterns, load variation).

Different rules are used in Europe for the determination of GSK (e.g., merit order, linear GSK). For the indicator, the computation of the GSK must be standardised in order 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, a bidding zone produces 2,000 MW and a power plant in the bidding zone produces 100 MW. If the bidding zone production is increased by 30 MW, the power plant production will be increased by 1.5 MW, since 100 / 2,000 × 30 = 1.5.´

The generation of a bidding zone is increased by 100 MW. If the load of a line increases by 5 MW, the PTDF of the bidding zone on the given line will be 0.05. This computation is carried out for each tie-line and each bidding zone. However, the results are not given per tie-line but rather aggregated for each border between bidding zones.

The PTDF matrix is computed on the bidding zone level; however, in the ENTSO-E Verification Platform database, the resolution may be different. Austria-Germany-Luxembourg consisted of a single bidding zone until 1 October 2018. Allocated and non-allocated flows are not calculated on the border between Germany and Austria, as this is considered a border within a bidding zone where cross border allocation does not exist. However, information about physical flows and commercial exchanges are available in ENTSO-E Verification Platform until 1 October 2018. After this date, the data is also calculated at the AT-DE border. The shape of the PTDF matrix for k bidding zones and n borders is as follows:

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

## 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, as well as to 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[4].

In this sense, **Load Frequency Control** (although the LFC works on the control area level) **ensures that the sum of all differences between commercial and physical flows over all borders of a bidding zone and the respective control area is very close to zero.** From the bidding zone 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 bidding zone, differences between schedules and physical flows can be observed.

### 3.3.1 Results of the PTDF Flow Indicator for the years 2018, 2019 and 2020

The advantages and limitations of the PTDF Flow indicator are shown in Table 2. This is followed by a graphical representation of the indicator for the years 2018, 2019 and 2020.

| | |
|---|---|
| The physics of the flows are considered by translating commercial exchanges into physical flows between bidding zones. | 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 prorata GSK. |
| | Data availability of net position (for aggregation of countries see also 3.2.2) |
| | 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 2: Advantages and limitations of the PTDF flow indicator

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

Based on the given input data set and the necessary assumptions and limitations, the PTDF indicator estimates the size of loop flows 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.

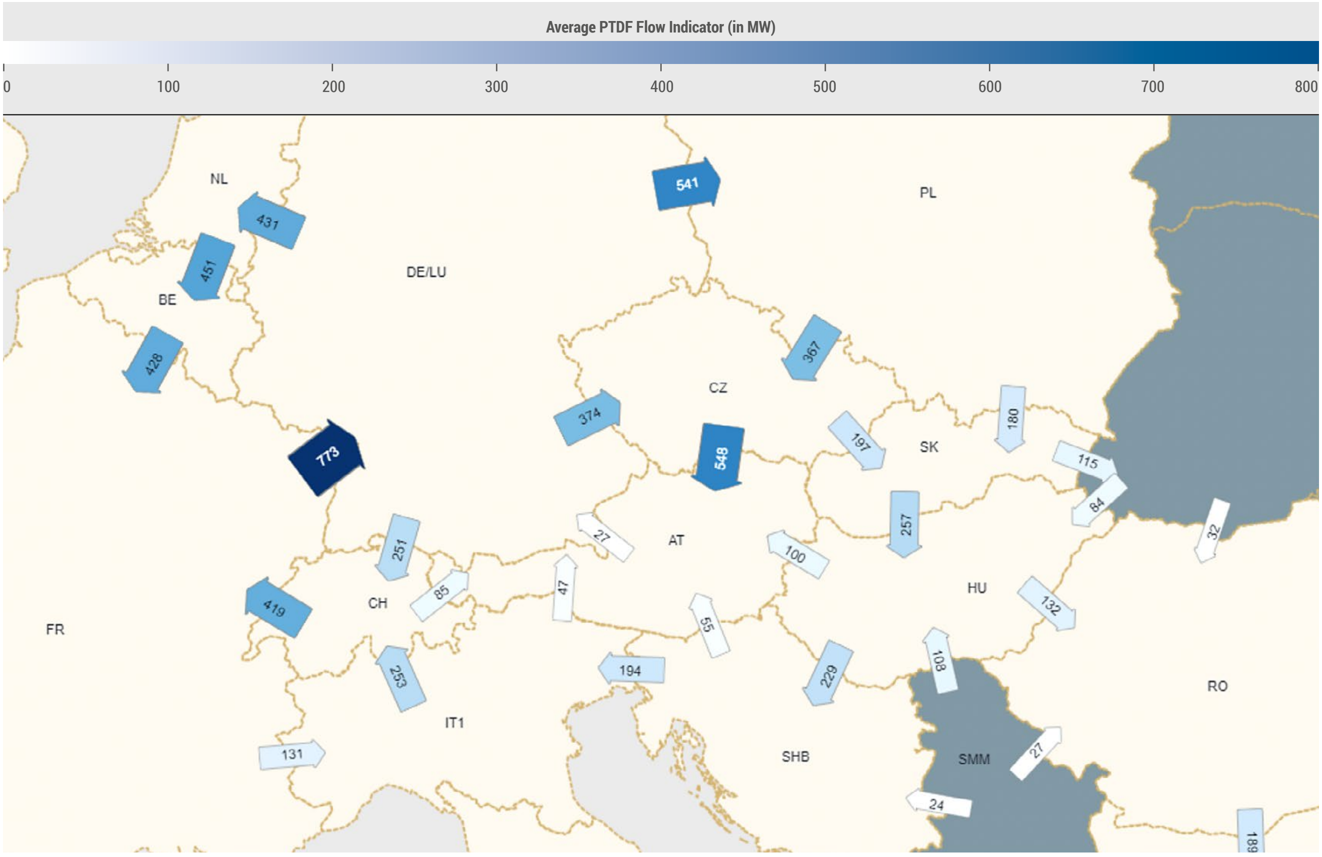



Figure 50: Average PTDF Flow Indicator for 2018 (in MW). CCR: Core and Italy North

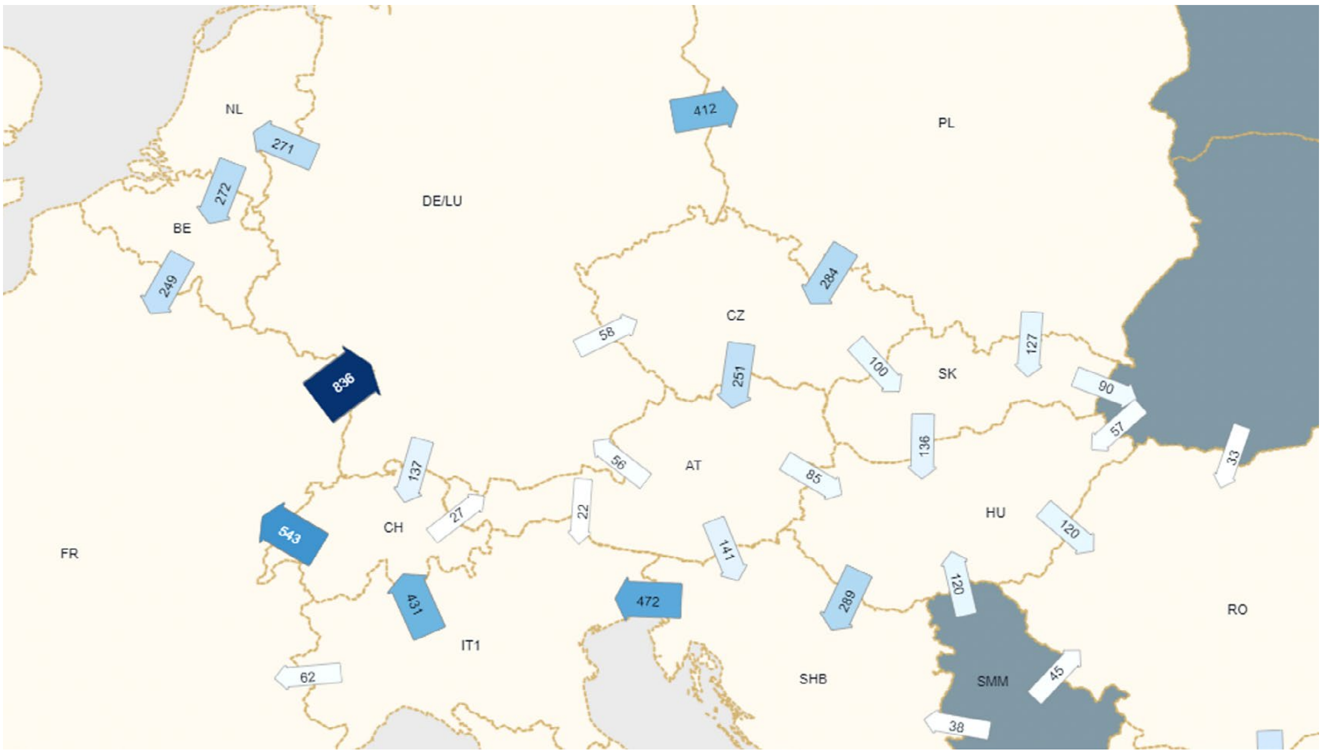



Figure 51: Average PTDF Flow Indicator for 2019 (in MW). CCR: Core and Italy North

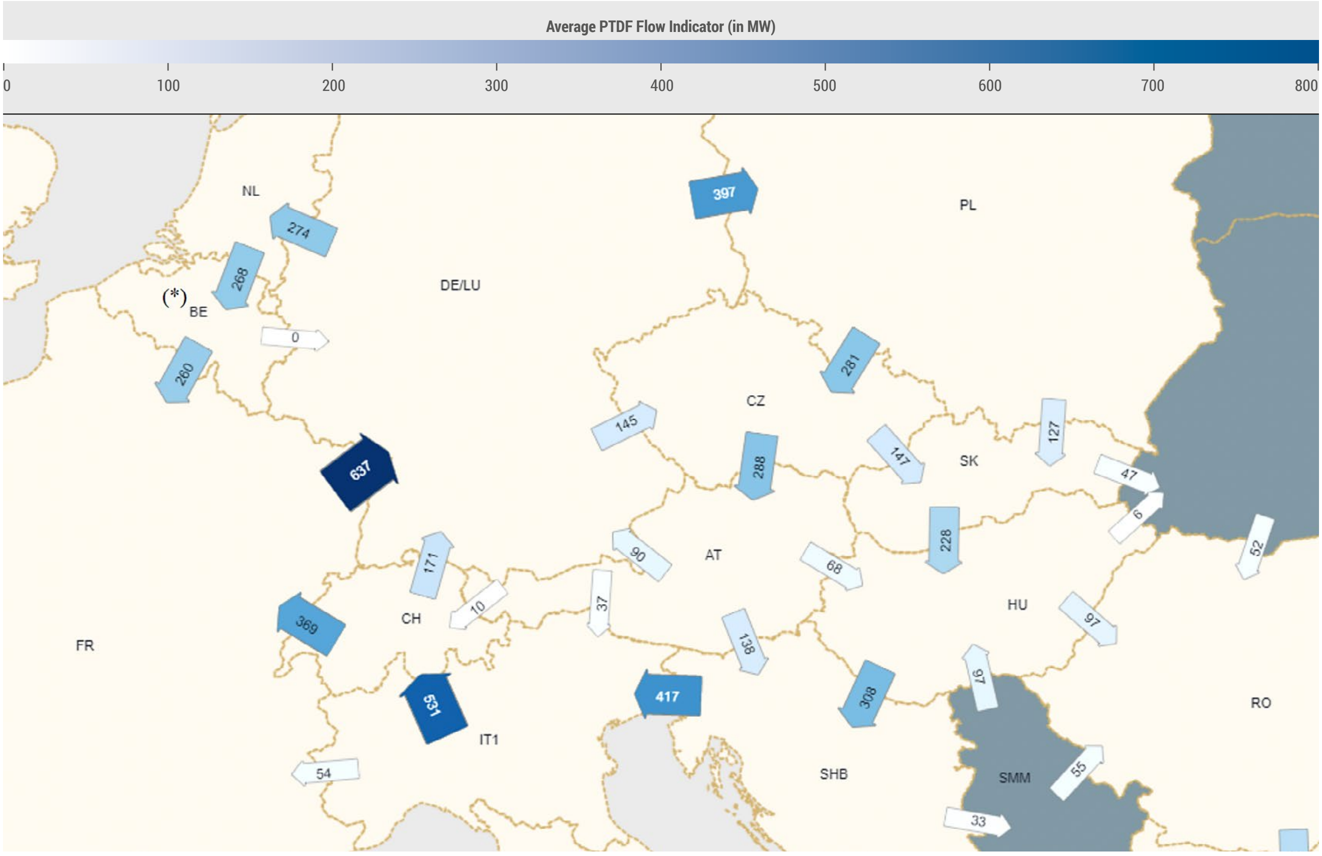



Figure 52: Average PTDF Flow Indicator for 2020 (in MW). CCR: Core and Italy North (CH-FR, CH-IT, CH-DE/LU, CH-AT, UA-SK, UA-HU, UA-RO bidding zone borders are not part of these CCRs). *Please note that in the context of the minimum 70 % requirement set by Regulation 2019/943, Elia and TenneT TSO B.V. obtained a derogation for excessive loopflows. The methodology for calculation of the loopflows is described in the respective derogations granted to Elia and TenneT TSO B.V. and differs from the methodology applied in this report, the key difference being that the loopflows are calculated using the CWE FB DA CC parameters and thus D2CF data. The result of these loopflow calculations is reported through the JAO Utility Tool.

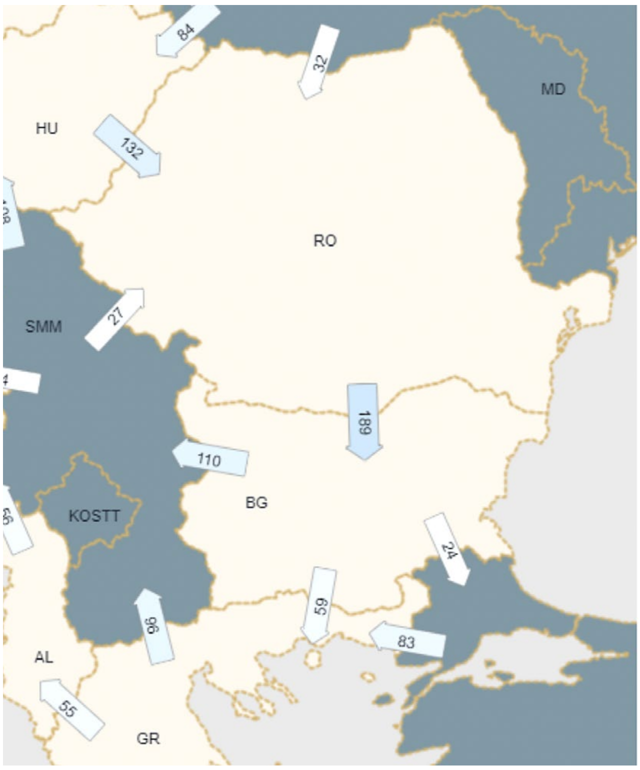



Figure 53: Average PTDF Flow Indicator for 2018 (in MW) – CCR: Southeast Europe (SEE)

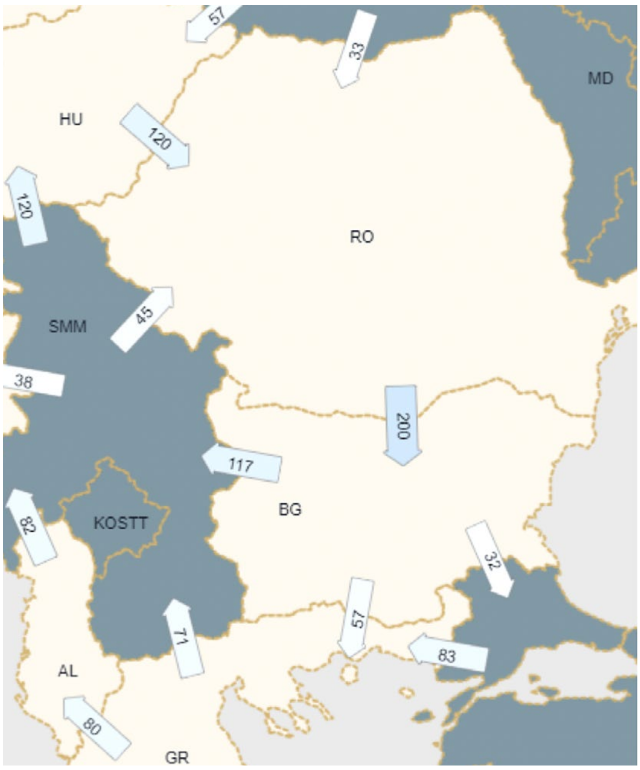



Figure 54: Average PTDF Flow Indicator for 2019 (in MW) – CCR: Southeast Europe (SEE)

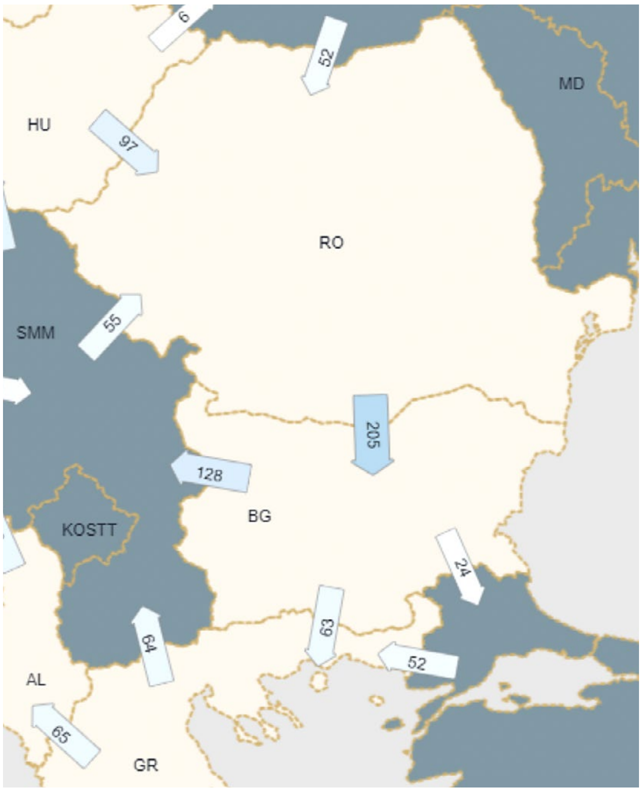



Figure 55: Average PTDF Flow Indicator for 2020 (in MW) – CCR: Southeast Europe (SEE)

## 3.4 Conclusions

Chapter 3 provides 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 that used by ACER for the Market Monitoring Report. However, the current methodology used to compute these indicators has some limitations, which are described in Table 2. Calculated PTDFs are available for the years 2018, 2019 and 2020.

Figure 56 below provides an overview of these flows across all relevant bidding zone borders for 2018, 2019, and 2020. Average values are shown for the PTDF Indicator.

**As seen below, the overall magnitude of the PDTF flow indicator decreased over the three observed years and also compared with the last technical report. There are only a few borders with a higher PTDF flow indicator in 2020 compared with 2018. The following observations are worth noting:**

DE/AT/LU had been a single bidding zone until October 2018, when the bidding zone was split into the two parts DE/LU and AT. Allocated and non-allocated flows are not calculated for the border between Germany and Austria for the period before the split, since it was considered a border within a bidding zone where cross border allocation does not exist. After this date, the data is also calculated at the AT-DE border.

In all years, the highest value of the PTDF indicator was been observed on the FR-DE border, where the geographical position and strong exporting character of these countries tends to increase the indicator, as in the last Technical Report. Whereas then the highest value was 1,149 MW (2015), this time it is 836 MW (2019). Even though in 2020 the value declined to only 637 MW, this still represents the highest value of all borders, as shown in Figure 56.

In general, high values of the PTDF indicator can be seen for borders between central European countries, especially in parts where the grid is more meshed.

A north-to-south power flow can be observed on the borders DE-NL-BE-FR in all years but with a decreasing trend: the numbers almost halved from 2018 to 2020.

A north-to-south power flow can be observed for the borders SK-HU-SHB for all years as well. On the other hand, there are increasing values for the IT-CH and IT-SHB borders.

Kosovo became an independent grid starting on 14/12/2020. Since then, it has been part of the SMM control block and it was included in the Albania control block (Albania and Kosovo). Because of this, reporting of flows not resulting from capacity allocation is technically complex. Please note that for 2018, 2019 and most of 2020, Kosovo was included in SMM exchanges, but for the last weeks of 2020, it was included in the Albanian exchanges.

In the context of the minimum 70 % requirement set by Regulation 2019/943, Elia and TenneT TSO B.V. obtained a derogation for excessive loop flows. The methodology for calculation of the loop flows is described in the respective derogations granted to Elia and TenneT TSO B.V. and differs from the methodology applied in the Technical Report, the key difference being that the loop flows are calculated using the CWE FB DA CC parameters and thus D2CF data. The results of these loop flow calculations are reported through the JAO Utility Tool.

Figure 57 below shows the evolution, as summed totals, of the following values over all borders.14 As indicated in the conclusion PTDF indicator shows a slowly decreasing trend over the reported years.

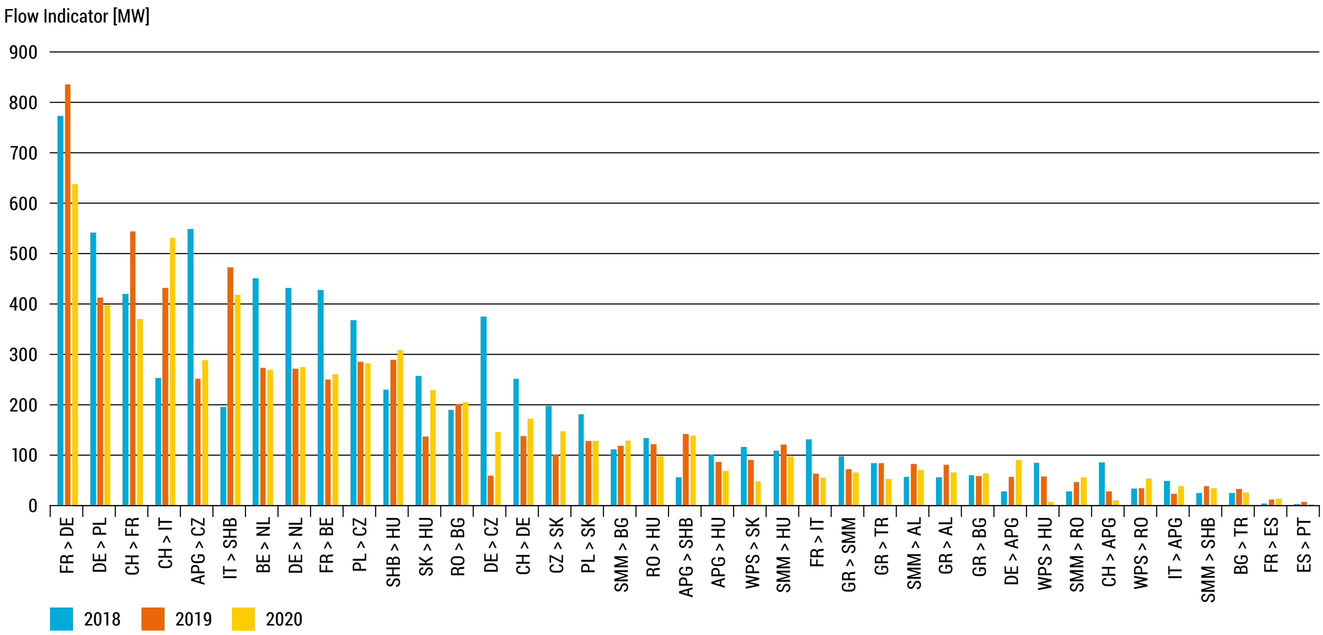



Figure 56 The three-year comparison shows different trends for each border. The highest values can still be found on the French-German border, where the geographical position and strong exporting character of these countries tends to increase the indicator.

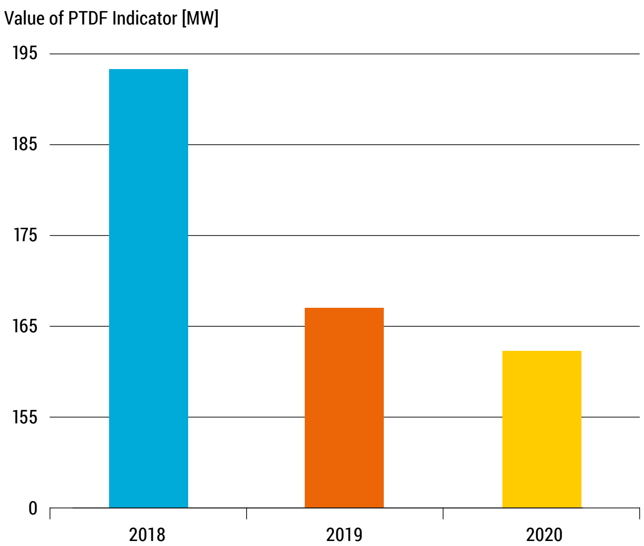



Figure 57: Average values of indicators among all borders (All borders for which 2018, 2019 and 2020 data is available have been considered in the average.)

# 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, one distinguishes between financial and physical firmness costs. Congestion income and firmness costs are relevant with regard to bidding zones since to an extent they indicate internal and cross-border congestions.

## 4.1 Congestion income

Congestion income is defined in Article 2.16 of the Regulation (EU) 2015/1222 (CACM Regulation) as "the revenues received as a result of capacity allocation". The capacity allocation could be long-term, day-ahead and/or intraday, as well as either explicit or implicit. These revenues are shared between involved TSOs, 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 "General principles of capacity allocation and congestion management" of Regulation 2019/943, 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.

Total yearly income data was gathered on a country level for 2018, 2019 and 2020, and the revenues are presented in the graphs below. The income data was gathered on country and border levels for those borders where capacity allocation mechanisms exist. For the few countries (Italy, Norway, Sweden, Denmark) which have more than one bidding zone, the internal congestion income is represented at the top of bar. In October 2018, the border DE - AT was introduced after a split of the DE/LU/AT Bidding Zone.

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

- Development of prices in individual countries (this 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?).
- Amount of capacity made available to the market. This impacts prices but also determines the volume that can be traded (so there may be a lower volume, but due to reduced capacity there may also exist an increased willingness of traders to pay high prices).
- Grid investments (may lead to more cross-zonal capacity on a specific border to be offered to the market and may lead to lower prices).
- Method of capacity allocation (implicit vs explicit, where implicit allocation leads to higher price convergence and thus to lower price difference).
- The number of borders a country shares with other countries (the more borders one has, the more congestion income one may 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) may lead to new congestion income and thus to more total congestion income (so more cross-zonal capacity does not automatically lead to reduced congestion income).

A short analysis accompanies each graph. This analysis is complemented by an assessment done by the TSOs at the end of the section.

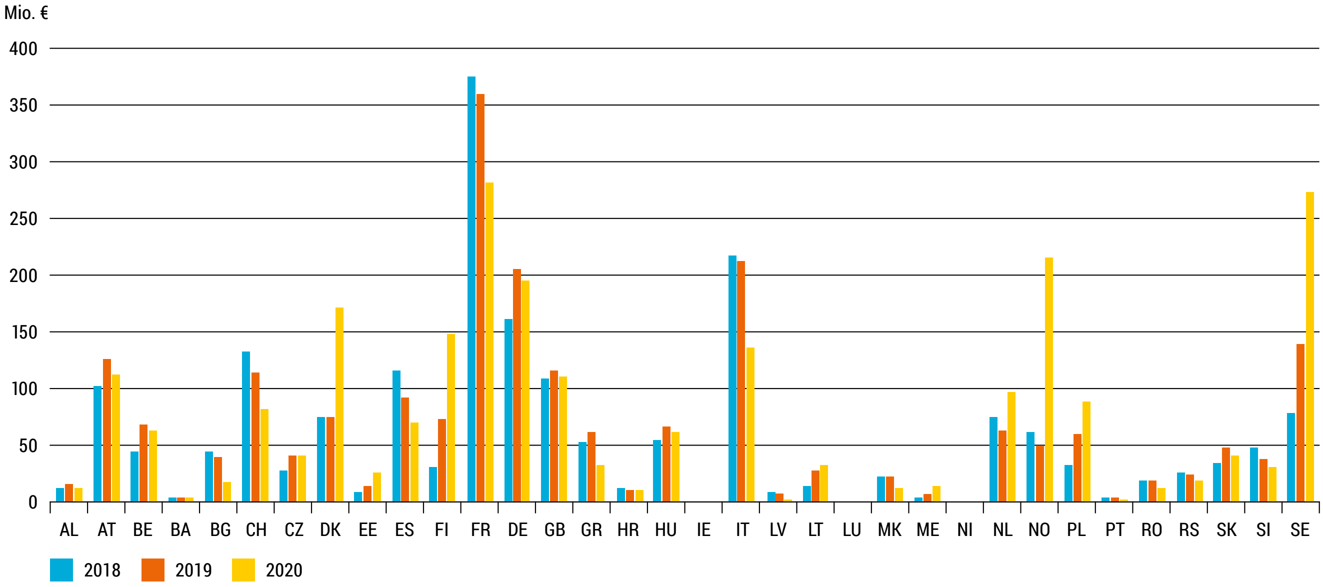



Figure 58: Congestion Income 2018–2020

From the graph above it is evident that very high congestion revenues were received in France, Italy, Germany, Sweden and Norway. Congestion income was relatively stable for most countries but increased substantially in the Nordics in 2020.

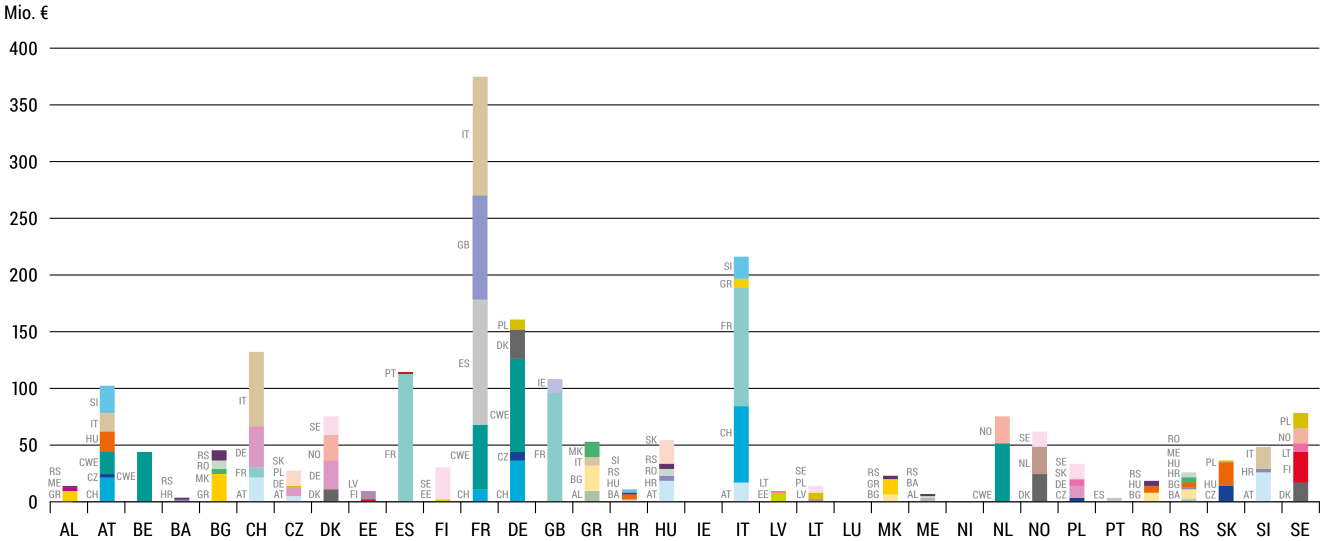



Figure 59: Congestion income 2018

As can be seen from the graph for 2018, FR, IT and DE received the highest quantities of congestion income. As the revenues from flow-based day-ahead allocation cannot be split per border, only the total value of congestion income for all the CWE borders can be displayed for the concerned countries.

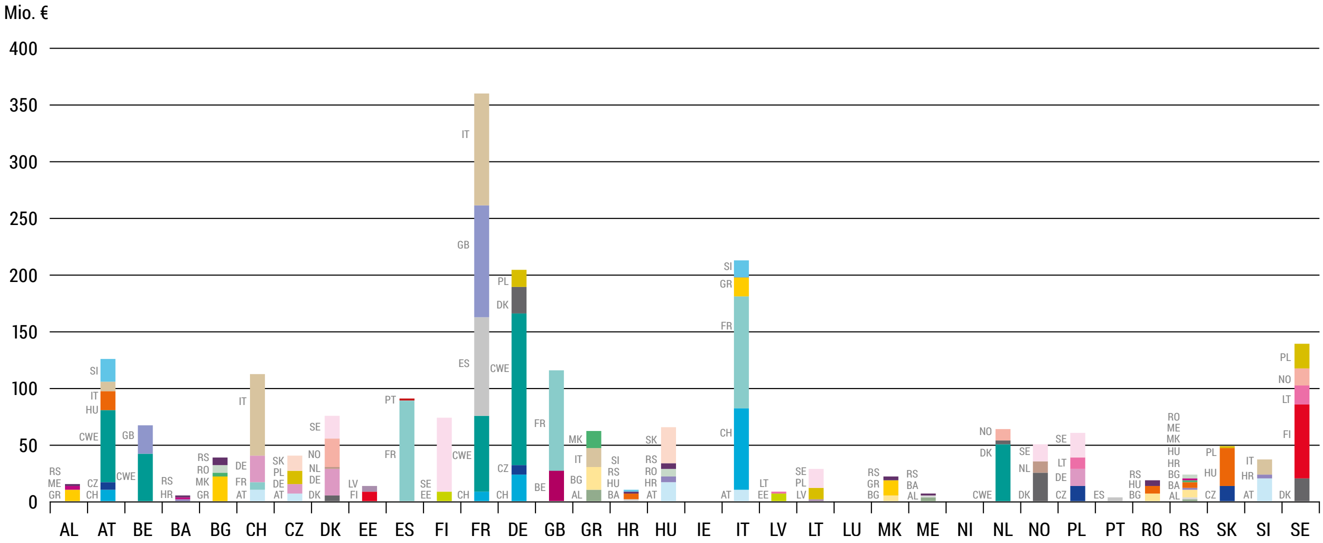



Figure 60: Congestion income 2019

As can be seen from the graph for 2019, FR, IT and DE still have the most congestion income from the capacity allocation process.

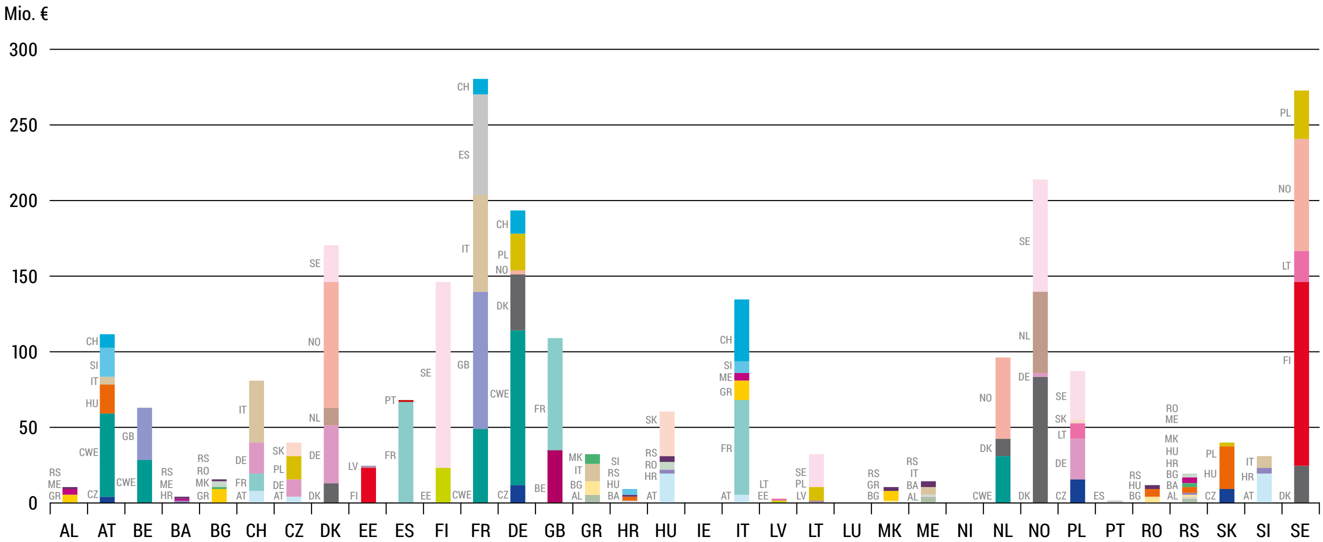



Figure 61: Congestion income 2020

As can be seen from the graph for 2020, congestion income in the Nordics has increased significantly. SE, FR and NO now have the most congestion income, followed by DE, DK and FI.

### 4.1.1 Summary and comments from TSOs for congestion income

The Congestion income sub-chapter is prepared according to the requirements stated in the Article 34 of the CACM Regulation as well as Article 16 "General principles of capacity allocation and congestion management" of Regulation 2019/943. The "Congestion income revenues" part presents the total yearly incomes on a country level for three different years and on a border level for those borders where capacity allocation mechanisms exist.

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

#### Albania

Congestion income for OST varies between EUR 10 million and 12 million each year.

#### Austria

Austrian congestion income varies between EUR 100 million and EUR 120 million over the period 2018–2020. The increase in congestion income from 2018 to 2019 is mainly caused by the split of the DE/AT bidding zone in October 2018. The decrease in 2020 can primarily be explained by the special market situation due to COVID-19.

#### Belgium

Regulatory-wise the congestion income on the BE-GB interconnector NemoLink is separated from the Belgian congestion income, yet for the sake of simplicity the congestion income as illustrated on the graphs includes half of the congestion income reported through NemoLink.

The CWE congestion income varies in the range of EUR 45 – 30 million in the period from 2018 to 2020. In 2018 and 2019 the congestion income levels were stable between EUR 40–45 million. The decrease in 2020 can be attributed to the effects of the COVID-19 pandemic on the electricity market.

#### Bulgaria

Bulgarian congestion income varies in the range of EUR 42–50 million in the period 2018–2019 for both EU and non-EU borders. In 2020 the congestion income drops to EUR 24 million. The decrease in 2020 can be attributed to the effects of the COVID-19 pandemic on the electricity market.

#### Croatia

Since June 2018, Croatia is in market coupling with Slovenia, and since then Croatia has had occasional congestion on the border with Slovenia in the direction from Slovenia to Croatia. Congestion income peaked in the year 2019, and since then congestion income has decreased.

#### Czech Republic

For the Czech Republic, revenues are generally stable and unchanged. The difference between 2018 and 2019 was mainly due to the launch of long-term auctions on the CZ-SK profile. The change is expected with Interim coupling launched in June 2021 and the subsequent FB MC in 2022. From the observation of price formation after Interim coupling, a slight average increase in congestion income is possible, but so far there is not enough data for a statistically reliable estimate.

#### 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 2020, congestion income increases rapidly, as can be seen in the numbers for the same year. The largest fraction of the congestion income comes from the DK1-NO2 border, which is a direct result of the high supply of hydrological energy in the Nordics, which decreases prices in the region and increases fuel costs ($CO_2$, gas, coal) throughout Europe and particularly in Germany.

#### Estonia

Congestion income has slightly increased from 2018. Congestion income in 2020 was generally higher due to higher imports from the Nordic countries.

#### Finland

Congestion income was slightly higher during 2018–2019 and reached a record high in 2020 compared to the historical long-term average. Congestion incomes above the long-term average are due to the Finnish bidding zone dependence on import electricity from Sweden (SE1-FI, SE3-FI) where most congestion income historically has been generated. Furthermore, the Baltic States' increased dependence on relatively inexpensive electricity has increased congestion income in Finland.

High congestion income is due to a plentiful hydrological situation and high wind production in the Nordics, in addition to lower consumption due to the COVID-19 pandemic in 2020. As a result, prices were extremely low in certain areas of the Nordic market, particularly the prices of Norwegian bidding zones, which has been a driving force of increased price differences in the Nordics. Also, an increased $CO_2$ emission allowance price began to affect the price difference in the Finnish bidding zone at the end of 2020.

## France

After a spike in 2018, French congestion income decreased to reach EUR 283 million in 2020. It is balanced between all borders, except the Swiss border, due to the historical long-term contracts that give priority and free access to capacity.

## Hungary

Congestion income was relatively stable over the years. The Austrian, Slovak and Romanian borders were the primary contributors to the total income.

## Italy

Congestion income was mainly associated with the borders with France and Switzerland. Values were stable over the years with a decrease in 2020, particularly for the border with Switzerland.

## Latvia

Congestion on both borders, EE-LV and LV-LT, mainly occurred in the summer periods, when local generation was lower and temperatures and repairs had lowered transmission capacities.

## Lithuania

Congestion income has increased significantly since 2019 due to higher imports from Sweden and higher exports to Poland.

## Luxembourg

No comments, since Luxembourg has no congestion income.

## Netherlands

Congestion income increased in 2020, mainly due to higher income from Norway. Increased price differences (prices in NO2 are increasingly lower than in NL) lead to higher congestion income.

In addition, congestion income from CWE shows a decreasing trend, caused by greater price convergence within the region.

## Norway

There was a significant increase in congestion income in 2020. This is due to fundamental price drivers in the Nordics and on the continent. In the Nordics, high hydrological inflows cased low prices, whereas increased fuel cost (CO2, gas, coal) in Europe and particularly Germany caused higher prices there. Additionally, in Q4 2020, the new NordLink HVDC interconnector between Norway and Germany became operational (it is currently in the test phase, but still generates some congestion revenues).

## Poland

PSE recorded a slight increase in congestion income between 2018 and 2020.

## Slovakia

The congestion income for Slovakia is usually stable and has not changed significantly over the years.

## Slovenia

In recent years, Slovenia has faced a gradual decrease in the total congestion rent. This is mainly related to the decreasing price difference between the German and Italian markets on one side and on the other fewer and fewer surpluses of energy in SE Europe. Some effects can also be attributed to the splitting of the German-Austrian bidding zone.

## Spain

More than 98 % of congestion income collected is generated at the FR-ES border, which is by far that which presents a highest utilisation ratio (60.6 % of hours presented congestion after the day-ahead market in 2020 compared to 4.1 % in the case of the PT-ES border) and day-ahead market spread (5.85 €/MWh in 2020 compared to 0.12 €/MWh in PT-ES).

Spain experienced a gradual decrease in congestion incomes from 2018 to 2020 due to both a progressive increase in cross-zonal capacity at the FR-ES border and a decreasing tendency in day-ahead market spread between France and Spain, which has been exacerbated in 2020 (5.85 €/MWh compared to 10.81 €/MWh and 10.12 €/MWh in 2018 and 2019 respectively) in the context of the special situation around the day-ahead markets caused by the COVID-19 crisis. As it can be seen, both the ratio of utilisation and the day-ahead market spread indicate the need for reinforcement of the FR-ES interconnection to allow proper integration of the Iberian Peninsula in the Internal Electricity Market.

#### Sweden

During 2020, electricity prices were generally low, but price differences between areas were large, which resulted in exceptionally high congestion income. The high congestion income derives from a price situation caused by mild, wet, and windy weather during winter and prolonged maintenance periods and reduced transmission capacities during summer.

## 4.2 Firmness costs and volumes

According to CACM Regulation, '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:

- Financial firmness costs: If there is 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 bidding zone, 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 Member States of the EU have been set forth in harmonised allocation rules for long-term transmission rights 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'). The HAR considers the general principles, goals and other methodologies set out in the Regulation (EU) 2016/1719 and in these Allocation Rules, as well as including the related regional and/or border-specific annexes and contains the terms and conditions for the allocation of Long- Term Transmission Rights on Bidding Zone borders in the European Union.

**The HAR contains:**

- At minimum, harmonised definitions and scopes of application,
- The description of the allocation process or procedure for long-term transmission rights, 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 long-term transmission rights, the use-it-or-sell-it principle, rules as regards force majeure and liability,
- regional or bidding zone border specific requirements with regard (but not limited) to the description of the type of long-term transmission rights which are offered on each bidding zone border within the capacity calculation region,
- the type of long-term transmission rights remuneration regime to be applied on each bidding zone border within the capacity calculation region according to the allocation in the DA time frame,

- 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 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 or safety of power systems or other costs for financial firmness. The related financial firmness costs were delivered on a TSO level for 2018, 2019 and 2020 and they are represented as total financial firmness costs and firmness costs by border.

Please note that financial firmness costs are usually shared between the involved TSOs, but not always equally. The costs that country A had to pay for border A/B need to be added to the costs that country B had to pay for border A/B in case of curtailment. Costs are reported on a TSO basis.

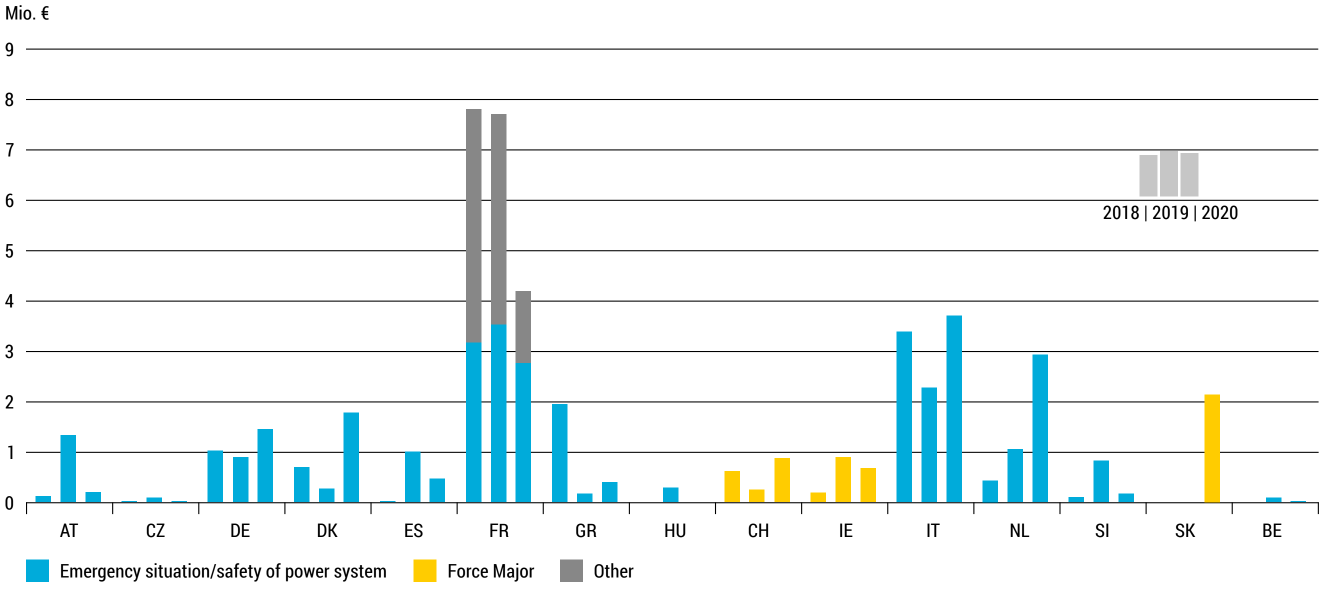



Figure 62: Total financial firmness costs

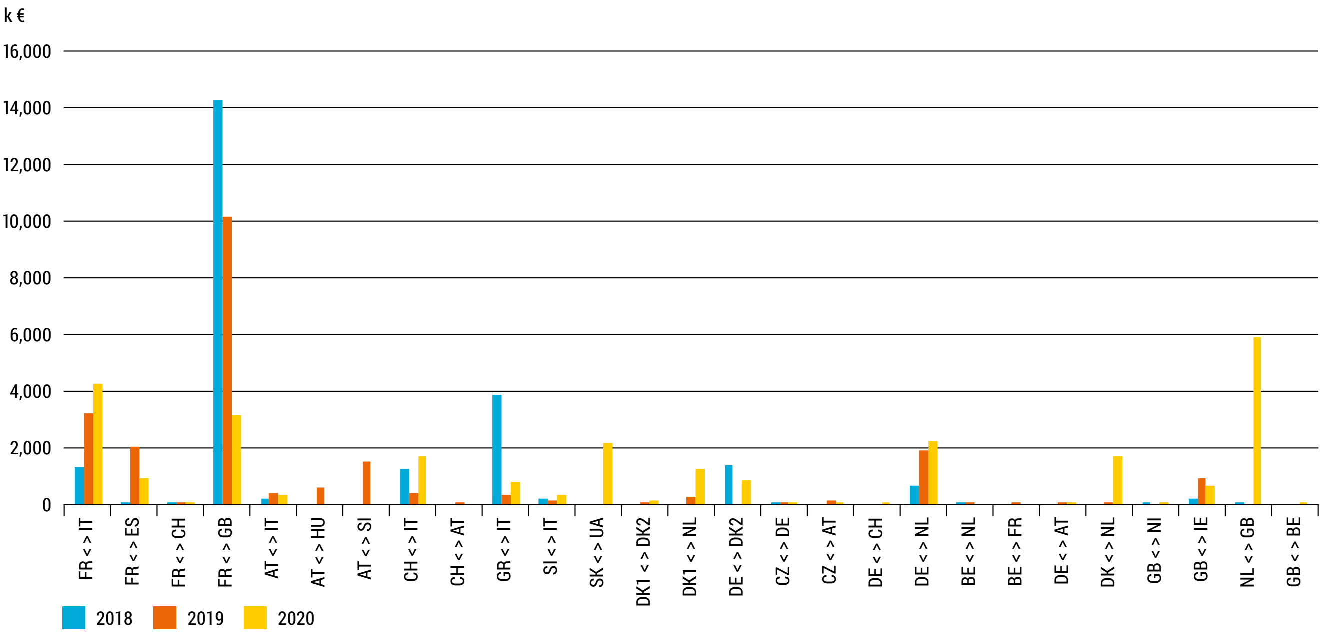



Figure 63: Financial firmness costs by border

As can be seen in Figure 62, most of the costs paid in order to ensure the financial firmness of cross-border capacity in the years 2018–2020 are due to curtailments caused by emergency situations, safety of the power systems or other reasons. Highest costs are observed in France and Italy. The costs in the Netherlands almost doubled year by year.

The detailed representation of total financial firmness costs by border for the respective years only shows borders which have applied financial firmness. Borders with zero values are not included. It is observed that the highest costs for financial firmness appeared on the border France-Great Britain followed by France-Italy. High costs are observed on the border Netherlands-Great Britain for the year 2020.

#### 4.2.1.1 Summary and comments from TSOs for financial firmness costs

The financial firmness was delivered for three years as total amounts and they differentiate between force majeure, emergency situations/safety of power system and others. However, they are presented for three years by costs per cross-border as well as by reason for curtailment.

##### Austria

Financial firmness costs in the period from 2018 to 2020 are small compared to congestion income during the given period. In 2018 and 2020, financial firmness costs varied between EUR 100k and EUR 190k. In 2019, financial firmness costs were higher due to capacity reduction at the borders of AT – HU, AT – SI and AT – IT because of critical grid situations.

##### Belgium

In March 2019, an exceptional curtailment had to be performed on the FR – BE border due to planned outages that took longer than foreseen. In line with HAR, full compensation of EUR 69 k has been granted.

##### Bulgaria

During years 2018 – 2020, no curtailments were performed and no financial firmness costs were recorded.

##### Croatia

In exceptional cases of high power flows during high hydrological conditions in the region, we had to limit intraday capacities with BA and SI to ensure operational security in the transmission network. No financial firmness costs occurred in those situations.

##### Denmark

The large congestion income on most of the Danish borders out represent the relativly small financial firmness which are to be found on the borderrs where LTTRs are offered.

##### France

Financial firmness costs in France are small in comparison with its high congestion income.

The main portion of the financial firmness costs is at the British border and is linked to the imbalances which are financially settled on this border (while they are physically settled on the other borders of France). The reported values of the costs have not been confirmed by the National Grid.

On the Italian border, financial firmness costs and volumes increased between 2018 and 2020, due to more important capacity reductions.

On the Spanish border, capacity reductions are more frequent and the spike of costs in 2019 is linked to higher price spreads.

##### Greece

For 2018, whole of financial firmness costs and volumes occurred on the IT – GR border. Since the interconnection between Italy and Greece is composed by only one HVDC cable, planned and unplanned outages of the link required the application of curtailment measures to ensure system security. For 2019 and 2020, financial firmness costs and volumes between Italy and Greece had a significant reduction thanks to the reduction of outages.

##### Hungary

Hungary had a curtailment once in 2019, when the capacity on the Austrian-Hungarian border was reduced. There was no other case registered in the period 2018 – 2020.

## Italy

For 2018, 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 2019 and 2020, financial firmness costs and volumes between Italy and Greece saw a significant reduction thanks to the reduction of outages. For these years, the greatest values are represented by the interconnection with the France border.

## Latvia

No curtailment process were applied.

## Lithuania

During years 2018-2020, no curtailments were performed.

## Luxembourg

No comments; since Luxembourg does not commercialise any border, no firmness costs or volumes are required.

## Netherlands

2020 shows a significant increase of financial firmness costs (specifically NL <> DK), due to an unscheduled outage of the COBRA-cable for three months (Oct-Dec), which led to significant costs regarding financial firmness (EUR 800 k).

Financial firmness costs for the border NL – DE/LUX increased in 2019 (EUR 600 k) and 2020 (EUR 300 k). The increase in costs is due to an increasing quantity of LTA rights being cancelled.

## Poland

For the years analysed (2018–2020), PSE did not record financial firmness costs.

## Slovakia

We recorded one event during the years 2018, 2019, and 2020: the request from the Ukrainian TSO, received in March 2020, to disconnect the 400 kV transmission line Veľké Kapušany – Mukačevo, when the cross-border transmission capacity on the SK/UA profile was reduced.

## Slovenia

Financial firmness costs in the period from 2018 to 2020 represent roughly 1 % of total congestion income in the given period. They varied from EUR 100k to EUR 820k in this period. Historically, these costs are mostly related to the reduction of capacity on SI-IT and the AT-SI border.

## Spain

In the three-year study period, curtailments were only applied at the FR–ES border. The spike in firmness compensation costs was reached during the period between April and July 2019 and mainly in the FR–ES direction, due to a specific unplanned network situation in the French electric system with relevance to the interconnection that led to a significant reduction on already allocated cross-zonal capacity. The curtailed capacity was compensated at positive market spread. This amount is deducted from the congestion income.

### 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, there may also be measures needed to solve internal congestions within a bidding zone. For the purposes of this report, such measures are considered part of physical firmness volumes and costs.

Each participating TSO delivered the costs and respective volumes for 2018, 2019 and 2020 for all measures that have been taken 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 bidding zone borders, including multilateral redispatch. Internal redispatch means redispatch measures activated within the bidding zone. For most TSOs, these classic measures are not filtered to separate them in cross-border relevant and non-cross-border relevant or current and voltage related measures but contain all measures of each TSO.

The measures 'renewable curtailment' 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 category 'other', TSOs included values such as:

- preventive restriction agreements
- Downward MEAS and MEAS
- Costs related to distribution system bottlenecks (in normal situations or during special maintenance situations)
- Planned and unplanned outages

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 comments from TSOs).

For Germany, Austria, and Luxembourg, the split of the bidding zone dividing Germany/Luxembourg from Austria in October 2018 must also be considered. For CH only, the volumes of the measures have been reported, as the costs are only available for the national NRA.

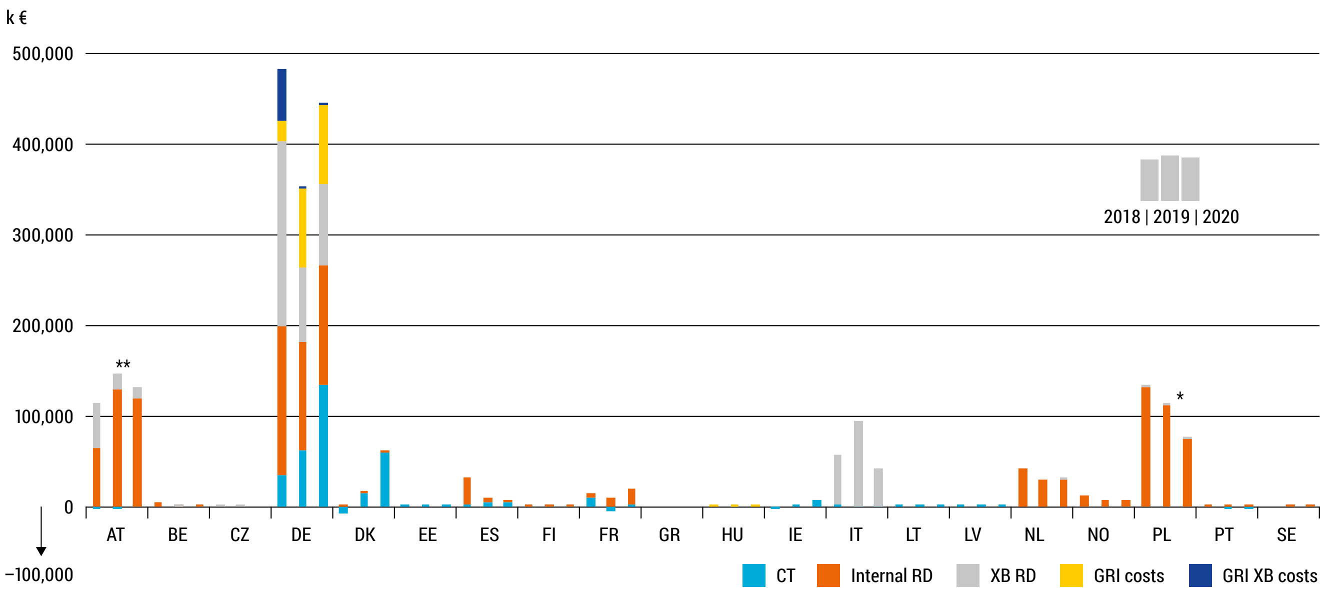



Figure 64: Costs of measures applied

* Since PSE applies ISP, cost and volume reported by PSE cover the whole ISP, i. e. not only congestion management, and thus reported cost and volume should be deemed to be strongly overestimated. For a more detailed explanation, see Section 4.2.2.1. ** Redispatch and grid reserves are illustrated in a summarised form in this graph to prevent unintended market repercussions. Detailed data were provided to the regulatory authorities in a transparent manner.

The graph shows countertrade (CT), internal redispatch (internal RD), cross-border redispatch (XB RD), internal grid reserves (GRI) and cross-border grid reserves (GR XB) for the years 2018, 2019 and 2020. Costs have to be analysed in conjunction with volumes (see figure 66). Data on physical firmness costs are not provided for Switzerland.

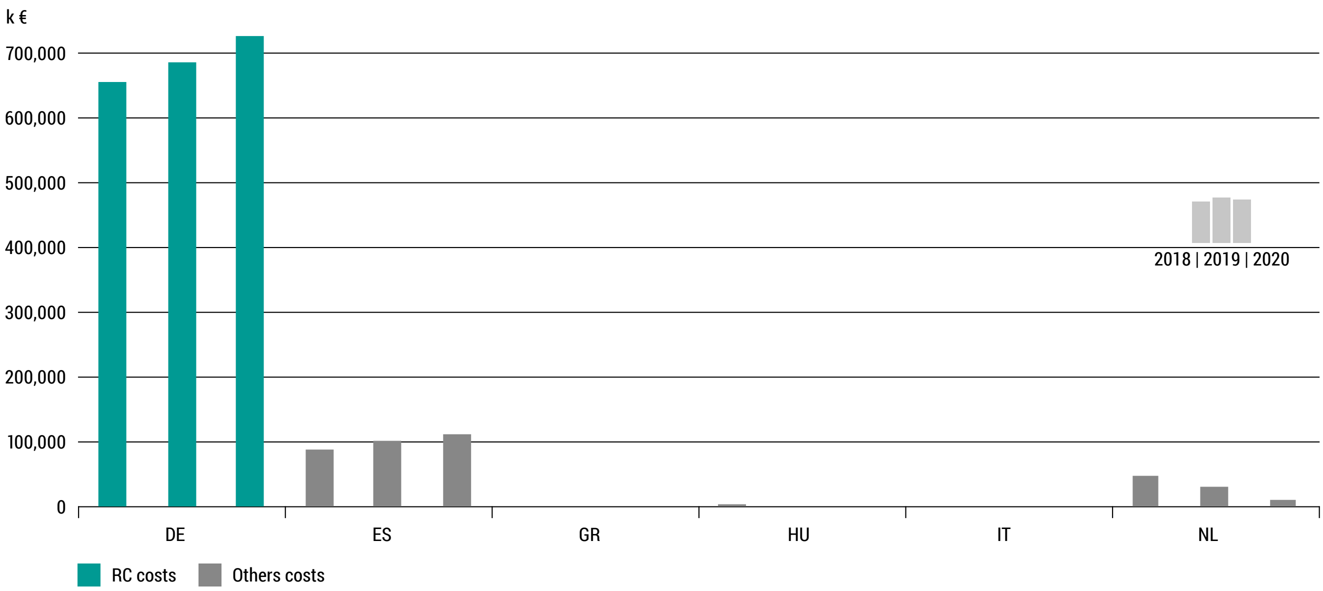



Figure 65: Costs for other measures applied.

This graph shows the countries which have reported costs for other measures such as renewable curtailment (RC), and other costs related to congestion management. The costs related to renewable curtailment are difficult to compare amongst countries, as they result from different compensation rules, which are subject to political decisions. The values in the category 'other' for the Netherlands are related to preventive restriction agreements. The values in the category 'other' for Hungary represent costs related to distribution system bottlenecks related to ensuring special maintenance situations. The values in the category 'other' for Spain represent costs related to distribution system bottlenecks related to ensuring the distribution network security and planned or unplanned outages. The highest value is observed in DE, followed by ES and NL.

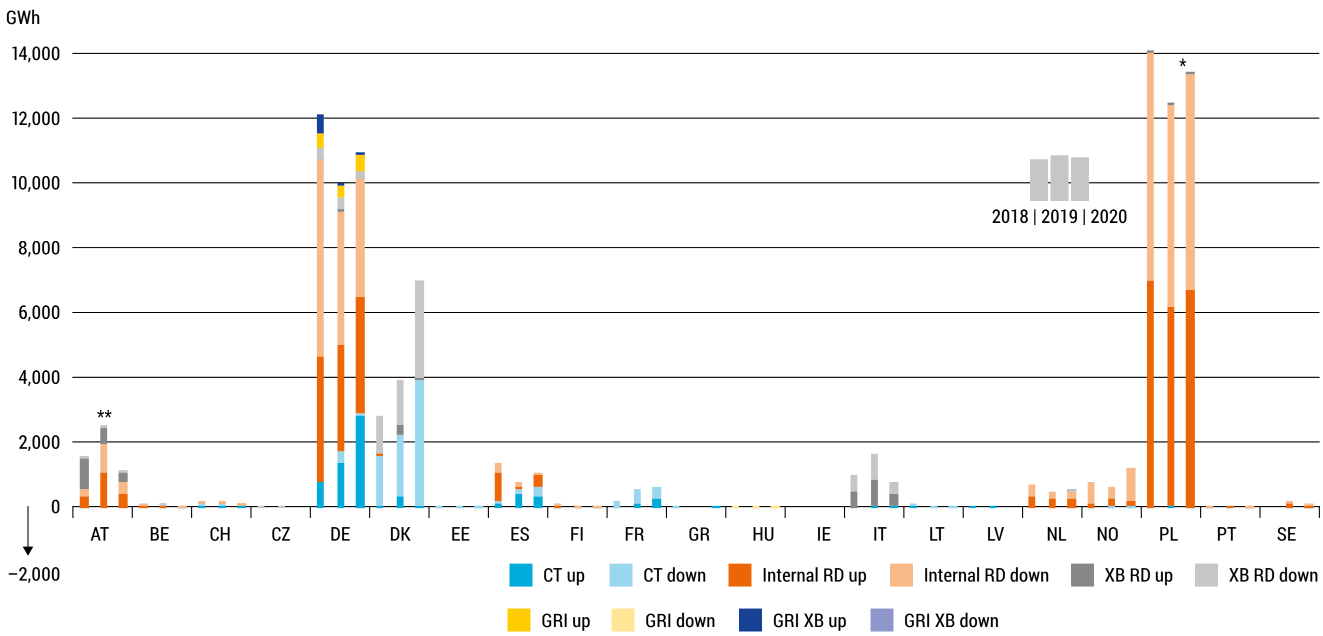



Figure 66: Volume of measures applied

*Since PSE applies ISP, the cost and volume reported by PSE cover the whole ISP, i.e., not only congestion management, and thus reported cost and volume should be deemed to be strongly overestimated. For a more detailed explanation, see Section 4.2.2.1. ** Redispatch and grid reserves are illustrated in a summarised form in this graph to prevent unintended market repercussions. Detailed data were provided to the regulatory authorities in a transparent manner.

This graph shows measures of 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; economic and/or political factors such as prices or regulated components are not included in this measure.

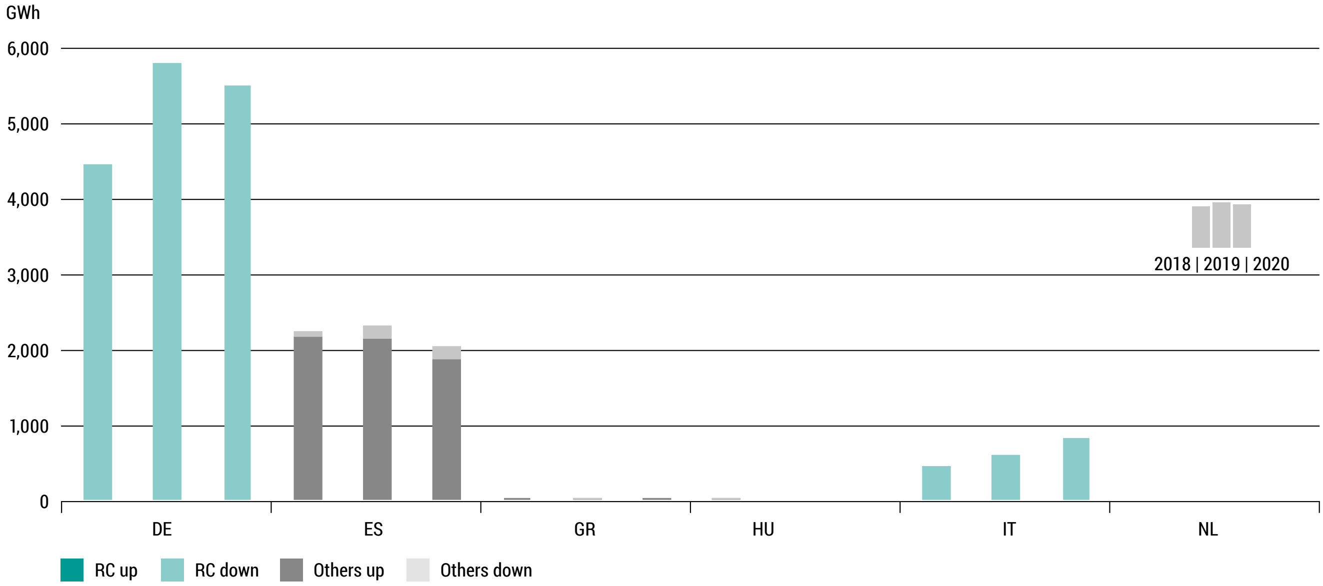



Figure 67: Volume of other measures applied

The figure shows the evolution of volumes of other measures such as renewable curtailment (RC) and other measures of congestion management. Renewable curtailment is highly related to installed RES production capacities in the respective countries. The values in the category 'other' for the Netherlands are related to preventive restriction agreements. The values in the category 'other' for Hungary represent volumes related to distribution system bottlenecks for ensuring special maintenance situations. The values in the category 'other' for Spain represent volumes related to distribution system bottlenecks for ensuring distribution network security and planned or unplanned outages. The highest value is observed in DE, followed by ES and IT.

Further analyses on the physical firmness costs and volumes can be found in Annex II, Figure 118 and 119.

### 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 bidding zones and to guarantee unchanged cross-zonal capacity rights.

TSOs were asked to report on the costs and respective volumes of all measures that were taken to manage congestions, regardless of the product design or activation process, for the years 2018, 2019 and 2020. The measures are categorised and presented in two graphs. The first contains congestion management measures such as countertrade, redispatch and grid reserves which are divided into internal and cross-border activation. Moreover, measures which might not be relevant for all TSOs are presented under the category 'Other'. Generally, the figures contain all measures of TSOs, whether triggered by voltage or current related problems and whether or not they are of 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 RES curtailment 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 RES curtailment compensation scheme, which aims to incentivise and support RES according to the Green Deal of the European Union. 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 illustrated in a summarised form in this report to prevent unintended market repercussions. Detailed data were provided to the regulatory authorities in a transparent manner.

Total physical firmness costs incurred by APG were between EUR 116 million and EUR 149 million per year from 2018 to 2020. After a peak in 2019, the cost of the measures applied decreased slightly in 2020. The greater part of the costs in 2019 and 2020 were caused by internal redispatch.

Total physical firmness volume activated in Austria was at its highest in 2019, with 2497 GWh and at its lowest in 2020, with 1123 GWh for the period under consideration. For the years in scope, internal redispatch up constitutes the greater part of the volume of measures applied, followed by cross-border redispatch up and internal redispatch down.

It must be emphasised that the data for 2020 should be interpreted with caution with respect to the volume and costs of activated remedial actions since these data have been strongly influenced by the COVID-19 pandemic, which led to a decrease in energy consumption within Europe.

## 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 a great deal of time and effort into the optimisation of non-costly remedial actions which for the time being permit it to keep redispatching needs relatively limited.

## Bulgaria

No cross-border redispatching and counter trading with neighbouring TSOs were applied during the period 2018-2020.

## Croatia

HOPS currently uses occasional free redispatching (limiting the production of individual power plants).

## Denmark

The increasing volume of physical firmness is largely due to the strong collaboration between TSOs to solve congestion until such a time as they can solved by infrastructure means.

## Finland

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

Counter-trading and internal redispatching volumes were normal during the years 2019–2020. In 2018, greater volumes originated from the Olkiluoto nuclear power plant (located in southern Finland) due to outage and disconnection of one of the transmission lines between north and south of Finland.

The resources of counter-trading and internal redispatch are market-based. Due to this, prices are generally slightly higher than the average day-ahead price in Finland.

## France

The low 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. Countertrading amounts are decreasing, and activations are concentrated at the FR-ES border.

## Germany

The overall volumes and costs of measures that German TSOs consider relevant for physical firmness are higher compared to other countries or bidding zones. The reasons behind this are manifold and a more detailed analysis is necessary in the context of comparison across European countries.

According to CACM, the German reported values contain all costs and volumes of congestion management measures, including voltage-related and local measures triggered by system needs which could not be relieved by a bidding zone reconfiguration.

First, it must be acknowledged that renewable curtailment accounts for a significant share of volume and costs. Germany has 62 GW installed wind power capacity onshore and offshore as of 2021, which represents 27 % of its overall production capacity.[5] Hence, Germany has already made significant steps towards the overall goal which the European Union formulated in the EU Green Deal. One measure aiding the faster deployment of renewable energy sources (RES) is an adequate compensation scheme that grants RES producers a fixed and corresponding compensation in case of curtailment. Furthermore, curtailment of RES producers is subordinate to conventional energy sources. Therefore, renewable curtailment costs, which are mainly driven by wind production in Germany, cannot easily be compared fairly between countries since the legal framework, which is a result of political decisions, varies greatly. It is of note that RES producers might even receive a compensation of zero in some countries. Hence, the volumes representing the actual physics are a more relevant figure.

Second, when comparing the volumes of congestion management measures, the huge size of Germany must be acknowledged. For example, in 2018, Germany used measures in the order of around 3 % of its yearly consumption to manage congestions (consumption 538.1 TWh; sum of measures 16.6 TWh). The range of these values in Europe is from 0.01 % up to 8.6 %[6]. In 2020, the overall volumes of congestion management measures [16.3 TWh] amounted to 2.9 % of annual net electricity production [553 TWh].

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

Finally and importantly, Germany is not only in the centre of Europe but also in the midst of a major system change, so tremendous efforts are put into analyzing the system and modelling the future while taking into account several scenarios that might materialise. One of these network analyses, the so-called 'Bedarfsanalyse' (BA), which translated to "to determine the prospective redispatch volume and therefore the required reserve power plants", is performed to determine the prospective redispatch volume and therefore the required reserve power plants. The latest results show a clear and notable decrease in yearly redispatch volumes, as displayed in figure 68.

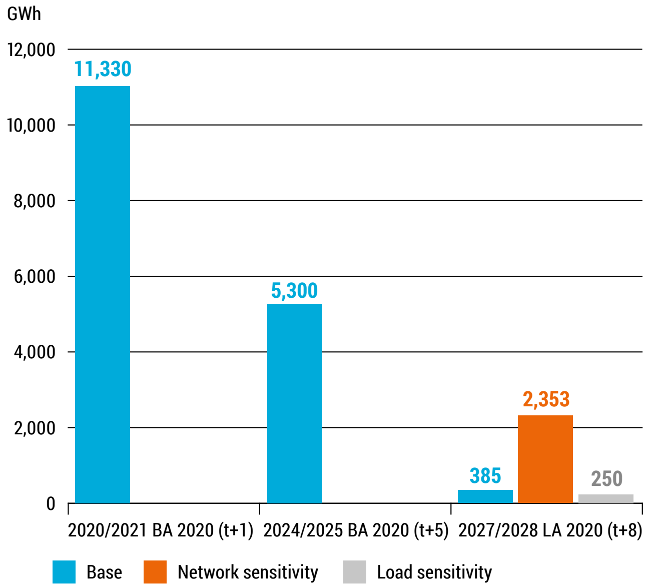



Figure 68: Total redispatch volume over the year (8,760h) in GWh. Source: German TSOs, 'Executive Summary, langfristige Netzanalyse 2020 (t+8)', page 7

The forecast for the years 2024/2025 already shows a considerable decrease equal to more than half of the volume for the years 2020/2021. In 2027/2028, the decrease is even more pronounced and robust over the calculated base case and the two sensitivities. The main reasons for the expected decrease are various projects aimed at expanding the network[7] that are planned or under construction, along with the stepwise decommissioning of hard coal plants. Moreover, the final decommissioning of nuclear power plants at the end of 2022

5 Bundesnetzagentur, SMARD.de, (downloaded 29th July 2021); for an European overview see "Cumulative wind power capacity in the European Union (EU-28) as of 2019, by country (in megawatts)", accessed 29th July, 2021

6 Based on own calculations. Data source for consumption is the ENTSO-E Statistical Factsheet.

7 For details see www.netzentwicklungsplan.de

further relieves congestion, as two of the relevant plants are in the north of Germany, affecting north-south flows. The two sensitivities shown here have been discovered to highly influence redispatch volumes. They incorporate potential delays in network development projects and reduced load.[8]

## Hungary

In Hungary, redispatch was only applied in a few cases in the period 2018 – 2020, mostly to ensure sufficient grid reserves.

There were a few cases in 2018 in which internal redispatch was activated because of distribution system security violations in special maintenance cases. These cases did not have cross-border relevance.

Hungary continued its participation in the Multilateral Remedial Action (MRA) agreement among the members of the TSC security cooperation and contributed twice to relevant multilateral measures in 2019.

## 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 an SCOPF algorithm (to minimise system costs), costs and volumes cannot be associated ex post to a single constraint in a straightforward way.

## Latvia

In Latvia, redispatch is not used and countertrade was only applied due to congestions on the Latvian- Estonian border.

## Lithuania

In Lithuania, redispatch is not applied, but countertrade was applied due to congestions on HVDC links LT-SE4 and LT-PL.

## Luxembourg

No comments; as Luxembourg does not commercialise any border, no firmness cost and volumes are required.

## Netherlands

During the period 2018 – 2020, the total physical firmness costs increased from EUR 53.5 million in 2018 to 78.7 million in 2020. Besides the application of (internal) redispatch, TenneT also resolves congestion problems through restriction agreements with market participants in the case of insufficient bids or frequent congestion problems in a specific area. The involved market participants limit their electricity generation or offtake in a specific region when called upon by TenneT, in return for a negotiated compensation. TenneT makes use of negotiated restriction agreements in case congestion issues persist over a longer period of time, typically during planned and unplanned grid outages. The costs for these restriction agreements have been reported under 'other'.

The increase of physical firmness costs can mostly be attributed to an increase of the costs for restriction agreements. The underlying cause is a combination of an increased utilisation of the Dutch grid, as well as an intensified investment and maintenance program to upgrade the capacity of the Dutch grid. In order to upgrade the capacity of network elements, the network elements are temporarily taken out of operation and TenneT has to take measures such as restriction agreements to maintain operational security while guaranteeing financial and physical firmness of allocated cross-zonal and internal capacity. TenneT regards these costs as unavoidable costs to be able to in the long term provide more capacity for the market.

## Norway

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

The resources of counter-trading and internal redispatch are market-based. Due to this, prices are generally slightly higher than average day-ahead price in Norway.

8 Extensive material; for further information, click here

## Poland

In Poland, network constraints are managed within an ISP run by the TSO. The ISP process involves bid-based securi¬ty constraint unit commitment and economic dispatch, where balancing, reserve procurement and congestion management are co-optimised within one integrated process run by the TSO immediately after the DA market closure.

Due to the co-optimisation applied in the ISP process, it is not possible to calculate separate redispatching costs or redispatching volume, unlike in self-dispatch systems. In the ISP network constraints are identified and managed within one process that is integrated with balancing and reserves procurement. There is no sequential process that involves identification of overload and a subsequent manual decision to do congestion management. Therefore, any action taken by the TSO cannot be unambiguously assigned to any specific overload or even category of actions such as balancing or congestion management.

Consequently, the reported cost and volume cover the whole ISP, i. e. not only congestion management, and thus reported cost and volume should be deemed to be strongly overestimated.

## Slovakia

SEPS does not use costly remedial actions for relieving congestion.

## Slovenia

No additional cost has been induced based on redispatch.

## Spain

The costs of internal redispatch in the Spanish electrical system have decreased significantly from 2018 to 2020, mainly due to progressive commissioning of uprates, run-back automatisms or new network elements.

With regard to 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 border. Countertrading activations increased in 2019 and 2020 compared to 2018, mainly due to the increase in reductions of cross-zonal capacity after the day-ahead market.

In Spain, most physical firmness costs are caused by 'other costs' incurred in Spain, and are strictly composed of costs related to distribution system bottlenecks and to planned and unplanned outages, with costs related to ensuring distribution network security representing the principal contribution (over 89 %) to all physical firmness costs incurred in Spain in 2020.

## Sweden

Countertrade and internal redispatch are used in Sweden to relieve short-term congestions in the Swedish transmission network. The physical firmness costs for countertrade increased in 2020 relative to 2019, following decreased electricity production in southern Sweden and limited transmission capacities, both of which were consequences of prolonged maintenance periods for nuclear power plants in 2020.

The resources of counter-trading and internal redispatch are market based. Due to this, prices are generally slightly higher than the average day-ahead price in Sweden.

## 4.3 Conclusions

Chapter 4 provides information on collected congestion income, congestion management measure volumes and the respective costs incurred to ensure firmness of cross-border capacities.

For the years 2018 and 2019 the highest total congestion income was collected by France, Italy and Germany. The main factors that influence the amount of congestion income are described in the corresponding section. In 2020, the highest congestion incomes was collected by France, followed by Sweden and Norway, then Germany, Denmark, and Finland. Please note that congestion income for Great Britain is not always reported.

When it comes to the financial firmness costs incurred by TSOs to ensure firmness of cross-border capacities, these costs in all reported years are dominated by curtailments caused by emergency grid security or safety issues, followed by other reasons that TSOs did not specify. Italy and France had the highest costs over all three displayed years. In the Netherlands, financial firmness costs almost doubled year to year. Please note that the financial firmness cost for Great Britain is not always reported.

The highest costs for physical firmness measures were incurred by Germany, followed by Austria and Poland. The highest volumes of measures have been reported by Poland, Germany, and Denmark. In Germany, the costs for renewables curtailment compensation make up the majority of total physical firmness costs. These costs are influenced by the adequate compensation RES producers receive due to the underlying political decisions. When considering the cost-volume relation, this dependence can be clearly discovered. The values in Poland are overestimated, as explained in the sections above. There is no general trend visible for all countries. It seems that countries with high amounts of installed RES production capacities tend to manage higher volumes to deal with congestions. Still, it should be highlighted that a comparison of the absolute values of the countries should be read carefully. An analysis of the physics must carefully consider the volumes of measures and relate them to relevant factors, including but not limited to country size.

**It should be noted that it is important to consider explanations from each country.**


Price
Avg 15
Vol
Real-Time
Weekly
Volatility Index
1D
5D
Open 150.23
High 152.43
Low 147.34
Close 148.30
Volume 1.89M
%Change 1.25%
Jan
Feb
Mar
Apr
May
Indicators
Date Range
Comparison
Settings
Share
Reset

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

The CEP entered into force on 4 July 2019. As one of the main provisions of Regulation (EU) 2019/943 on the internal market for electricity (EU electricity regulation), it specified that from 1 January 2020, at least 70 % of the capacity of internal and cross-zonal critical network elements, taking into account contingencies, (CNECs) had to be made available for cross-zonal electricity trading at borders using a flow-based approach, with 70 % of the transmission capacity respecting operational security limits after deductions of contingencies set for trading of borders using a coordinated net transmission capacity approach (Article 16(8)). The inclusion of 'derogations'[9] and 'action plans'[10] in the EU electricity regulation provides temporary exemptions, which can be applied to achieve the 70 % (CEP70) target via a transitionary phase.

During the legislative process, ENTSO-E raised concerns as to whether a general minimum cross-zonal trading margin would be an appropriate instrument to enhance European market integration. While ENTSO-E fully supports the general optimisation of the use of trading capacities, the economic and technical impact of the CEP70 target requires further analysis and discussion. Such an assessment should particularly focus on system security, economic efficiency and decarbonisation targets.

Nevertheless, TSOs and ENTSO-E continue to invest significant efforts and apply the appropriate tools to implement the existing CEP70 rule and achieve compliance with the legal provisions, while also accommodating fallback options to always ensure system security.

According to EU electricity regulations, the national regulatory authorities (NRAs) are responsible for assessing TSO compliance with the CEP70 rule. Moreover, ENTSO-E is required to publish this technical report every three years, which should assess whether the cross-zonal trade capacity met the CEP70 target (Article 14(2)).

## 5.1 CEP70: situation in 2020

The following table presents the status of the CEP70 provisions as of 2020. As a central performance indicator, the share of market time units (MTUs) during which the respective TSO achieved compliance with the CEP70 provisions is shown. Additional information and detailed graphs can be found in Annex III.

9 Option to deviate from the minimum cross-zonal capacity target for a predefined period. In 2020, this option was applied by Sweden, the Netherlands, Belgium, France, Spain, Portugal, Italy, Austria, Czech Republic, Poland, Hungary, Slovakia, Croatia, Romania, Bulgaria, and Greece.

10 Option to achieve the 70 % minimum cross-zonal trading capacity via a linear trajectory by 31 December 2025 in case of internal structural congestions. In 2020, this option was applied by the Netherlands, Germany, and Poland.

| Country | TSO | Border/Region | % of MTUs in which minimum target was reached (considering action plans and/or derogations) | % of MTUs in which TSOs consider themselves as compliant* | Exemption clause applied |
|---|---|---|---|---|---|
| Austria | APG | AT-CZ > HU > SI-AT | 100 % | 100 % | Derogation |
| Austria | APG | CWE | 100 % | 100 % | Derogation |
| Austria | APG | INB | 100 % | 100 % | Derogation |
| Belgium | Elia | CWE | 81.3 % | NRA appreciation, link | Derogation |
| Belgium | Elia | BE > GB | 95.5 % | NRA appreciation, link | Derogation |
| Belgium | Elia | GB > BE | 99.7 % | NRA appreciation, link | Derogation |
| Bulgaria | ESO | BG > GR | 100 % | 100 % | Derogation |
| Bulgaria | ESO | GR > BG | 100 % | 100 % | Derogation |
| Bulgaria | ESO | BG > RO | 100 % | 100 % | Derogation |
| Bulgaria | ESO | RO > BG | 100 % | 100 % | Derogation |
| Croatia | HOPS | HR > SI | 100 % | 100 % | Derogation |
| Croatia | HOPS | SI > HR | 100 % | 100 % | Derogation |
| Croatia | HOPS | HR > HU | 100 % | 100 % | Derogation |
| Croatia | HOPS | HU > HR | 100 % | 100 % | Derogation |
| Czech Republic | ČEPS | CZ > (AT + DE + PL + SK) | 100 % | 100 % | Derogation |
| Czech Republic | ČEPS | (AT + DE + PL + SK) > CZ | 100 % | 100 % | Derogation |
| Denmark | Energinet | NO2 > DK1 | 99.59 % | 99.59 % | |
| Denmark | Energinet | DK1 > NO2 | 99.37 % | 99.37 % | |
| Denmark | Energinet | DK1 > SE3 | 95.45 % | 99.45 % | |
| Denmark | Energinet | SE3 > DK1 | 92.71 % | 92.71 % | |
| Denmark | Energinet | DK2 > DK1 | 99.51 % | 99.51 % | |
| Denmark | Energinet | DK1 > DK2 | 97.75 % | 97.75 % | |
| Denmark | Energinet | DK1 > NL | 91.73 % | 91.73 % | |
| Denmark | Energinet | NL > DK1 | 100 % | 100 % | |
| Denmark | Energinet | DK2 > DE | 99.32 % | 99.32 % | |
| Denmark | Energinet | DE > DK2 | 99.32 % | 99.32 % | |
| Estonia | Elering | EE-FI | 100 % | 100 % | |
| Estonia | Elering | EE-LV | N/A | N/A | According to approved CACM CCM in Baltic CCR, the CC process does not foresee daily CC with CGM and therefore CNEs cannot be provided. |
| Finland | Fingrid | FI-SE1 | 100 % | 100 % | |
| Finland | Fingrid | FI-SE3 | 100 % | 100 % | |
| Finland | Fingrid | FI-EE | 100 % | 100 % | |

* Art. 16 of EU Electricity Regulation allows – as a measure of last resort – the reduction of the offered cross-zonal capacity below the minimum targets, if TSOs or RCCs, respectively, can justify that their application would endanger system security. Among many reasons, this can particularly apply due to insufficient availability of remedial actions to solve grid overloads resulting from the application of the CEP's minimum targets. Therefore, a given MTU can still be considered as compliant with the CEP's provisions, even if the minimum target was not reached. Consequently, two different performance indicators are presented in this table.

| Country | TSO | Border/Region | % of MTUs in which minimum target was reached (considering action plans and/or derogations) | % of MTUs in which TSOs consider themselves as compliant* | Exemption clause applied |
|---|---|---|---|---|---|
| France | RTE | CWE | 100 % | 100 % | Derogation |
| France | RTE | SWE | 100 % | 100 % | Derogation |
| France | RTE | NIB | 100 % | 100 % | Derogation |
| Germany | Amprion | CWE | 100 % | 100 % | Action Plan |
| Germany | Amprion | ALEGrO (CWE) | 100 % | 100 % | Action Plan |
| Germany | TransnetBW | CWE | 100 % | 100 % | Action Plan |
| Germany | 50Hertz | DK2 > DE | 100 % | 100 % | Action Plan |
| Germany | 50Hertz | DE > DK2 | 100 % | 100 % | Action Plan |
| Germany | TenneT Germany | DE > SE4 | 70.30 %** | 100 % | Action Plan |
| Germany | TenneT Germany | SE4 > DE | 99.99 % | 100 % | Action Plan |
| Germany | TenneT Germany | CWE | 100 % | 100 % | Action Plan |
| Germany | 50Hertz/ TenneT Germany | DE > PL/CZ | 100 % | 100 % | Action Plan |
| Germany | 50Hertz/ TenneT Germany | PL/CZ > DE | 100 % | 100 % | Action Plan |
| Germany | TenneT Germany | DE > DK1 | 100 % | 100 % | Action Plan |
| Germany | TenneT Germany | DK1 > DE | 100 % | 100 % | Action Plan |
| Germany | TenneT Germany | DE > NO2 | 100 % | 100 % | Action Plan |
| Germany | TenneT Germany | NO2 > DE | 100 % | 100 % | Action Plan |
| Greece | IPTO | SEE | 100 % | 100 % | Derogation |
| Greece | IPTO | GRIT | 100 % | 100 % | Derogation |
| Hungary | MAVIR | AT > HU | 100 % | 100 % | Derogation |
| Hungary | MAVIR | HR > HU | 100 % | 100 % | Derogation |
| Hungary | MAVIR | RO > HU | 100 % | 100 % | Derogation |
| Hungary | MAVIR | SK > HU | 100 % | 100 % | Derogation |
| Hungary | MAVIR | HU > AT | 100 % | 100 % | Derogation |
| Hungary | MAVIR | HU > HR | 100 % | 100 % | Derogation |
| Hungary | MAVIR | HU > RO | 100 % | 100 % | Derogation |
| Hungary | MAVIR | HU > SK | 100 % | 100 % | Derogation |
| Ireland | EirGrid | | N/A | N/A | |
| Italy | Terna | Italy North | 100 % | 100 % | Derogation |
| Italy | Terna | IT-GR | 100 % | 100 % | |

** This number differs from the one in the ENTSO-E Market Report 2021 published earlier, which contains a wrong number (99.31 %).

| Country | TSO | Border/Region | % of MTUs in which minimum target was reached (considering action plans and/or derogations) | % of MTUs in which TSOs consider themselves as compliant* | Exemption clause applied |
|---|---|---|---|---|---|
| Latvia | AST | | N/A | N/A | According to approved CACM CCM in Baltic CCR, the CC process does not foresee daily CC with CGM and therefore CNEs cannot be provided. |
| Lithuania | Litgrid AB | LT-SE4 | 97.6 % | 100 % | |
| Lithuania | Litgrid AB | LT-PL | 100 % | 100 % | |
| Lithuania | Litgrid AB | LT-LV | N/A | N/A | According to approved CACM CCM in Baltic CCR, the CC process does not foresee daily CC with CGM and therefore CNEs cannot be provided |
| Luxembourg | Creos | | N/A | N/A | Creos does not have commercialised borders. |
| Norway | Statnett | | N/A | N/A | |
| Poland S1 2020 | PSE | CZ-DE-SK->PL | 100 % | 100 % | Derogation and Action Plan |
| Poland S1 2020 | PSE | PL->CZ-DE-SK | 100 % | 100 % | Derogation and Action Plan |
| Poland S1 2020 | PSE | PL > LT | 100 % | 100 % | Derogation and Action Plan |
| Poland S1 2020 | PSE | LT > PL | 100 % | 100 % | Derogation and Action Plan |
| Poland S1 2020 | PSE | PL > SE4 | 100 % | 100 % | Derogation and Action Plan |
| Poland S1 2020 | PSE | SE4 > PL | 100 % | 100 % | Derogation and Action Plan |
| Poland S2 2020 | PSE | CZ-DE-SK->PL | 99.98 % | 99.98 % | Derogation and Action Plan |
| Poland S2 2020 | PSE | PL->CZ-DE-SK | 100 % | 100 % | Derogation and Action Plan |
| Poland S2 2020 | PSE | PL > LT | 100 % | 100 % | Action Plan |
| Poland S2 2020 | PSE | LT > PL | 100 % | 100 % | Action Plan |
| Poland S2 2020 | PSE | PL > SE4 | 100 % | 100 % | Derogation and Action Plan |
| Poland S2 2020 | PSE | SE4 > PL | 100 % | 100 % | Action Plan |
| Portugal | REN | PT-ES | 100 % | 100 % | Derogation |
| Romania | Transelectrica | RO_Import | 100 % | 100 % | Derogation |
| Romania | Transelectrica | RO_Export | 100 % | 100 % | Derogation |
| Slovak Republic | SEPS | SK-CZ | 100 % | 100 % | Derogation |
| Slovak Republic | SEPS | SK-PL | 100 % | 100 % | Derogation |
| Slovak Republic | SEPS | SK-HU | 100 % | 100 % | Derogation |
| Slovenia | ELES | SI-AT | 100 % | N/A | |
| Slovenia | ELES | SI-HR | 100 % | N/A | |
| Slovenia | ELES | CSE | 100 % | N/A | |
| Spain | REE | FR > ES | 100 % | 100 % | Derogation |
| Spain | REE | ES > FR | 100 % | 100 % | Derogation |
| Spain | REE | PT > ES | 100 % | 100 % | Derogation |
| Spain | REE | ES > PT | 100 % | 100 % | Derogation |
| Sweden | Svenska Kraftnät | | N/A | N/A | Derogation |
| The Netherlands | TenneT NL | CWE | 84 % | 99 % | Derogation and Action Plan |
| The Netherlands | TenneT NL | DK1 > NL | 81 % | 100 % | Derogation |
| The Netherlands | TenneT NL | NL > DK1 | 100 % | 100 % | Derogation |
| The Netherlands | TenneT NL | NO2 > NL | 86 % | 100 % | Derogation |

| Country | TSO | Border/Region | % of MTUs in which minimum target was reached (considering action plans and/or derogations) | % of MTUs in which TSOs consider themselves as compliant* | Exemption clause applied |
|---|---|---|---|---|---|
| The Netherlands | TenneT NL | NL > NO2 | 100 % | 100 % | Derogation |
| The Netherlands | BritNed | NL > GB | 100 % | 100 % | Derogation |
| The Netherlands | BritNed | GB > NL | 100 % | 100 % | Derogation |

Table 3: TSO's performance in regard to the CEP70 provisions from 2020

## 5.2 ACER Report

ACER has also published reports[11 12], on the implementation of the CEP70 provisions. The reports have no direct legal reference and were written on a voluntary basis under ACER's broader market monitoring competencies. ENTSO-E understands that the reports are intended to deliver a harmonised view of the state of CEP70 across Europe.

The results of these reports should be interpreted in the context of the specific analytical assumptions that ACER has made. ENTSO-E has published its view on these assumptions in a technical document available from its website.

The following general aspects are relevant regarding the assessment of the CEP70 rule:

- An assessment must consider the full capacity offered for cross-zonal trading, including day-ahead, intraday and long-term time frames, as well as balancing.
- Electricity exchanges with non-EU countries (for example, Switzerland) have an impact that TSOs must manage daily. It should therefore be possible for such exchanges to be considered in the margin available for cross-zonal trade where needed.
- TSOs believe that the assessment should reflect operational reality. Data delivered by TSOs must not be recalculated to make them fit for purpose.
- The assessment must respect the transitional arrangements applied by many TSOs (derogations, action plans) in accordance with the approval of competent NRAs as set out in the CEP70 provisions. It is apparent that these TSOs cannot be benchmarked against the 70 % criterion.
- The same principles and standards must be applied for all Member States, especially with respect to the presentation of the results. A harmonised view cannot be achieved if the presentation varies from country to country in terms of the period covered, definition of coordination areas, consideration of allocation constraints and inclusion of exchanges with non-EU countries.
- Network elements should be fully assessed. An assessment that focuses on a worst-case scenario by solely considering network elements that provided the smallest margins for cross-zonal trading during the respective MTUs will not deliver an accurate picture.

### Do CEP minimum targets for cross-zonal trading capacity create value for Europe?

The economic efficiency (along with various other impacts) of the CEP minimum targets has not been deeply assessed. This is particularly surprising, as virtual cross-zonal trading capacities do not create economic welfare gains under all circumstances and can even reduce economic efficiency. In times of price convergence, in which the offered trading capacity fully satisfies market demand – and is therefore not limited by congestions) – additional fictive trading capacity will not create any additional cross-zonal trade or increase economic value. The benefit of the increased offered capacity should always be assessed against the corresponding increase of the overall costs for remedial actions required to ensure system security.

In recent years, electricity markets have become fully interconnected and their performance has greatly improved. TSOs, in cooperation with all stakeholders, are continuously working to ensure the optimal use of transmission infrastructure and market functioning while maintaining the highest system security. Transmission investments and improved coordination continue to result in increased availability of cross-border capacities and price convergence in Europe.

However, the CEP70 provisions and its assessment by European authorities do not recognise that more cross-border capacity during hours with price convergence will not

11 Published on 18 December 2020.
12 Published on 2 June 2021.

benefit consumers. TSOs are therefore of the opinion that the European electricity market performs better than many stakeholders believe and advise policymakers to reassess the economic efficiency of the CEP70 provisions.

## 5.3 Conclusions

As one of the main provisions of Regulation (EU) 2019/943 on the internal market for electricity (EU electricity regulation), starting 1 January 2020, at least 70 % of the capacity of internal and cross-zonal critical network elements, taking into account contingencies, (CNECs), as per 2019/943 Art 16(8), must be made available for cross-zonal electricity trading of borders that use a flow-based approach, with 70 % of the transmission capacity respecting operational security limits after deductions of contingencies set for trading of borders that use a coordinated net transmission capacity approach (Article 16(8)). The inclusion of 'derogations'[13] and 'action plans'[14] in the EU electricity regulation provides temporary exemptions, which can be applied to achieve the 70 % (CEP70) target via a transitionary phase.

According to the EU electricity regulation, national regulatory authorities (NRAs) are responsible for assessing TSO compliance with the CEP70 rule. Moreover, ENTSO-E is required to publish this technical report every three years, which should assess whether the cross-zonal trade capacity met the CEP70 target (Article 14(2)).

The overview given in Table 3 for the year 2020 shows that the vast majority of TSOs acted in accordance with the CEP70 rules 100 % of the time, considering action plans and/or derogations. Moreover, even when the minimum target was not reached, very often the TSO still considered itself compliant, as Art. 16 of EU Electricity Regulation allows – as a measure of last resort – the reduction of the offered cross-zonal capacity below the minimum targets, if the TSOs or RCCs, respectively, can justify that their application would endanger system security.

TSOs and ENTSO-E continue to invest significant efforts and apply the appropriate tools to implement the existing CEP70 rule and achieve compliance with its legal provisions, while also accommodating fallback options to ensure system security at all times.

13 Option to deviate from the minimum cross-zonal capacity target for a predefined period. In 2020, this option was applied by Sweden, the Netherlands, Belgium, France, Spain, Portugal, Italy, Austria, Czech Republic, Poland, Hungary, Slovakia, Croatia, Romania, Bulgaria, and Greece.

14 Option to achieve the 70 % minimum cross-zonal trading capacity via a linear trajectory by 31 December 2025 in case of internal structural congestions. In 2020, this option was applied by the Netherlands, Germany, and Poland.

# Annex I – congestions without frequency threshold

## 1 List of congestions

### Austria

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV phase shifting transformer Tauern | - | - | 0 % | 1 % | 0 % | 1 % | 0 % | - | 0 % |
| 220 kV line Aschach - Hausruck 1 | - | - | - | 0 % | 0 % | 0 % | 0 % | 1 % | - |
| 220 kV line Bisamberg - WienSüdOst 1 | - | - | - | 0 % | 2 % | 1 % | 0 % | 0 % | 1 % |
| 220 kV line Bisamberg (APG) - Sokolnice (CEPS) 1 | - | - | N/A | 0 % | 0 % | - | 0 % | 0 % | - |
| 220 kV line Bisamberg (APG) - Sokolnice (CEPS) 2 | - | - | N/A | 0 % | 0 % | - | 0 % | - | - |
| 220 kV line Ernsthofen - Hausruck 1 | - | - | - | 1 % | 1 % | - | 0 % | 0 % | - |
| 220 kV line Ernsthofen - Sattledt 1 | - | - | - | 1 % | 1 % | - | 0 % | 0 % | - |
| 220 kV line Hausruck - Sattledt 1 | - | - | - | 1 % | 1 % | - | 0 % | 0 % | - |
| 220 kV line Hausruck - St. Peter 1 | - | - | - | 1 % | - | 0 % | 0 % | - | - |
| 220 kV line Hessenberg - Weißenbach 1 | - | - | - | 0 % | 8 % | 3 % | 0 % | 1 % | 1 % |
| 220 kV line Hessenberg - Weißenbach 2 | - | - | - | 0 % | 8 % | 3 % | 0 % | 1 % | 1 % |
| 220 kV line Lienz (APG) - Soverzene (TERNA) 1 | - | - | - | 2 % | 4 % | 2 % | 2 % | 10 % | 2 % |
| 220 kV line Neusiedl (APG) - Györ (MAVIR) 1 | - | - | N/A | - | 0 % | 1 % | 0 % | 0 % | 1 % |
| 220 kV line Obersielach (APG) - Podlog (ELES) 1 | N/A | N/A | N/A | 0 % | 3 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV line Salzburg - Tauern 1 | - | - | - | 0 % | 2 % | 1 % | - | 1 % | 0 % |
| 220 kV line Salzburg - Tauern 2 | - | - | - | 0 % | - | 1 % | - | 0 % | 0 % |
| 220 kV line St.Peter (APG) - Altheim (TTG) 1 | 0 % | - | - | 6 % | 6 % | 4 % | 0 % | 0 % | 1 % |
| 220 kV line St.Peter (APG) - Pleinting (TTG) 1 | 2 % | 1 % | 4 % | 4 % | 5 % | 2 % | 0 % | 0 % | 0 % |
| 220 kV line St.Peter (APG) - Simbach (TTG) 1 | 0 % | - | - | 8 % | 6 % | 4 % | 0 % | 0 % | 0 % |
| 220 kV line Tauern - Weißenbach 1 | - | N/A | N/A | 7 % | 15 % | 11 % | 2 % | 8 % | 4 % |
| 220 kV line Tauern - Weißenbach 2 | - | N/A | N/A | 7 % | 16 % | 11 % | 2 % | 8 % | 4 % |
| 220 kV line Ternitz - WienSüdost 1 | - | - | - | 1 % | 0 % | - | 0 % | - | - |
| 220 kV line Ternitz - WienSüdost 2 | - | - | - | 1 % | 0 % | - | 0 % | 0 % | - |
| 220 kV line WienSüdOst (APG) - Györ (MAVIR) 1 | - | - | N/A | - | 1 % | 0 % | - | 0 % | 0 % |
| 380/220 kV transformer RHU41 substation Ernsthofen | - | - | N/A | - | - | - | - | - | - |
| 380/220 kV transformer RHU41 substation Lienz | - | - | N/A | 1 % | 9 % | 2 % | 0 % | 2 % | 1 % |
| 380/220 kV transformer RHU41 substation Obersielach | - | - | - | 1 % | 0 % | - | 0 % | 0 % | - |
| 380/220 kV transformer RHU41 substation St.Peter | - | - | - | 1 % | 0 % | 0 % | - | - | - |
| 380/220 kV transformer RHU41 substation Tauern | 1 % | 0 % | 0 % | 2 % | 4 % | 0 % | 0 % | 0 % | - |
| 380/220 kV transformer RHU41 substation Westtirol | 2 % | 1 % | 1 % | 2 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 380/220 kV transformer RHU42 substation Ernsthofen | - | - | N/A | - | - | - | - | - | - |
| 380/220 kV transformer RHU42 substation Lienz | - | - | N/A | 1 % | 10 % | 2 % | 0 % | 2 % | 1 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380/220 kV transformer RHU42 substation Obersielach | - | - | - | 1 % | 0 % | 0 % | 0 % | - | - |
| 380/220 kV transformer RHU42 substation Tauern | - | - | - | 2 % | 4 % | 0 % | 0 % | 0 % | - |
| 380/220 kV transformer RHU43 substation Obersielach | - | - | - | 1 % | 0 % | - | 0 % | - | - |
| 380/220 kV transformer RHU43 substation Tauern | - | - | 0 % | - | - | 0 % | - | - | 0 % |
| 380 kV line Dürnrohr (APG) - Slavetice (CEPS) 1 | N/A | N/A | N/A | 0 % | - | - | - | - | - |
| 380 kV line Dürnrohr (APG) - Slavetice (CEPS) 2 | N/A | N/A | N/A | - | - | - | - | - | - |
| 380 kV line Kainachtal (APG) - Maribor (ELES) 2 | - | - | N/A | - | - | - | - | - | - |
| 380 kV line Kainachtal (APG) - Maribor (MAVIR) 1 | - | - | N/A | - | - | - | - | - | - |
| 380 kV line Westtirol (APG) - Leupholz (Amprion) 1 | 1 % | 1 % | - | 0 % | 0 % | - | - | - | - |
| 380 kV line Westtirol (APG) - Pradella (SG) 1 | - | - | - | 0 % | 1 % | - | 0 % | 0 % | - |
| 380 kV line Westtirol (APG) - Pradella (SG) 2 | - | - | - | 0 % | 1 % | - | 0 % | 1 % | - |
| 380 kV line Zurndorf (APG) - Györ (MAVIR) 1 | - | - | N/A | - | - | - | - | - | - |
| 380 kV line Zurndorf (APG) - Szombathely (MAVIR) 1 | - | - | N/A | - | - | - | - | - | - |

## Belgium

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV Aubange - Moulaine | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 221 kV Aubange - Moulaine | 3 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Achene - Lonny | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Avelgem - Avelin | 5 % | 1 % | 0 % | 2 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Avelgem - Horta | 0 % | 5 % | 4 % | 1 % | 3 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Avelgem - Mastaing | 0 % | 0 % | 0 % | 1 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Bruegel - Mercator | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Doel - Mercator | 0 % | 0 % | 1 % | 4 % | 5 % | 10 % | 0 % | 0 % | 0 % |
| 380 kV Doel - Zandvliet | 2 % | 1 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Gramme - Achene | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Gramme - Champion | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Gramme - Courcelles | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Mercator - Horta | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Van Eyck - Maasbracht | 2 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Zandvliet - Rilland | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PST Van Eyck 380 kV | 2 % | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PST Zandvliet 380 kV | 11 % | 3 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| Nemo Link (Belgium - UK) | 0 % | 81 % | 71 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Bulgaria

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV BG_L1 | 5 % | 5 % | 9 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV BG_L2 | 4 % | 3 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV BG_L3 | 2 % | 2 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV BG_L4 | 4 % | 3 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV BG_L5 | 24 % | 5 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Croatia

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV Brinje - Konjsko | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 2 % | 0 % | 0 % |
| 220 kV Brinje - Mraclin | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Konjsko- VE Pađene | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % |
| 220 kV Međurić - xnode Prijedor | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV Melina - Pehlin 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Melina - Pehlin 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mraclin - TE Sisak 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mraclin - TE Sisak 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mraclin - Žerjavinec | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Pehlin - Plomin 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Pehlin - xnode Divača | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Senj - Brinje | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Senj - Melina | 0 % | 0 % | 0 % | 9 % | 2 % | 2 % | 9 % | 2 % | 2 % |
| 220 kV TE Sisak - Međurić | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV TE Sisak - xnode Prijedor | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV VE Pađene - Brinje | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Zakučac - Konjsko | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 2 % | 0 % | 0 % |
| 220 kV Zakučac - xnode Mostar | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % |
| 220 kV Žerjavinec - xnode Cirkovce | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % |
| 400 kV Konjsko - RHE Velebit | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Melina - xnode Divača | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BIL 220AT2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BIL 220AT4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| BRINJ 220TR1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DAKOV 220TR1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DAKOV 220TR2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ERNES 401TR1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ERNES 401TR2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| HEZAK 220ATR | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KONJ 220T1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| KONJ 220T2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KONJ 220T3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MEDUR 220TR3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MELIN 220AT5 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MELIN 220AT6 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MELIN 402ATR1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MELIN 402ATR2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MRACL 221TR1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MRACL 221TR2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MRACL 221TR3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PEHL 220AT1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PEHL 220AT2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| RHEVE 401AT | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TEPLO 220AT1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TEPLO 220AT2 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| TEPLO 220AT3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TUMBR 401TR1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TUMBR 401TR2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TUMBR 401TR3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ZERJA 401TR1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ZERJA 401TR2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Czech Republic

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV V201 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV V202 | 0 % | 0 % | 0 % | 3 % | 5 % | 2 % | 2 % | 1 % | 0 % |
| 220 kV V203 | 0 % | 0 % | 0 % | 0 % | 0 % | 4 % | 0 % | 0 % | 1 % |
| 220 kV V208 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV V223 | 0 % | 0 % | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 3 % |
| 220 kV V224 | 0 % | 0 % | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 3 % |
| 220 kV V243_Sokolnice-Bisamberg | 6 % | 6 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV V244_Sokolnice-Bisamberg | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV V245_Lískovec-Bujakow | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV V246_Lískovec-Kopanina | 8 % | 2 % | 9 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV V251 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV V252 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV V253 | 0 % | 0 % | 0 % | 6 % | 4 % | 1 % | 4 % | 3 % | 1 % |
| 220 kV V254 | 0 % | 0 % | 0 % | 7 % | 4 % | 1 % | 4 % | 3 % | 1 % |
| 220 kV V280_Sokolnice-Senica | 2 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 400 kV V401 | 0 % | 0 % | 0 % | 5 % | 10 % | 4 % | 3 % | 3 % | 2 % |
| 400 kV V404_Nošovice-Varín | 4 % | 6 % | 2 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V420 | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 400 kV V422 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV V424_Sokolnice-Križovany | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V430 | 0 % | 0 % | 0 % | 1 % | 5 % | 6 % | 1 % | 1 % | 1 % |
| 400 kV V431 | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV V432 | 0 % | 0 % | 0 % | 13 % | 3 % | 0 % | 8 % | 1 % | 0 % |
| 400 kV V433 | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV V435 | 0 % | 0 % | 0 % | 9 % | 0 % | 1 % | 5 % | 1 % | 1 % |
| 400 kV V436 | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 1 % | 0 % | 1 % |
| 400 kV V437_Slavětice-Dürnrohr | 6 % | 11 % | 16 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V438_Slavětice-Dürnrohr | 10 % | 4 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V441_Hradec-Etzenricht | 17 % | 18 % | 22 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V442_Přeštice-Etzenricht | 3 % | 3 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V443_Albrechtice-Dobrzen | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V444_Nošovice-Wielopole | 11 % | 17 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV V445_Hradec-Röhrsdorf | 30 % | 28 % | 25 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV V446_Hradec-Röhrsdorf | 0 % | 1 % | 17 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV V454 | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 2 % |
| 400 kV V473 | 0 % | 0 % | 0 % | 14 % | 13 % | 4 % | 8 % | 7 % | 3 % |
| 400 kV V474 | 0 % | 0 % | 0 % | 10 % | 0 % | 0 % | 6 % | 0 % | 0 % |
| 400 kV V476 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % |

## Denmark

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| HVE_400_XSA_HO11 | 20 % | 27 % | 33 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ABS_150_SØN | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ADL_150_ÅBØ | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ASR_150_THY | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ASR_400_TJE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FER_400_TRI | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FVO_150_GRP | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| GLN_132_STA | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| GØR_400_132_T41A | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| GØR_400_SÅN | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| GRP_150_KIN | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| GRP_150_RYT | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| GULØ_132_TEG | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| HASV_150_MAL | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| HCV_400_132_T41 | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| HNB_150_TRI | 0 % | 2 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KAS_150_150_KT33 | 1 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KAS_220_150_020_KT41 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KAS_400_REV 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KNA_150_THY | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KONTEK | 63 % | 58 % | 51 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KRL_132_MOSØ | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| LAG_150_KNA | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| LYK_150_RIB | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| NVV_150_ÅBØ | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| RYT_150_SVS | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TAN_150_TJE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TJE_400_150_KT51 | 0 % | 16 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VHA_150_ÅBØ | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FGD_400_XFG_HK11 (DK1–DK2) | 37 % | 33 % | 44 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| HKS_400_XFG_HK12 (DK1–DK2) | 37 % | 33 % | 44 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| EDR_400_XED_EE1D (DK1–NO) | 0 % | 62 % | 61 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TJE_150_XKR_TJ13 (DK1–NO2) | 49 % | 58 % | 79 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TJE_150_XKR_TJ21 (DK1–NO2) | 49 % | 58 % | 79 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TJE_400_XJR_TJ31 (DK1–NO2) | 49 % | 58 % | 79 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TJE_400_XJR_TJ41 (DK1–NO2) | 49 % | 58 % | 79 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VHA_400_XVH_LI11 (DK1–SE3) | 54 % | 76 % | 65 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VHA_400_XVH_LI21 (DK1–SE3) | 54 % | 76 % | 65 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Estonia

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 150 kV DC-EE-FI | 5 % | 12 % | 34 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV DC-EE-FI | 5 % | 12 % | 34 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |

## Finland

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 150 kV DC-FI-EE | 5 % | 12 % | 34 % | 0 % | 1 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV Haapavesi-Petäjävesi | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV DC-FI-SE3 | 36 % | 70 % | 67 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % |
| 400 kV FI-SE1 | 44 % | 54 % | 77 % | 0 % | 0 % | 0 % | 3 % | 3 % | 3 % |
| 400 kV Keminmaa-Pikkarala | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## France

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV - Argia - Mouguerre 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV - Argia - Mouguerre 2 | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV - Cantegrit - Mouguerre 1 | 9 % | 4 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV - Florensac - Saint-Vincent | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV - Lannemezan - Pragnères | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV - Marsillon - Pragnères | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV - Genissiat - Chavanod | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV - Malgovert - Passy | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV - Menton - Trinite Victor | 3 % | 1 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV - Pressy - Passy | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Albertville - Chavanod - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Albertville - Longefan - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Albertville - Piquage Randens | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Aubusson - Mole (La) - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Bezon - Pontchateau - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Carrieres - Plessis Gassot - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Champagnole - Genissiat - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Compiegne - Latena - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Compiegne - Moru - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Contamine - Malgovert - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Cordemais - Piquage A Prinquiau - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Cornier - Genissiat - 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Cornier - Piquage Cruseilles - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Cornier - Pressy - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Courtry - Plison - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Donzac - Verlhaguet - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Eguzon - Montlucon - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Eguzon - Orangerie (L) - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Elancourt - Piquage Montjay | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Ganges - St Victor - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Genissiat - Piquage Cruseilles - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Godin - Rueyres - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Grosne - Macon - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Jalis - Lesquive - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Jonquieres - Montagnette (La) - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Laveyrune - Pied De Borne - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Leguevin - Lesquive - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Leguevin - Portet-St-Simon - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Lesquive - Verlhaguet - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Lesquive - Verlhaguet - 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 225 kV Longefan - Piquage Randens - 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Longefan - Piquage Vieux-Moulin - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Margeride - Pratclaux - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Montgros - Montpezat - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Montgros - Pratclaux - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Montlucon - Montvicq - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Onet-Le-Chateau - Rueyres - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Pertain - Roye - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Piquage Montjay - Villejust - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Plan-D Orgon - Roquerousse - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Praz-St-Andre - Saussaz Ii (La) - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Pressy - Vallorcine - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Riddes - Cornier - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Rognac - Roquerousse - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Roquerousse - Piquage A Vilassole - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Saussaz Ii (La) - Piquage Vieux-Moulin - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Serrieres - St-Vulbas-Est - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV St-Esteve - Ste-Tulle - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Theix - Piquage A Prinquiau - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Trinite-Victor - Piquage Menton - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Trois Domaines - Vandieres - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV - Argia - Cantegrit 1 | 11 % | 36 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV - Clerac - Cubnezais | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV - Préguillac - Braud 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Gaudiere - Rueyres | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380/220 kV - Argia At761 | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380/220 kV - Argia At762 | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380/220 kV - Cantegrit At761 | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380/220 kV - Cantegrit At762 | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380/220 kV - Marsillon At761 | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV - Albertville - Grande Ile 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV - Albertville - Grande Ile 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV - Albertville - Grande Ile 3 | 1 % | 1 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV - Albertville - La Coche | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV - Albertville - Montagny | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV - Cornier - Montagny | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Asphard - Sierentz - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Avelin - Gavrelle | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Avelin - Mastaing 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Bois-Tollot - Genissiat - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Boutre Transformer | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 400 kV Chaingy Transformer | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Chesnoy (Le) - Cirolliers - 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 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Creys - St-Vulbas-Ouest - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Dambron - Verger - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Dambron - Verger - 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Dambron - Villejust - 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Dambron Transformer | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Donzac Transformer | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Eguzon - Rueyres - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Frasne - Genissiat - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Genissiat Transformer | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Realtor - Tavel - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Realtor - Tavel - 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| Bypass La Praz Saint Andre | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PST La Praz Saint Andre | 2 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Avelin - Avelgem (France - Belgium) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Lonny - Achêne (France - Belgium) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Mastaing - Avelgem (France - Belgium) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Ensdorf - Vigy - 1 (France - Germany) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Muhlbach - Eichstetten (France - Germany) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Vigy - Ensdorf 2 (France - Germany) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 225 kV Menton - Camporosso (France - Italy) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Albertville - Rondissone 1 (France - Italy) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Albertville - Rondissone 2 (France - Italy) | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Venaus - Villarodin (France - Italy) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Argia - Arkale 1 (France - Spain) | 3 % | 7 % | 6 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Biescas - Pragneres 1 (France - Spain) | 0 % | 1 % | 12 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Argia - Hernani 1 (France - Spain) | 5 % | 3 % | 12 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Vich - Baixas 1 (France - Spain) | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| IFA 2000 DC cables: Les Mandarins - Sellindge (France - UK) | 84 % | 81 % | 73 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Germany

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 110 kV D7NRHE2 TR | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7AMEL2 D7GERS2 WERSE W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BENT2 D7HANE2 BENTLR | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BGLU2 D7YBEL2S POLSUM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BGLU2 D7YGEL2W GLADBK W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BOCH2 D7EIBE2 BOCHUM W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BOCH2 D7YPOE2W HOCHLR W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BOCK2N D7BRAU2 BOCKLE N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BRAU2 D7SECH2 GODORF W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BRAU2 D7YSEC2W OLEFIN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BUER1 D7LAMB1 BUERST W | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 3 % |
| 220 kV D7BUER2 D7YBIB2 BIBLIS3C | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BUER2 D7YBUE2N OTT ROX | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BUER2 D7YPFU2 RHEIN O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BUES2D D7YBGL2E SHOLVN E | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BW2 D7MAXA2 WEINGT | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BW2 D7YBW2S OTT ROX | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7BW2 D7YBW2S ROXHM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7DIEF2 D7TRIE2 SAAR N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7EIBE2 D7REIS2 ITTERB W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7EIBE2 D7YGEL2W GLADBK W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7EIBE2 D7YHAT2O ITTERB O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7ELME2 D7GERS2 CAPPEN S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7ELME2 D7YELM2S ELMENH S | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV D7GARE2 D7YGAR2W BIGGE W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7GERS2 D7YPOE2N CAPPEN N | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV D7GRON2 D7YHAN2 GRAFSH W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7HANE2 D7YHAN2 GRAFSH W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7HATT2 D7LAER2 LAER W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7HATT2 D7YHAT2O ITTERB O | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV D7HATT2 D7YKRC2O POEPPI O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7HONE2 D7YPFU2 RHEIN O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7KEMP2 D7YKEM2 FUESSN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7KUSE2 D7YBEL2S POLSUM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7KUSE2 D7YHAN2W GRAFSH W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7KUSE2 D7YPOE2W HOCHLR W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7LAER2 D7POEP2 POEPPI W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7LAER2 D7YKRC2O POEPPI O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7LUES2 D7WEHR2 BOHMTE O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7LUES2 D7WEHR2 BOHMTE W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV D7MAXA2 D7MUTT2 BIENWD W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7MUEN2 D7GELL2 STRATM W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV D7MUEN2 D7RHAU2 RHAUSN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7MUTT2 D7BW212 ROXHM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7MUTT2 D7YBW2S ROXHM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7NORF2 D7PETE2 NORF W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7NORF2 D7PETE2 STUERZ W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7NORF2 D7ROKI2 FRIXHM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7NORF2W D7OSTR2 ZONS W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7NRHE2 D7SPEL2 SPELLN S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV D7NSTE2 D7WENG2 WENGER | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7OPLA2 D7ROKI2D STOMM N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7OPLA2 D7YHAT2 ITTERB O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7OSTR2 D7YOST2N FRIXHM N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7OWESTT2 D7YKEM2 FUESSN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7PETE2 D7YPET2S FRIXHM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7PFUN2 D7URBE2 KRANI O | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 1 % | 0 % | 0 % |
| 220 kV D7PFUN2 D7YPFU2 RHEIN O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7POEP2 D7YELM2S ELMENH S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7POEP2 D7YKRC2O POEPPI O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7POEP2 D7YPOE2N CAPPEN N | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV D7REIS2 D7YMET2W ITTERB W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7REIS2 D7YPET2 FRIXHM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7ROKI2 D7YPET2S FRIXHM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7UCHT2 D7YDIE2S ENSDF S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7UERD2 D7UTFO2 UERDIN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7URBE2 D7YBIB2 BIBLIS3C | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7UTFO2 D7YEDE2W UTFORT W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7UTFO2 D7YOSS2O WESEL O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7VOEH2 D73YWB2O DELLM O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7VOEH2 D7YKEM2 FUESSN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7WENG2 D7WTHU2D KONDLW | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7WEST2 D7YHAN2 AMELSB | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV D7YHAT2O D7YMET2O ITTERBO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV DBA FL2 D7BAUL2 FLE BA N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV DDA MA2 D7MAXA2 GOLDGR | 0 % | 0 % | 0 % | 1 % | 0 % | 4 % | 7 % | 0 % | 4 % |
| 220 kV DGK MU2 D7MUTT2 RHEIN N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV DGK MU2 D7MUTT2 RHEIN S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV XBE TI2 D7TIEN2 AARE O | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Altlußheim - GKMB blau | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Bentwisch - Güstrow 275 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV Bentwisch - Lüdershagen 318 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Bertikow - Neuenhagen 303 | 0 % | 0 % | 0 % | 1 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Bertikow - Pasewalk 305 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Buehl - Daxlanden - Kuppenheim rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Buehl - Weier gruen | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Buers - Westtirol 421 weiss | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Daxlanden | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Daxlanden - Kuppenheim - Weier rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Daxlanden - Maximiliansau schwarz | 0 % | 0 % | 0 % | 1 % | 0 % | 4 % | 7 % | 0 % | 4 % |
| 220 kV Eichstetten - Gurtweil gelb | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Eichstetten - Gurtweil rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 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 Kuehmoos - Laufenburg weis | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Neuenhagen - Vierraden 304 | 2 % | 2 % | 46 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Neuenhagen - Wustermark 294 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Neurott | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Neurott - Weinheim rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Pasewalk - Güstrow - Iven 316 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Pasewalk - Güstrow 315 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Altheim - Sittling 219 | 1 % | 1 % | 4 % | 2 % | 2 % | 1 % | 0 % | 1 % | 1 % |
| 220 kV Stromkreis Altheim - Sittling 220 | 0 % | 0 % | 0 % | 2 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Altheim - Y Simbach 219/233/230 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 2 % | 0 % | 0 % |
| 220 kV Stromkreis Altheim - Y Simbach 233/230 | 0 % | 0 % | 0 % | 1 % | 3 % | 4 % | 0 % | 11 % | 7 % |
| 220 kV Stromkreis Altheim - Y Simbach 234/230 | 0 % | 0 % | 0 % | 3 % | 2 % | 2 % | 9 % | 4 % | 2 % |
| 220 kV Stromkreis Audorf - Flensburg blau | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 2 % | 0 % |
| 220 kV Stromkreis Audorf - Flensburg grün | 1 % | 1 % | 2 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Conneforde - Blockland weiss | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Conneforde - Unterweser rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Enstedvaerket (DK) - Flensburg gelb | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 1 % | 0 % |
| 220 kV Stromkreis Etzenricht - Schwandorf 248 | 0 % | 0 % | 0 % | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Flensburg - Kassoe rot | 5 % | 11 % | 3 % | 0 % | 0 % | 0 % | 0 % | 7 % | 0 % |
| 220 kV Stromkreis Göttingen - Würgassen 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Grosskrotzenburg - Trennfeld 217 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Grosskrotzenburg - Trennfeld 218 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Hardegsen - Göttingen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Hardegsen - Göttingen 3 | 0 % | 0 % | 0 % | 1 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Hardegsen - Y Erzhausen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Ingolstadt - Raitersaich 265 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Ingolstadt - Raitersaich 266 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV Stromkreis Inhausen - Maade schwarz | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Irsching - Zolling 262 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Landesbergen - Sottrum 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 2 % | 1 % |
| 220 kV Stromkreis Landesbergen - Y Wechold 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Landesbergen - Y Wechold 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 220 kV Stromkreis Lehrte - Godenau 1 | 0 % | 0 % | 0 % | 2 % | 1 % | 2 % | 3 % | 1 % | 1 % |
| 220 kV Stromkreis Lehrte - Göttingen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Lehrte - Hardegsen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Ludersheim - Raitersaich 237 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Ludersheim - Schwandorf 223 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Ludersheim - Sittling 221 | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV Stromkreis Mehrum - Hallendorf 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Mehrum - Lahe 2111 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Mehrum - Lehrte 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 3 % | 2 % |
| 220 kV Stromkreis Mehrum - Lehrte 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV Stromkreis Mehrum - Y Hallendorf 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Pirach - St. Peter (APG) 256 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Pleinting - Pirach 257 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Pleinting - Pleinting 220 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Pleinting - Schwandorf 226 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Sittling - Ingolstadt 227 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Sittling - Ingolstadt 228 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Sottrum - Blockland blau | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Sottrum - Y Huntorf gelb | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 1 % |
| 220 kV Stromkreis Sottrum - Y Wechold 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Sottrum - Y Wechold 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 220 kV Stromkreis St.Peter (APG) - Pleinting 258 | 0 % | 1 % | 2 % | 0 % | 0 % | 0 % | 2 % | 1 % | 1 % |
| 220 kV Stromkreis St.Peter (APG) - Y Simbach 219/233/230 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis St.Peter (APG) - Y Simbach 233/230 | 0 % | 0 % | 0 % | 1 % | 1 % | 2 % | 0 % | 11 % | 7 % |
| 220 kV Stromkreis St.Peter (APG) - Y Simbach 234/230 | 0 % | 0 % | 0 % | 2 % | 0 % | 1 % | 9 % | 4 % | 2 % |
| 220 kV Stromkreis Voslapp - Inhausen rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Voslapp - Maade weiss | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Wahle - Hallendorf 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Wahle - Lehrte 1 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Würgassen - Göttingen 4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Emden - Emden/Borssum schwarz | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Erzhausen - Godenau 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Erzhausen - Hardegsen 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Erzhausen - Lehrte 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Hallendorf - Gleidingen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Huntorf - Blockland rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV Stromkreis Y Huntorf - Blockland weiss | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Huntorf - Conneforde gelb | 0 % | 0 % | 0 % | 1 % | 1 % | 3 % | 0 % | 2 % | 1 % |
| 220 kV Stromkreis Y Huntorf - Conneforde rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Huntorf - Conneforde weiss | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Huntorf - Sottrum gelb | 0 % | 0 % | 0 % | 2 % | 2 % | 6 % | 0 % | 2 % | 1 % |
| 220 kV Stromkreis Y Wechold - Landesbergen 1 | 0 % | 0 % | 0 % | 2 % | 1 % | 3 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Wechold - Landesbergen 2 | 0 % | 0 % | 0 % | 1 % | 1 % | 3 % | 0 % | 1 % | 0 % |
| 220 kV Stromkreis Y Wechold - Sottrum 1 | 0 % | 0 % | 0 % | 5 % | 2 % | 5 % | 0 % | 0 % | 0 % |
| 220 kV Stromkreis Y Wechold - Sottrum 2 | 0 % | 0 % | 0 % | 3 % | 1 % | 4 % | 0 % | 1 % | 0 % |
| 220 kV Vierraden - Pasewalk 306 | 7 % | 64 % | 67 % | 0 % | 2 % | 3 % | 0 % | 1 % | 1 % |
| 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 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D2ASSL1 D7YDAU1 WESTW W1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D5DELL1 D7YVOE1 DONAU O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BACH1 D7WTHU1 SOONWD O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BACH1 D7YWDL1O WONNEG O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BISC1 D7KRIF1 TREBUR S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BISC1 D7YPFU1 RIED W | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV D7BUER1 D7HONE1 KUGELB O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BUER1 D7LAMB1 BUERST W | 1 % | 1 % | 4 % | 0 % | 1 % | 3 % | 1 % | 1 % | 0 % |
| 380 kV D7BUER1 D7REIN1 KURPFA W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BUER1 D7WDLA1 WONNEG W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BUER1 D7YWDL1O SOONWD O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7BUER1 D7YWDL1O WONNEG O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7DAUR1 D7YDAU11 WESTW W1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7DETT1 D7URBE1 KARLST S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7EIBE1 D7HUEL1 HUELLN W | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV D7EIBE1 D7OPLA1 OERKHS O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7EIBE1 D7YOHL1O OERKHS O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7ENSD1 D7UCHT1 TAUBNT N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7ENSD1 D7UCHT1 TAUBNT S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7GERS1 D7YGER1N UENTRO N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7GERS1 D7YGER1O GERSTE O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7GRON1 D7GRON1 TR 441 E | 4 % | 1 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7GRON1 XGR HG1 HENGL SW | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7GUET1 D7YGER1O GERSTE O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7GUET1 D7YGUE1S GUETER S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7HANE1 D7GRON1 GRONAU W | 1 % | 0 % | 1 % | 2 % | 2 % | 4 % | 0 % | 0 % | 0 % |
| 380 kV D7HANE1 D7MEPP1 MEPPEN | 0 % | 0 % | 0 % | 0 % | 2 % | 9 % | 0 % | 0 % | 0 % |
| 380 kV D7HANE1 D7YGER1N UENTRO N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV D7HANE1 D7YHAN11 MUENST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7HATT1 D7WITT1 KEMNAD S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7HONE1 D7REIN1 KUGELB O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 380 kV D7HONE1 D7REIN1 KUGELB W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7HONE1 D7YVOE1 DONAU O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7HUEL1 D7YHUE1W WESTFL W | 0 % | 0 % | 0 % | 0 % | 1 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV D7HULF1 D7YHUF11 DUEMM S1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KELS1 D7KRIF1 TREBUR N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KNAP1 D7SECH1 WABERG W | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KOBL1 D7LIMB1 NASSAU | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KRIF1 D7LIMB1 HESSEN O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KRUC1 D7MENG1 KIRCHL O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KUSE1 D7NRHE1 LIPPE N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KUSE1 D7ROSE1 KUSENH | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KUSE1 D7YHAN11 MUENST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7KUSE1 D7YHUE1 WESTFL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7LAMB1 D7WEIN1 LAMBSH W | 0 % | 0 % | 0 % | 1 % | 0 % | 3 % | 0 % | 0 % | 1 % |
| 380 kV D7LEUP1 XWE LE1 FUESSN O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7LIMB1 D7YDAU1 WESTW W1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7MENG1 D7YHUE1W WESTFL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7NRHE1 D7WALS1 NRHEIN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7NSTE1 D7OSBU1 GILZEM O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7NSTE1 D7YDAH1 SELHN O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7NSTE1 D7YDAH11 SELHN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7OBZI1 D7NSTE1 SELHN O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7OBZI1 D7SIER1 KIRCHB S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7OBZI1 D7YDAH1 SELHN O | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7OBZI1 D7YDAH1 SELHN W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7OBZI1 XOB MB1 SELFK WS | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7OHLI1V D7YOHL1O OERKHS O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7OPLA1 D7ROKI1 OPLADN N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7PAFF1 D7YPAF1 SECHTM N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % |
| 380 kV D7PAFF1 D7YPAF1 SECHTM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 6 % | 3 % | 0 % |
| 380 kV D7PFUN1 D7BUER1 RIED O | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % |
| 380 kV D7PFUN1 D7URBE1 GRIESH O | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV D7ROKI1 D7KNAP1 BRAUWL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7ROKI1 D7PAFF1 PAFFEN N | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV D7ROKI1 D7PAFF1 PAFFEN S | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 4 % | 0 % | 0 % |
| 380 kV D7ROKI1 D7SECH1 VILLE O | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7ROKI1 D7SECH1 VILLE W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7ROKI1 XRO MB1 SELFK WS | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV D7SECH1 D7YPAF1N SECHTM N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % |
| 380 kV D7SIER1 XSI MB1 SELFK SW | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7UCHT1 D7MITB1 BLIES S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7UENT1 D7YGUE1S GUETER S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7URBN1 D7URBE1 ERLENSEE | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV D7UTFO1 D7WALS1 LOHHEI W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7VOEH1 D7YVOE1O DONAU O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7VOEH1 DDE VO1 DONAU W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7VOEH1 DDE VO1 WESTFL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7WDLA1 D7WTHU19 SOONWD W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7WEHR1 D7YHUF11 DUEMM S1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7WEIN1 DDA WE11 GERMHM S | 0 % | 0 % | 0 % | 1 % | 0 % | 3 % | 0 % | 1 % | 3 % |
| 380 kV D7WTHU11 D7YWDL11 SOONWD O | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV D7YPAF1 D7OBZI1 SECHTM N | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % |
| 380 kV D7YPAF1 D7OBZI1 SECHTM S | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 6 % | 3 % | 0 % |
| 380 kV D7YPAF1 D7SECH1 SECHTM S | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 6 % | 3 % | 0 % |
| 380 kV D7YPFU1 D7BUER1 RIED W | 0 % | 0 % | 1 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV DAS DA11 D7YDAU11 WESTW W1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DBE GU1 D7GUET1 SENNE N2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV DBE GU1 D7GUET1 SENNE S1 | 1 % | 0 % | 0 % | 1 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV DDO HA1 D7HANE1 EMSLD WB | 0 % | 0 % | 0 % | 13 % | 11 % | 18 % | 3 % | 2 % | 0 % |
| 380 kV DFR KR11 D7KRIF1 TAUNUS 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DGK DE11 D7DETT1 UMAIN S1 | 0 % | 0 % | 0 % | 2 % | 2 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV DGK UR11 D7URBE1 UMAIN N2 | 0 % | 0 % | 0 % | 1 % | 2 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV DNL ME1 D7MEPP1 EMSLD OW | 0 % | 0 % | 0 % | 12 % | 11 % | 16 % | 13 % | 8 % | 0 % |
| 380 kV DOH WE1 D7WEHR1 DUEMM S1 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DOH WE11 D7YHUF11 DUEMM S1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DPU HO11 D7HONE1 HO PU WS | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 1 % |
| 380 kV DTW NE1 D7NEHD1U TWIST W4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV XEN VI1 D7ENSD1 VIGY1 N | 1 % | 1 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV XEN VI1 D7ENSD1 VIGY2 S | 1 % | 2 % | 4 % | 0 % | 1 % | 0 % | 0 % | 4 % | 1 % |
| 380 kV XGR HG1 D7GRON1 HENGL WS | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380/220 kV Buers Transformer 37 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Preilack - Ragow 540 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Altbach | 0 % | 0 % | 0 % | 3 % | 13 % | 8 % | 0 % | 0 % | 0 % |
| 380 kV Altenfeld - Redwitz 459 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Altenfeld - Redwitz 460 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Altenfeld - Vieselbach 467 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Bärwalde - Schmölln 551 | 0 % | 0 % | 0 % | 3 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Bärwalde - Schmölln 552 | 0 % | 0 % | 0 % | 3 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Brunsbüttel - Hamburg/Nord 951 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV Buers - Westtirol rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Charlottenburg - Mitte 906 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Daxlanden | 0 % | 0 % | 0 % | 4 % | 4 % | 10 % | 0 % | 0 % | 0 % |
| 380 kV Daxlanden - Weingarten gelb | 0 % | 0 % | 0 % | 1 % | 0 % | 3 % | 0 % | 1 % | 3 % |
| 380 kV Dellmensingen - Voehringen gruen | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Eichstetten - Muhlbach 1 rot | 0 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Eisenach - Vieselbach 454 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Eisenhüttenstadt 547/2 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Eisenhüttenstadt 548/2 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Endersbach | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Friedrichshain - Marzahn 921 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Friedrichshain - Marzahn 922 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Görries - Güstrow 423 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Grafenrheinfeld - Hoepfingen gelb | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Grafenrheinfeld - Stalldorf 416 rot | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Graustein - Bärwalde 565 | 0 % | 0 % | 0 % | 2 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Graustein - Bärwalde 566 | 0 % | 0 % | 0 % | 2 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Großgartach - Hueffenhardt blau | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Großgartach - Kupferzell weis | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Güstrow - Putlitz/Süd 514 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Hagenwerder-Schmölln 553 | 59 % | 48 % | 14 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Hagenwerder-Schmölln 554 | 59 % | 48 % | 13 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Hamburg/Nord - Hamburg/Ost 961 | 0 % | 0 % | 0 % | 2 % | 1 % | 0 % | 1 % | 1 % | 0 % |
| 380 kV Hamburg/Nord - Hamburg/Ost 962 | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV Hamburg/Ost - Hamburg/Süd 972 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Hamburg/Süd - Dollern 981 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 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 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Helmstedt - Wolmirstedt 492-2 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV Hoepfingen - Hueffenhardt gelb | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Hoheneck - Pulverdingen weiss | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 1 % |
| 380 kV Krümmel - Görries 419 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Krümmel - Hamburg/Ost 991 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Krümmel - Hamburg/Ost 992 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Krümmel - Hamburg/Süd 991-972 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Krümmel - Wessin 420 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Krümmel (50Hz) - Krümmel (TTG) 993 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Krümmel (50Hz) - Krümmel (TTG) 994 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Kuehmoos - Laufenburg braun | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Kuehmoos - Laufenburg gelb | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Kuehmoos - Laufenburg rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV Kupferzell | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Kupferzell - Stalldorf rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Lauchstädt - Klostermansfeld 538 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Lauchstädt - Vieselbach 471 | 0 % | 0 % | 0 % | 2 % | 3 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Lauchstädt - Vieselbach 472 | 0 % | 0 % | 0 % | 2 % | 3 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Lauchstädt - Wolmirstedt 535 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Marke - Lauchstädt 504 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Mecklar - Eisenach 450-2 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV Mecklar - Vieselbach 449-1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Muehlhausen | 0 % | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Neuenhagen - Gransee 517 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Preilack - Graustein 541 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Preilack - Graustein 542 | 0 % | 0 % | 0 % | 0 % | 0 % | 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 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Pulgar - Vieselbach 590 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Ragow - Streumen 561 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Ragow - Streumen 562 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Redwitz - Remptendorf 413 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Redwitz - Remptendorf 413-436 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Redwitz - Remptendorf 414 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Röhrsdorf - Remptendorf 574 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Röhrsdorf - Weida 573 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Schmölln - Dresden/Süd 555 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Schmölln - Dresden/Süd 556 | 0 % | 0 % | 0 % | 0 % | 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 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stendal/West - Wolmirstedt 489 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stendal/West - Wolmirstedt 490 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Streumen - Röhrsdorf 571 | 0 % | 0 % | 0 % | 4 % | 3 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Streumen - Röhrsdorf 572 | 0 % | 0 % | 0 % | 3 % | 3 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Alfstedt - Y Alfstedt blau | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Alfstedt - Y Alfstedt schwarz | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Algermissen - Wahle 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Altenfeld (50Hertz) - Redwitz 459 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Altenfeld (50Hertz) - Redwitz 460 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Aschaffenburg - Grosskrotzenburg 412 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Asslar - Borken 4/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 380 kV Stromkreis Audorf/S - Handewitt grün | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Audorf/S - Jardelund grün | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV Stromkreis AudorfS - Y Flensburg grün | 3 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Bechterdissen - Ovenstädt 3 | 0 % | 0 % | 0 % | 2 % | 1 % | 0 % | 1 % | 1 % | 1 % |
| 380 kV Stromkreis Bechterdissen - Y Eickum 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Bechterdissen - Y Eickum 4 | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Bergrheinfeld West - Grafenrheinfeld 427 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Bergshausen - Borken 2 | 0 % | 0 % | 0 % | 1 % | 1 % | 3 % | 0 % | 0 % | 1 % |
| 380 kV Stromkreis Bergshausen - Würgassen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Bergshausen - Y Vörden 1 | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Bergshausen 1 | 0 % | 0 % | 0 % | 1 % | 1 % | 3 % | 0 % | 0 % | 1 % |
| 380 kV Stromkreis Borken - Dillenburg 1/3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Giessen/N 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Giessen/N 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Karben 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Karben 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Mecklar 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Mecklar 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Twistetal 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Twistetal 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 380 kV Stromkreis Borken - Y GießenN 1 | 0 % | 0 % | 0 % | 2 % | 4 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Y GießenN 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Y GießenN 4 | 0 % | 0 % | 0 % | 1 % | 4 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Y Waldeck 1&2 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Borken - Y Waldeck 1&2 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Brunsbüttel - Büttel blau | 0 % | 1 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Brunsbüttel - Büttel grün | 1 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Conneforde - Diele rot | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Conneforde - Diele weiss | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Conneforde Ost - Diele rot | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Conneforde Ost - Diele weiss | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Conneforde Ost - Unterweser gelb | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Dauersberg (Amprion) - Asslar 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Dettingen (Amprion) - Grosskrotzenburg 1 | 0 % | 0 % | 0 % | 2 % | 2 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Diele - Dörpen West gelb | 0 % | 0 % | 0 % | 0 % | 3 % | 7 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Diele - Dörpen West schwarz | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Dipperz - Grosskrotzenburg 1 | 0 % | 0 % | 0 % | 6 % | 6 % | 5 % | 5 % | 12 % | 2 % |
| 380 kV Stromkreis Dipperz - Grosskrotzenburg 2 | 0 % | 0 % | 0 % | 6 % | 6 % | 5 % | 2 % | 3 % | 0 % |
| 380 kV Stromkreis Dipperz - Mecklar 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % |
| 380 kV Stromkreis Dipperz - Mecklar 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Dollern - Sottrum grün | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 12 % |
| 380 kV Stromkreis Dollern - Sottrum schwarz | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Dörpen West - Hanekenfähr (Amprion) EWBL | 0 % | 0 % | 0 % | 13 % | 11 % | 18 % | 3 % | 2 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV Stromkreis Eickum - Bechterdissen 1 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Eickum - Ovenstädt 4 | 0 % | 0 % | 0 % | 2 % | 1 % | 0 % | 1 % | 1 % | 0 % |
| 380 kV Stromkreis Eisenach (50Hertz) - Mecklar 450-2 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV Stromkreis Elsen - Bechterdissen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Eltmann - Redwitz 428 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Etzenricht - Mechlenreuth - Redwitz 437 | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 2 % | 0 % | 0 % |
| 380 kV Stromkreis Etzenricht - Mechlenreuth 437 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Etzenricht - Prestice (CZ) 442 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Giessen/N - Asslar 4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Giessen/N - Karben 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Giessen/N - Karben 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Giessen/N - Y GießenN 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Grafenrheinfeld - Bergrheinfeld West 426 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Grafenrheinfeld - Eltmann 422 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Grafenrheinfeld - Oberhaid 423 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Grohnde - Bergshausen 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 1 % |
| 380 kV Stromkreis Gütersloh (Amprion) - Bechterdissen 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Gütersloh (Amprion)- Bechterdissen 1 | 0 % | 0 % | 0 % | 1 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Hamburg/S (50Hertz) - Dollern 981 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Hamburg/S (50Hertz) - Dollern 982 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Handewitt - Jardelund blau | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Handewitt - Jardelund grün | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Handewitt - Kassoe (DK) 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Handewitt - Kassoe (DK) 2 | 0 % | 0 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Hattorf - Helmstedt 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Höpfingen (TNG) - Grafenrheinfeld 411 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Hradec A (CZ) - Etzenricht 441 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Irsching - Raitersaich 425 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Jardelund - Kassoe 1 | 22 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Jardelund - Kassoe 2 | 22 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Kriegenbrunn - Raitersaich 438 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Kriegenbrunn - Redwitz 432 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % |
| 380 kV Stromkreis Kriftel (Amprion) - Y Frankfurt/SW 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Krümmel - Stadorf 2 | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Krümmel (50Hertz) - Stadorf 994-BL | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Landesbergen - Ovenstädt 4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 1 % |
| 380 kV Stromkreis Lüneburg - Krümmel grün | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Lüneburg - Stadorf 1 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Mechlenreuth - Redwitz 469 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Mecklar - Dipperz 1 | 0 % | 0 % | 0 % | 4 % | 4 % | 4 % | 2 % | 2 % | 3 % |
| 380 kV Stromkreis Mecklar - Dipperz 2 | 0 % | 0 % | 0 % | 4 % | 4 % | 4 % | 2 % | 1 % | 0 % |

| CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|
| 380 kV Stromkreis Meeden (NL) - Diele schwarz | 10 % | 8 % | 8 % | 6 % | 13 % | 14 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Meeden (NL) - Diele weiss | 0 % | 0 % | 0 % | 7 % | 13 % | 14 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Meppen (Amprion) - Y Niederlangen EOWS | 0 % | 0 % | 0 % | 12 % | 10 % | 17 % | 13 % | 8 % | 0 % |
| 380 kV Stromkreis Oberhaid - Redwitz 435 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ohlensehlen - Landesbergen 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ottenhofen - Oberbachern 461 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ottenhofen - Oberbachern 462 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ovenstädt - Bechterdissen 4/1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ovenstädt - Landesbergen 4 | 0 % | 0 % | 0 % | 2 % | 2 % | 3 % | 1 % | 1 % | 1 % |
| 380 kV Stromkreis Ovenstädt - Sottrum 3 | 0 % | 0 % | 0 % | 1 % | 1 % | 5 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ovenstädt - Y Eickum 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ovenstädt - Y Eickum 4 | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Ovenstädt - Y-Eickum 4/1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 380 kV Stromkreis Raitersaich - Würgau 431 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Redwitz - Kriegenbrunn 432 | 0 % | 0 % | 0 % | 3 % | 3 % | 1 % | 1 % | 0 % | 0 % |
| 380 kV Stromkreis Remptendorf (50Hertz) - Redwitz 413 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Remptendorf (50Hertz) - Redwitz 413/436 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Remptendorf (50Hertz) - Redwitz 414 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Schuby W - Handewitt rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Sottrum - Dollern grün | 0 % | 0 % | 10 % | 2 % | 2 % | 9 % | 0 % | 3 % | 12 % |
| 380 kV Stromkreis Sottrum - Dollern schwarz | 0 % | 0 % | 3 % | 2 % | 2 % | 9 % | 1 % | 1 % | 2 % |
| 380 kV Stromkreis Sottrum - Landesbergen 2 | 0 % | 0 % | 0 % | 3 % | 2 % | 9 % | 4 % | 1 % | 2 % |
| 380 kV Stromkreis Stadorf - Wahle 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Stadorf - Wahle 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Stalldorf (TNG) - Grafenrheinfeld 416 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Urberach (Amprion) - Grosskrotzenburg 2 | 0 % | 0 % | 0 % | 1 % | 2 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Vieselbach (50Hertz) - Mecklar 449-1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wehrendorf (Amprion)- Ohlensehlen 1 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wilster - AudorfS blau | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wilster - AudorfS rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wilster - Büttel rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wilster - Dollern gelb | 1 % | 1 % | 0 % | 1 % | 0 % | 0 % | 3 % | 1 % | 0 % |
| 380 kV Stromkreis Wilster - Dollern rot | 7 % | 1 % | 0 % | 1 % | 0 % | 0 % | 1 % | 1 % | 0 % |
| 380 kV Stromkreis Wilster W - AudorfS blau | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wilster W - Dollern gelb | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wilster W - Dollern rot | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wolmirstädt (50Hertz) - Helmstedt 491-1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Wolmirstädt (50Hertz) - Helmstedt 492-2 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Würgassen - Grohnde 2 | 0 % | 0 % | 0 % | 1 % | 1 % | 1 % | 1 % | 0 % | 0 % |
| 380 kV Stromkreis Würgau - Redwitz 413/436 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Eickum - Ovenstädt 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| CCDA 2018 | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV Stromkreis Y Eickum - Ovenstädt 4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Flensburg - AudorfS blau | 1 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Flensburg - Handewitt blau | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Flensburg - Handewitt grün | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Flensburg - Jardelund blau | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Flensburg - Jardelund grün | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Frankfurt/SW - Karben 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Gießen - Asslar 4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Gießen - Karben 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Gießen - Karben 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Niederlangen - Dörpen West EOWS | 0 % | 0 % | 0 % | 7 % | 3 % | 10 % | 13 % | 6 % | 1 % |
| 380 kV Stromkreis Y Niederlangen - Niederlangen EOWS | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Rhede - Diele schwarz | 0 % | 0 % | 0 % | 1 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Rhede - Dörpen West schwarz | 0 % | 0 % | 0 % | 1 % | 1 % | 3 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Vörden - Grohnde 1 | 0 % | 0 % | 0 % | 1 % | 1 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Waldeck 1&2 - Borken 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Waldeck 1&2 - Borken 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Waldeck 1&2 - Twistetal 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Stromkreis Y Waldeck 1&2 - Twistetal 3 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Teufelsbruch - Reuter 907 | 0 % | 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 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Wendlingen | 0 % | 0 % | 0 % | 1 % | 9 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV Wessin - Güstrow 424 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Wolmirstedt Parchim/Süd 332-322 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Zwönitz 577/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV Zwönitz 578/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| HVDC NordLink cable | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PST-Röhrsdorf-Röhrsdorf 442 | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PST-Vierraden-Vierraden 441 | 0 % | 0 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PST-Vierraden-Vierraden 443 | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| Transformer-Vierraden-Vierraden 402 | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| Transformer-Vierraden-Vierraden 404 | 0 % | 0 % | 7 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Röhrsdorf - Hradec 445 (Germany - Czech Republic) | 12 % | 7 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Röhrsdorf - Hradec 446 (Germany - Czech Republic) | 10 % | 7 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| KONTEK (Germany - Denmark) | 63 % | 58 % | 51 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Hagenwerder - Mikulowa 567 (Germany - Poland) | 52 % | 36 % | 10 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Hagenwerder - Mikulowa 568 (Germany - Poland) | 46 % | 32 % | 10 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Greece

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 150 kV Argos - Korinthos | 0 % | 0 % | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 0 % |
| 150 kV Farsala - Domokos | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Filippoi - Kavala | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Megara - AgTheodoroi | 0 % | 0 % | 0 % | 0 % | 0 % | 10 % | 0 % | 0 % | 0 % |
| 150 kV Patra - Simopoulo | 0 % | 0 % | 0 % | 0 % | 0 % | 12 % | 0 % | 0 % | 0 % |
| 150 kV Sfikia - Katerini | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Arachthos - Galatina | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 25 % | 0 % | 0 % |
| 400 kV Babaeski - Nea Santa (Greek North imports) | 25 % | 18 % | 12 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Bitola - Meliti(Greek North imports) | 73 % | 80 % | 84 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Dubrovo - Thessaloniki(Greek North imports) | 2 % | 2 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Kardia - Larisa | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Kardia - Zemlak | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Meliti - Bitola (Greek North exports) | 98 % | 98 % | 96 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 400 kV Nea Santa - Babaeski (Greek North exports) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Thessaloniki - Dubrovo(Greek North exports) | 2 % | 2 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Thessaloniki - Blagoevgrad | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Hungary

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV Győr - Oroszlány | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 2 % |
| 220 kV Kisvárda - Sajószöged | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Sajószöged - Kisvárda | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Sajószöged - Tiszalök | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 400 kV Albertirsa - Göd | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Gönyű - Győr | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Győr - Litér | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Paks - Pécs 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Paks - Sándorfalva | 0 % | 6 % | 9 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Sándorfalva - Békéscsaba | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| Győr - 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| Győr - 2 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| Győr - 3 | 0 % | 0 % | 0 % | 21 % | 1 % | 0 % | 6 % | 0 % | 0 % |
| Győr - 4 | 1 % | 0 % | 0 % | 4 % | 1 % | 0 % | 0 % | 0 % | 1 % |
| Győr - 5 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Győr - Neusiedl (Hungary - Austria) | 2 % | 4 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Győr - Wien SO (Hungary - Austria) | 27 % | 9 % | 9 % | 1 % | 0 % | 2 % | 0 % | 0 % | 2 % |
| 400 kV Göd - Levice (Hungary - Slovakia) | 14 % | 48 % | 27 % | 0 % | 0 % | 0 % | 0 % | 1 % | 4 % |
| 400 kV Győr - Gabcikovo (Hungary - Slovakia) | 8 % | 24 % | 29 % | 1 % | 4 % | 0 % | 3 % | 5 % | 3 % |
| 220 kV Kisvárda - Mukachevo (Hungary - Ukraine) | 9 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Sajószöged - Mukachevo (Hungary - Ukraine) | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Ireland

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 400 kV EWIC HVDC Interconnector | 4 % | 3 % | 2 % | 0 % | 0 % | 0 % | 2 % | 0 % | 1 % |

## Northern Ireland

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 250 kV Moyle HVDC Interconnector | 1 % | 3 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Italy

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV ABBADIA NK - CANDIA | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ABBADIA NK - ROSARA NK | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ACC. BZ NK - PONTERESIA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV AIRL.VR NK - MINCIO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ALA - BUSSOL. SS | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % |
| 220 kV ALA - VICENZA MV | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV ARCO - S.MASSENZA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV AREZZO C - PIETRAF220 | 15 % | 12 % | 12 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV AREZZO C - S.BARBARA | 15 % | 12 % | 12 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV AVENZA - COLORNO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 6 % | 2 % | 1 % |
| 220 kV AVENZA - SPEZIA STA 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % |
| 220 kV Avise - RIDDES | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV BAGGIO - MAGENTA ST | 1 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV BIELLA EST - TURBIGO ST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV BORGOVALSU - LAVIS | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV BRUSCIANO - NOLA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV BUIA - SOMPLAGO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 5 % | 12 % | 14 % |
| 220 kV BUIA - UDINE N.E. | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % |
| 220 kV BUSACHI - MOGORELLA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV BUSACHI - OTTANA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV BUSSOL. SS - S.MASSENZA 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV BUSSOL. SS - S.MASSENZA 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % |
| 220 kV BUSSOL. SS - SANDRA' 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV BUSSOL. SS - SANDRA' 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % |
| 220 kV BUSSOL. SS - VR BORGOMI | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CALENZANO - S.B.QUERCE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CAMPOCHIES - CAMPOROSSO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CAMPOCHIES - VADO LIGU. | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV CARACOLI - CORRIOLO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV CARDANO - S.MASSENZA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % |
| 220 kV CARDANO NK - S.FLORIANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CASANOVA - MONCALIER 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 220 kV CASANOVA - VIGNOLE B. | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CASTELBELL - MASO PILL | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 220 kV CATT. S.NE - FAVARA SE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CATT. S.NE - SAMBUCA SE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CESANO M. - TAVAZZ.EST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % |
| 220 kV CESANO M. - TIRANO ST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 6 % | 2 % | 0 % |
| 220 kV CODRO - ORISTANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CODRO - OTTANA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV COLA' - SANDRA' | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV COLA' - TAVAZZ.EST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV COLUNGA - S.B.QUERCE | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV CORMANO - OSPIATE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 4 % | 4 % |
| 220 kV CORRIOLO - SORGENTE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV DELTAC. NK - DELTACOGNE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Divaca - PADRICIANO | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 10 % | 3 % | 2 % |
| 220 kV DOLO - MALCONTENT | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV DUGALE - VICENZA MV | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 220 kV ENICHEM - OTTANA 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ERCOLANO - TORRE N | 2 % | 1 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV FAVARA SE - PARTANNA 1 | 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 % | 0 % |
| 220 kV GRAGNANO - TORRE N | 5 % | 3 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV GROSIO - RIC.SUD MI | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV LANA - S.ANTONIO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV LANA - S.MASSENZA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV LEYNI - MONTJOVET | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV M/CORVINO - SALERNO N 1 | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV M/CORVINO - SALERNO N 2 | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MAGENTA ST - PALLANZENO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MALCONTENT - ST.5-259NK | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MELILLI - MRBIANCO 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MELILLI - MRBIANCO 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MOGORELLA - VILLASOR | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV MONCALIER - SANGONE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 220 kV MONFALC.CE - REDIPUGLIA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 16 % | 0 % | 0 % |
| 220 kV MONTESANO - TUSCIANO | 1 % | 4 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV MONTOR.SE - ROSARA NK | 1 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MONTOR.SE - VILLANOVA | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MRBIANCO - SORGENTE 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MUSOCCO ST - PORTAVOLTA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV NAT.P4 NK - NAT.P41 NK | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % |
| 220 kV NAT.P4 NK - NATURNO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 2 % |
| 220 kV NAT.P41 NK - RAT.P62 NK | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % |
| 220 kV NOCERA - S.VALENT. | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV NOCERA - SALERNO N | 3 % | 2 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV NOLA - S.VALENT. | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ORISTANO - SULCIS | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV OSPIATE - CORMANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % |
| 220 kV P.VENEZIA - PORTAVOLTA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PARTANNA - SAMBUCA SE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PIETRAF220 - VILLAVALLE | 15 % | 12 % | 12 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PONTE V.F. - All'Acqua | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PORDENONE - SALGAREDA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 1 % |
| 220 kV PORDENONE - SOMPLAGO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 4 % | 4 % |
| 220 kV PREMAD. AL - TIRANO ST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 2 % | 0 % |
| 220 kV PROVVID.A2 - S.GIACO.SE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PROVVID.A2 - VILLAVALLE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV REDIPUGLIA - PADRICIANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV RIC.NORD M - VERDERIO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV RIC.OV. MI - RIC.SUD MI | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV RIC.SUD MI - TAVAZZ.220 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Riddes - VALPELLINE | 1 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ROMA SUD - A.S.PAOLO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ROSONE - VILLA | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV RUMIANCA - SULCIS | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV RUMIANCA - VILLASOR | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV S.ANTONIO - S.MASSENZA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV S.COLOM.GE - TORNOLONK | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 2 % |
| 220 kV S.COLOM.GE - VIGNOLE B. | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 12 % | 13 % | 5 % |
| 220 kV S.MASSENZA - TAIO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV S.VALB. CP - S.VALBURGA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV SAFAU NK - UDINE N.E. | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV SAFAU NK - UDINE SUD | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV SALGAREDA - TREVISOSUD | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 1 % |
| 220 kV SANDRA' - TAIO | 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 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV SCORZE' - SOVERZENE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 2 % |
| 220 kV SCORZE' - TREVISOSUD | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 2 % | 1 % |
| 220 kV Serra - PALLANZENO | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 1 % | 1 % | 1 % |
| 220 kV SESTO S.G. - TORRETTA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV SOVERZENE - LIENZ | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 2 % | 3 % |
| 220 kV SPEZIA STA - TORNOLONK | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 2 % |
| 220 kV TAVAZZ.EST - TAVAZZ.220 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV TORRETTA - CORMANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 3 % | 3 % |
| 220 kV VELLAI - SOVERZENE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV Bertola-Udine | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PST-Padriciano | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Albertville - RONDISSONE 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Albertville - RONDISSONE 2 | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ALIANO - LAINO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ALIANO - MATERA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ALTOMONTE - LAINO | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV APRILIA380 - ROMA SUD | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV AVELLINO N - S.SOFIA | 1 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BAGGIO - LACCHIAREL | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BAGGIO - PIEVE ALBI | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BARGI STAZ - CALENZANO | 7 % | 9 % | 9 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV BARGI STAZ - MARTIGNONE | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV BELCAS.ALL - MAGISANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BENEVEN. 2 - BENEVEN.3 | 3 % | 0 % | 1 % | 2 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV BENEVEN. 2 - PRESENZANO | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BENEVEN.3 - TROIA 380 | 4 % | 5 % | 6 % | 6 % | 3 % | 4 % | 0 % | 0 % | 0 % |
| 380 kV BISAC.380 - MELFI 380 | 1 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BOLANO - PARADISO | 0 % | 0 % | 0 % | 1 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV BOLANO - RIZZICONI | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BOVISIO - VERDERIO | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CAGNO - MENDRISIO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CAGNO - MUSIGNANO | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CALENZANO - CASELLINA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CALENZANO - SUVERETO | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV CANDIA - FANO E.T. | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CASANOVA - CHIVASSO S | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CASELLINA - POGGIO A C | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CEPRANO380 - GARIGL. ST | 1 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CEPRANO380 - LATINA NUC | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CHIGNOLO - LACCHIAREL | 0 % | 0 % | 0 % | 0 % | 4 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CHIVASSO S - RONDISSONE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV CREMONA - FLERO ST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV CREMONA - MALEO | 0 % | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Divaca - REDIPUGLIA | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV F.SANTO CR - ITTIRI | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV FANO E.T. - FORLI' | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV FANO E.T. - S.MART. XX | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV FLERO ST - NAVE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV FLERO ST - TRAVAGLIAT | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV FOGGIA - S.SEVER380 | 3 % | 1 % | 2 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV FOGGIA PST - TROIA 380 | 3 % | 1 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV FORLI' - S.MART. XX | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV GALATINA - GALATINA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GARIGL. ST - LATINA NUC | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GARIGL. ST - PATRIA | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GENZANO380 - MATERA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GENZANO380 - MELFI 380 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GISSI - VILLAN.NK 1 | 3 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GISSI - VILLAN.NK 2 | 3 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Gorlago - ROBBIA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GORLAGO - VERDERIO | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV LAINO - M/CORVINO 1 | 0 % | 0 % | 0 % | 3 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV LAINO - M/CORVINO 2 | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV LAINO - ROSSANO TE 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV LAINO - ROSSANO TE 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV LARINO - GISSI | 3 % | 1 % | 2 % | 1 % | 1 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV LARINO - ROTELLO380 | 3 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV LATINA NUC - VALMONTONE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Lavorgo - MUSIGNANO | 12 % | 10 % | 16 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV M/CORVINO - S.SOFIA | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV MALEO - S.ROCCO PO | 0 % | 0 % | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 0 % |
| 380 kV MARGINONE - POGGIO A C | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV MARTIGNONE - S.DAMASO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 380 kV MONFALC.CE - REDIPUGLIA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| 380 kV P.SPERANZA - ROMA NORD | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV PARADISO - SORGENTE | 0 % | 0 % | 0 % | 1 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV PARMA VIGH - S.ROCCO PO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV PARMA VIGH - SPEZIA STA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV PATERNO SE - SORGENTE | 0 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV PIEVE ALBI - VOGHERA ST | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV POGGIO A C - P.SPERANZA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV POGGIO A C - SUVERETO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV POGLIANO - RHO 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV POGLIANO - RHO 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ROMA EST - VALMONTONE | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV RONDISSONE - TRINO | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV RONDISSONE - TURBIGO ST | 0 % | 0 % | 0 % | 2 % | 4 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV ROSSANO TE - SCANDALE | 0 % | 0 % | 0 % | 2 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV ROTELLO380 - S.SEVER380 | 3 % | 1 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV S.Fiorano - ROBBIA | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV S.ROCCO PO - TURANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Soazza - BULCIAGO | 7 % | 7 % | 9 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV TAVAZZ. ST - TURANO | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV VADO LIGU. - VIGNOLE B. | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV Venaus - VILLARODIN | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV VILLAN.NK - VILLANOVA 1 | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ACCIAIOLO_ATR1 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ACCIAIOLO_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ANDRIA_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| ANDRIA_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| ANDRIA_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| ANDRIA_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| ATR 1/2 SPEZIA | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ATR 380/150kV Paternò | 31 % | 31 % | 24 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ATR 380/220kV SRG | 4 % | 1 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BAGGIO_ATR41/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BARI O_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BARI O_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BARI O_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BARI O_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BISAC.380_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BISAC.380_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BISAC.380_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BISAC.380_ATR3 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BRINDISI_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BRINDISI_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CANDIA_ATR1 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CANDIA_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CANDIA_ATR1 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CANDIA_ATR31/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CAPRIATI_TRG2 1/8 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CAPRIATI_TRG2 1/8 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CASELLINA_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| CASSANO_ATR11/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CEPAGATTI_TRCONV1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| CHIARAMONT_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| DOLO_ATR41/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DUGALE_ATR31/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ENICHEM_TRG2 2/8 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FANO E.T._ATR1 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FANO E.T._ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FANO E.T._ATR3 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FANO E.T._ATR1 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FANO E.T._ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FEROLETO_ATR21/3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FOGGIA_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FOGGIA_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FOGGIA_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| FOGGIA_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| GALATINA_TRCONV. | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| GLORENZACE_TRG2 2/9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| ISAB IGCC_TRGA 1/8 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| LATINA NUC_TRCONV1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| M/CORVINO_ATR1 1/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| M/CORVINO_ATR11/2 | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| M/CORVINO_ATR2 1/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| M/CORVINO_ATR21/2 | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % |
| M/CORVINO_ATR4 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| M/CORVINO_ATR5 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MALCONTENT_ST.5 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MANTOVA CE_TRB 2/9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| MANTOVA CE_TRC 2/9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| MANTOVA CE_TRS 1/9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MANTOVA CE_TRS2 1/9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MANTOVA CE_TRS1/9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MANTOVA CE_TRS21/9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MARTIGNONE_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MARTIGNONE_ATR3 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MRBIANCO _ATR1 2/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| MRBIANCO_ATR1 2/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| NAVE_ATR81/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PADRICIANO_ATR1 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PADRICIANO_ATR2 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PADRICIANO_PDRTA3 2/2 X | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 4 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| PADRICIANO_ATR2 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| PADRICIANO_PDRTA3 2/2 X | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| PATERNO SE_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| PATERNO SE_ATR1 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| RAGUSA_ATR1 2/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| RAGUSA_ATR2 2/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| REDIPUGLIA_ATR31/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 5 % | 0 % |
| ROMA OVEST_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| ROMA OVEST_ATR3 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| ROMA OVEST_ATR2 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ROMA OVEST_ATR3 1/3 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| RONDISSONE_ATR11/2 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| ROSARA_ATRA 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| ROSARA_ATRA 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| RUMIANCA_ATR51/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| S.ANTONIO_Cavo F 12 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| S.BARBARA_ATR21/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| S.DAMASO_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| S.GIACO.SE_ATR11/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| S.MART. XX_ATR1 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| S.MART. XX_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| SACOI link | 26 % | 34 % | 18 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| SALGAREDA_ATR11/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| SAPEI link | 1 % | 1 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| SCORZE'_ATR1 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| SCORZE'_ATR2 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| SPEZIA STA_ATR1 1/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| TIRANO ST_PST1 2/3 X | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TIRANO ST_PST1 2/3 X | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TORNOLO C._TR R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TORRE N_ATR1 2/3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TURBIGO ST_ATR3 1/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| TURBIGO ST_ATR31/2 | 0 % | 0 % | 0 % | 0 % | 4 % | 1 % | 0 % | 0 % | 0 % |
| UDINE SUD_ATR21/2 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| VADO LIGU._ATR1 1/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VADO LIGU._ATR11/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VENEZIA N._ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % |
| VENEZIA N._ATR3 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VENEZIA N._ATR3 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| VILLABONA_ATR1 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 13 % | 0 % |
| VILLABONA_ATR1 2/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 4 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| VILLANOVA_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VILLANOVA_ATR3 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VILLANOVA_ATR2 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VILLANOVA_ATR3 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VILLANOVA_ATR41/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| VILLANOVA_ATR5 1/4 R | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| VILLAVALLE_ATR31/2 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| Voltage limits at area SICI | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Lithuania

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 330/400 kV LitPol Link | 29 % | 41 % | 34 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 330/400 kV NordBalt | 30 % | 43 % | 56 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| Siauliai AT-2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Netherlands

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV EEM-RBB a | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV EEM-RBB b | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV MEE-WEW B | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV RBB-VVL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV RBB-WEW P | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV VVL-EEM G | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV VVL-RBB Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BKK-DIM W | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BSL-RLL G | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BSL-RLL Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV BSL-ZVL G | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DIM-LLS W | 0 % | 0 % | 0 % | 4 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 380 kV DIM-LLS Z | 2 % | 0 % | 1 % | 3 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV DOD-DTC W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DOD-DTC Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DTC-HGL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV DTC-HGL Z | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV EEM-MEE W | 0 % | 0 % | 0 % | 3 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV EEM-MEE Z | 0 % | 0 % | 0 % | 3 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV ENS-ZL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ENS-ZL Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 380 kV GNA-HGL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV GNA-HGL Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV KIJ-BKK W | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV KIJ-GT W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV KIJ-GT Z | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV KIJ-OZN Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV LLS-ENS W | 1 % | 1 % | 0 % | 11 % | 4 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV LLS-ENS Z | 10 % | 3 % | 2 % | 13 % | 5 % | 2 % | 0 % | 0 % | 0 % |
| 380 kV MBT-EHV Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV MBT-OBZ W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV MBT-RMK W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV MBT-SDF Z | 2 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV MBT-VYK W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV MBT-VYK Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV MEE-DIL W | 0 % | 1 % | 1 % | 6 % | 12 % | 13 % | 0 % | 0 % | 0 % |
| 380 kV MEE-DIL Z | 1 % | 7 % | 11 % | 6 % | 12 % | 13 % | 0 % | 0 % | 0 % |
| 380 kV OZN-DIM G | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV RLL-GT W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV RLL-GT Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV RLL-ZVL G | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV RLL-ZVL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV WTR-BWK W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ZL-HGL W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ZL-HGL Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ZL-MEE W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ZL-MEE Z | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 380 kV ZVL-GT W | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 320 kV Eemshaven - Endrup (Netherlands - Denmark) | 0 % | 62 % | 61 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 450 kV Eemshaven - Feda (Netherlands - Norway) | 76 % | 66 % | 98 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 450 kV Maasvlakte - Grain (Netherlands - UK) | 75 % | 68 % | 63 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Poland

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220/110 kV Lesniow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220/110 kV Plewiska | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220/110 kV Swiebodzice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220/400 kV Dunowo | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220/400 kV Gdansk | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220/400 kV Mikulowa | 11 % | 21 % | 23 % | 0 % | 4 % | 4 % | 0 % | 0 % | 0 % |
| 220 kV Dunowo-Zydowo | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Janow-Rogowiec | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % |
| 220 kV Janow-Zgierz | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Jasiniec-Grudziadz | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Jasiniec-Patnow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Joachimow-Lagisza-Wrzosowa | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Joachimow-Losnice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Joachimow-Wrzosowa | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Kielce-Joachimow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Konin-Patnow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Konin-Plewiska-PoznańPołudnie | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Kopanina-Liskovec | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Kozienice-Rozki | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Krajnik - Glinki | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Krajnik - Gorzów | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mikulowa - Cieplice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mikulowa - Lesniow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mikulowa - Polkowice | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mikulowa - Swiebodzice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Milosna - Ostroleka | 7 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Mory - Kozienice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Morzyczyn - Krajnik | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Oltarzew - Mory | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Patnow - Bydgoszcz | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Patnow - Wloclawek | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PilaKrzewina - Plewiska | 6 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV PilaKrzewina - Zydowo | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Plewiska - Konin | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Plewiska - Polkowice | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Polaniec - Chmielow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Polkowice - Leszno | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Pulawy - Kozienice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Radkowice - Kielce | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Rogowiec - Joachimow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV Siersza - Byczyna | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Swiebodzice - Zabkowice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Zydowo - Gdansk | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ZydowoKierzkowo - Gdansk | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Zydowo - ZydowoKierzkowo | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/110 kV Czarna | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV Kozienice | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV Krajnik | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV Wielopole | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 1 % |
| 400 kV GdanskBlonia - Gdansk | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Kozienice - Milosna | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Krajnik - Vierraden | 5 % | 2 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Krosnolskrzynia - Lemesany | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Krosnolskrzynia - Rzeszow | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Krosnolskrzynia - Tarnow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Mikulowa - Czarna | 0 % | 9 % | 14 % | 1 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV Mikulowa - Hagenwerder | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Mikulowa - PST | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Morzyczyn - Dunowo | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Narew - Stanislawow | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Oltarzew - Mosciska | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Oltarzew - Rogowiec | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Rogowiec - Joachimow | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Rogowiec - Tucznawa | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SiedlceUjrzanow - Narew | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Slupsk - Zarnowiec | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Wielopole - Nosovice | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Zarnowiec - Gdansk | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| BtB-Elk-Alytus | 48 % | 46 % | 37 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DC-LINK-Slupsk - Starno | 73 % | 71 % | 68 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Krajnik - Vierraden 507 (Poland - Germany) | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Krajnik - Vierraden 508 (Poland - Germany) | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Portugal

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 150 kV Bouça - Zêzere 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Bouça - Zêzere 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Cabril - Bouça | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Caniçada - Riba d'Ave - Frades | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Monte da Pedra – Sines | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Riba d'Ave - Oleiros | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Vilarinho Furnas - Caniçada | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 150 kV Zêzere - Falagueira | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Carregado - Sacavém 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Carregado - Sacavém 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Picote - Mogadouro | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Pocinho - Armamar 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220/150 kV Zêzere Transformer | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Aldeadavilla - Lagoaça | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Alto Lindoso - Cartelle 1 e 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Armamar - Lagoaça | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Batalha - Ribatejo | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Pedralva - Riba d'Ave | 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 % |
| 400 kV Vieira do Minho - Pedralva 2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Romania

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 110 kV Salonta - Chisineu Cris | 3 % | 6 % | 7 % | 2 % | 2 % | 2 % | 0 % | 0 % | 0 % |
| 220 kV Baru Mare - Hasdat | 1 % | 1 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Paroseni - Baru Mare | 1 % | 1 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Portile de Fier - Resita circ. 1 | 11 % | 12 % | 11 % | 4 % | 4 % | 5 % | 0 % | 0 % | 2 % |
| 220 kV Portile de Fier - Resita circ. 2 | 11 % | 12 % | 11 % | 4 % | 4 % | 5 % | 0 % | 0 % | 2 % |
| 220 kV Resita - Timisoara circ. 1 | 4 % | 5 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Resita - Timisoara circ. 2 | 4 % | 5 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Targu Jiu Nord - Paroseni | 2 % | 2 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV Urechesti - Targu Jiu Nord | 2 % | 2 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400/220 kV AT Rosiori | 11 % | 12 % | 13 % | 2 % | 2 % | 3 % | 0 % | 0 % | 1 % |
| 400/220 kV AT1 Iernut | 0 % | 0 % | 1 % | 0 % | 0 % | 2 % | 0 % | 0 % | 1 % |
| 400/220 kV AT3 Arad | 1 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV Portile de Fier - Djerdap | 21 % | 22 % | 23 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Slovakia

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV SK_L1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV SK_L2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV SK_L3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV SK_L4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV SK_L5 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L6 | 4 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 400 kV SK_L7 | 12 % | 16 % | 11 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L8 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L10 | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV SK_L11 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L12 | 19 % | 45 % | 37 % | 0 % | 0 % | 1 % | 0 % | 0 % | 1 % |
| 400 kV SK_L13 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L14 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L15 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L16 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L17 | 0 % | 0 % | 6 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L18 | 11 % | 9 % | 5 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV SK_L19 | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV SK_L20 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

## Slovenia

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| DV 220 kV Beričevo - Kleče | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DV 220 kV Beričevo - Podlog | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DV 220 kV Cirkovce - Podlog | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DV 400 kV Beričevo - Divača | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DV 400 kV Beričevo - Podlog | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DV 400 kV Divača - Redipuglia | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| DV 400 kV Tumbri - Krsko 1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV Cirkovce - Zerjavinec | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 3 % |
| 220 kV Divača - Padriciano | 0 % | 0 % | 0 % | 0 % | 0 % | 4 % | 2 % | 0 % | 2 % |
| 220 kV Divača - Pehlin | 0 % | 0 % | 0 % | 2 % | 0 % | 2 % | 0 % | 0 % | 9 % |
| 220 kV Kleče - Divača | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 3 % | 0 % | 0 % |
| 220 kV Podlog - Obersielach | 0 % | 0 % | 0 % | 0 % | 6 % | 2 % | 1 % | 1 % | 1 % |
| 400 kV Divača - Melina | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |

## Spain

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV ES_L1 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L2 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L3 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L4 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L5 | 7 % | 3 % | 7 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV ES_L6 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L7 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L8 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L9 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L10 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV ES_L11 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L12 | 0 % | 0 % | 0 % | 7 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L13 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L14 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L15 | 0 % | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % |
| 220 kV ES_L16 | 0 % | 0 % | 0 % | 0 % | 2 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV ES_L17 | 0 % | 0 % | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 0 % |
| 220 kV ES_L18 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L19 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L20 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L21 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L22 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L23 | 0 % | 0 % | 0 % | 36 % | 0 % | 0 % | 1 % | 0 % | 0 % |
| 220 kV ES_L24 | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L25 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L26 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L27 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV ES_L28 | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L29 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L30 | 0 % | 0 % | 0 % | 32 % | 8 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L31 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L32 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L33 | 0 % | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L34 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L35 | 0 % | 0 % | 0 % | 8 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L36 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L37 | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L38 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L39 | 2 % | 0 % | 2 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L40 | 0 % | 0 % | 13 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV ES_L41 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L42 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L43 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L44 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L45 | 0 % | 0 % | 0 % | 4 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L46 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L47 | 0 % | 0 % | 0 % | 2 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L48 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L49 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L50 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L51 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L52 | 0 % | 0 % | 0 % | 0 % | 2 % | 4 % | 0 % | 0 % | 2 % |
| 220 kV ES_L53 | 0 % | 0 % | 0 % | 1 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV ES_L54 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 220 kV ES_L55 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L56 | 4 % | 0 % | 1 % | 0 % | 0 % | 3 % | 0 % | 0 % | 1 % |
| 220 kV ES_L57 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L58 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L59 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L60 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L61 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L62 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L63 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % |
| 220 kV ES_L64 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L65 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L66 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L66 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 4 % |
| 220 kV ES_L67 | 1 % | 0 % | 0 % | 0 % | 2 % | 1 % | 0 % | 2 % | 2 % |
| 220 kV ES_L68 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L69 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L70 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L71 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L72 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L73 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L74 | 0 % | 0 % | 0 % | 0 % | 0 % | 2 % | 0 % | 0 % | 0 % |
| 220 kV ES_L75 | 2 % | 0 % | 0 % | 12 % | 5 % | 3 % | 1 % | 0 % | 0 % |
| 220 kV ES_L76 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L77 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L78 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L79 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 220 kV ES_L80 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L81 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L82 | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L83 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L84 | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L85 | 0 % | 0 % | 0 % | 5 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L86 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L87 | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L88 | 4 % | 3 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L89 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L90 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L91 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 220 kV ES_L92 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L93 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L94 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L95 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L96 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 5 % |
| 400/220 kV ES_L97 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L98 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L99 | 0 % | 0 % | 0 % | 3 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L100 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L101 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L102 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400/220 kV ES_L103 | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L104 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV ES_L105 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L106 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L107 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L108 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L109 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L110 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L111 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L112 | 1 % | 1 % | 9 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L113 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L114 | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L115 | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L116 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L117 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV ES_L118 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L119 | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L120 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

| Grid element | CCDA 2018 | CCDA 2019 | CCDA 2020 | D-1 2018 | D-1 2019 | D-1 2020 | CTRT 2018 | CTRT 2019 | CTRT 2020 |
|---|---|---|---|---|---|---|---|---|---|
| 400 kV ES_L121 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L122 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L123 | 0 % | 0 % | 0 % | 1 % | 1 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L124 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV ES_L125 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L126 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L127 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L128 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L129 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L130 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L131 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L132 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L133 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L134 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L135 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L136 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L137 | 0 % | 0 % | 1 % | 32 % | 9 % | 4 % | 0 % | 0 % | 0 % |
| 400 kV ES_L138 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L139 | 0 % | 0 % | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV ES_L140 | 1 % | 0 % | 1 % | 17 % | 6 % | 1 % | 0 % | 0 % | 0 % |
| 400 kV ES_L141 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L142 | 0 % | 0 % | 0 % | 1 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| 400 kV ES_L143 | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |

# 2 Capacity calculation for the purpose of capacity allocation without threshold

## 2018 – Capacity calculation for the purpose of DA allocation without threshold

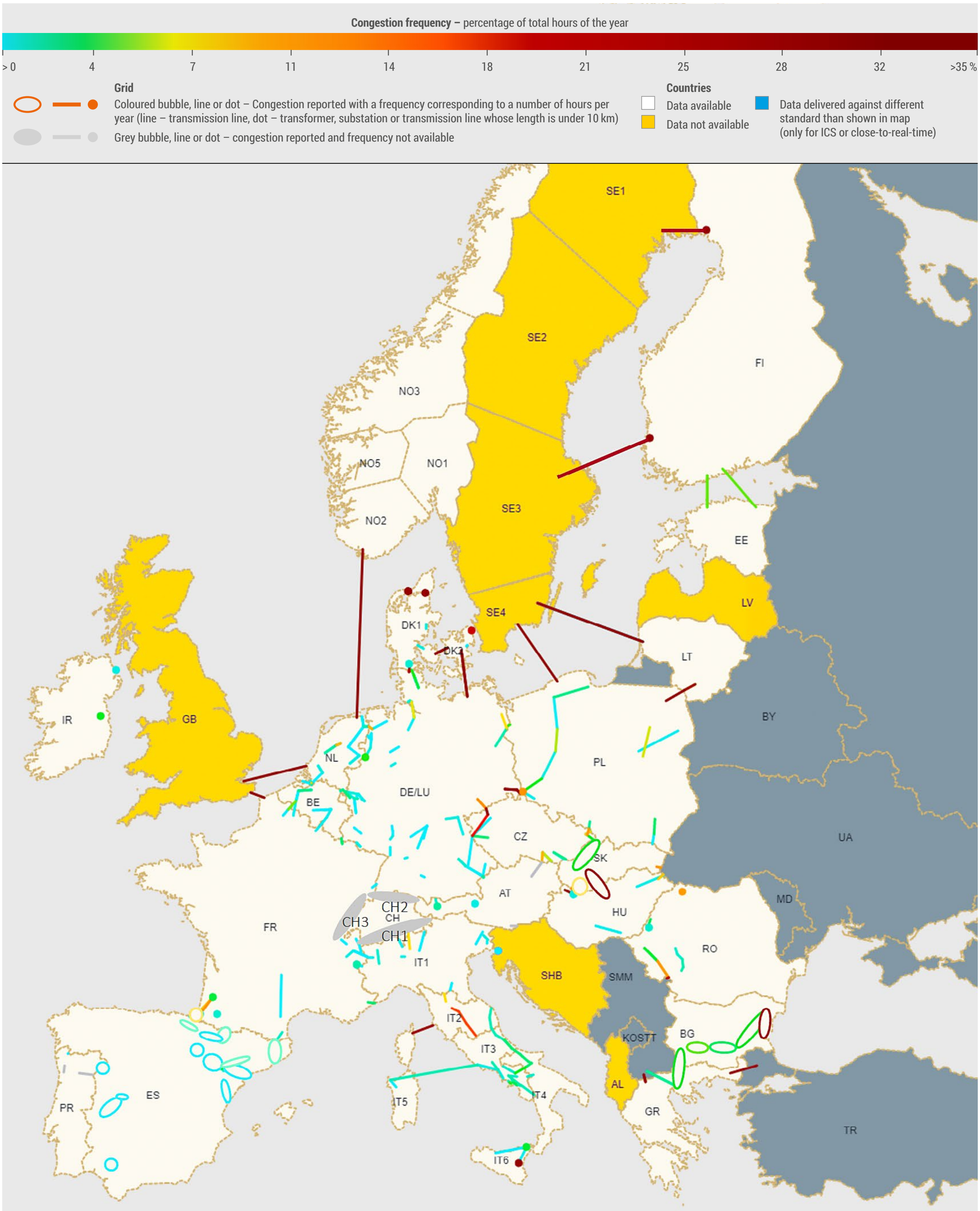



Figure 69: CCDA for 2018 – Europe without threshold

## Zooms

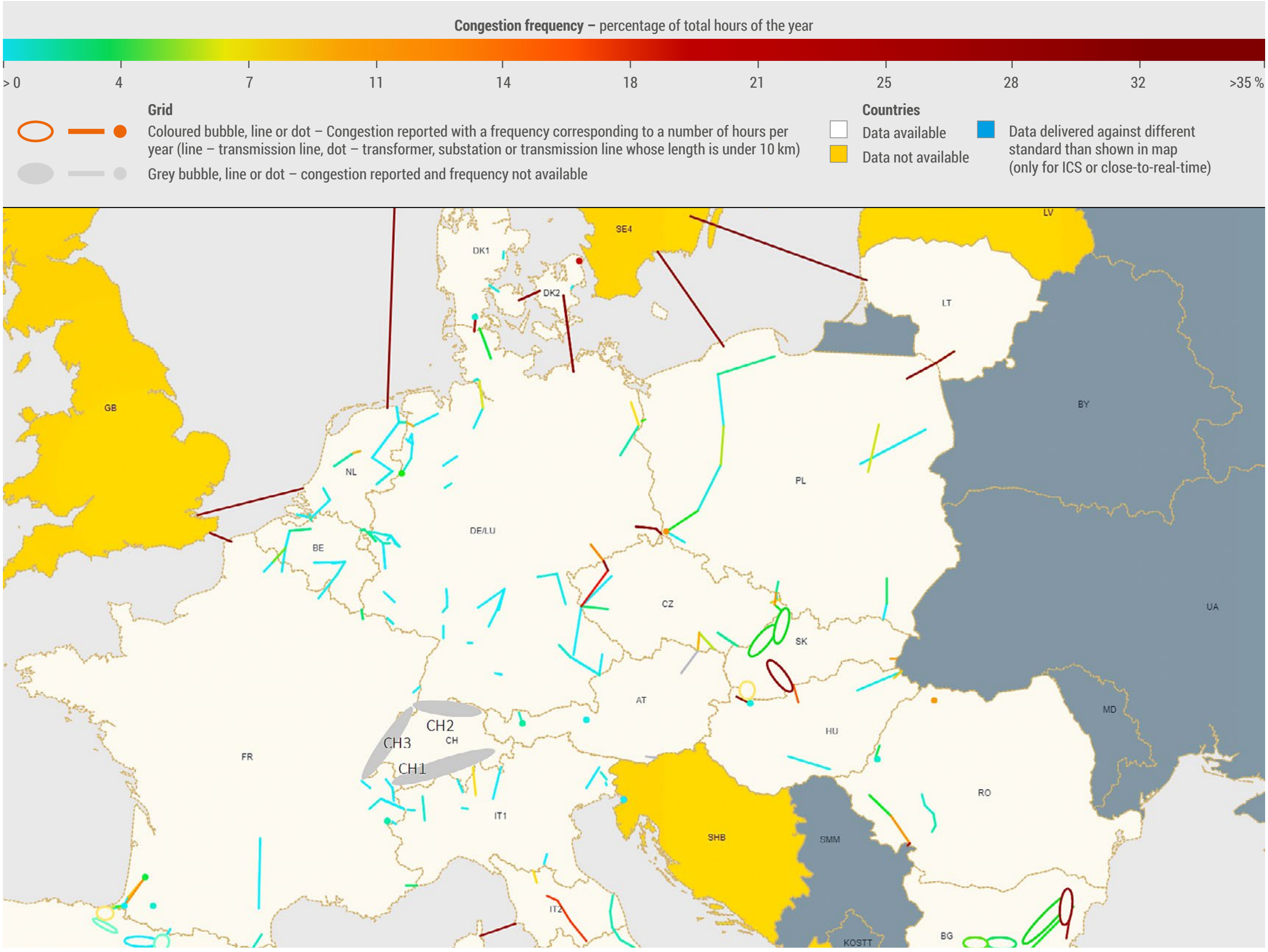



Figure 70: CCDA for 2018 – Central Europe without threshold

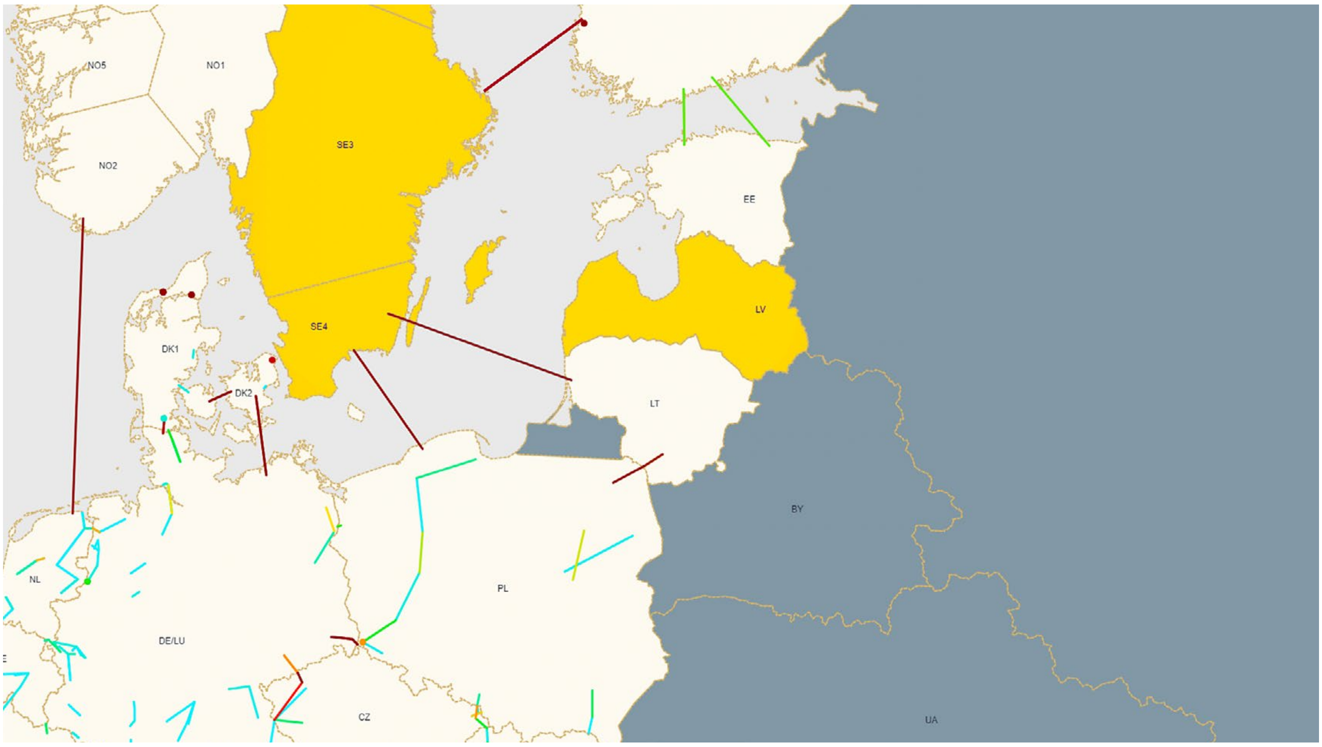



Figure 71: CCDA for 2018 – Baltic countries and Denmark/Sweden without threshold

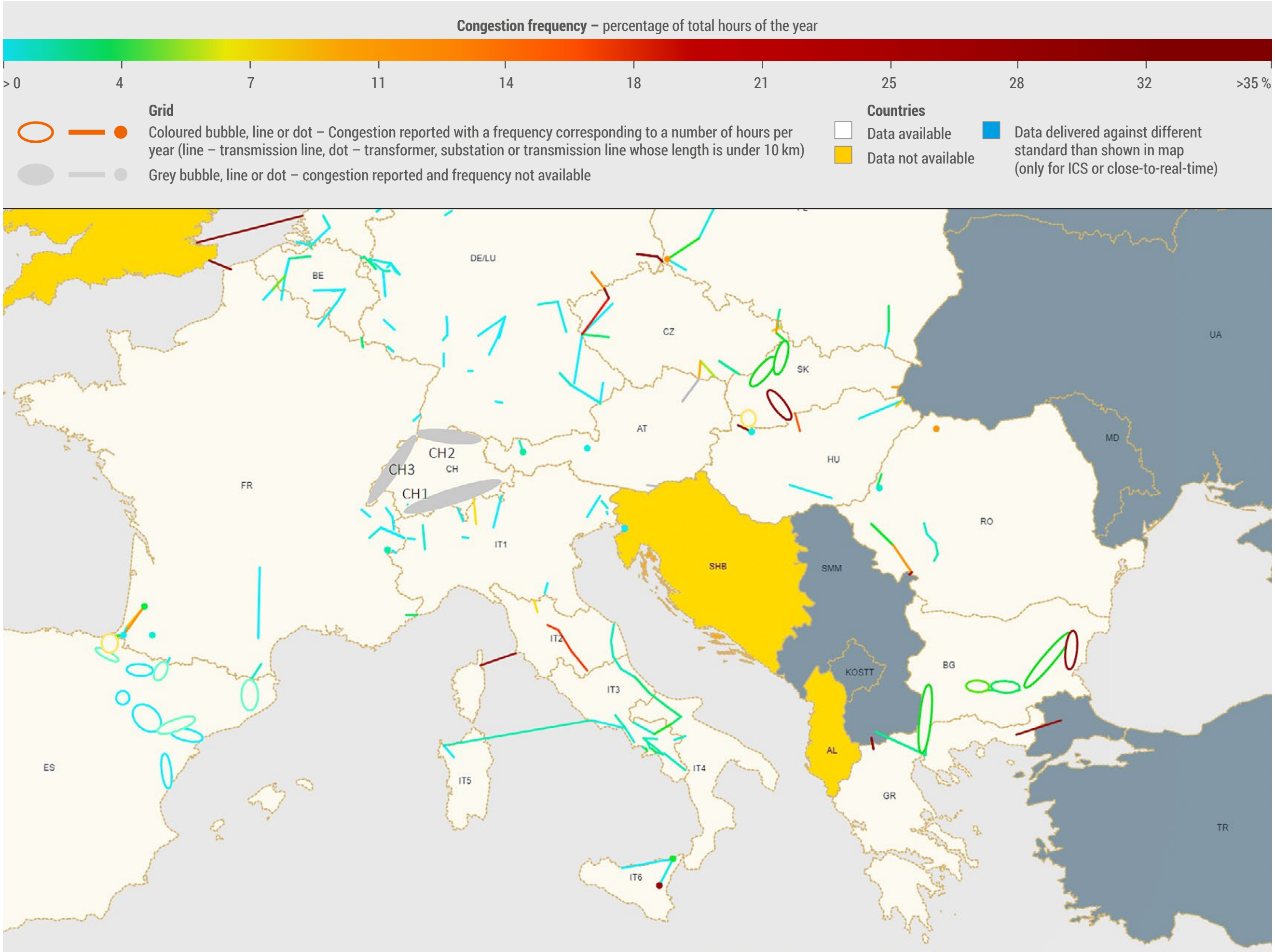



Figure 72: CCDA for 2018 – Balkans and Italy without threshold

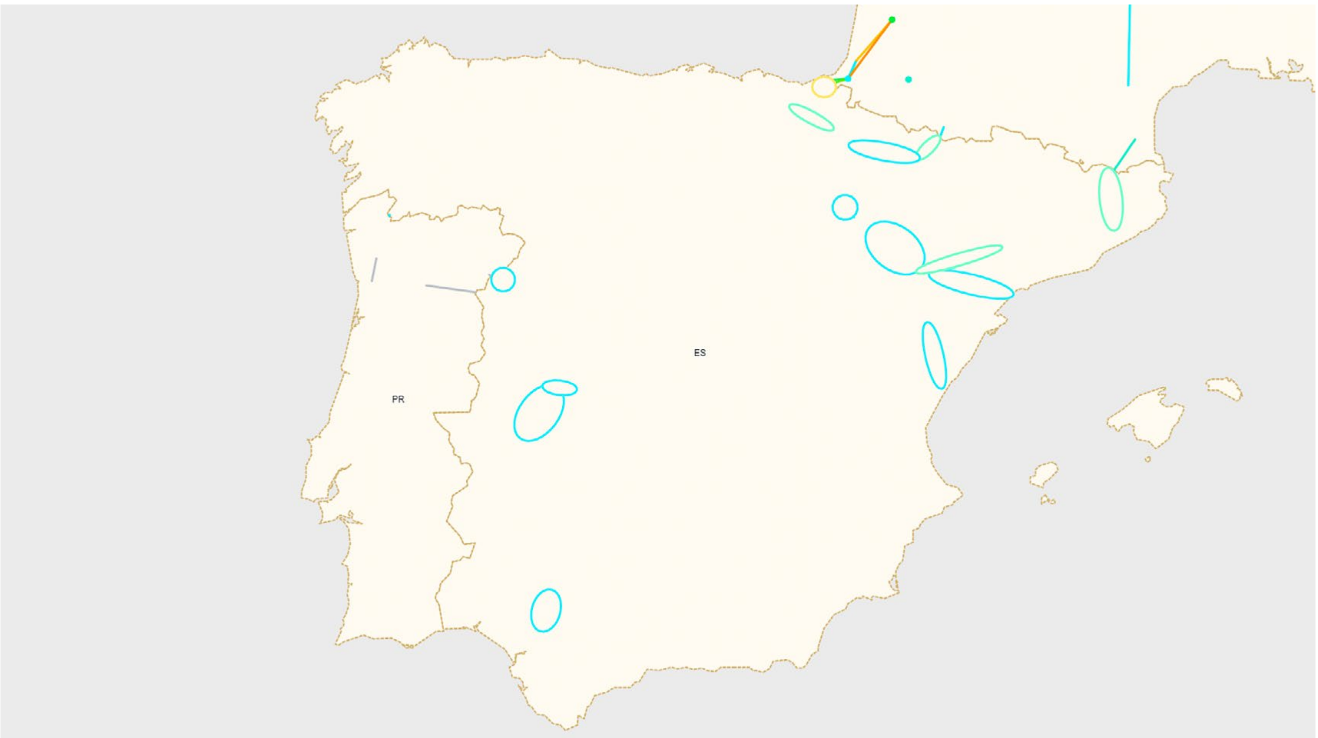



Figure 73: CCDA for 2018 – Spain/Portugal without threshold

## 2019 – Capacity calculation for the purpose of DA allocation without threshold

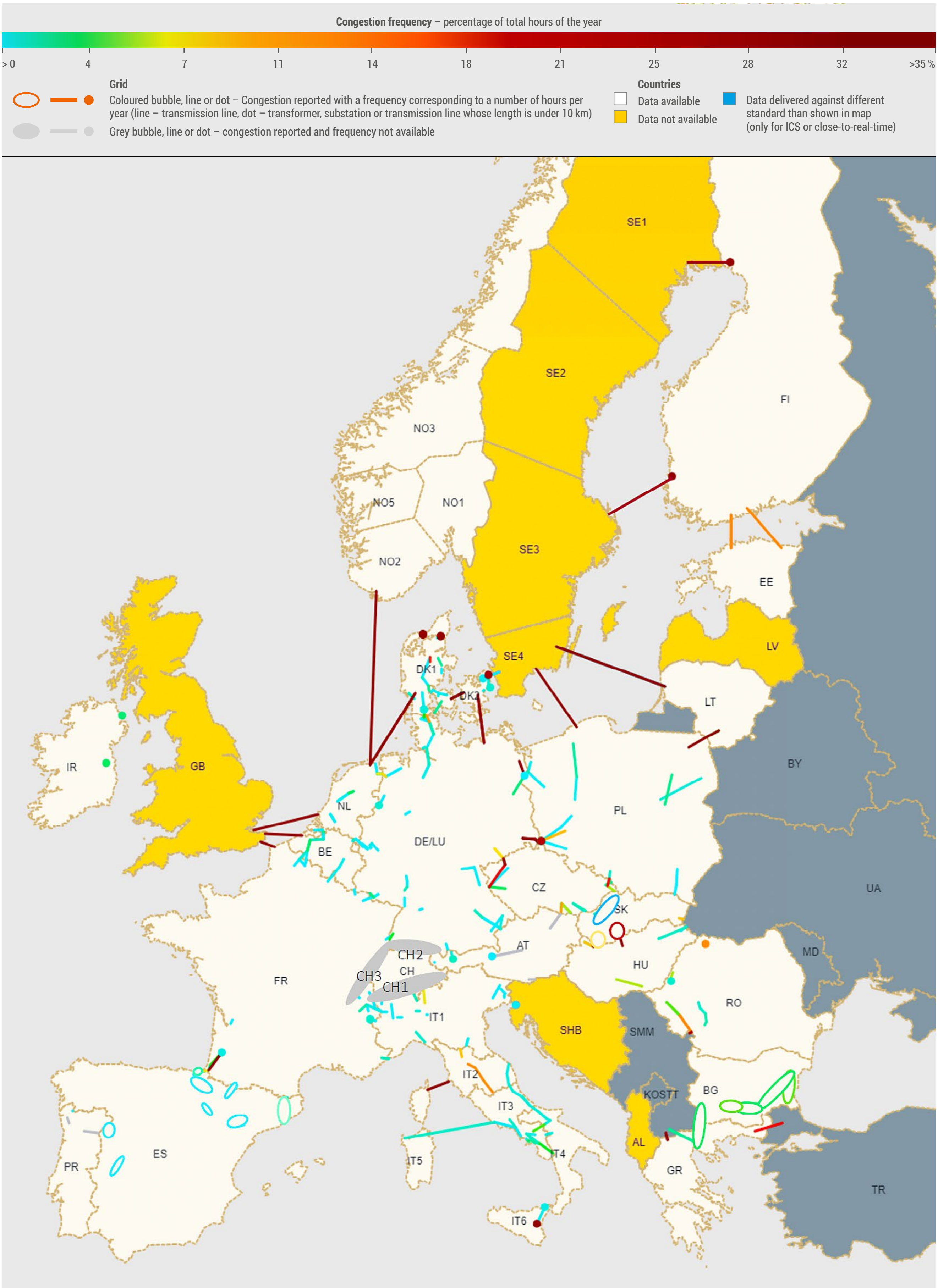



Figure 74: CCDA for 2019 – Europe without threshold

## Zooms

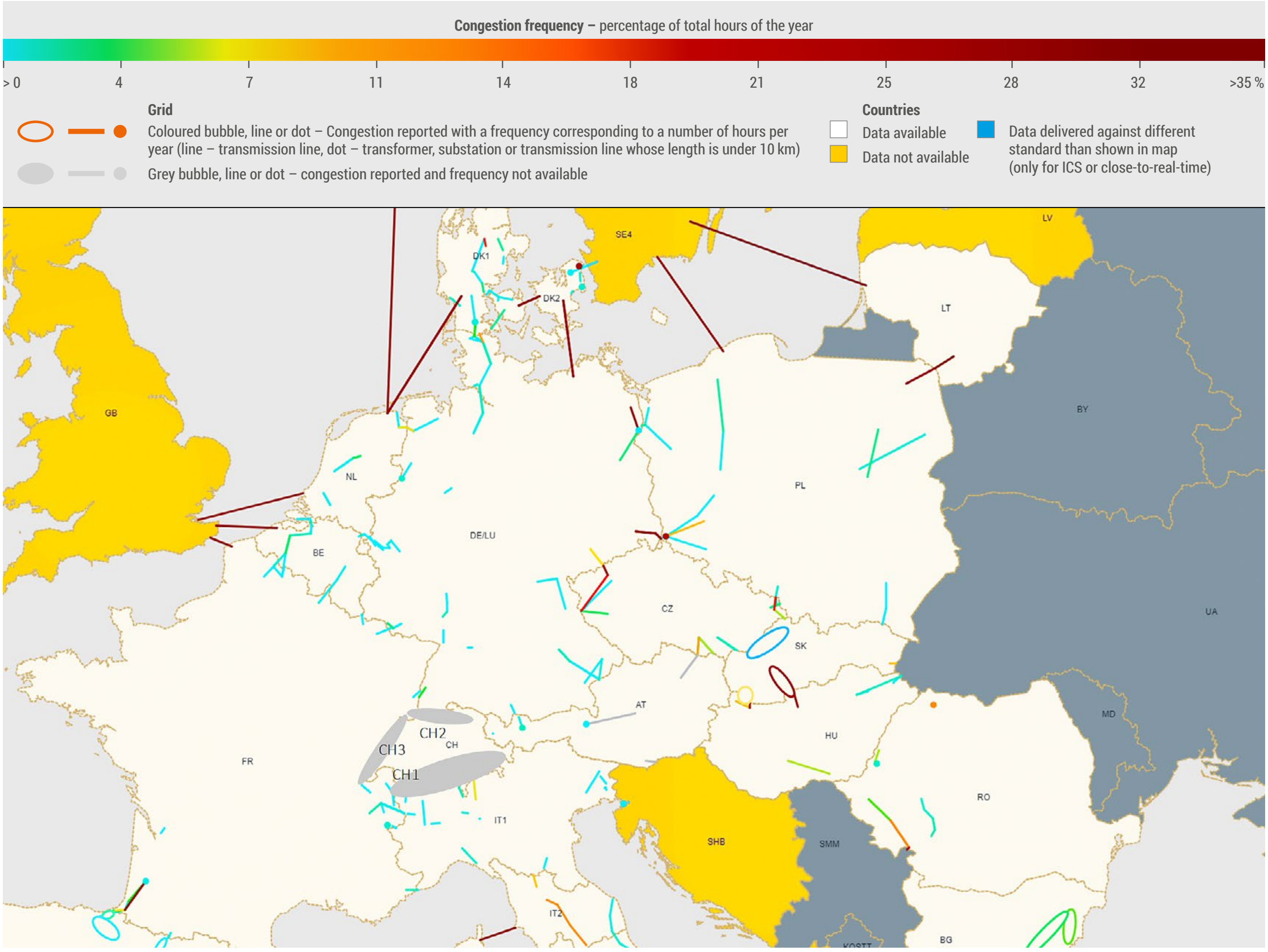



Figure 75: CCDA for 2019 – Central Europe without threshold

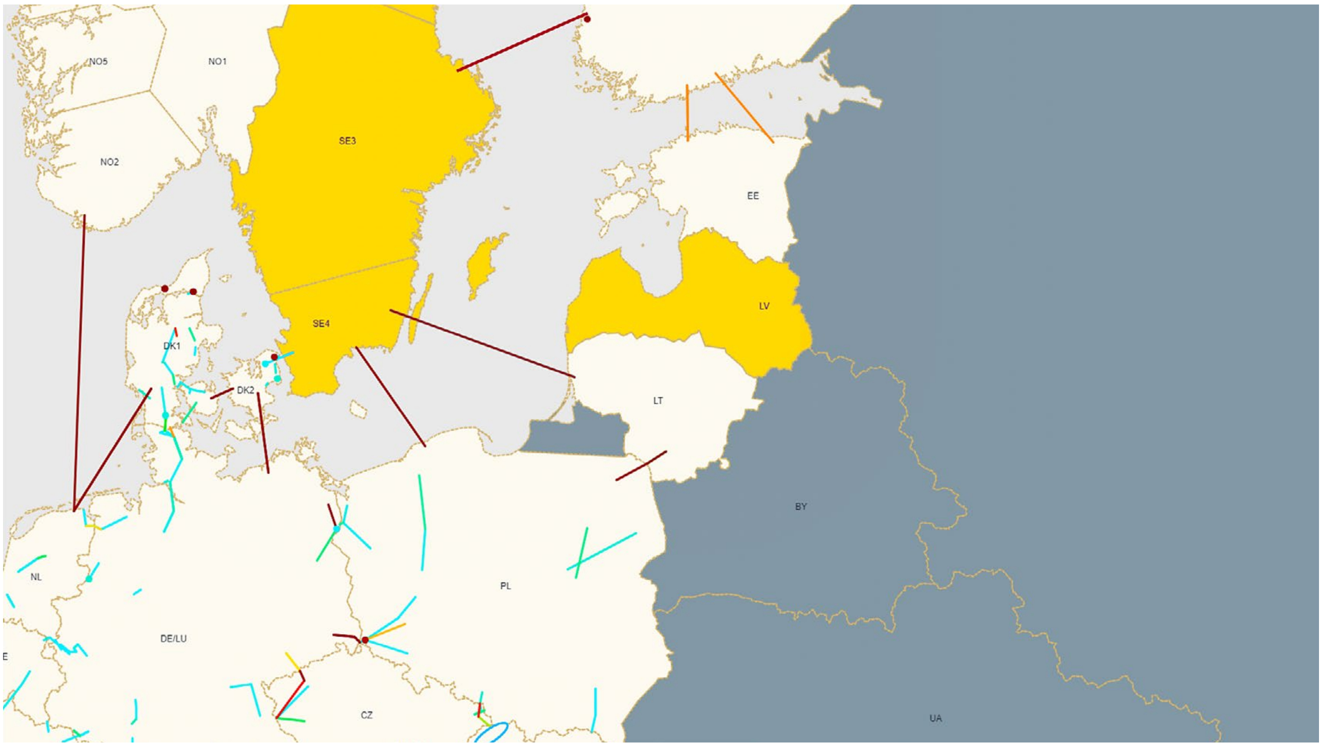



Figure 76: CCDA for 2019 – Baltic countries and Denmark/Sweden without threshold

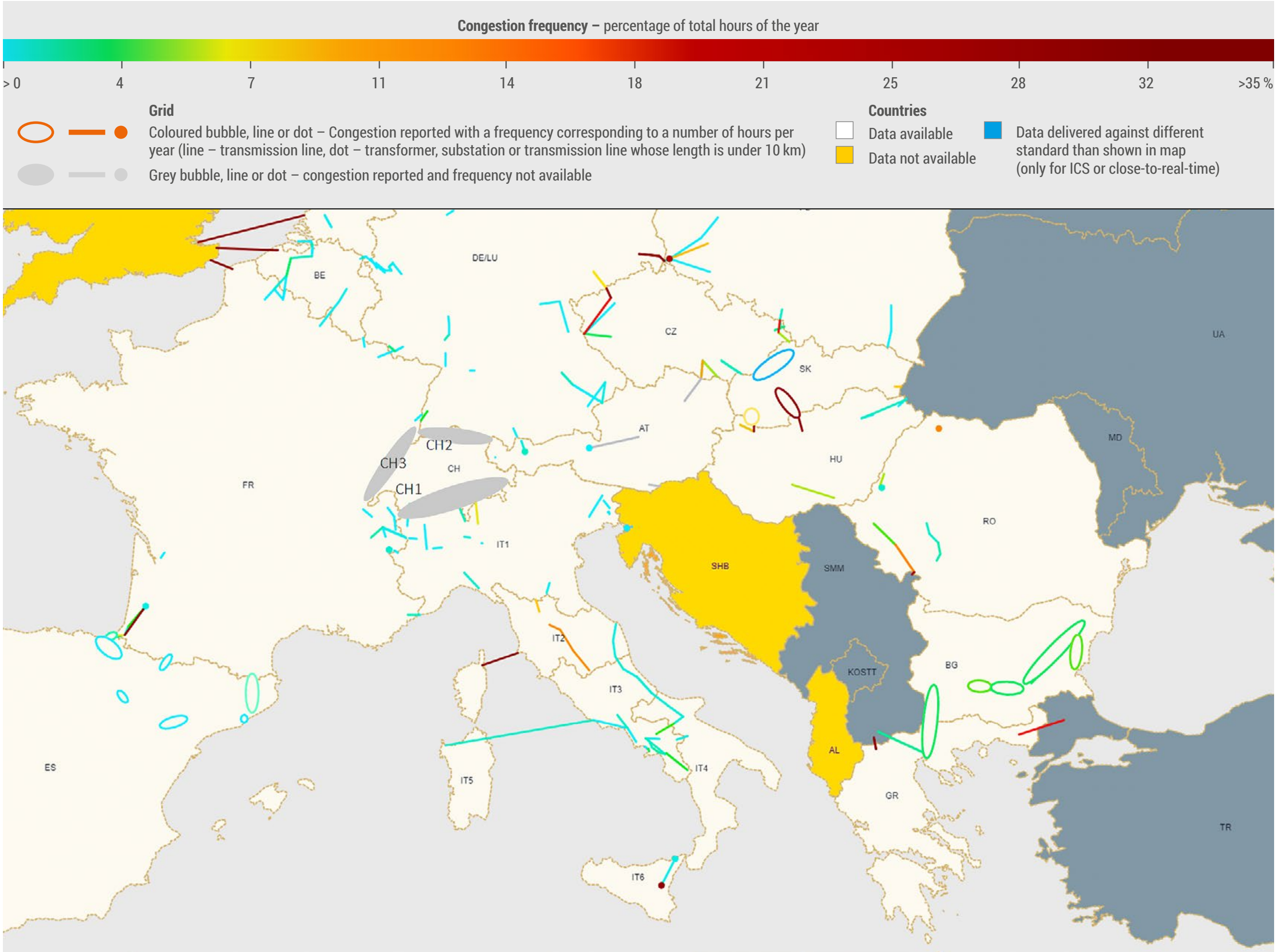



Figure 77: CCDA for 2019 – Balkans and Italy without threshold

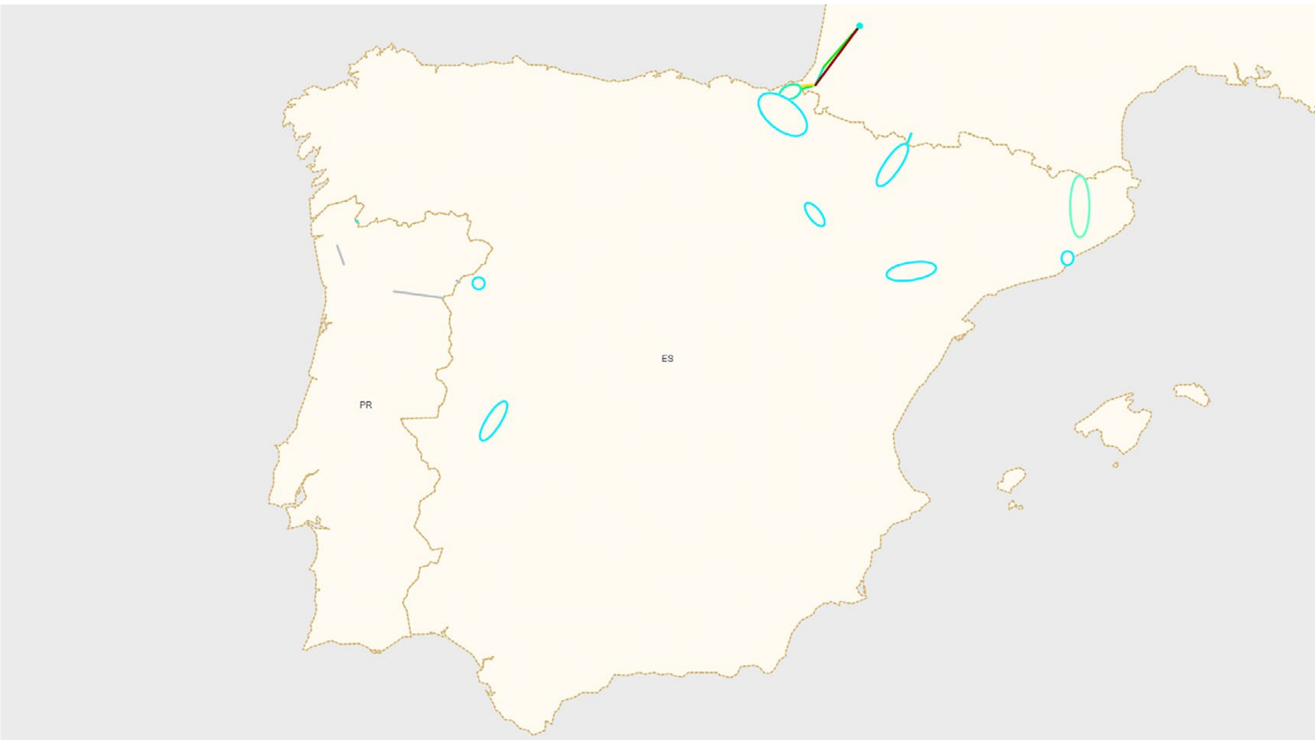



Figure 78: CCDA for 2019 – Spain/Portugal without threshold

## 2020 – Capacity calculation for the purpose of DA allocation without threshold

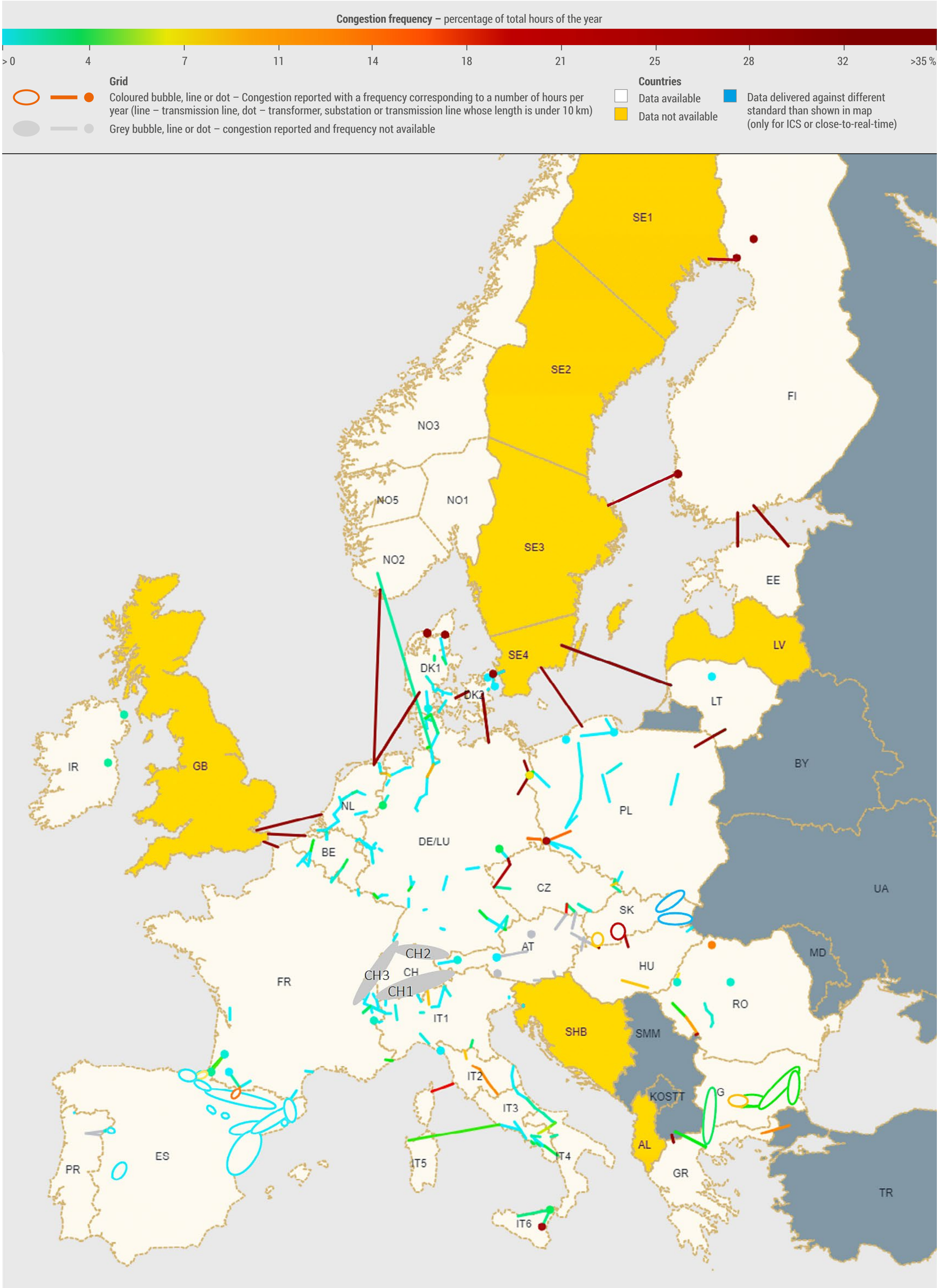



Figure 79: CCDA for 2020 – Europe without threshold

## Zooms

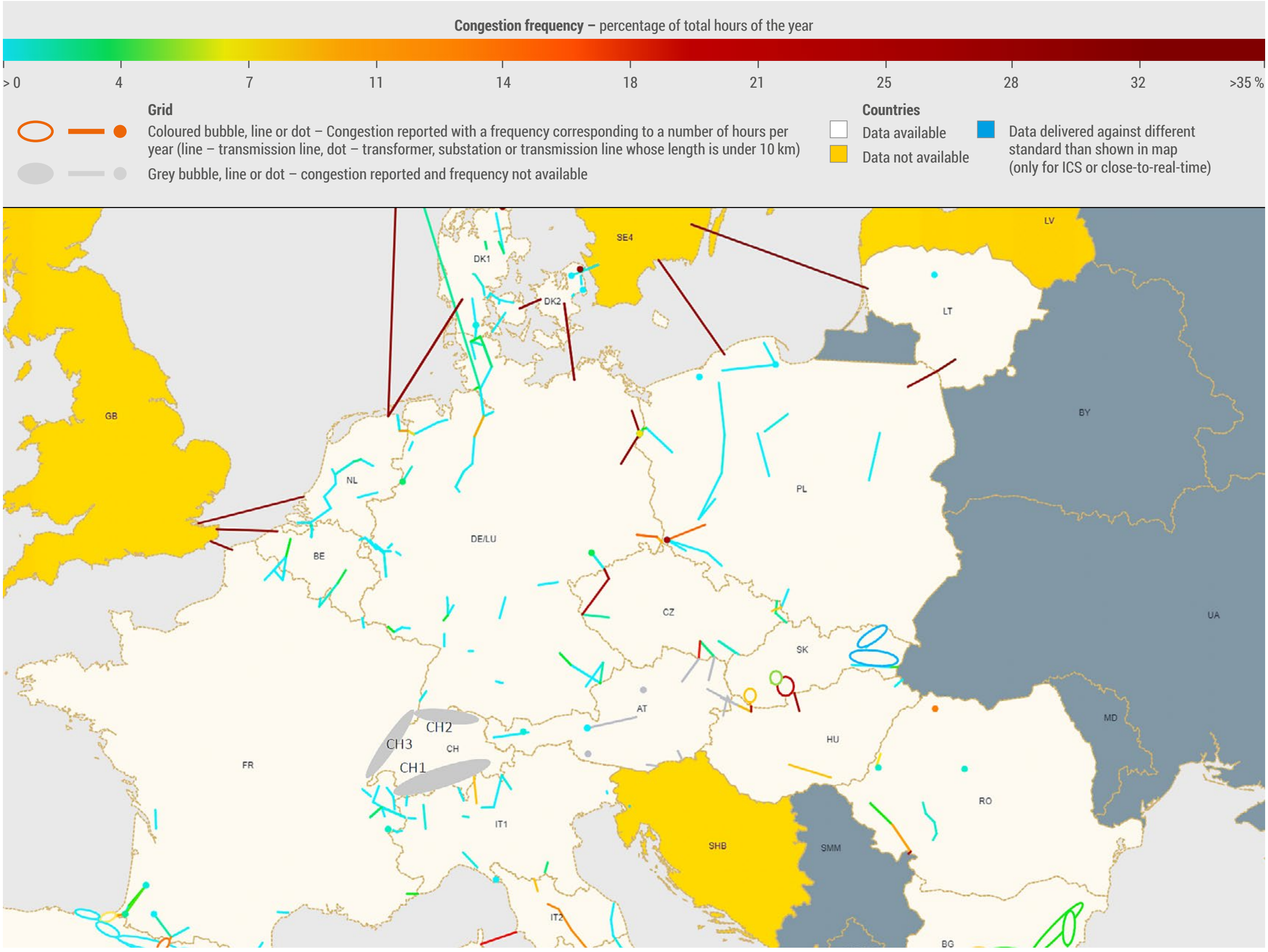



Figure 80: CCDA for 2020 – Central Europe without threshold

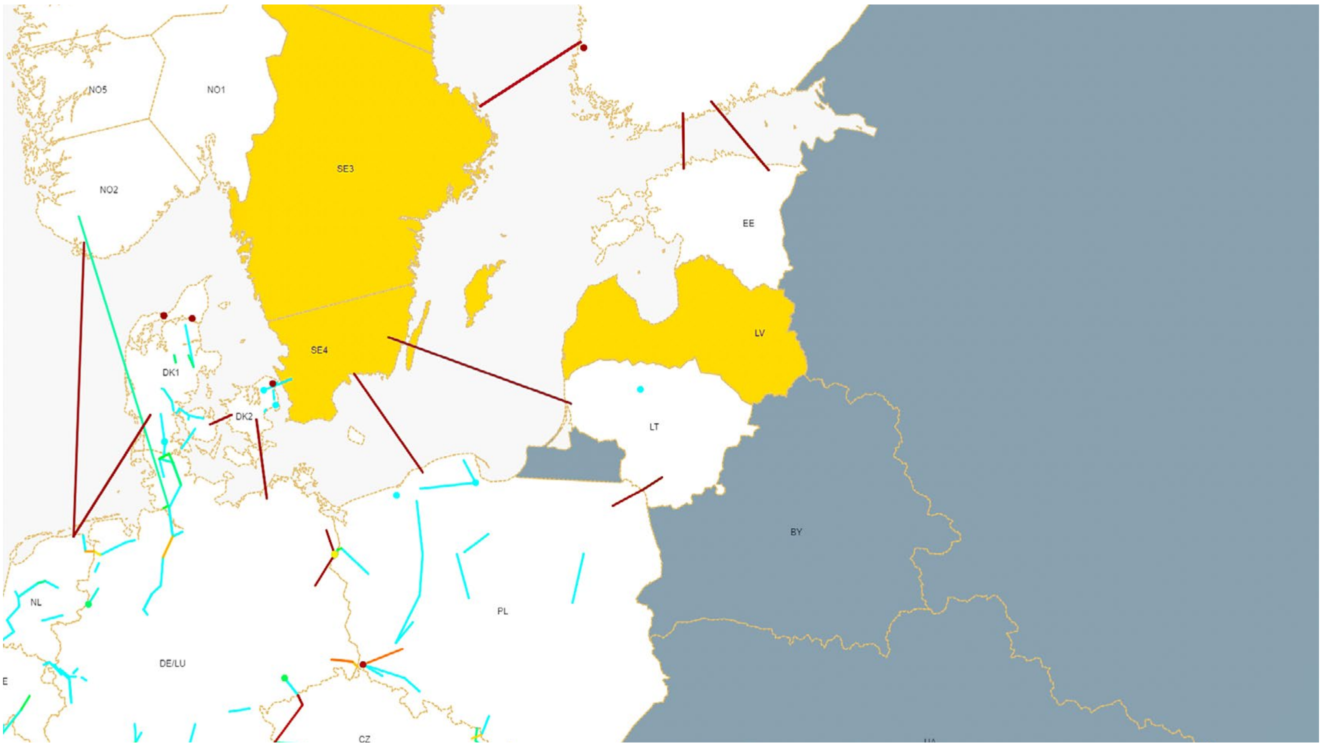



Figure 81: CCDA for 2020 – Baltic countries and Denmark/Sweden without threshold

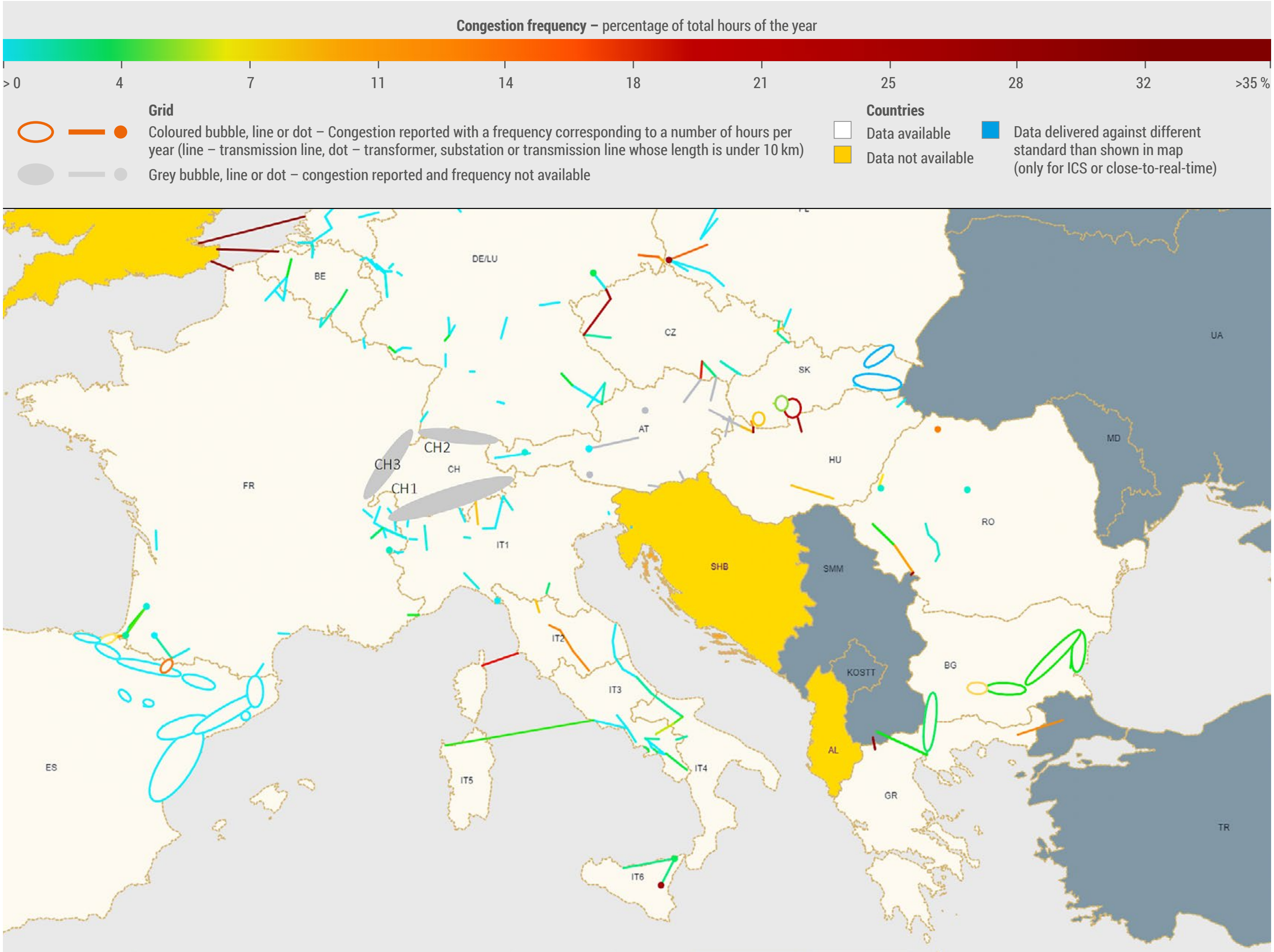



Figure 82: CCDA for 2020 – Balkans and Italy without threshold

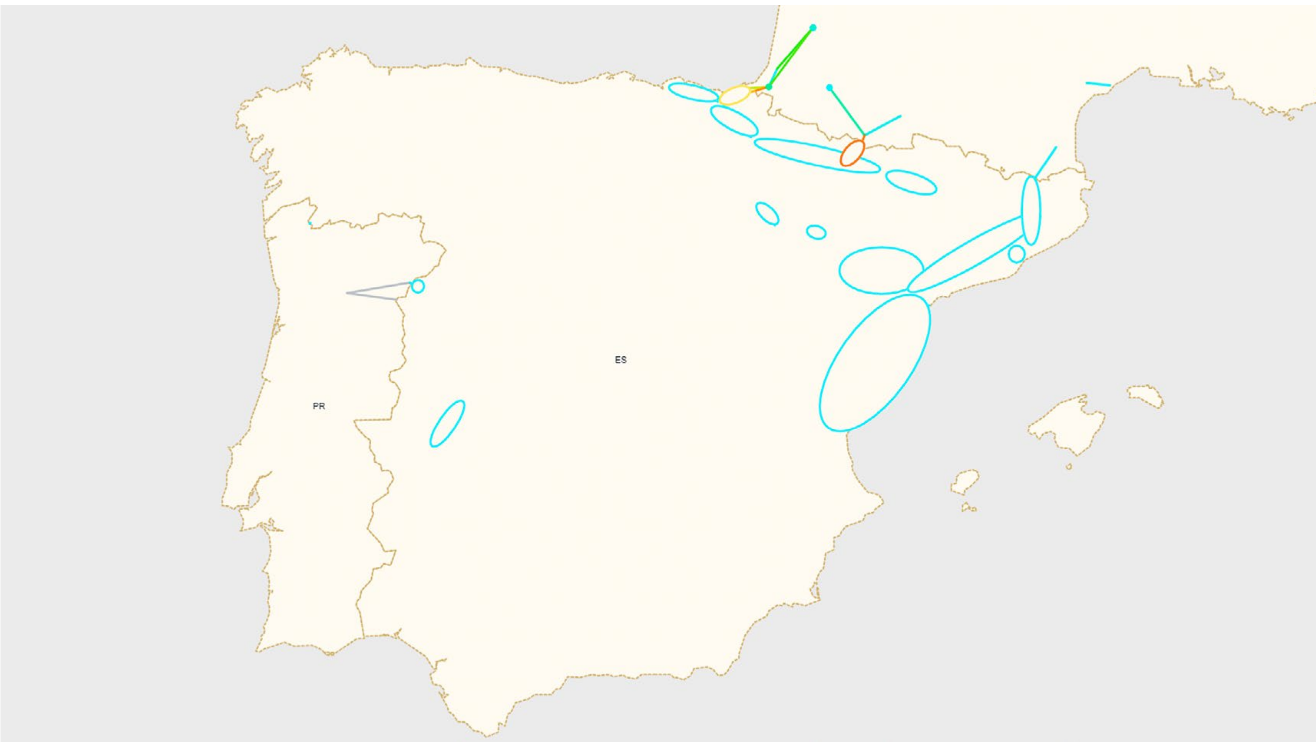



Figure 83. CCDA for 2020 – Spain/Portugal without threshold

# 3 D-1 timeframe without threshold

## 2018 – D-1 without threshold

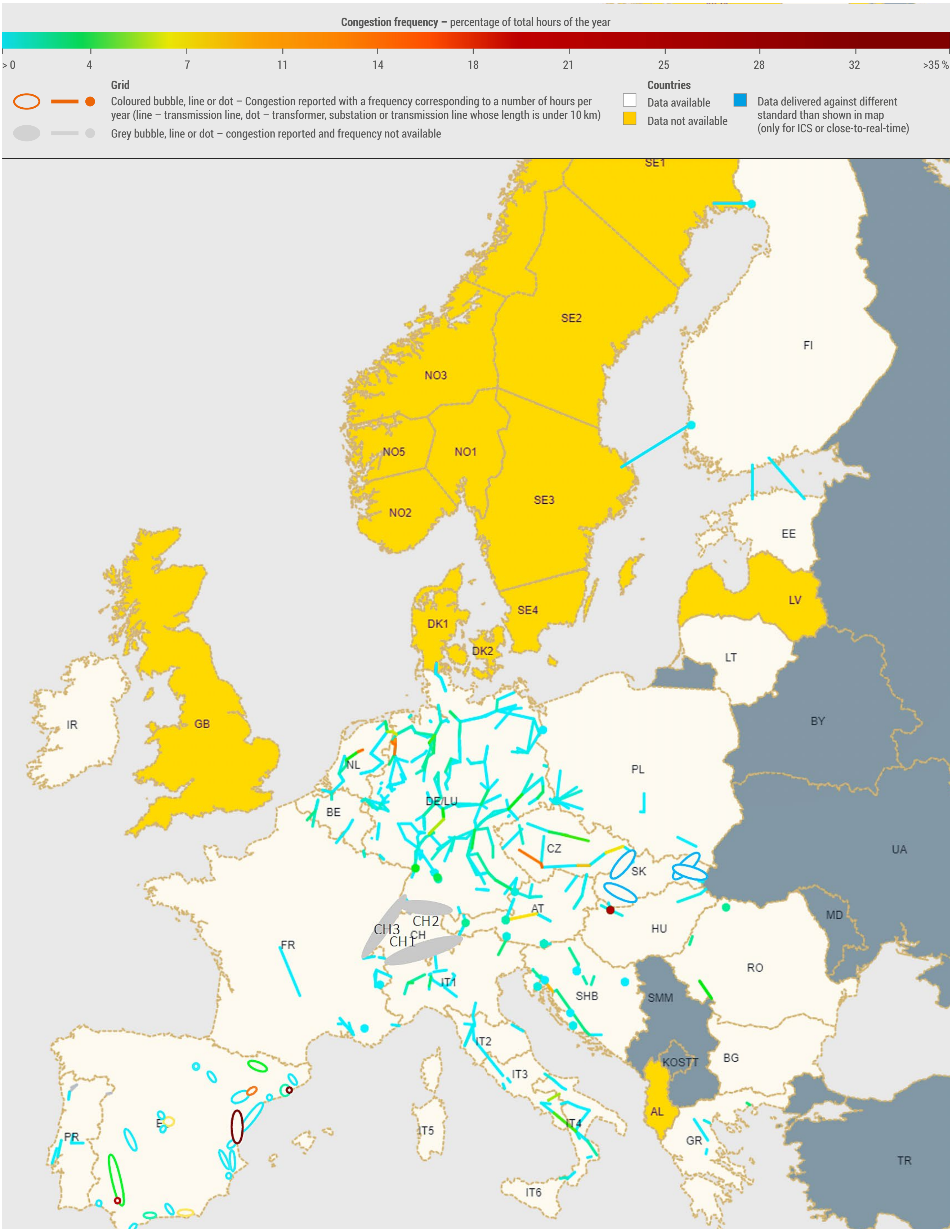



Figure 84: D-1 for 2018 – Europe without threshold

## Zooms

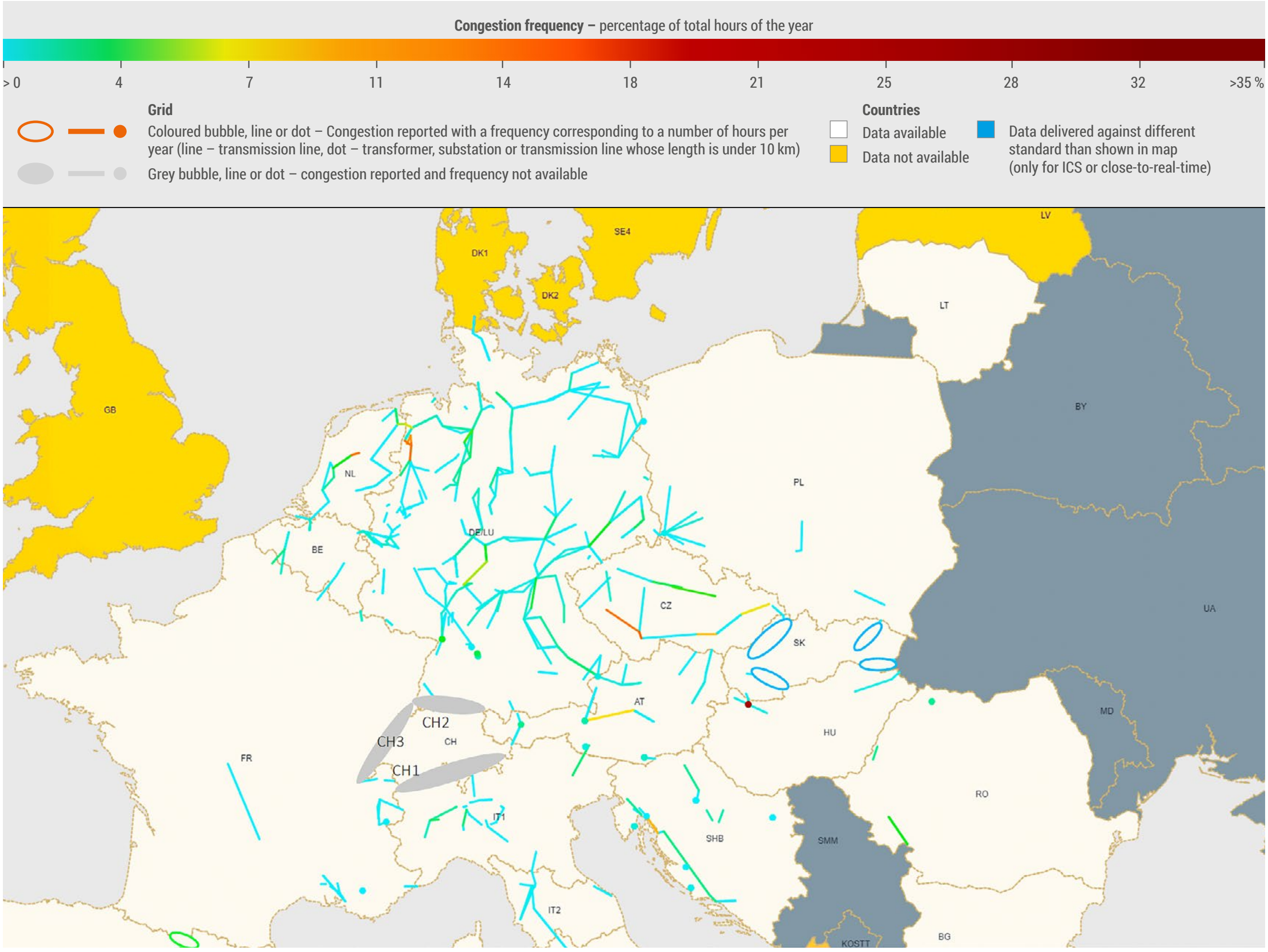



Figure 85: D-1 for 2018 – Central Europe without threshold

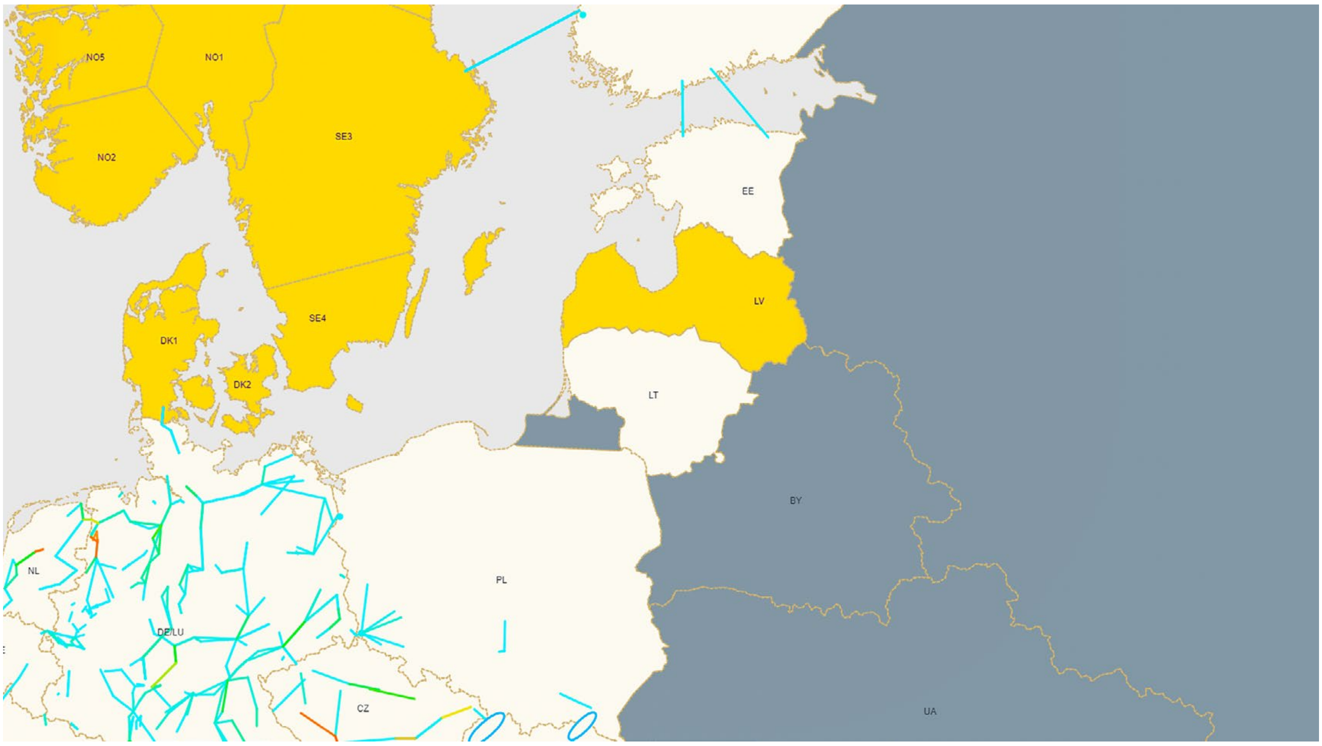



Figure 86: D-1 for 2018 – Baltic countries and Denmark/Sweden without threshold

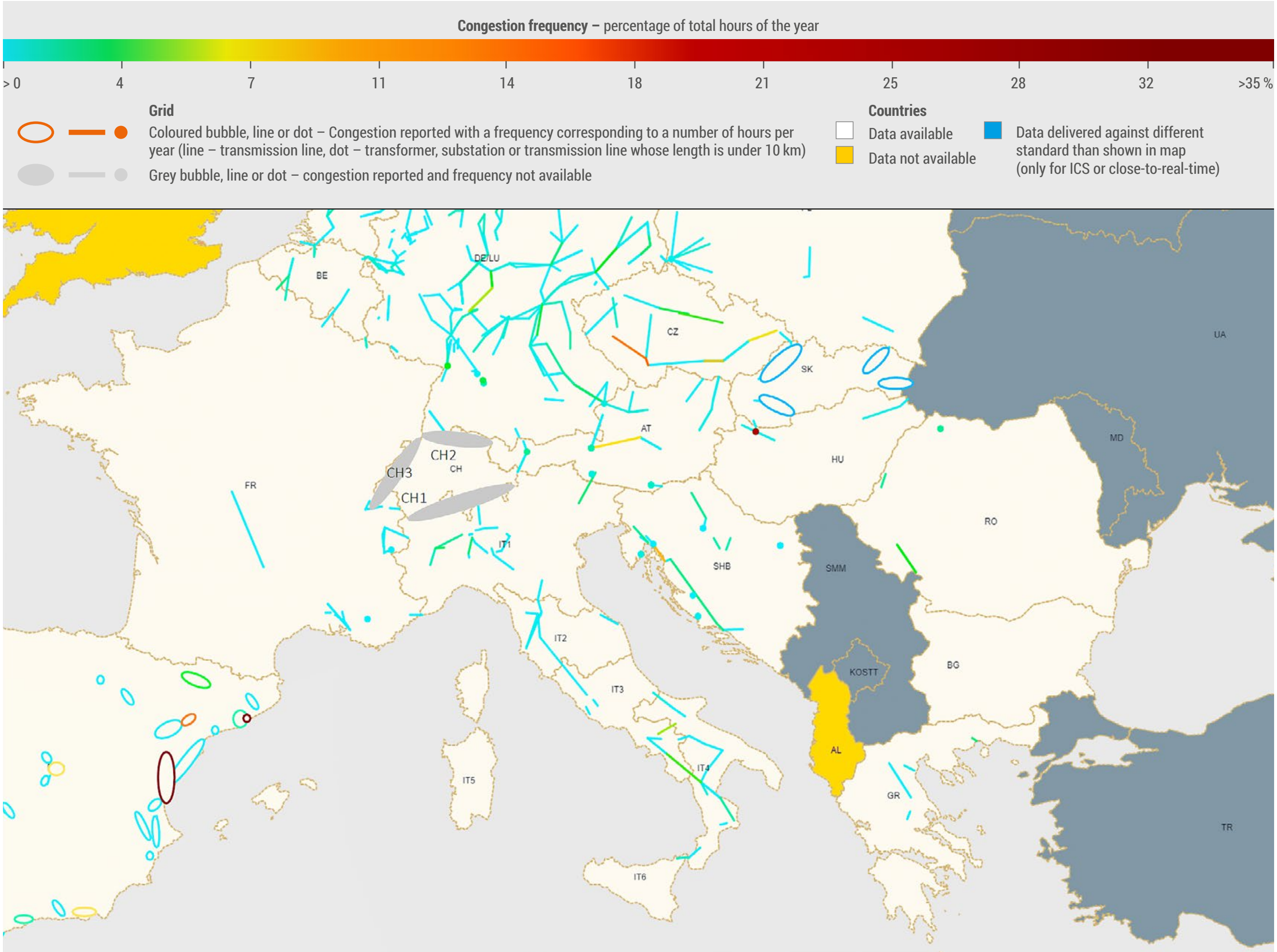



Figure 87: D-1 for 2018 – Balkans and Italy without threshold

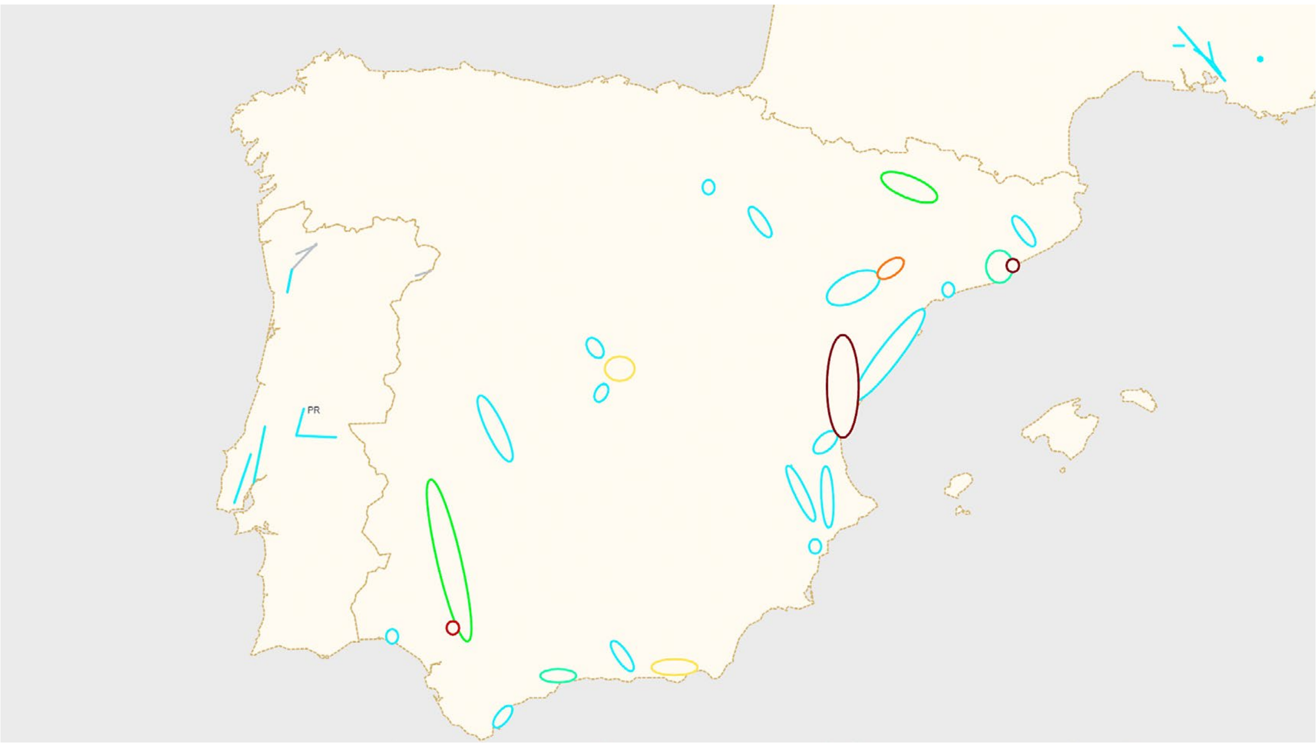



Figure 88: D-1 for 2018 – Spain/Portugal without threshold

## 2019 – D-1 without threshold

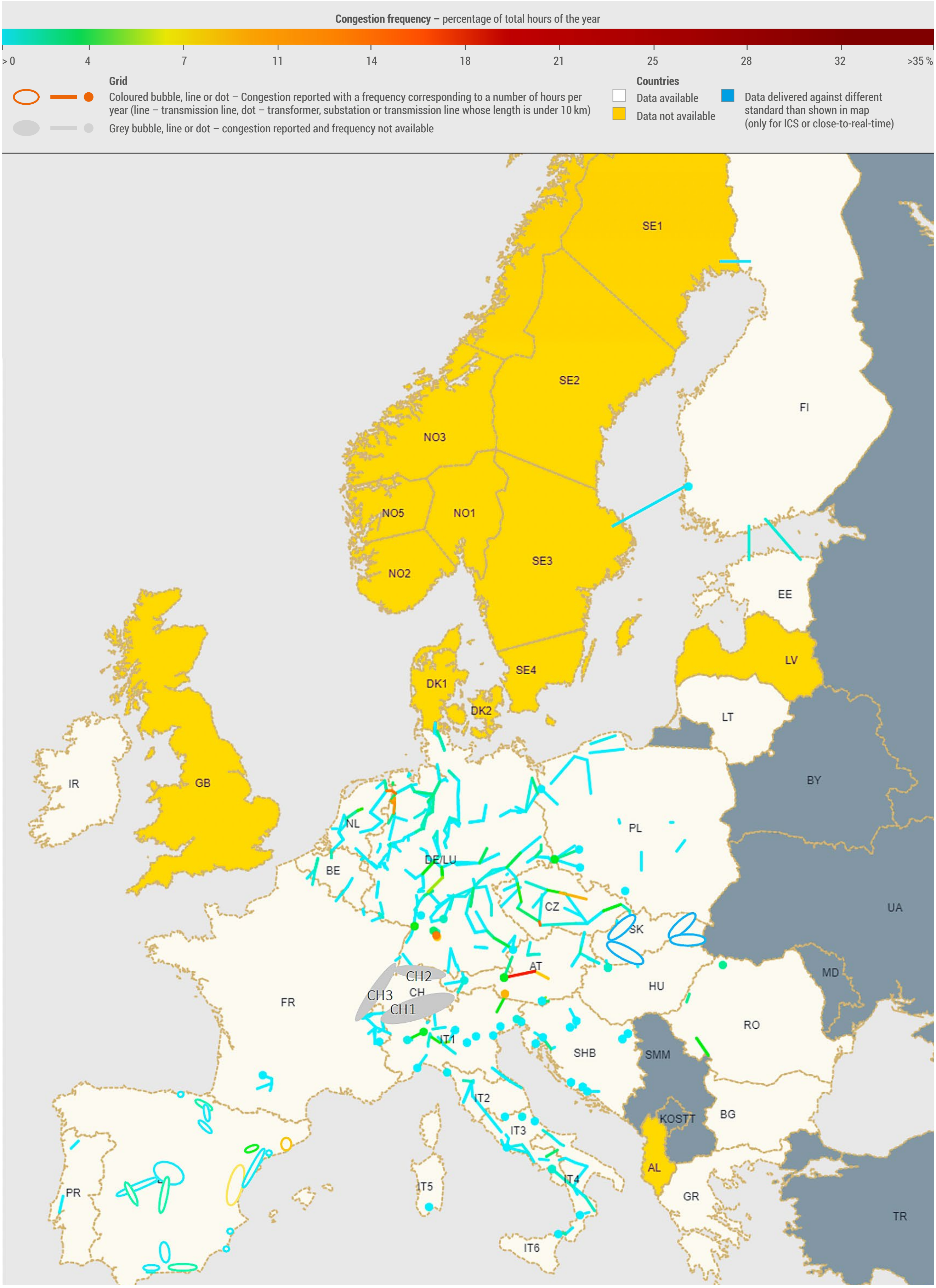



Figure 89: D-1 for 2019 – Europe without threshold

## Zooms

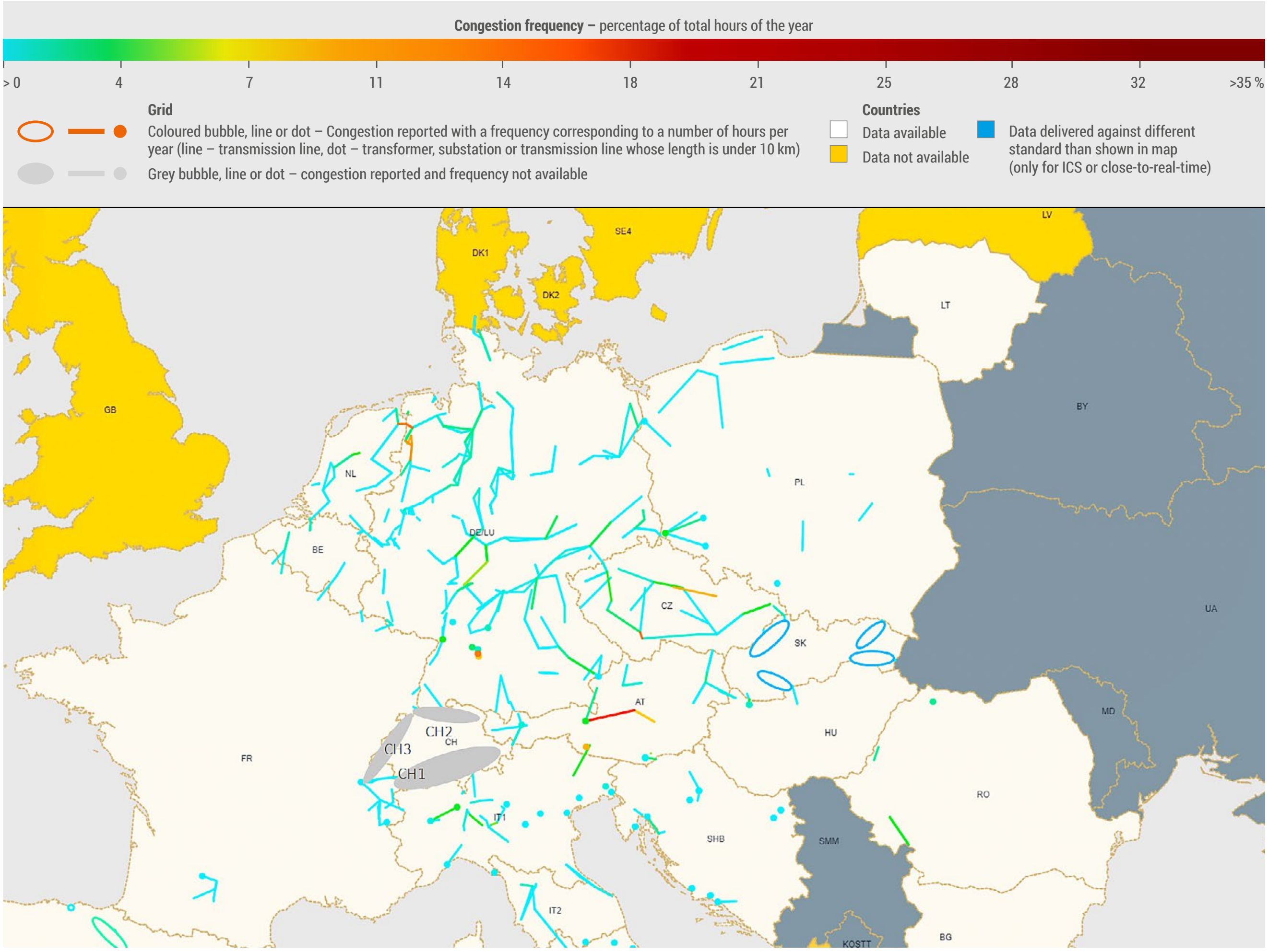



Figure 90: D-1 for 2019 – Central Europe without threshold

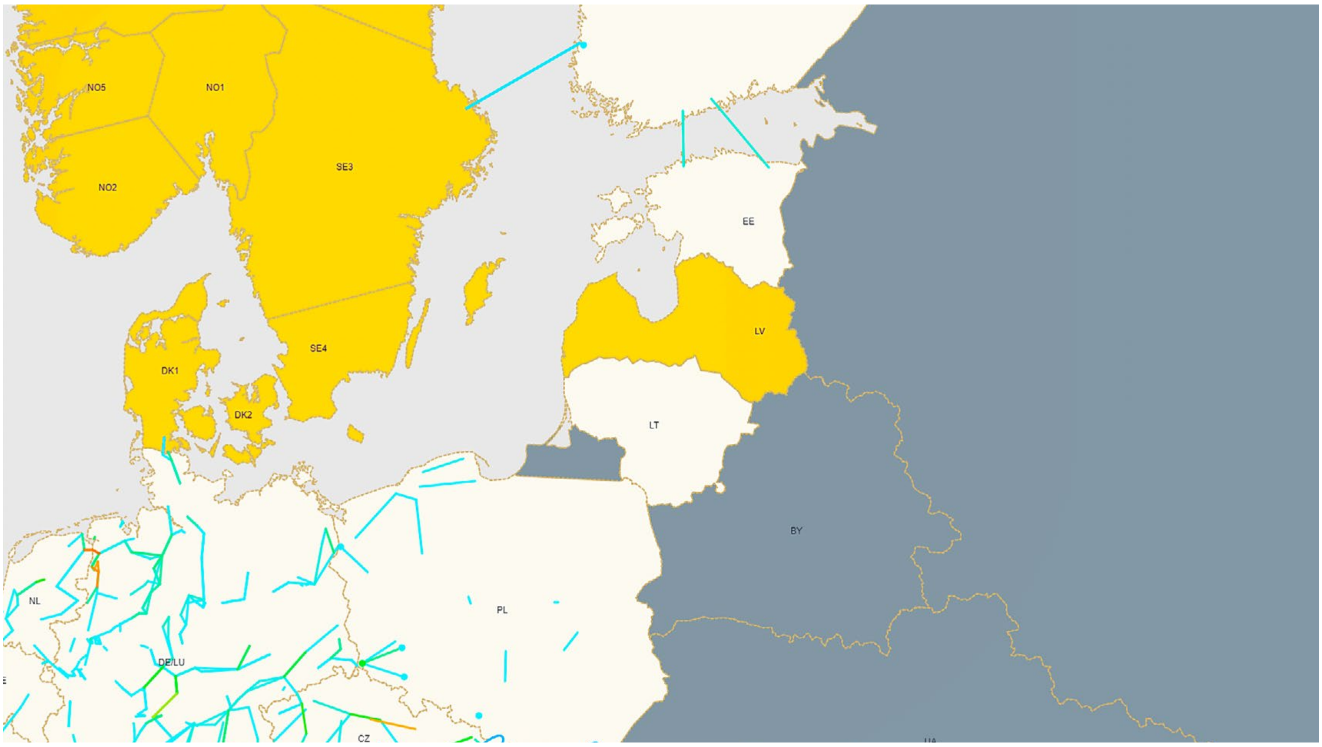



Figure 91: D-1 for 2019 – Baltic countries and Denmark/Sweden without threshold

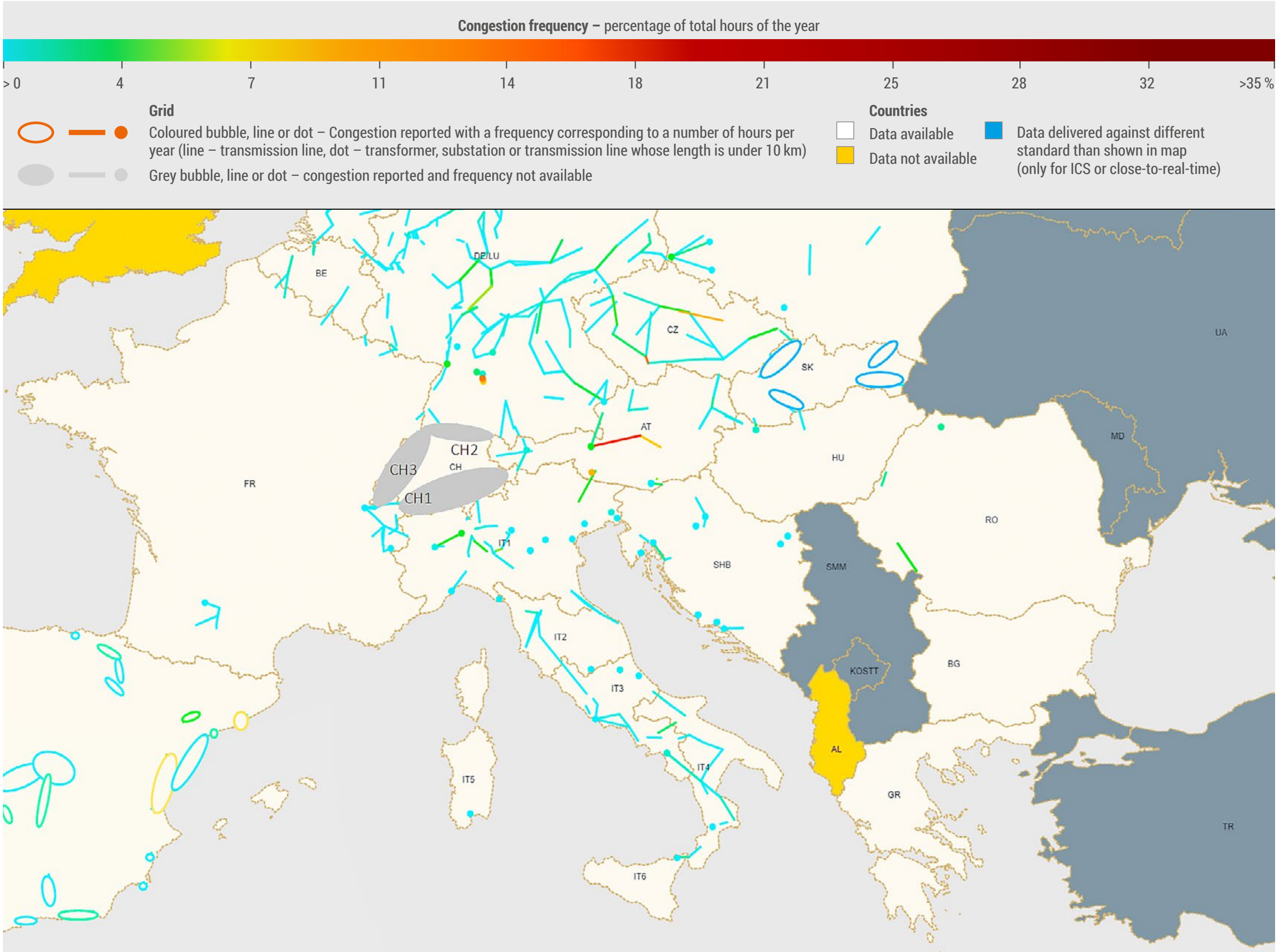



Figure 92: D-1 for 2019 – Balkans and Italy without threshold

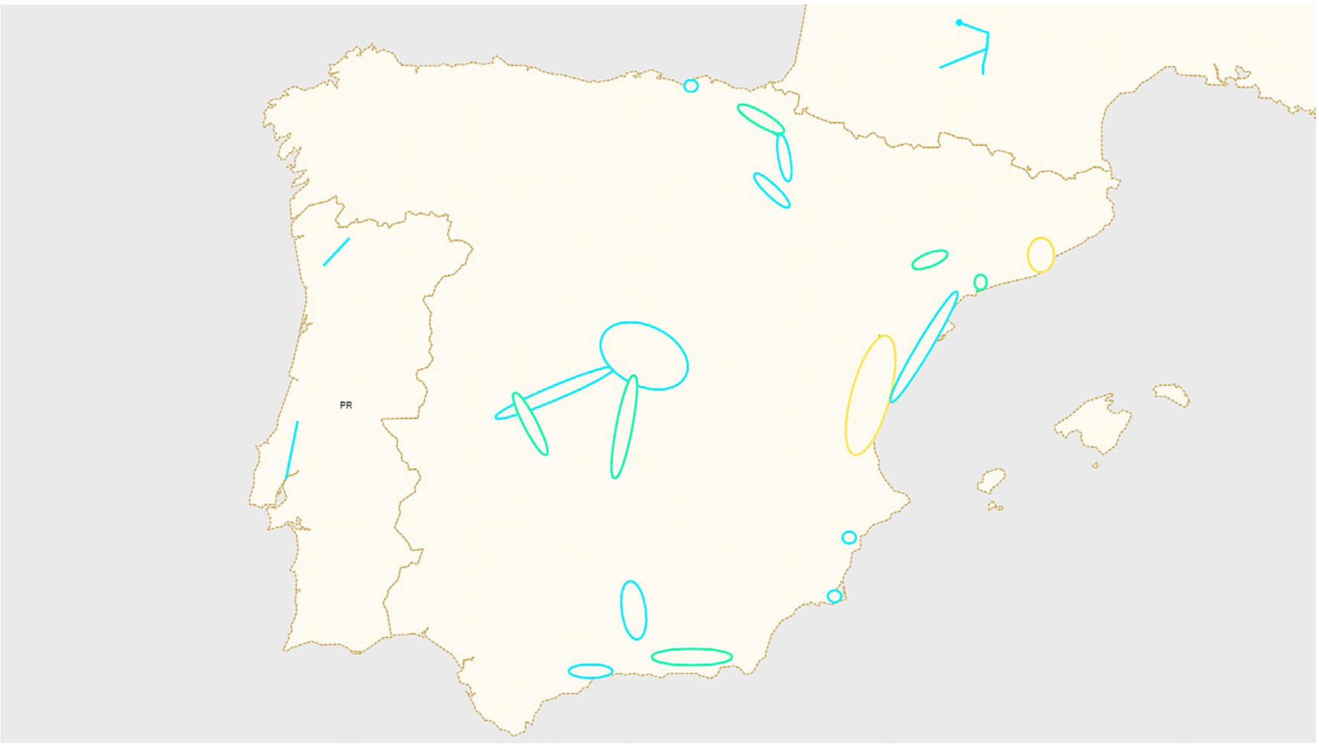



Figure 93: D-1 for 2019 – Spain/Portugal without threshold

## 2020 – D-1 without threshold

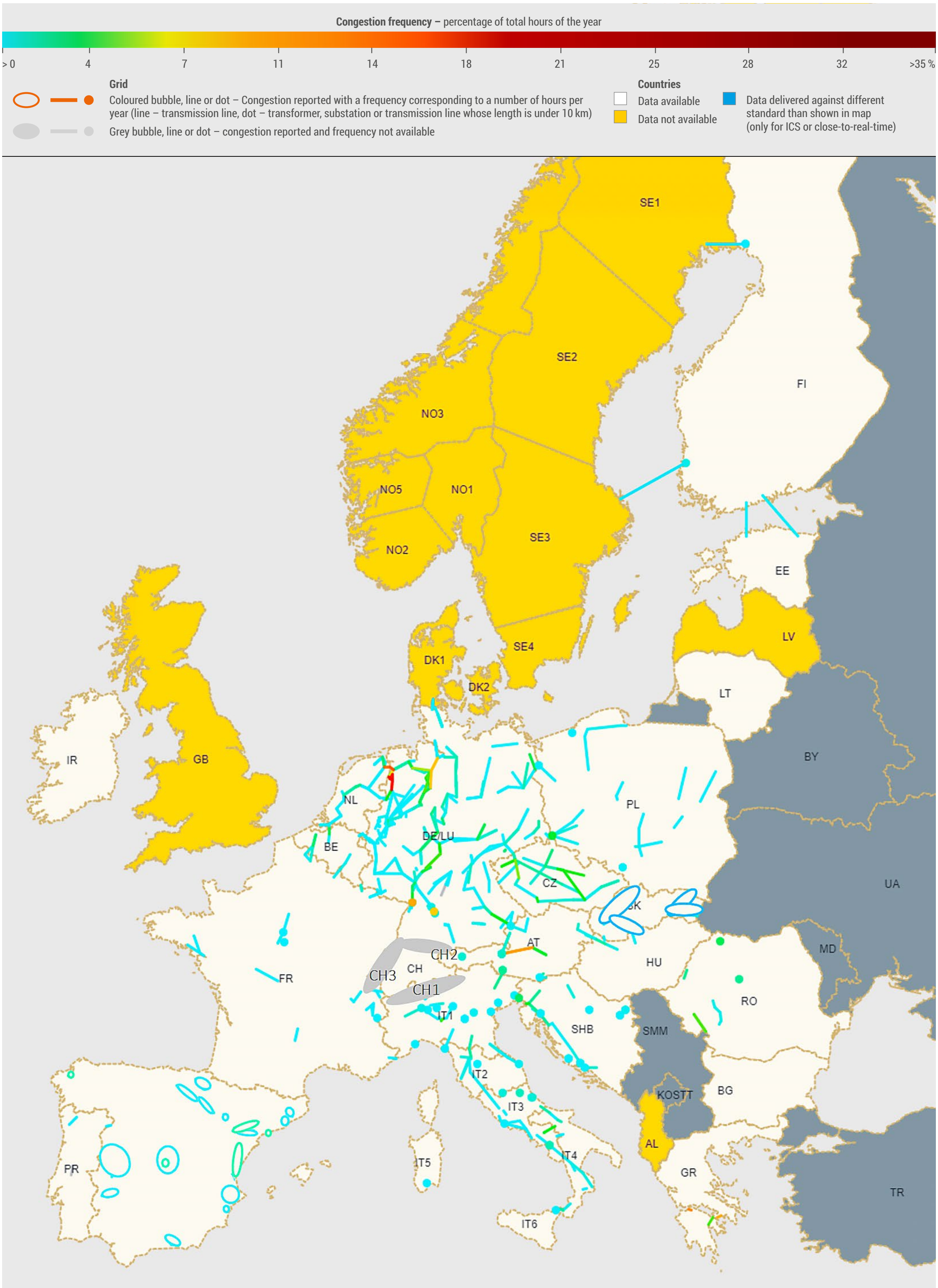



Figure 94: D-1 for 2020 – Europe without threshold

## Zooms

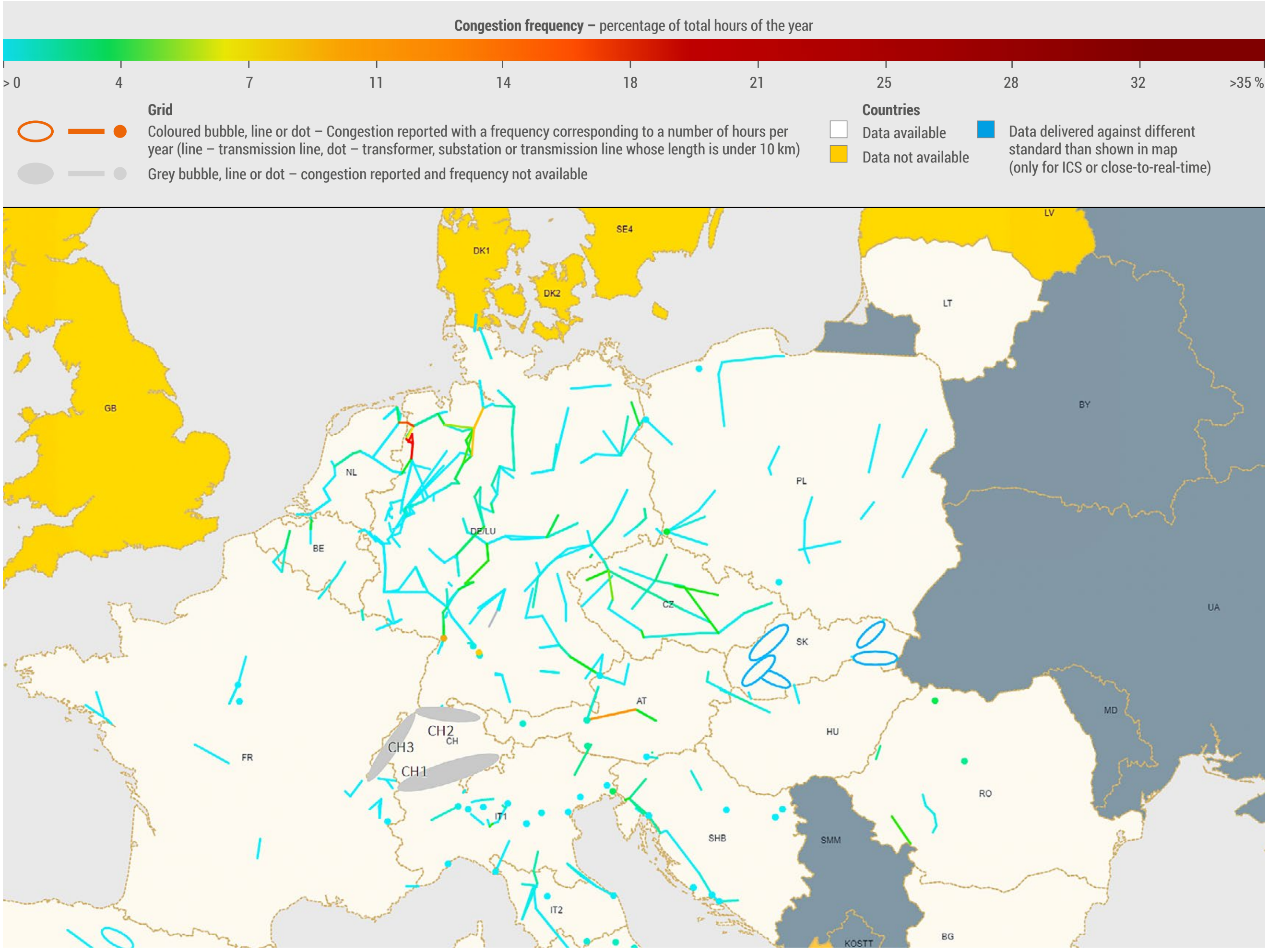



Figure 95. D-1 for 2020 – Central Europe without threshold

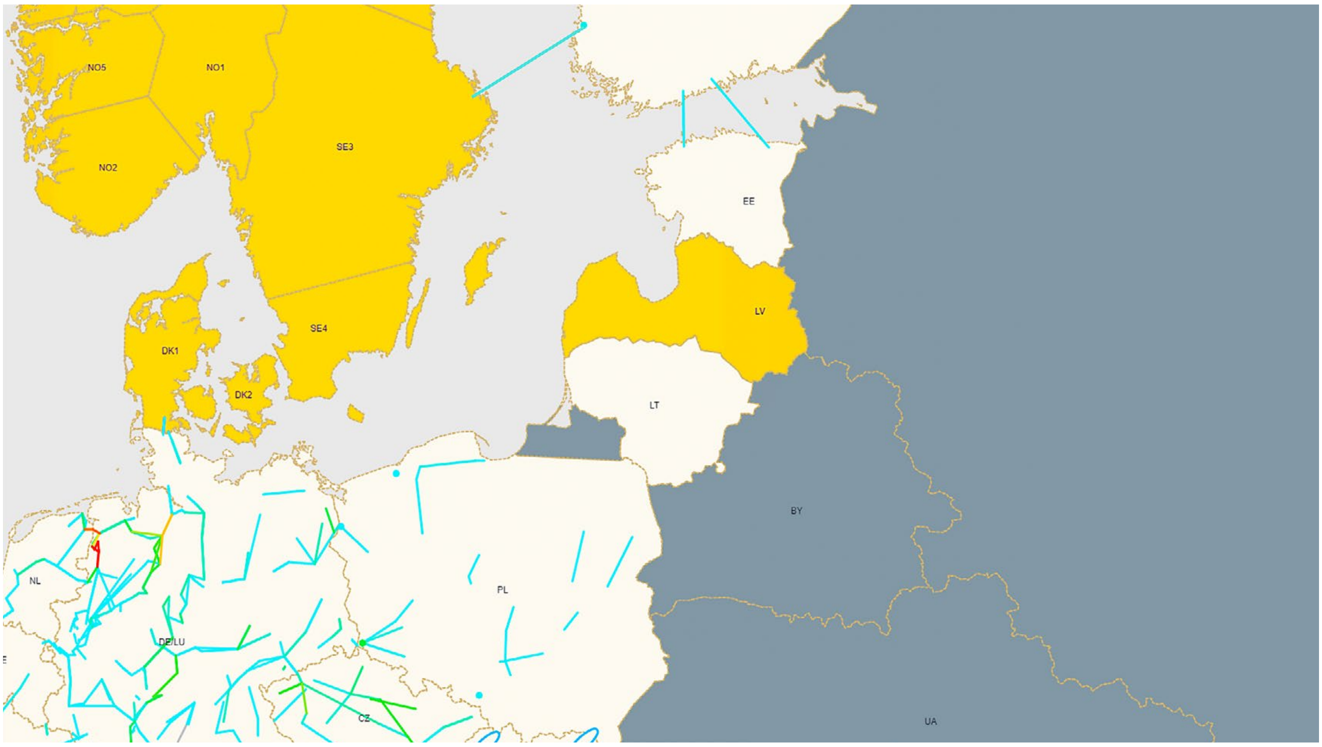



Figure 96: D-1 for 2020 – Baltic countries and Denmark/Sweden without threshold

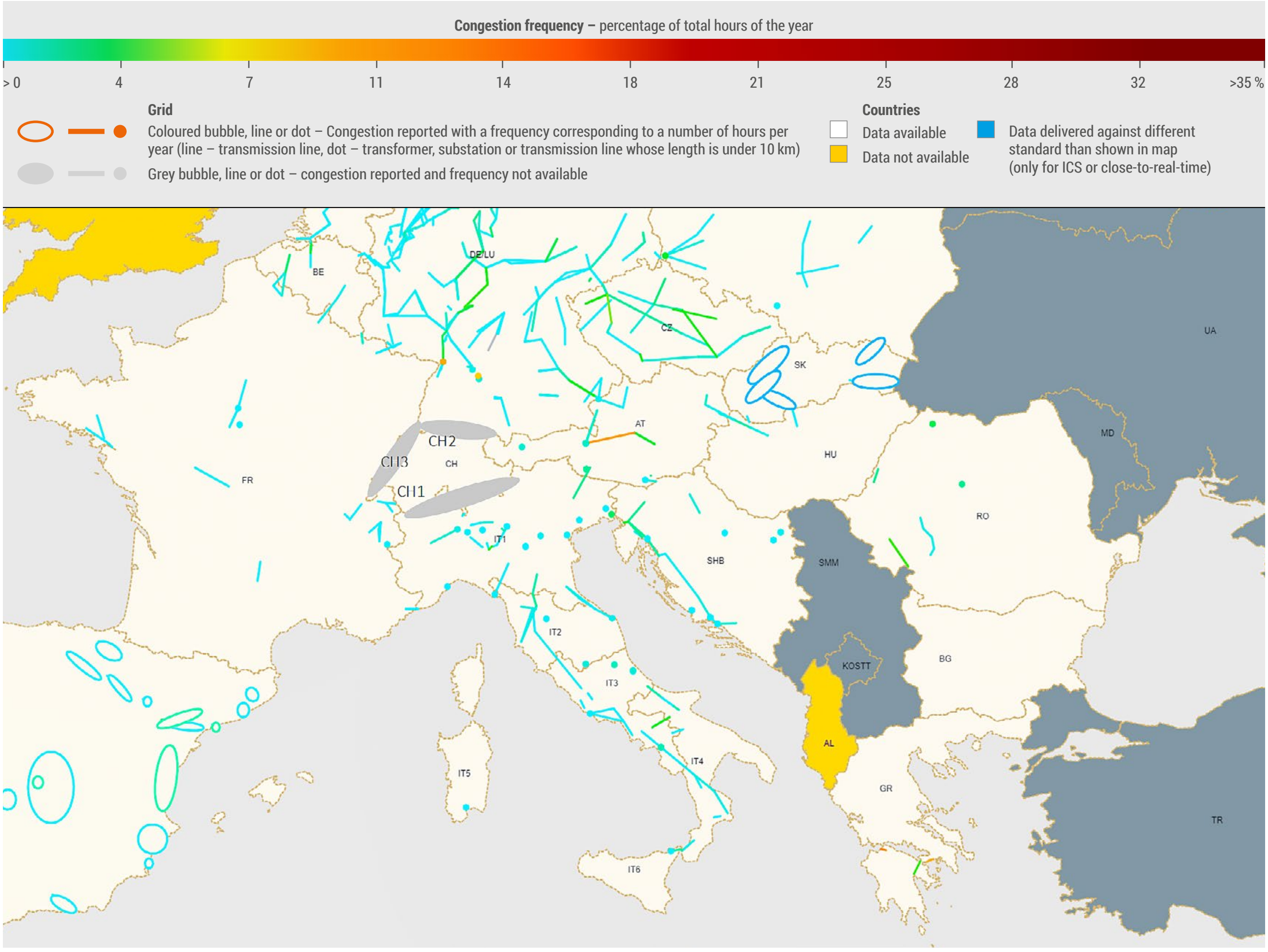



Figure 97. D-1 for 2020 – Balkans and Italy without threshold

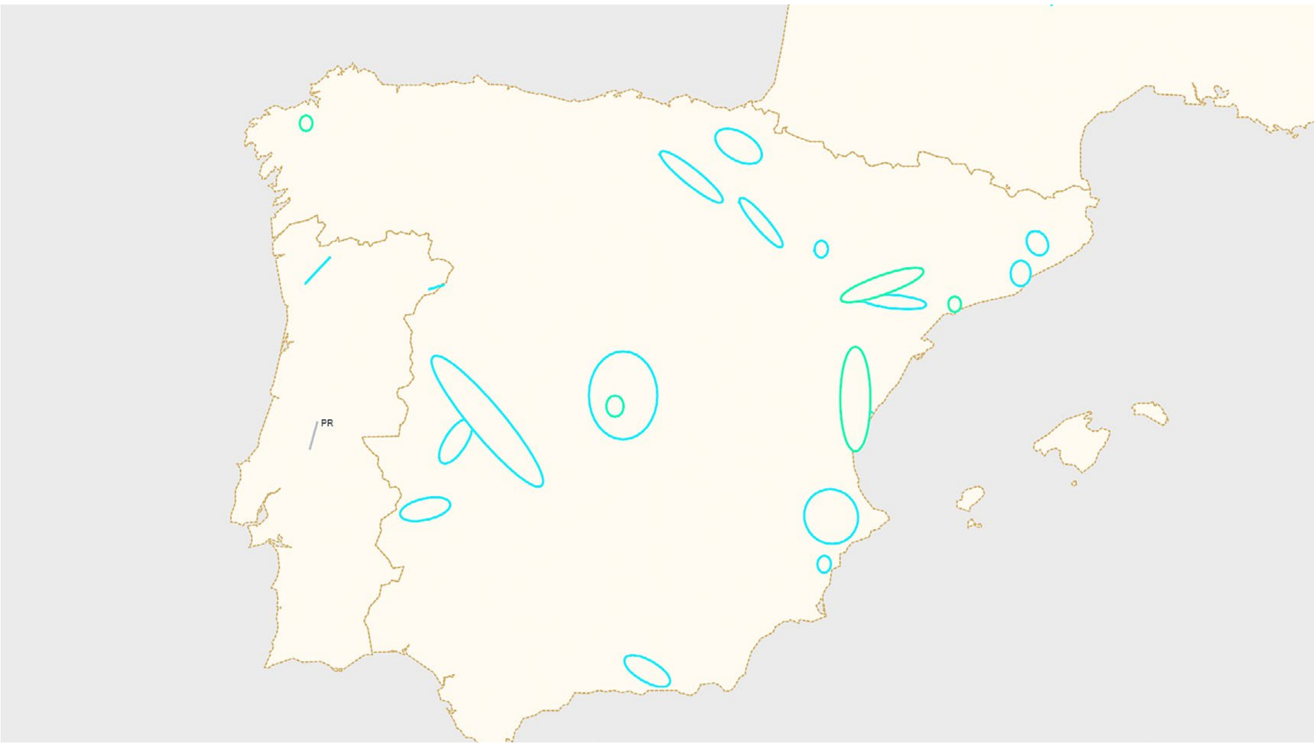



Figure 98: D-1 for 2020 – Spain/Portugal without threshold

# 4 Close to Real-time maps of the TSOs which used up to 1 hour real-time data without threshold

## 2018 – 1 hour real-time without threshold

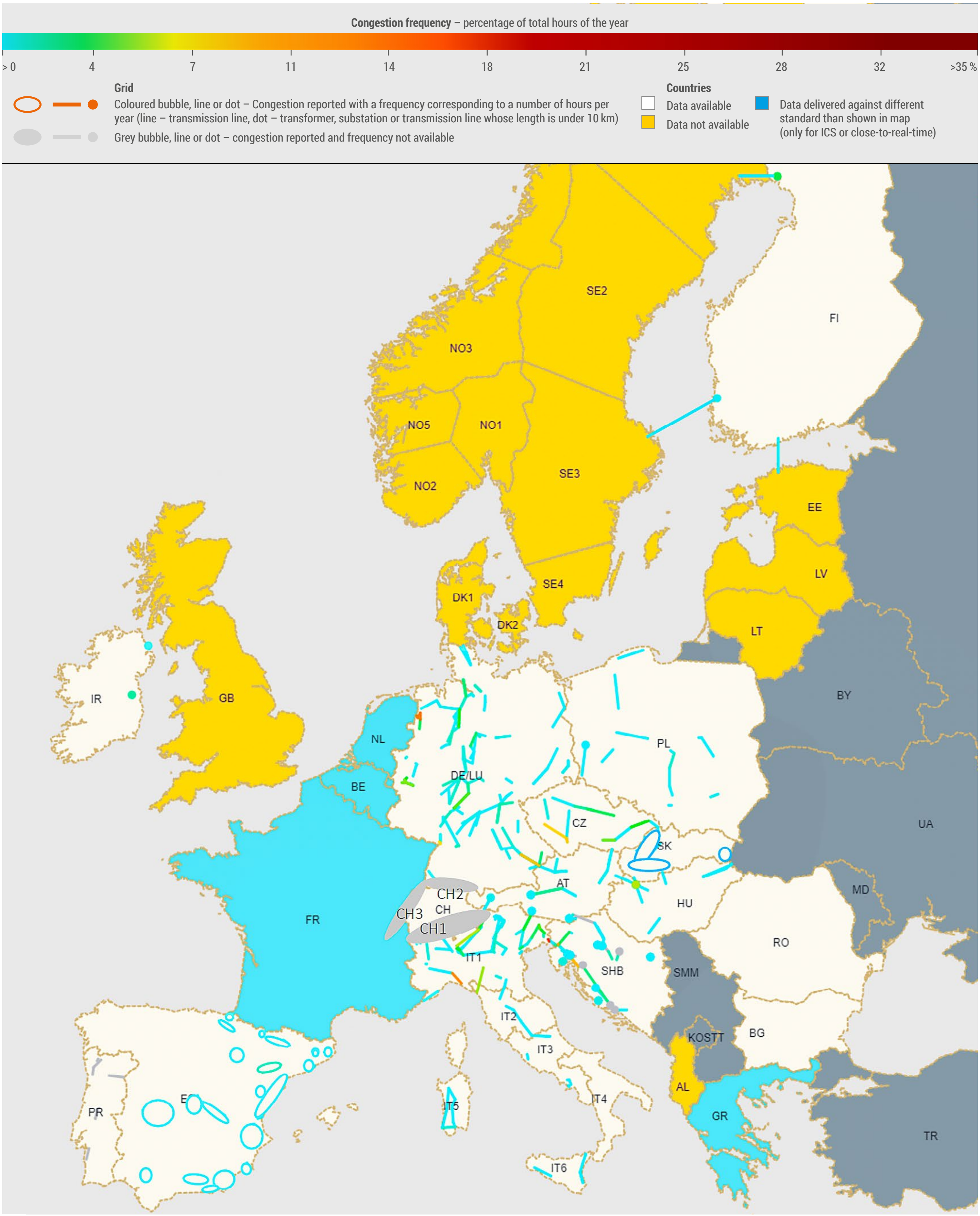



Figure 99: real-time for 2018 – Europe without threshold

## Zooms

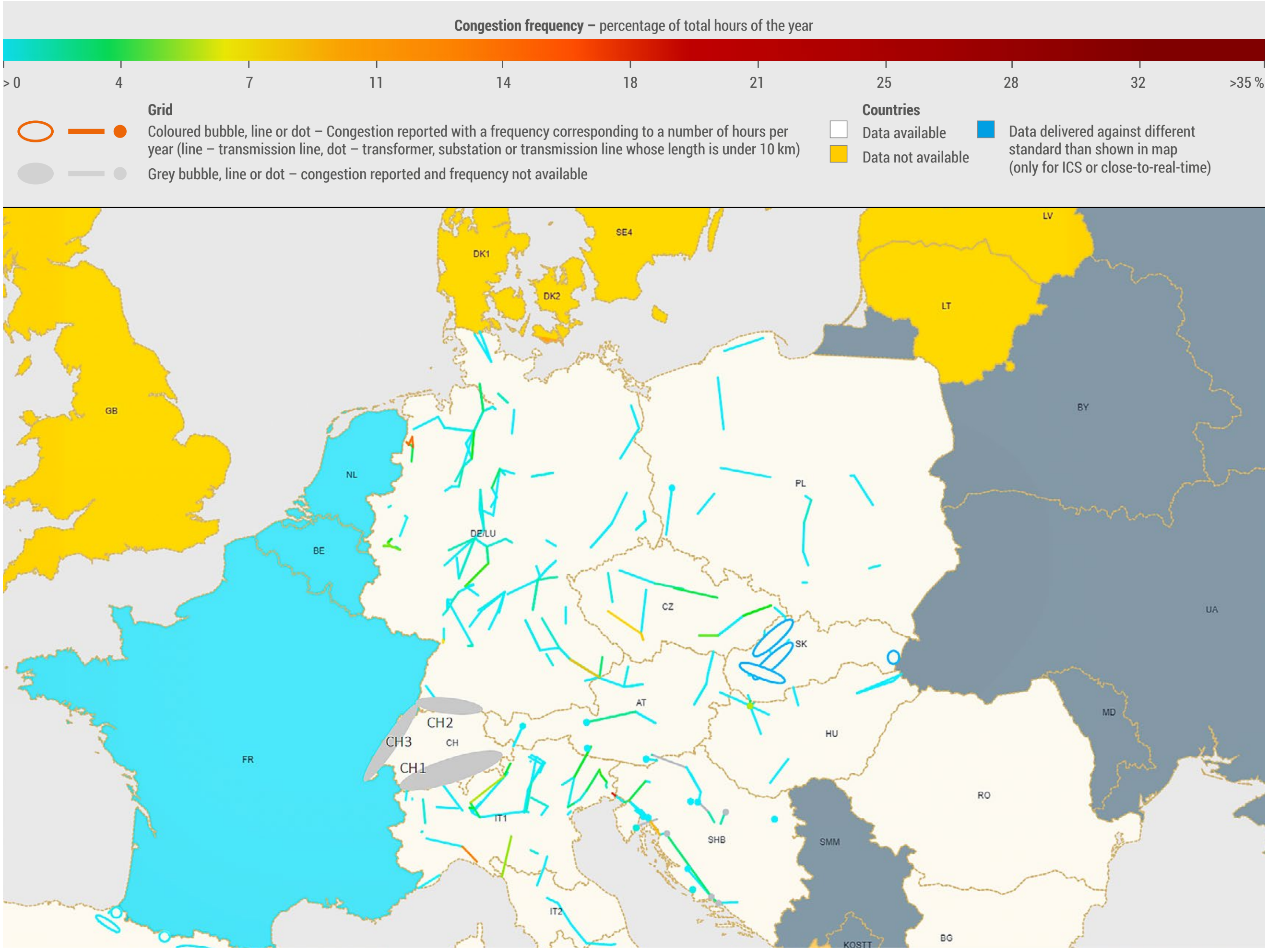



Figure 100: real-time for 2018 – Central Europe without threshold

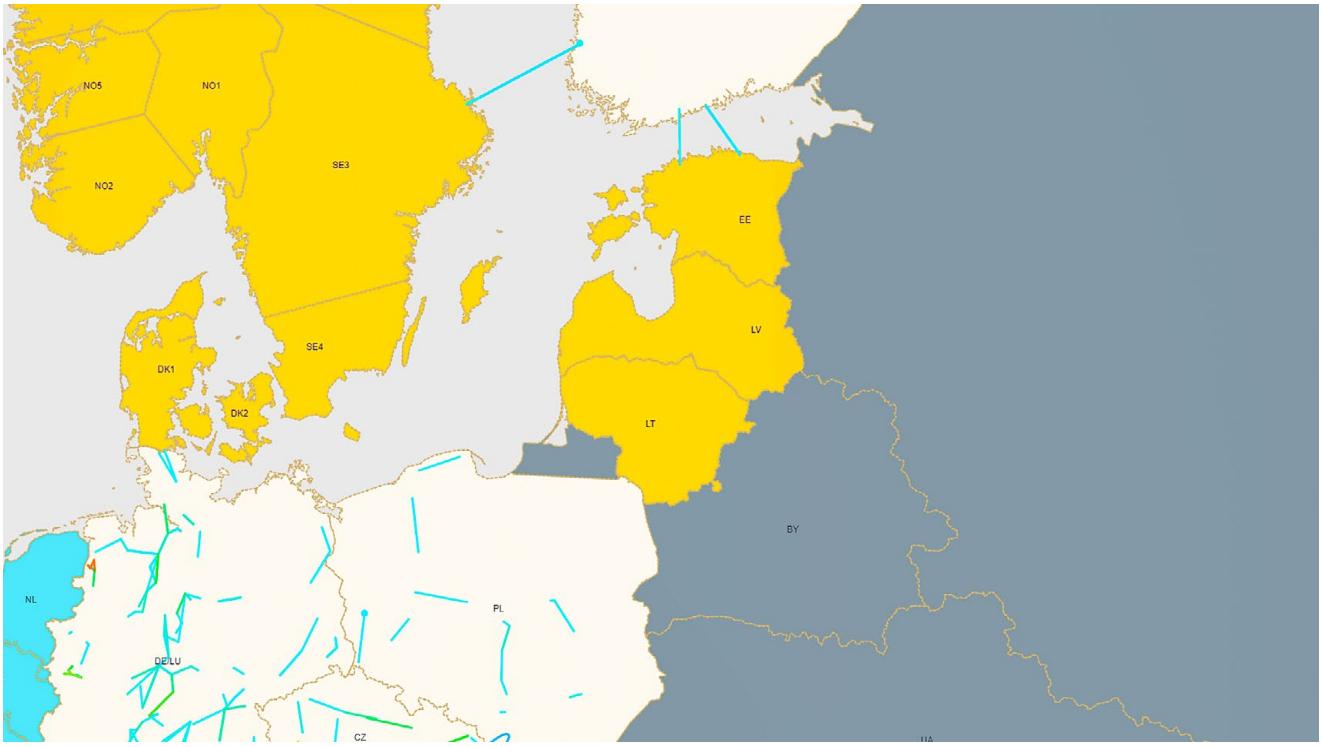



Figure 101: real-time for 2018 – Baltic countries and Denmark/Sweden without threshold

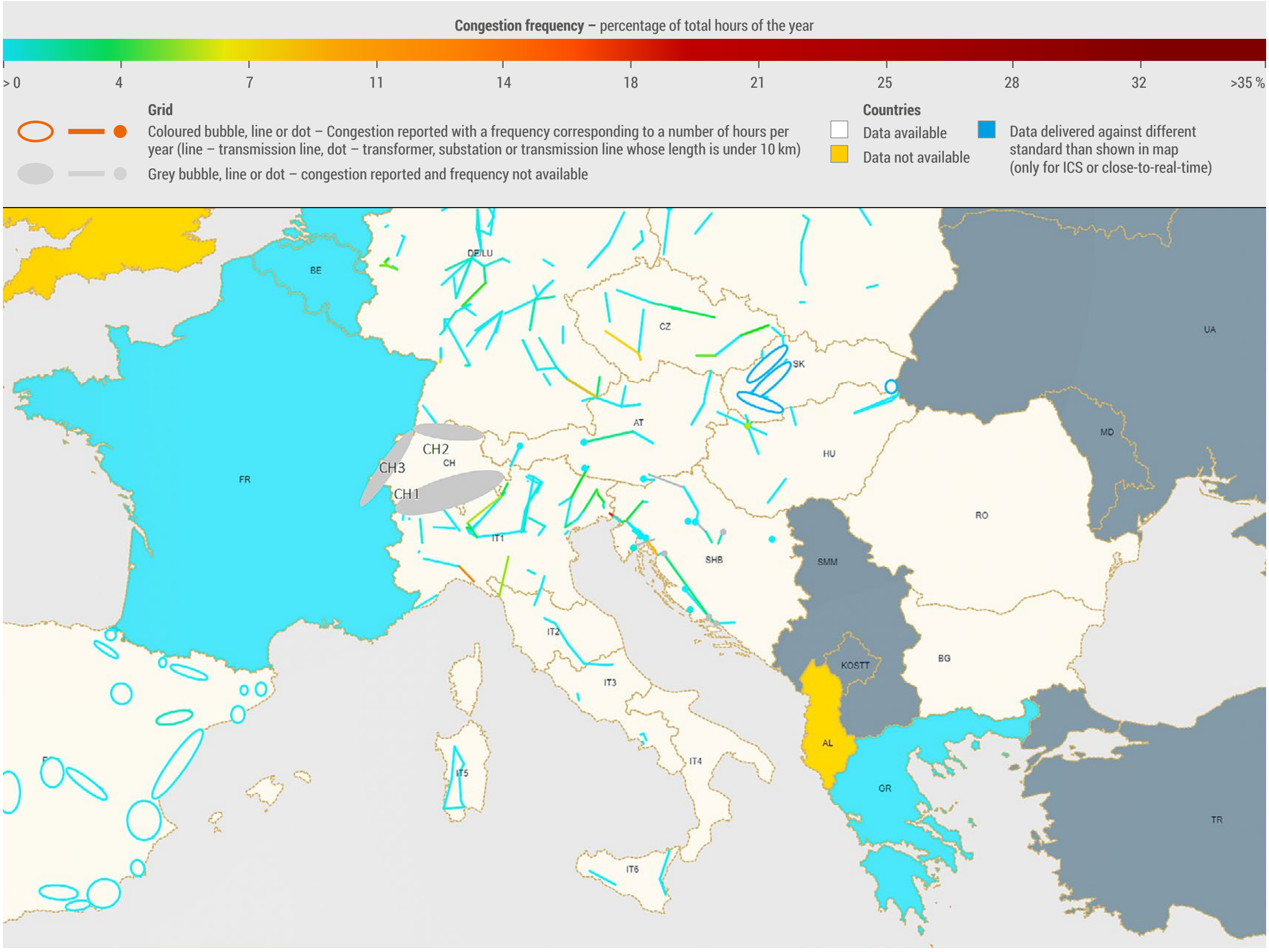



Figure 102: real-time for 2018 – Balkans and Italy without threshold

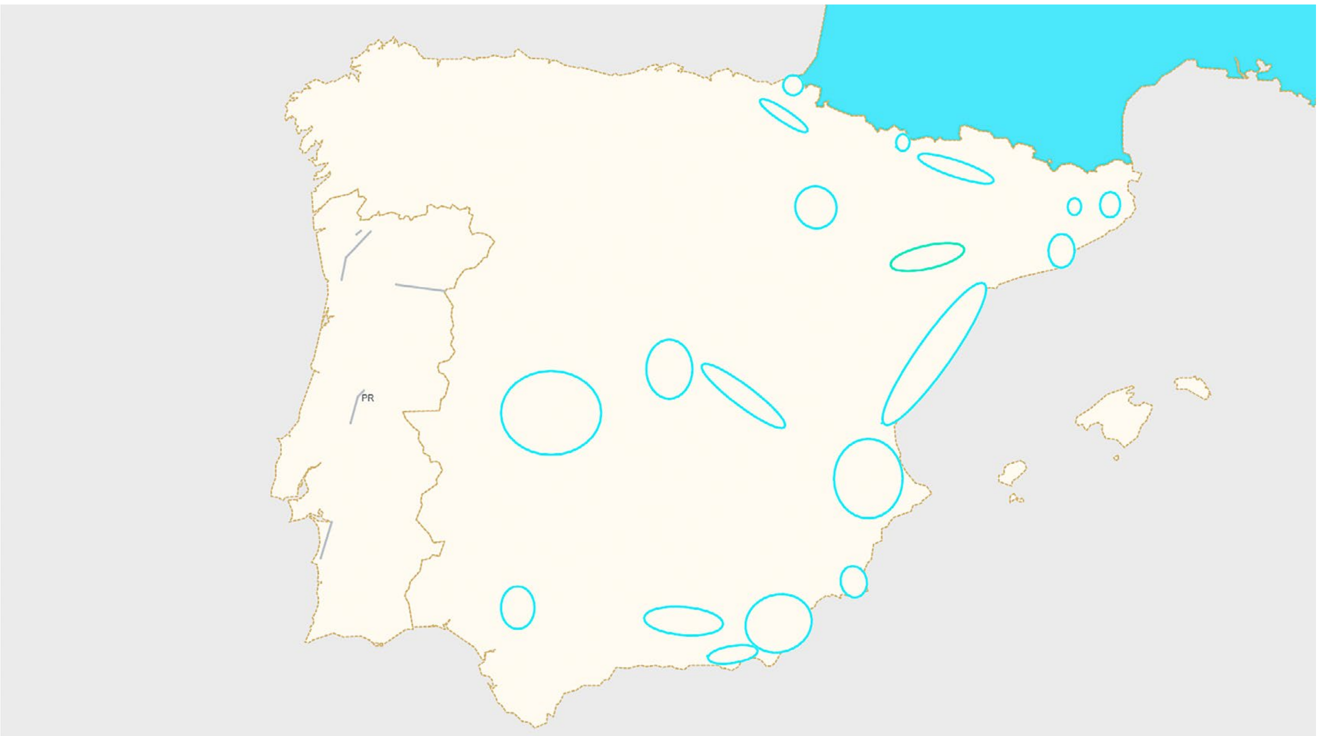



Figure 103: real-time for 2018 – Spain/Portugal without threshold

## 2019 – 1 hour real-time without threshold

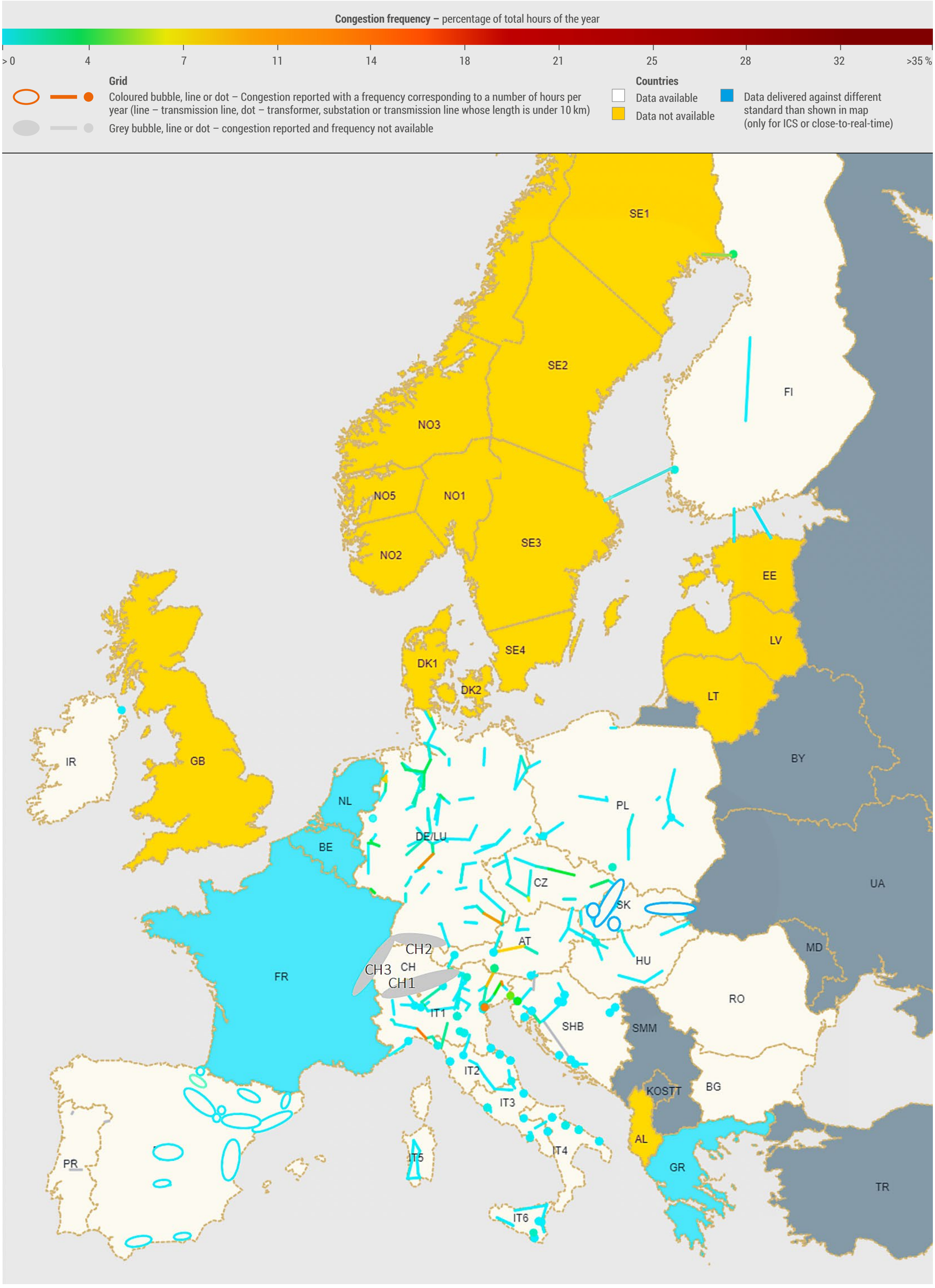



Figure 104: real-time for 2019 – Europe without threshold .

## Zooms

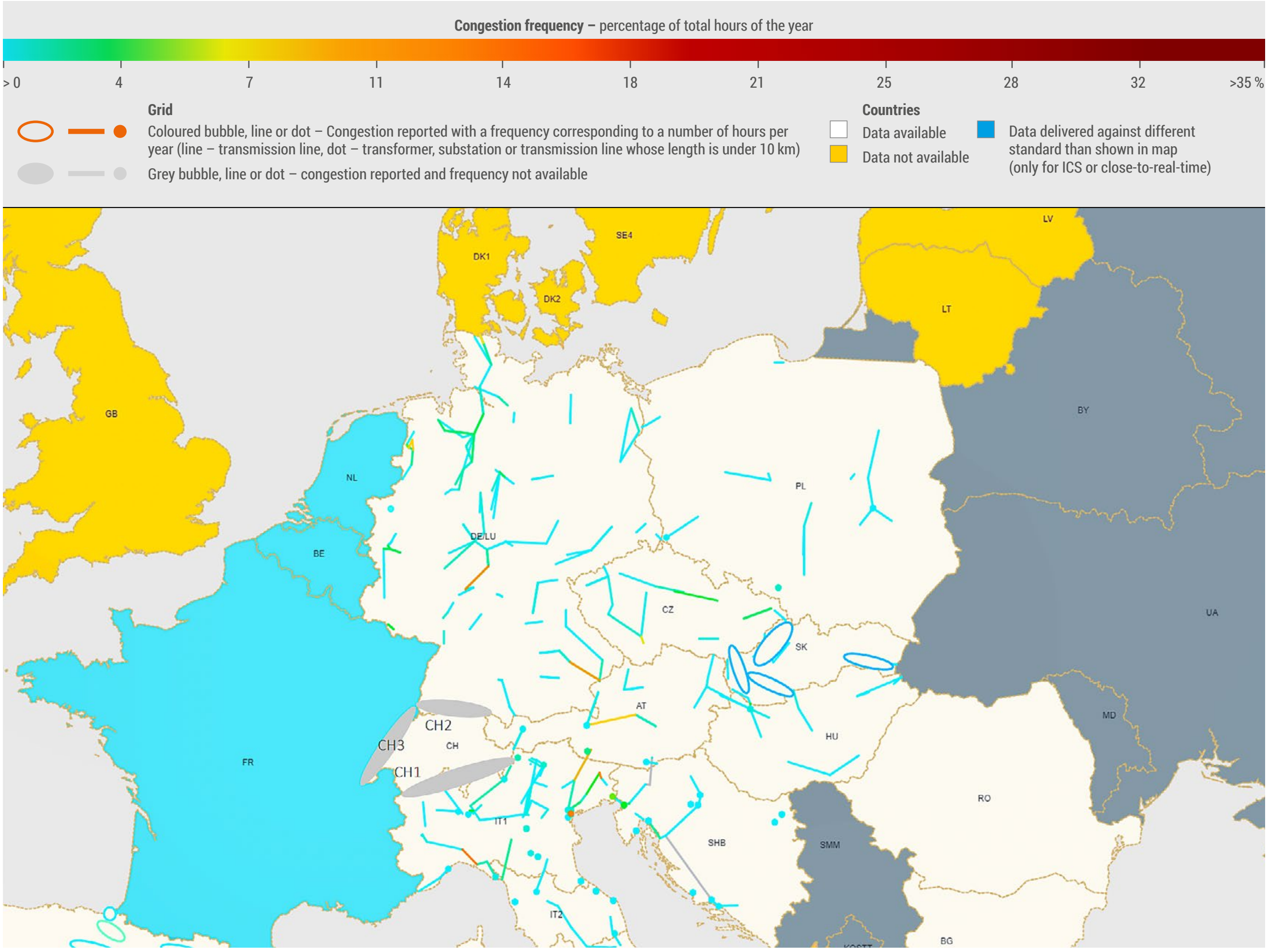



Figure 105: real-time for 2019 – Central Europe without threshold

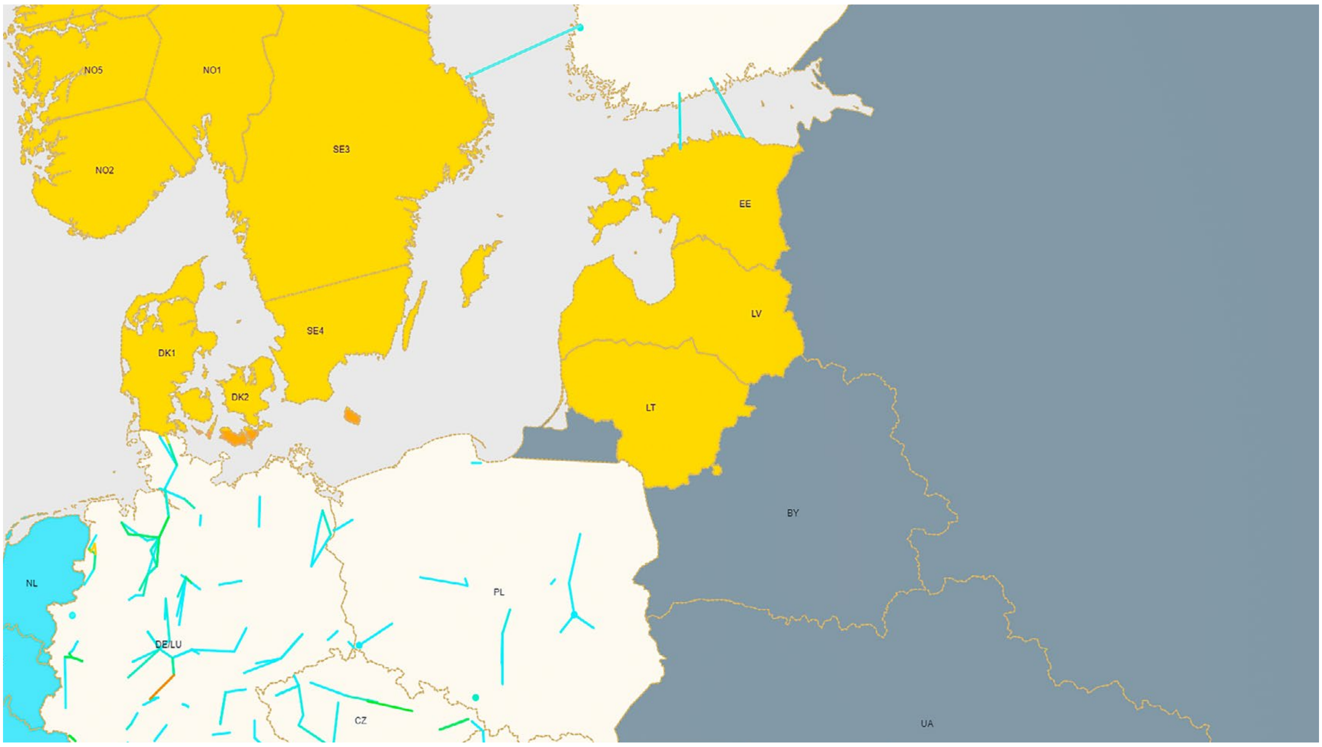



Figure 106: real-time for 2019 – Baltic countries and Denmark/Sweden without threshold

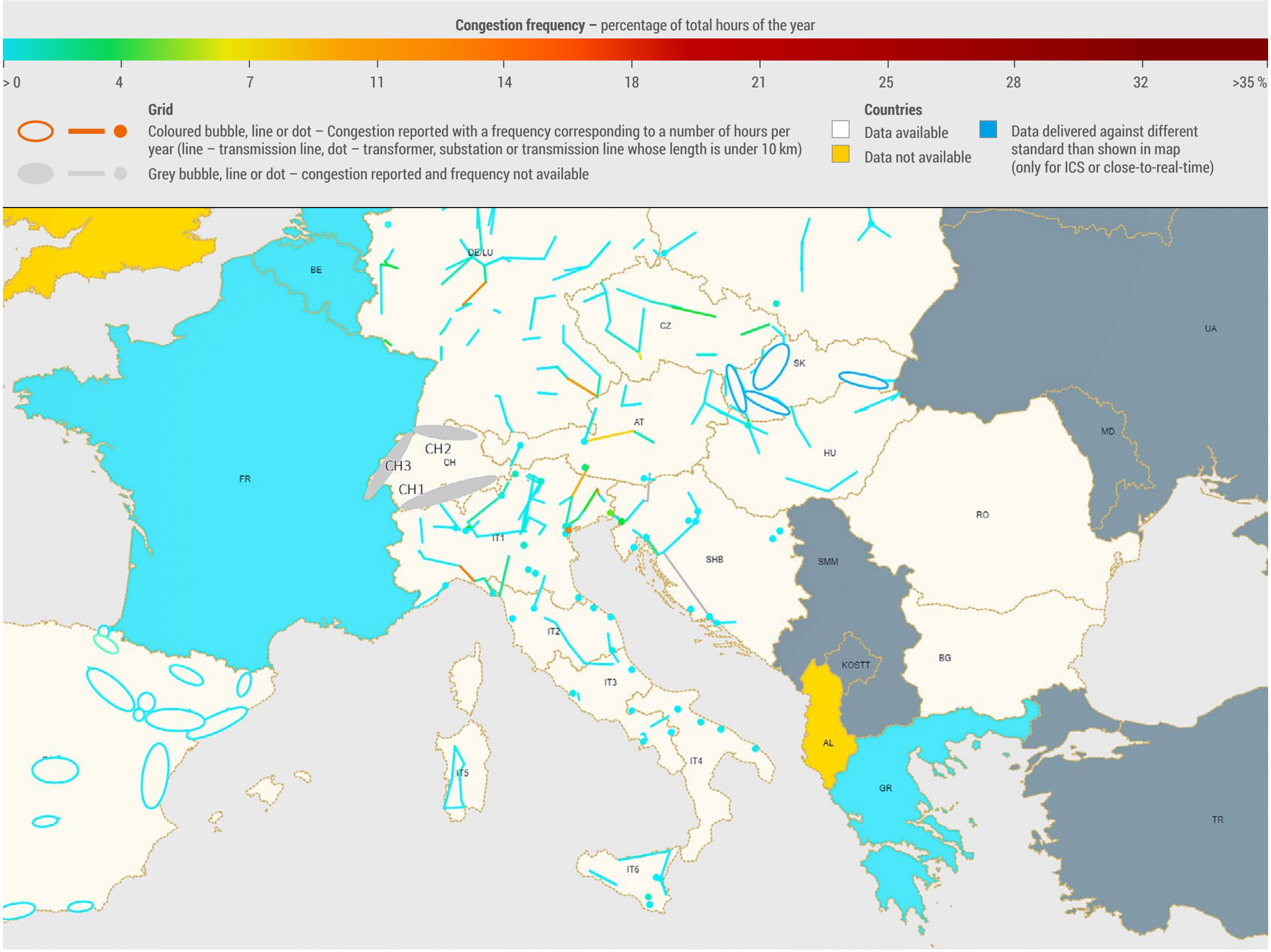



Figure 107: real-time for 2019 – Balkans and Italy without threshold

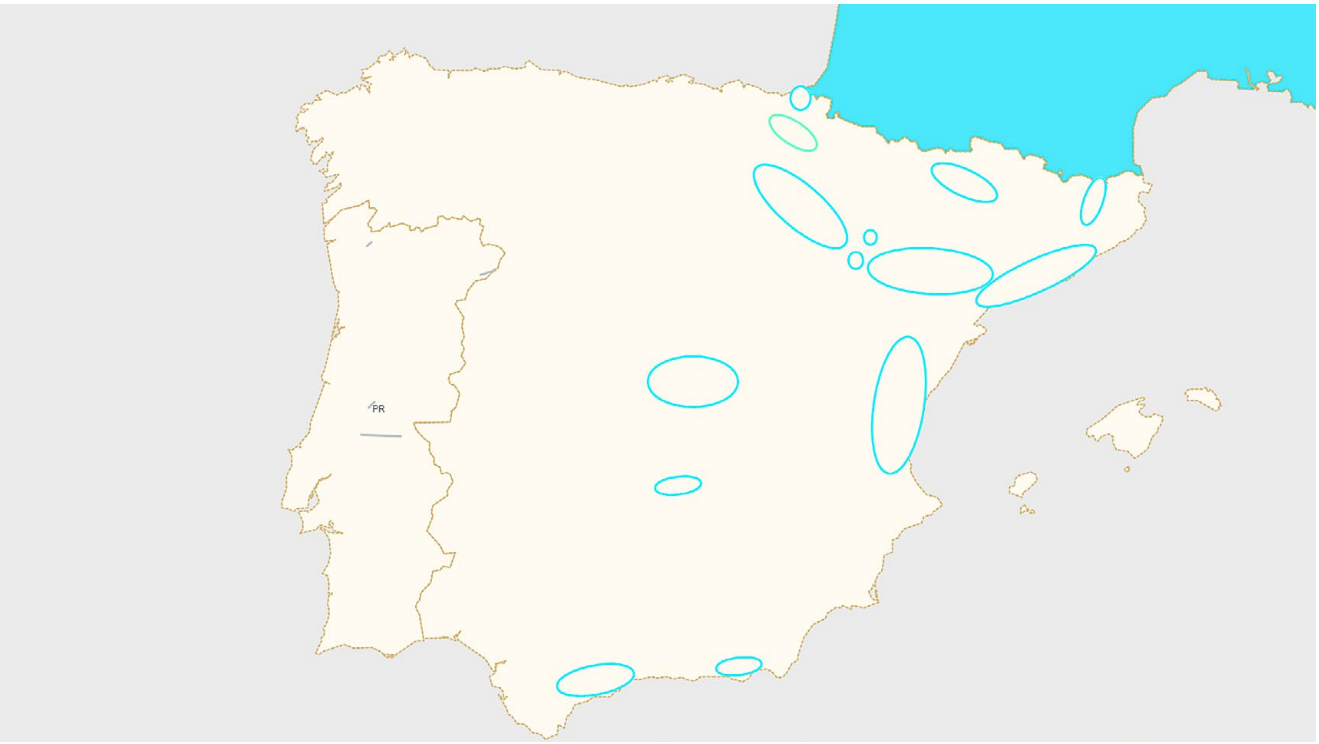



Figure 108: real-time for 2019 – Spain/Portugal without threshold

## 2020 – 1 hour real-time without threshold

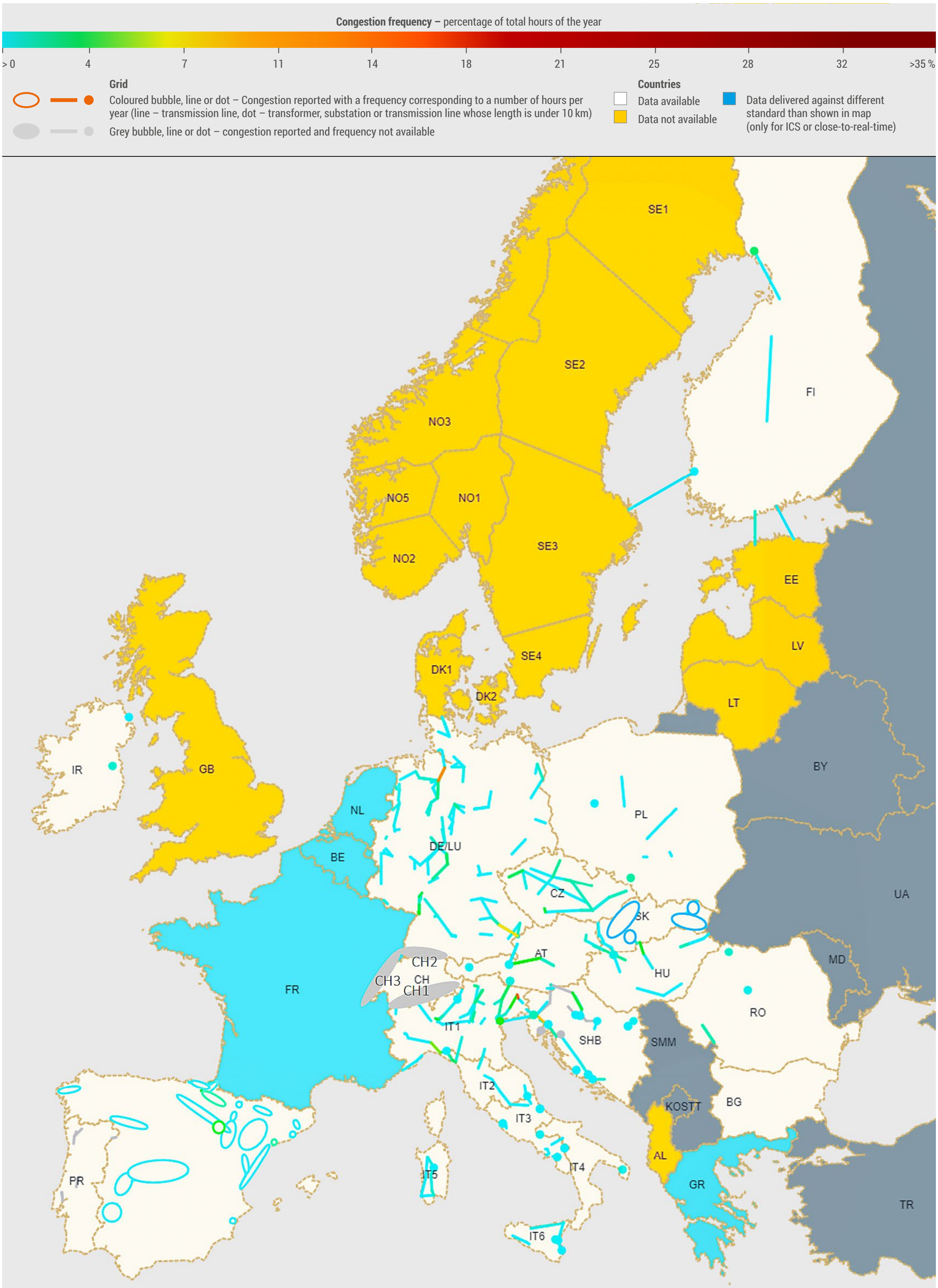



Figure 109: real-time for 2020 – Europe without threshold

## Zooms

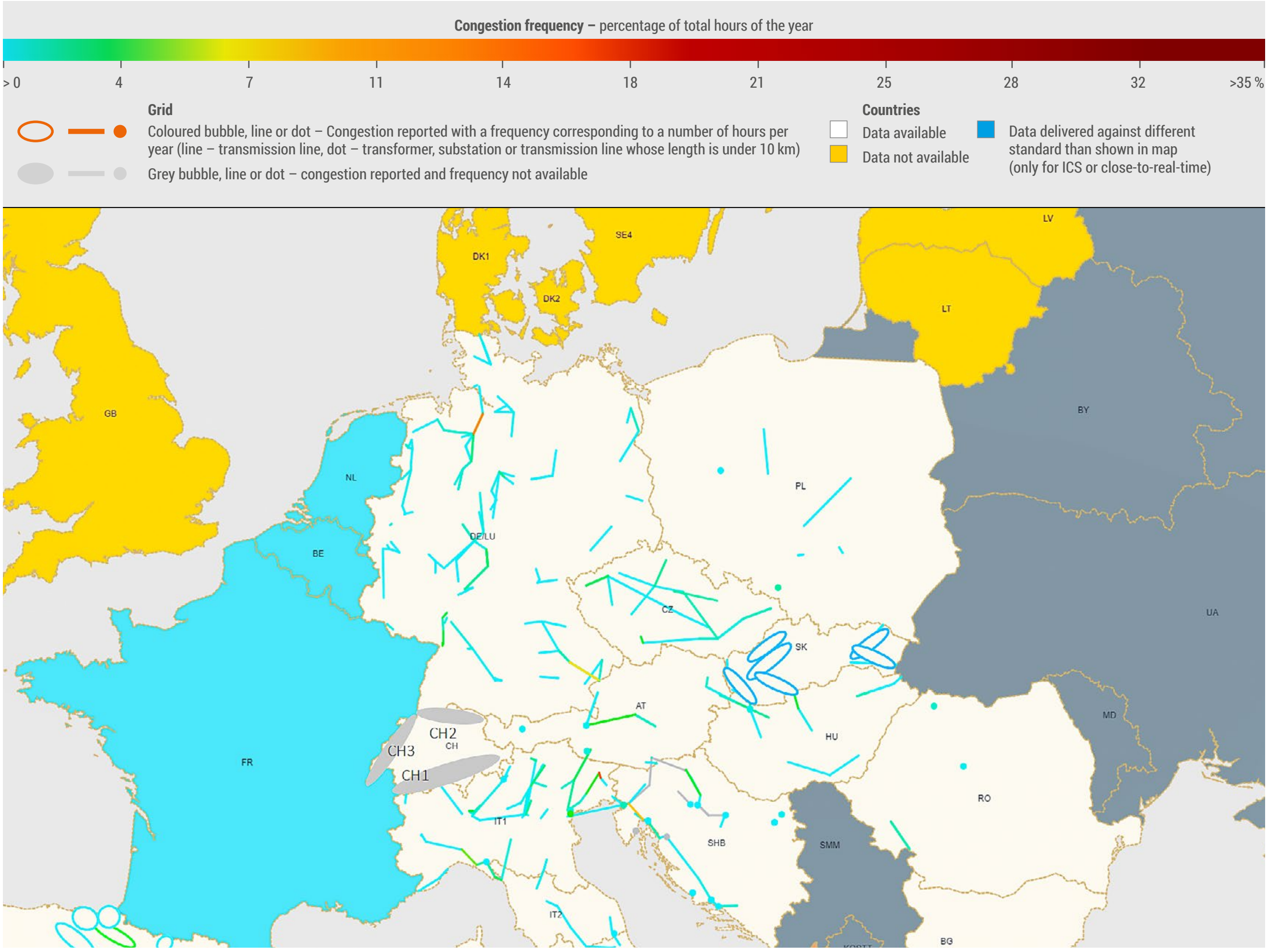



Figure 110: real-time for 2020 – Central Europe without threshold

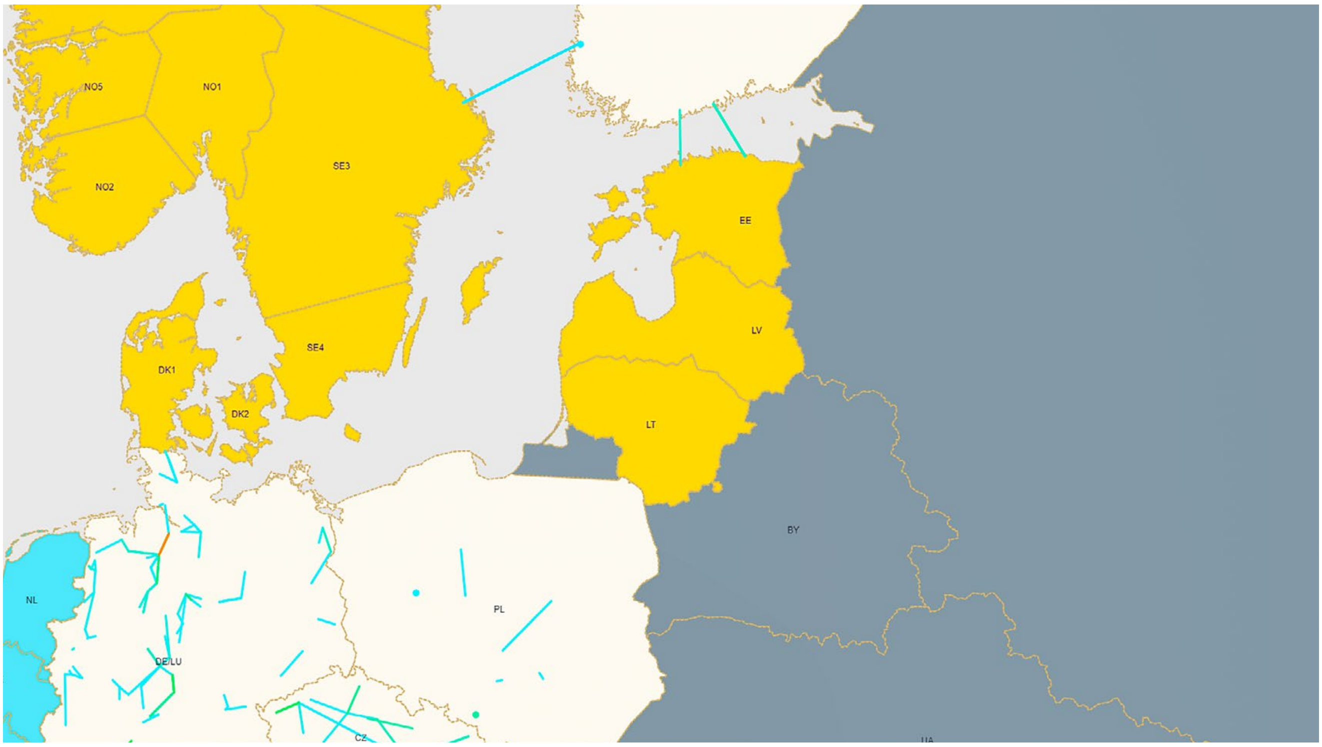



Figure 111: real-time for 2020 – Baltic countries and Denmark/Sweden without threshold

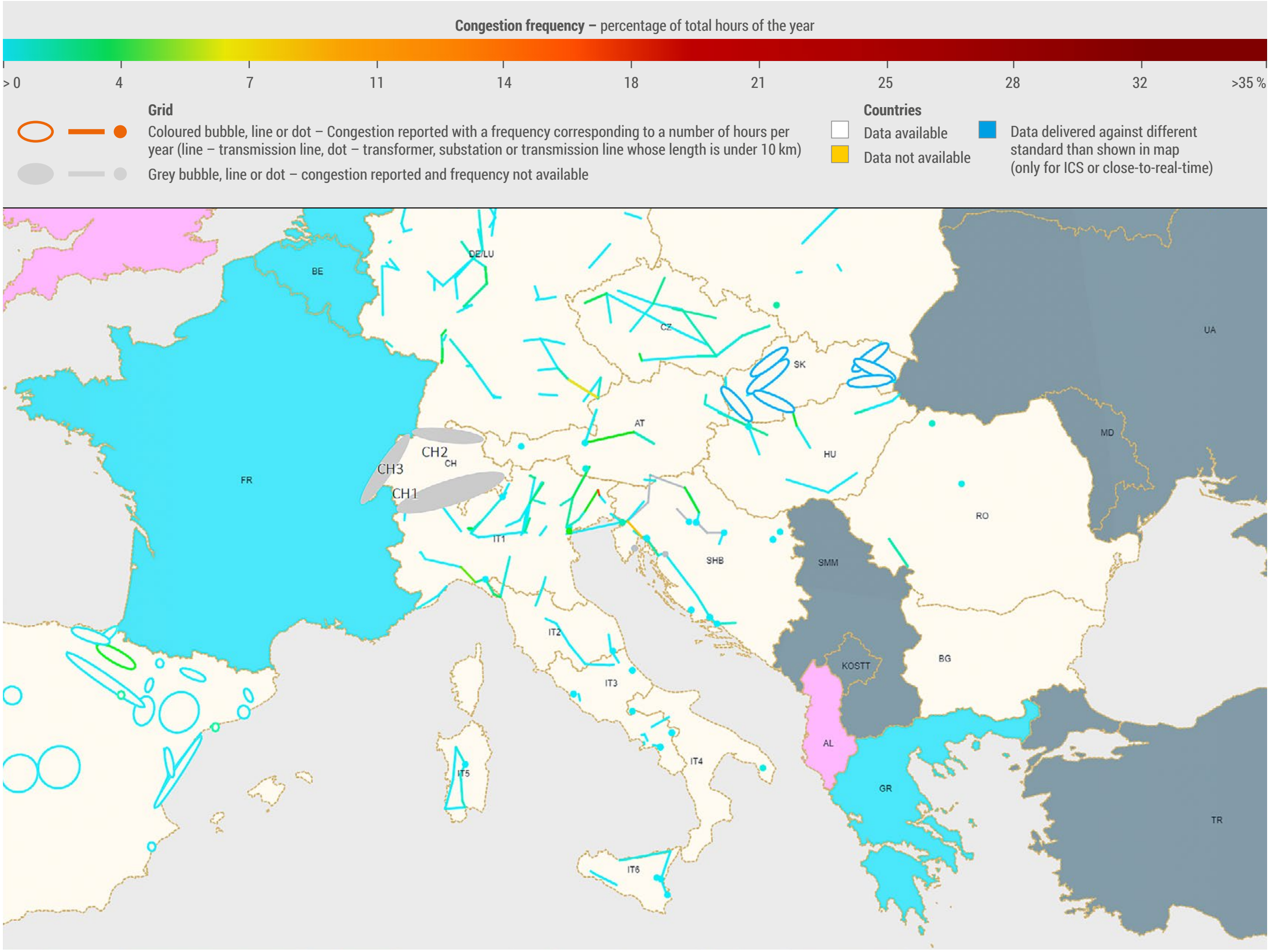



Figure 112: real-time for 2020 – Balkan and Italy without threshold

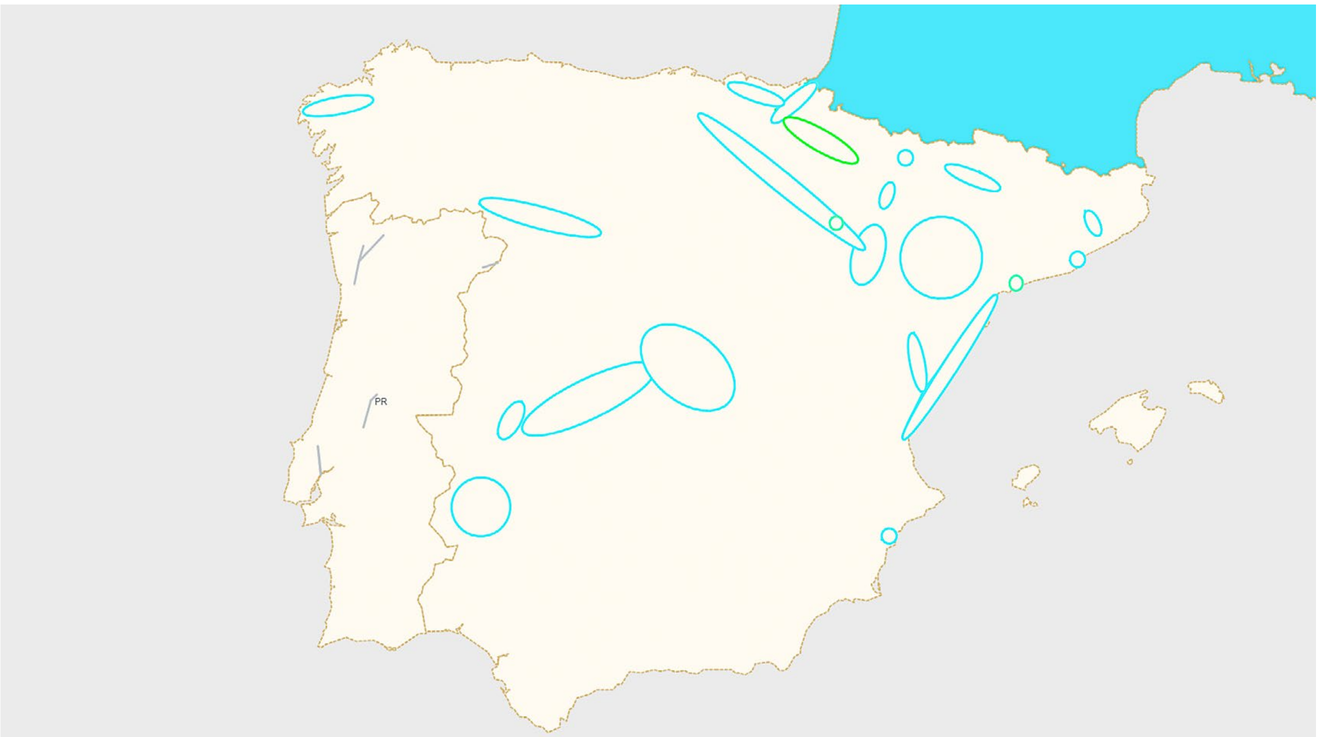



Figure 113: real-time for 2020 – Spain/Portugal without threshold

## 2018 Countries with ICS data

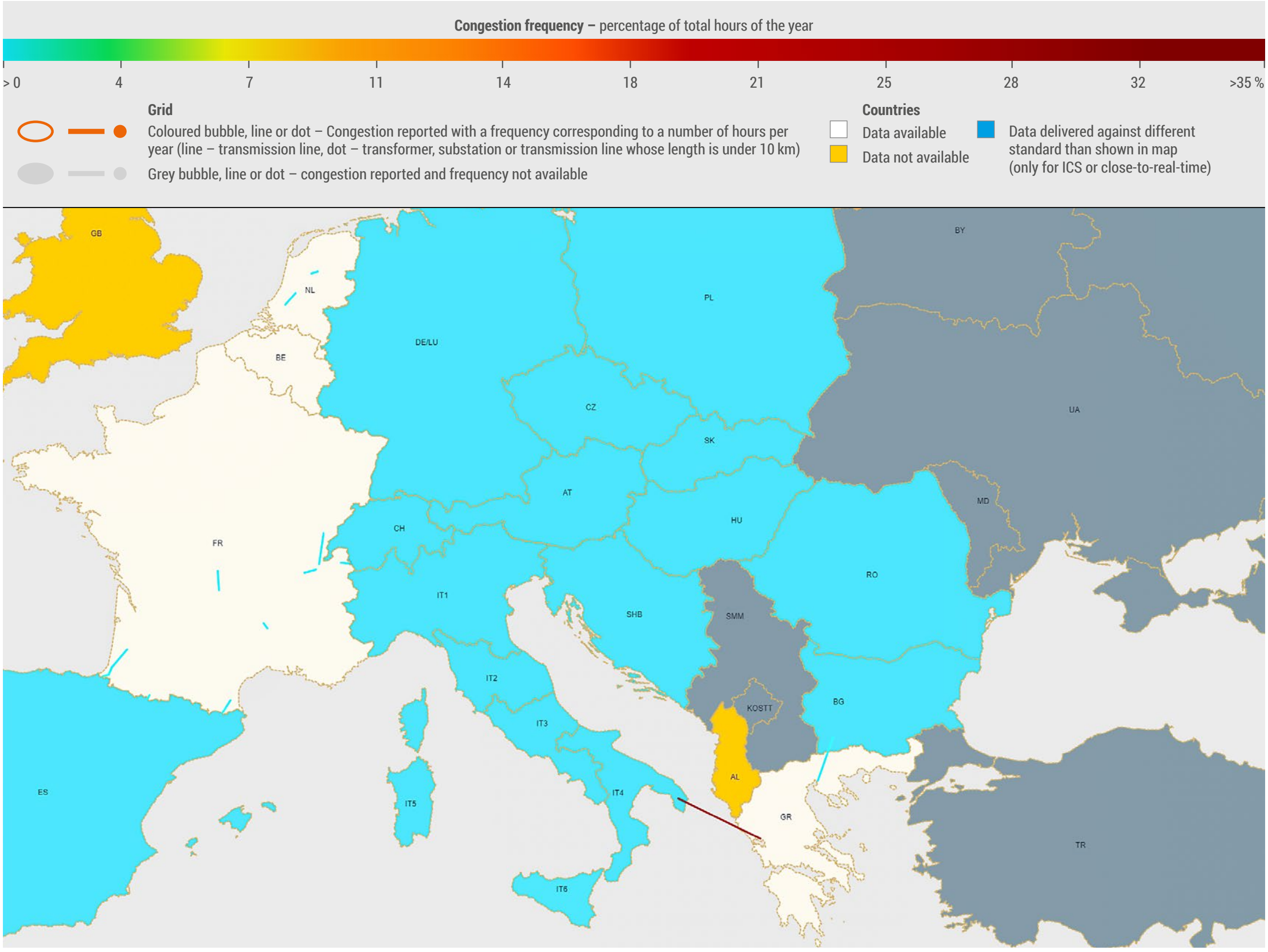



Figure 114: Countries with ICS data, FR, BE, NL and GR only. No threshold

## 2019 Countries with ICS data

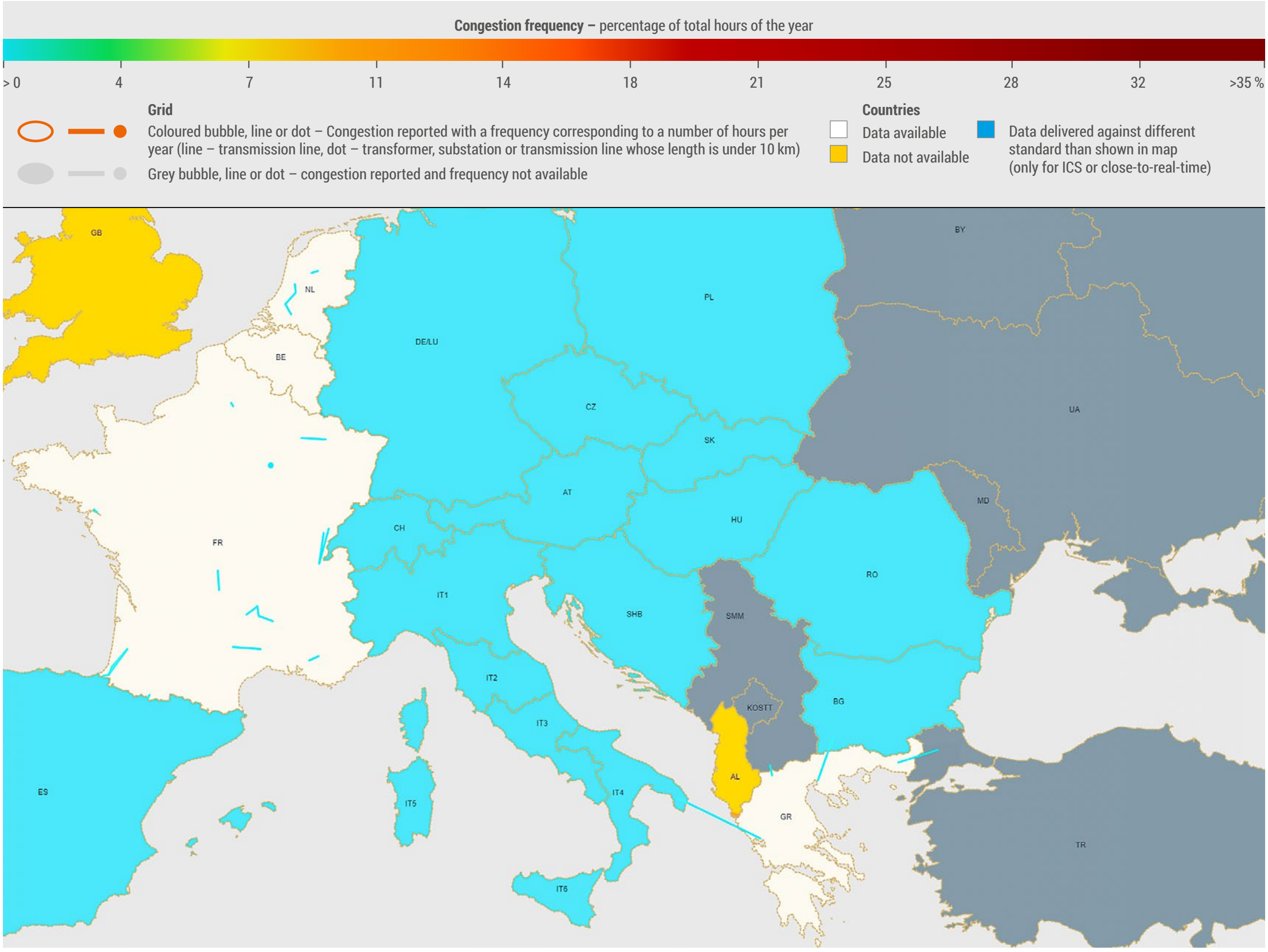



Figure 115: NL and GR only. No threshold. Countries with ICS data, FR, BE, NL and GR only. No threshold. Countries with ICS data, FR, BE, NL and GR only. No threshold and GR only. No threshold

## 2020 Countries with ICS data

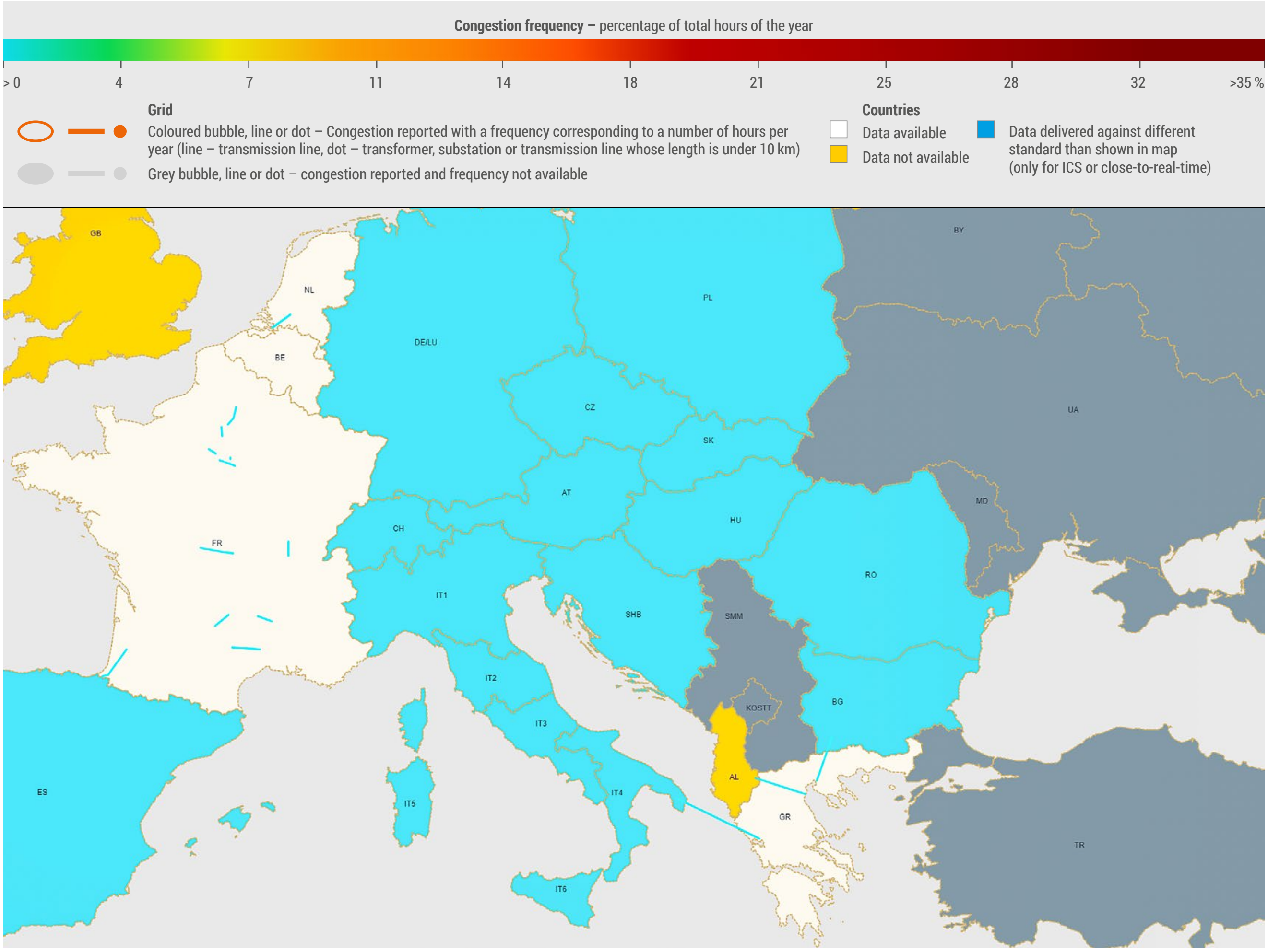



Figure 116: NL and GR only. No threshold. Countries with ICS data, FR, BE, NL, and GR only. No threshold. Countries with ICS data, FR, BE, NL, and GR only. No threshold and GR only. No threshold.

# Annex II – Additional analyses on physical firmness costs and volumes

Congestion management measures are induced and influenced by a variety of factors. The graphs in Figures 117 and 118 try to consider the ratio between the size of a BZ compared to the absolute numbers of congestion management costs and volumes.

A factor to determine the size of a BZ may be 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, as well as 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 graphs above present the total volume and total costs of congestion management measures related to net generation [MWh] and gross generation capacity [MW]. The annual net generation represents the electricity that the grids had to transfer from generation to load after the application of TSO7 measures for congestion management and balancing.

Still, these graphs should be read carefully. It must be noted that these graphs contain the total volumes and costs, respectively, 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 the curtailment of renewable energy resources. The following relative numbers aim to stipulate awareness for this with no claim to be complete.

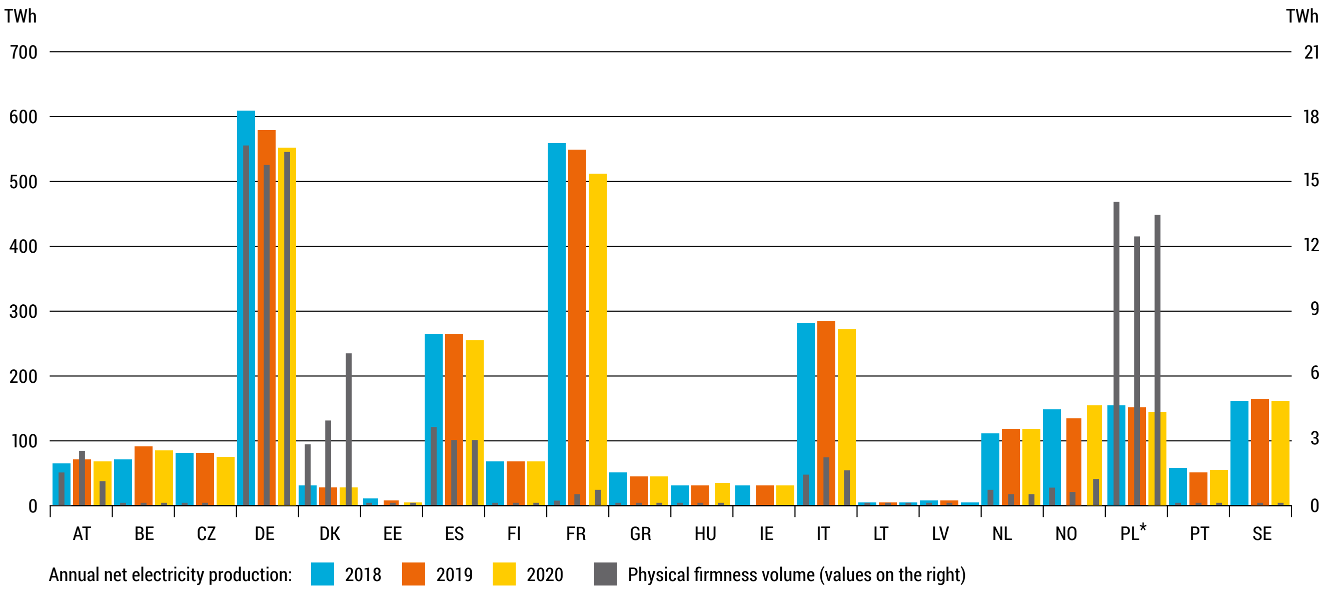



Figure 117: Total physical firmness measure volumes [TWh] (sum of figures as presented in Figures 66 and 67) and annual net electricity production [TWh]. *Since PSE applies ISP, the cost and volume reported by PSE cover the whole ISP, i. e., not only congestion management, and thus reported cost and volume should be deemed to be strongly overestimated. For a more detailed explanation, see Section 4.2.2.1

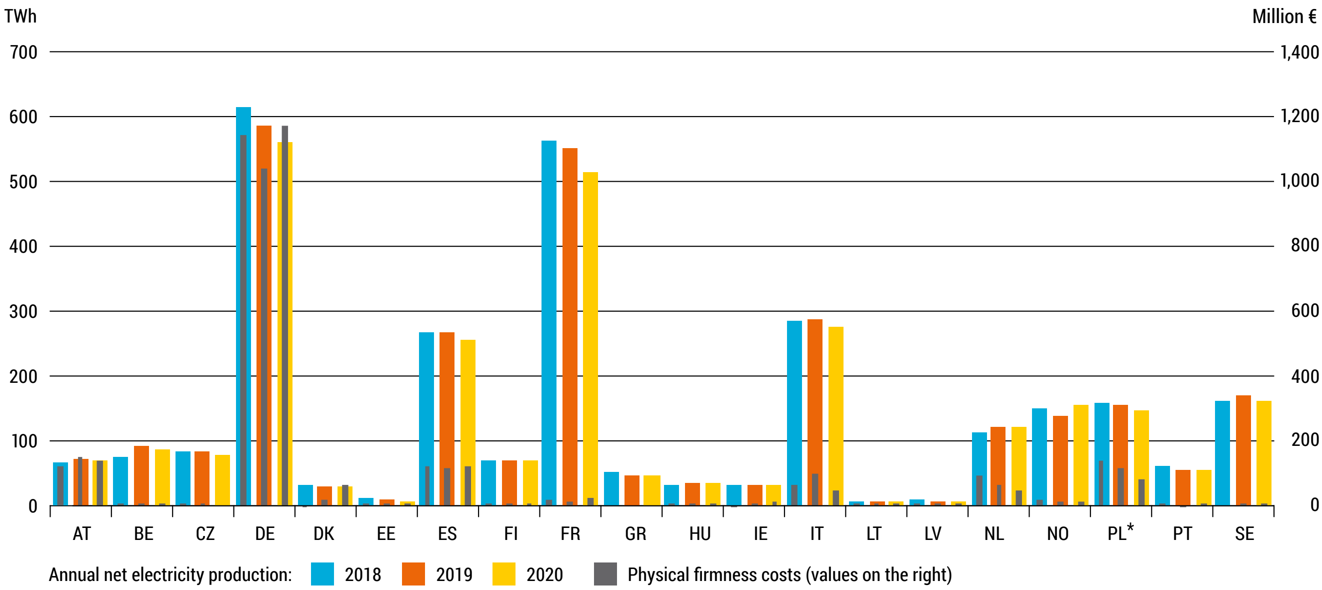



Figure 118. Total amount of physical firmness costs [millions of euro] (sum of figures presented in Figures 64 and 65) and annual net electricity production [TWh]. *Since PSE applies ISP, the cost and volume reported by PSE cover the whole ISP, i. e., not only congestion management, and thus reported cost and volume should be deemed to be strongly overestimated. For a more detailed explanation, see Section 4.2.2.1.

# Annex III – Additional assessments of the state of CEP70

## 1 Austria

### 1.1 Current status of the implementation of CEP70 requirements

A derogation with no minimum capacity value for cross-zonal trade (expressed as a percentage of MACZT per CNEC) was applied in 2020 for both Core and INB CCRs. The derogation was granted based on foreseen security issues linked to missing concepts and industrialised IT tools for the operational calculation and validation of capacities according to a certain MACZT target, as well as uncertainties deriving from the non-existence of a common net position-forecasting process. Furthermore, the derogation is also based on other foreseeable grounds affecting the security of system operation, meaning the lack of (cross-border) RD potential due to the non-existence of certain bilateral contracts and excessive loop flows and PST flows going over a certain predefined threshold.

In December 2020, an action plan was released by the Austrian government (BMK), which is valid from 1st of January 2021 onwards. In addition to improvements and projects to increase the available capacity for cross-zonal trade, it also includes the linear trajectory for reaching 70 % MACZT by the end of December 2025. According to this action plan, the MACZT target for 2021 (starting point of the linear trajectory) is 18.4 %, but this value is only to be applied once the corresponding tools have been finalised and put into operation, as stated in the derogation for Core and INB for the year 2021 (granted by the Austrian Regulatory Authority, E-Control, in December 2020).

The concept for capacity calculation approved in derogation 2021 is built upon that used for derogation for 2020, and therefore allows for the application of a margin reflecting the uncertainties of MNCC flows (‘MNCC Margin’) due to a missing common net position forecasting process, as well as the possible reduction of the MACZT target in case of excessive loop flows and PST flows that exceed a certain predefined threshold. Such design parameters are necessary because the APG network is located between Core and INB CCR and needs to cope with large uncertainties caused by the different assumptions and non-harmonised capacity calculation approaches active in both regions.

### 1.2 Assessment methodology

The methodology due to ACER’s Recommendation No 01/2019 is applied, except for the different monitoring of the Austrian-Italian border, which is part of the INB CCR. Due to the non-existence of IT tools, the assessment could not be performed considering the granted reasons for derogation, such as the MNCC Margin and loop flow threshold. This results in the following assessment of the three border types:

| Design element | Design choice of Austria | | |
|---|---|---|---|
| Border/Region | AT-CZ--HU--SI_AT | CWE | INB |
| Grid elements considered | All limiting CNECs | All CNECs | All limiting CNECs |
| Third countries considered | Yes | Yes | Yes |
| Hours considered | All hours | All hours | All hours, not only those in which APG had a limiting CNEC |
| Timeframes considered | DA | DA | DA |

Table 4: Prominent design choices of the assessment methodology of Austria

## 1.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Austria:

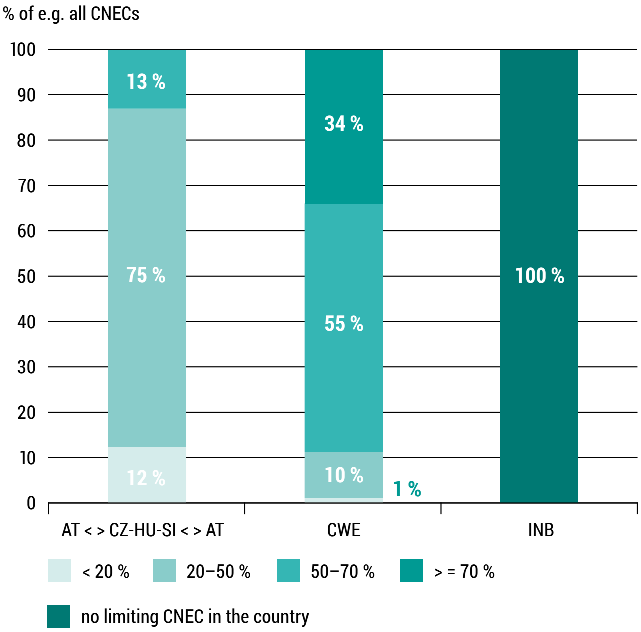



Figure 119: Relative cross-zonal trading margin of Austria

Based on Figure 119, INB border monitoring shows that in almost 100 % (99.84 %) of the hours of the year 2020, APG had no limiting CNEC during the DA CC process of this CCR. APG considers those hours as hours with more than 70 % MACZT available, as there was no impact from APG's network elements on the DA CC results and allocation.

For the CCR Core (CWE and NTC borders AT < > CZ-HU-SI < > AT), Figure 119 shows the monitoring result based on ACER's monitoring assessment, which always takes the 'worst' CNEC (the CNEC with lowest MACZT) as representative of the hour and calculation area. In case of AT < > CZ-HU-SI < > AT, the lower MACZT of the limiting CNEC for import and export direction defines the hour (e. g., if the MACZT on the limiting CNEC in one direction of the border is < 20 % while the MACZT of the limiting CNEC in the other direction is higher, than the entire profile is labelled as < 20 % for this hour). This means that these bars show a negatively distorted image of the real performance of APG in Core.

Due to missing tools for the operational MACZT calculation, APG had no possibility to reflect the granted MNCC margin as well as the loop flow threshold in the calculations for 2020, which would have resulted in higher MACZT values. As these derogation reasons are still valid and granted by the national regulatory authority, they will be considered once the operational calculation with the industrialised tool can be performed and put into operation (expected in 2021).

# 2 Belgium

## 2.1 Current status of the implementation of CEP70 requirements

For the CWE region, as in 2020, BE has been granted a derogation for excessive loop flows in 2021.

## 2.2 Assessment methodology

For the CWE region, BE applies ACER's recommendation, complementing the 'lowest MACZT per MTU' view expressed in the main table above with an 'All CNECs' view, for which the assessment results are shown below. In this fashion, a complete picture is devised. For the borders BE > GB and GB > BE, BE applies ACER's recommendation, illustrated in this report as the monitoring of the NTC provided on the DC link.

| Design element | Design choice of Belgium | |
|---|---|---|
| Border/Region | CWE | BE > GB, GB > BE |
| Grid elements considered | All CNECs | Monitoring NTC provided on the DC link |
| Third countries considered | Yes | N/A |
| Hours considered | All hours from Q2 onwards (from 1 April through 31 December 2020) as per the derogation applicable in 2020 | All hours 2020 |
| Timeframes considered | DA | DA |

Table 5: Prominent design choices of the assessment methodology of Belgium

## 2.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Belgium:

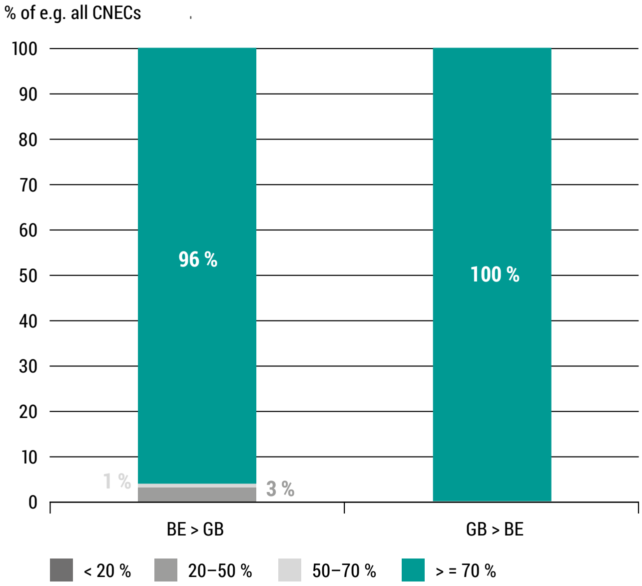



Figure 120: Relative cross-zonal trading margin of Belgium's DC link on the BE–GB border

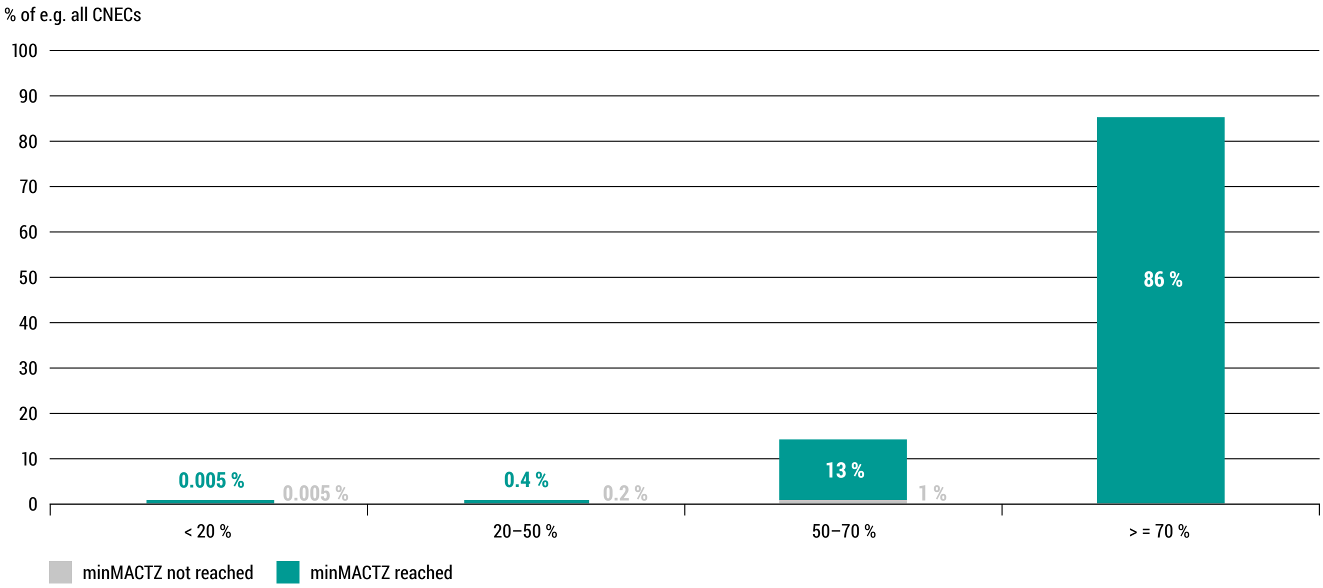



Figure 121: Relative cross-zonal trading margin of Belgium for CWE

## 2.4 Additional information

The Belgian NRA, CREG, published its first study on the performance of Elia's compliance in 2020. For the purpose of this study, CREG performed calculations using the data provided by Elia, whereas this data is aligned with the principles laid down in ACER's recommendation.

As illustrated in the below figures, the study highlights the following for Belgian CNECs in CWE:

- In 81.3 % of MTUs, the minimum capacity target is reached simultaneously on each CNEC, whereas looking at the totality of all CNECs across all MTUs, the minimum capacity in reached in more than 99 % of the more than 13 million CNECs.
- On the vast majority of CNECs, 70 % or more capacity has been offered for market exchanges.

- Furthermore, CNECs on which less than 70 % capacity is offered can be compliant. This follows from the application of the derogation for excessive loop flows. In the majority of cases, excessive loop flows lead to a capacity reduction of up to 20 %, and in some cases to a capacity reduction up to 50 %.
- It is rather rare that a grid element on which the minimum capacity was not reached limited the market: i. e., it concerns 75 CNECs spread across 66 hours out of more than 13 million CNECs across 6,528 MTUs.

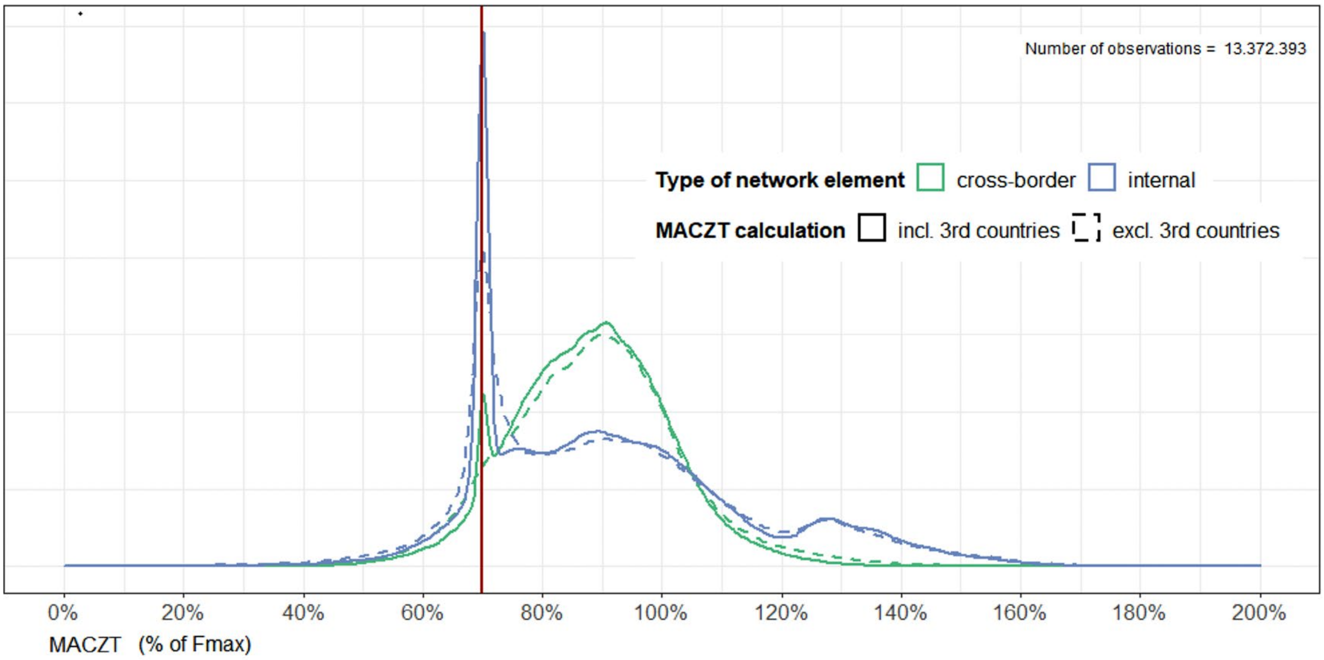



Figure 122: all observed MACZTs

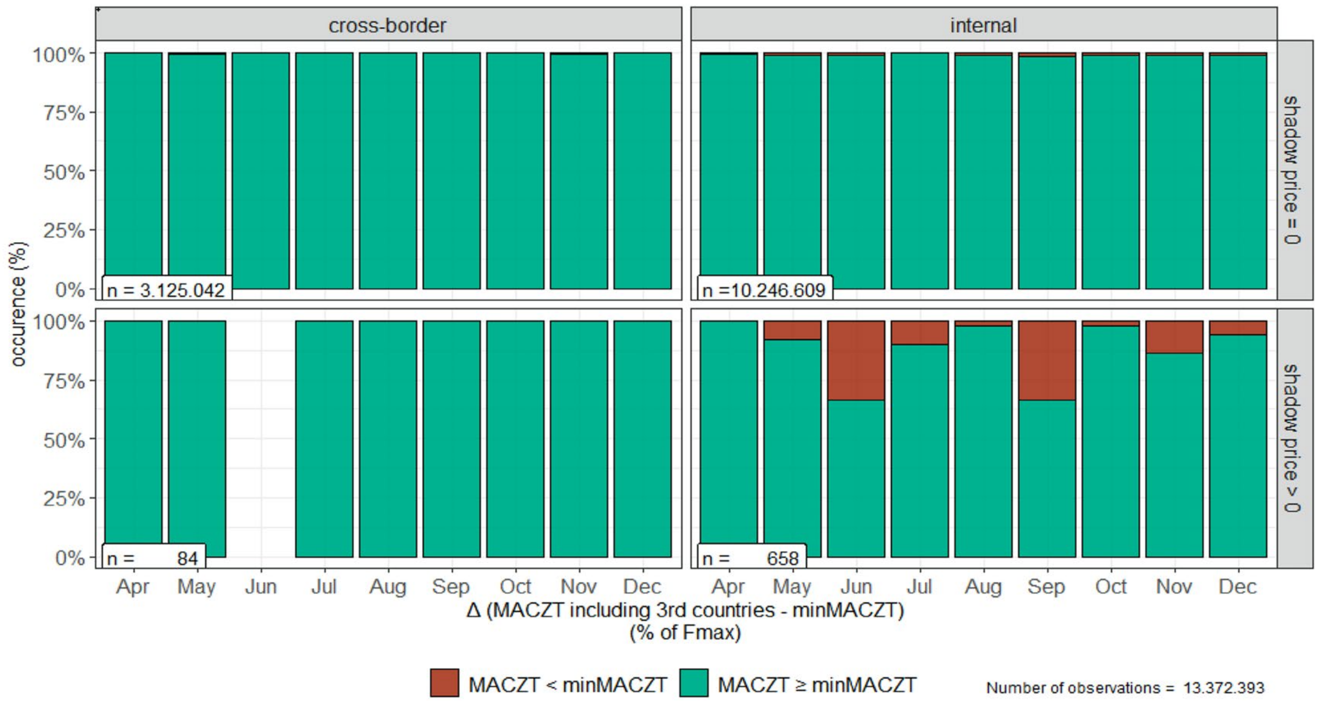



Figure 123: All observed deltas between target (minMACZT) and offered capacity (MACZT)

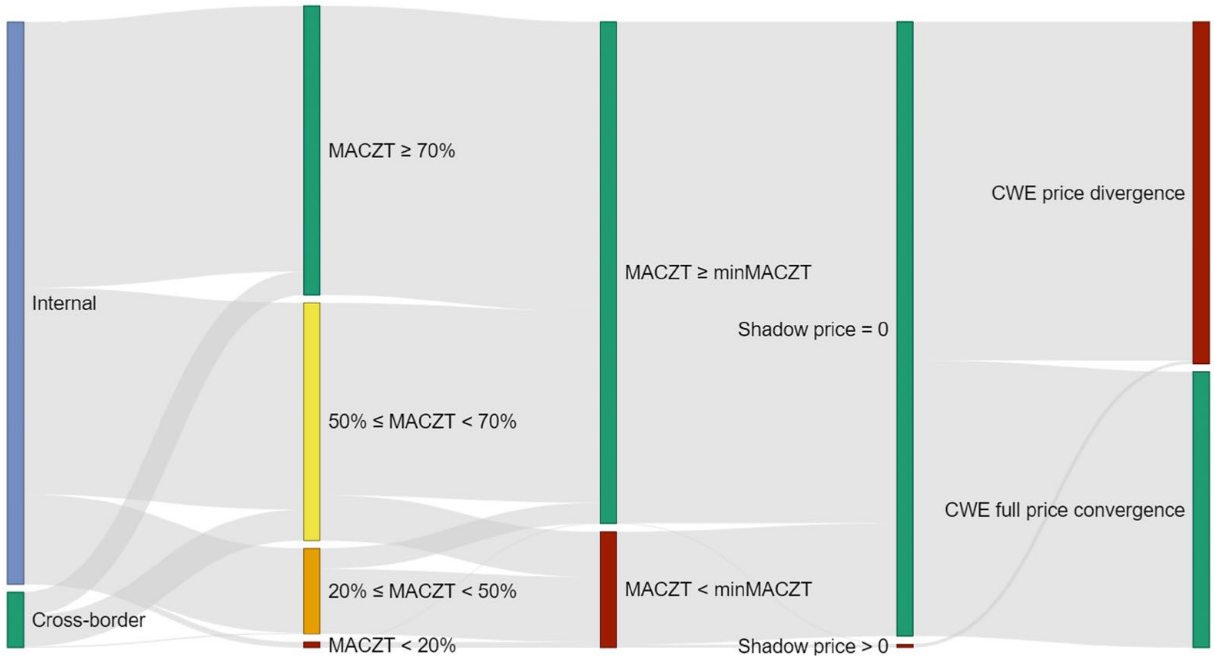



Figure 124: Sankey diagram with lowest observed delta between target (minMACZT) and offered capacity (MACZT) per MTU

# 3 Bulgaria

## 3.1 Current status of the implementation of CEP70 requirements

As in 2020, BG has been granted a derogation for 2021.

## 3.2 Assessment methodology

The MACZT data in this report are the NTC values agreed upon bilaterally between ESO (BG) and Transelectrica (RO), and between ESO (BG) and IPTO (GR), respectively. These NTC values have been published on the ESO-EAD web site. The results are based on AC load-flow calculations using the common-grid model of the SEE Region. The MACZT considers the voltages and other additional operational specifics, which it is not yet possible to consider based only on ACER's 01/2019 recommendation on MACZT calculation. The results take into consideration the long-term available capacities on the given borders and on operational experience with neighbouring third countries (TR, NMK, RS). The provided MACZT data represents the calculated NTCs on a given border in both directions, divided by the rating/ratings of the interconnection line/lines.

| Design element | Design choice of Bulgaria |
|---|---|
| Border/Region | … |
| Grid elements considered | All limiting CNECs, but please refer to explanations in 3.2 and 3.4 |
| Third countries considered | Yes, but please refer to explanations in 1.2 and 1.4 |
| Hours considered | Yes, but please refer to explanations in 1.2 and 1.4 |
| Timeframes considered | LT |

Table 6: Prominent design choices of the assessment methodology of Bulgaria

## 3.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Bulgaria:

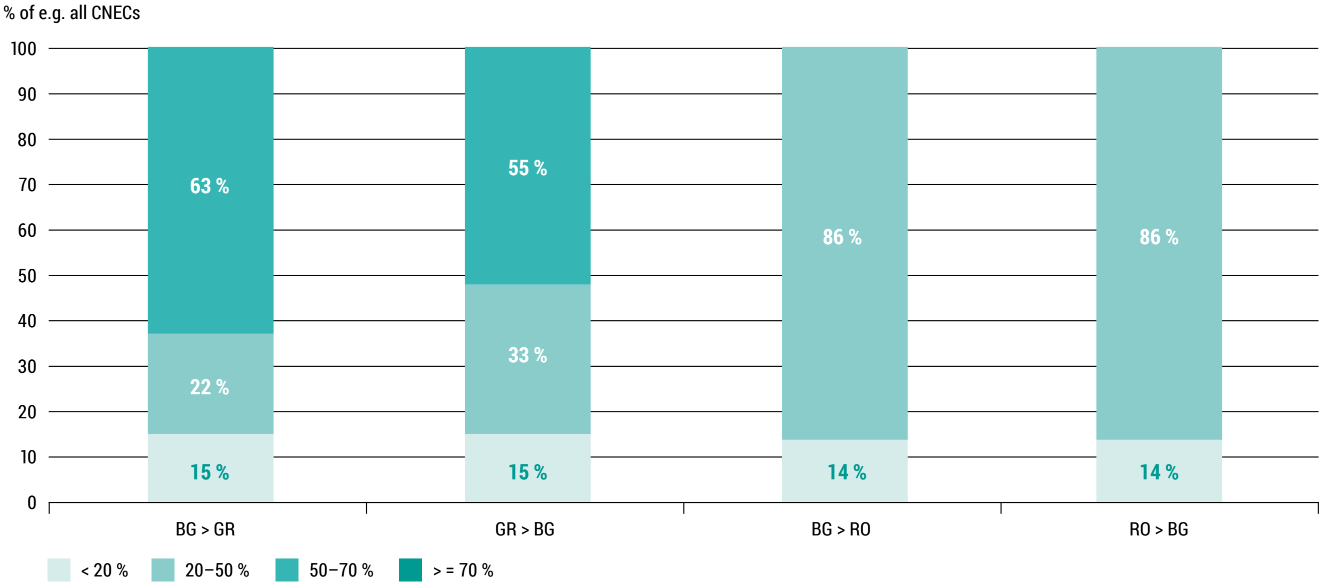



Figure 125 : Relative cross-zonal trading margin of Bulgaria, *Concerning the values <20 % for the borders BG–GR and GR–BG: In both directions, the percentage indicated in the row < 20 % is related to the periods when the only interconnection line between Bulgaria and Greece was out of operation according to the maintenance program for 2020. Concretely, in this period the NTC value was 0, and as such the MACZT should be 0 as well.

## 3.4 Additional information

The computation of the MACZT is assumed to be performed by SEE RSC in Thessaloniki (SELENE). SELENE will implement the Coordinated Capacity Calculation Methodology of the SEE region for day-ahead and intraday time frames. Currently, SEE TSOs and SEE RSC are performing implementation tests. It is expected that the methodology for day-ahead capacity calculation will go live starting on 01.07.2021. We then expect to cooperate with the RSC regarding calculation of the day-ahead capacities made available to the market.

The SEE TSOs have already made first steps toward the initiative for concluding agreements with third countries in the region (Serbia, North Macedonia, and Turkey) taking into account the EU Commission letter regarding the capacity calculation and third-country flows sent to ENTSO-E and ACER on 16 September 2019. On 5 October 2020, a letter was sent on behalf of the three SEE EU TSOs (Bulgaria, Romania and Greece) to the non-EU TSOs of Albania, Turkey, North Macedonia and Serbia. Considering the recommendations given by the European Commission, it was proposed to conclude agreements with neighbouring countries to address the treatment of the capacity calculation constraints and the cost sharing of remedial actions in the region in a common coordinated manner. The signing of such agreements with neighbouring non-EU countries would be a good starting point for an amendment of the methodology for calculating cross-zonal capacity for the day-ahead and intraday timeframes, already adopted by national regulators in the Southeast Europe region. By changing the existing methodology and including the BG-MK, BG-SR, BG-TR, GR-AL, GR-MK, GR-TR and RO-SR borders, a balance will be achieved between a more efficient cross-zonal capacity calculation that considers all the peculiarities while maintaining the secure operation of the electricity systems in the region. So far, we do not have an official response to the letter we sent, and it is not clear whether the above countries are willing to join the requirement of at least 70 % availability for their borders with Bulgaria, Romania and Greece. Without the consent of these parties, we cannot include the above-mentioned borders in our methodology for day-ahead and intraday capacity calculation timeframes and adequately calculate the MACZT according to the ACER recommendations.

# 4 Croatia

## 4.1 Current status of the implementation of CEP70 requirements

A derogation with no minimum capacity is applied in 2020.

## 4.2 Assessment methodology

The methodology according to ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Croatia |
|---|---|
| Border/Region | … |
| Grid elements considered | All limiting CNECs |
| Third countries considered | No |
| Hours considered | All hours for first semester 2020 |
| Timeframes considered | Only DA |

Table 7: Prominent design choices for the assessment methodology of Croatia

## 4.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Croatia.

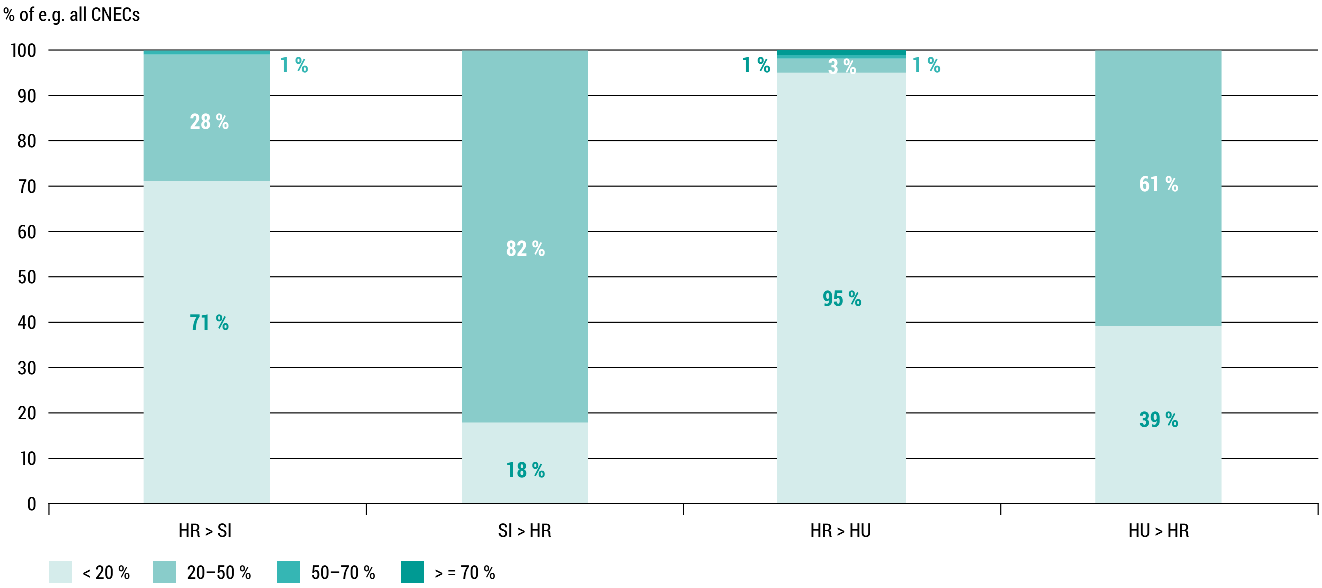



Figure 126: Relative cross-zonal trading margin of Croatia

# 5 Czech Republic

## 5.1 Current status of the implementation of CEP70 requirements

A derogation with no minimum capacity is applied in 2020.

## 5.2 Assessment methodology

The methodology according to ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Czech Republic |
|---|---|
| Border/Region | … |
| Grid elements considered | All CNECs |
| Third countries considered | No |
| Hours considered | All hours |
| Timeframes considered | DA |

Table 8: Prominent design choices of the assessment methodology of Czech Republic

## 5.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Czech Republic:

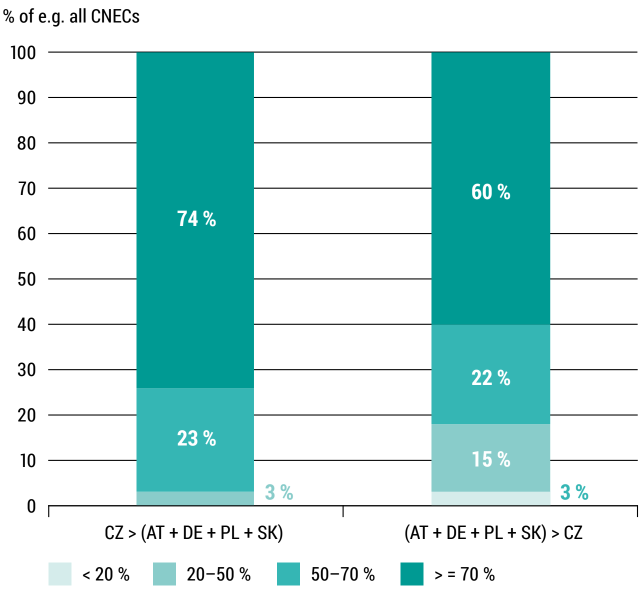



Figure 127: Relative cross-zonal trading margin of Czech Republic

# 6 Denmark

## 6.1 Current status of the implementation of CEP70 requirements

The 70 % rule is applied in 2020.

## 6.2 Assessment methodology

The methodology according to ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Denmark |
|---|---|
| Border/Region | … |
| Grid elements considered | All limiting CNECs |
| Third countries considered | N/A |
| Hours considered | All hours |
| Timeframes considered | DA |

Table 9: Prominent design choices of the assessment methodology of Denmark

## 6.3 Assessment results

Based on the above assessment methodology, for Denmark the following results are obtained.

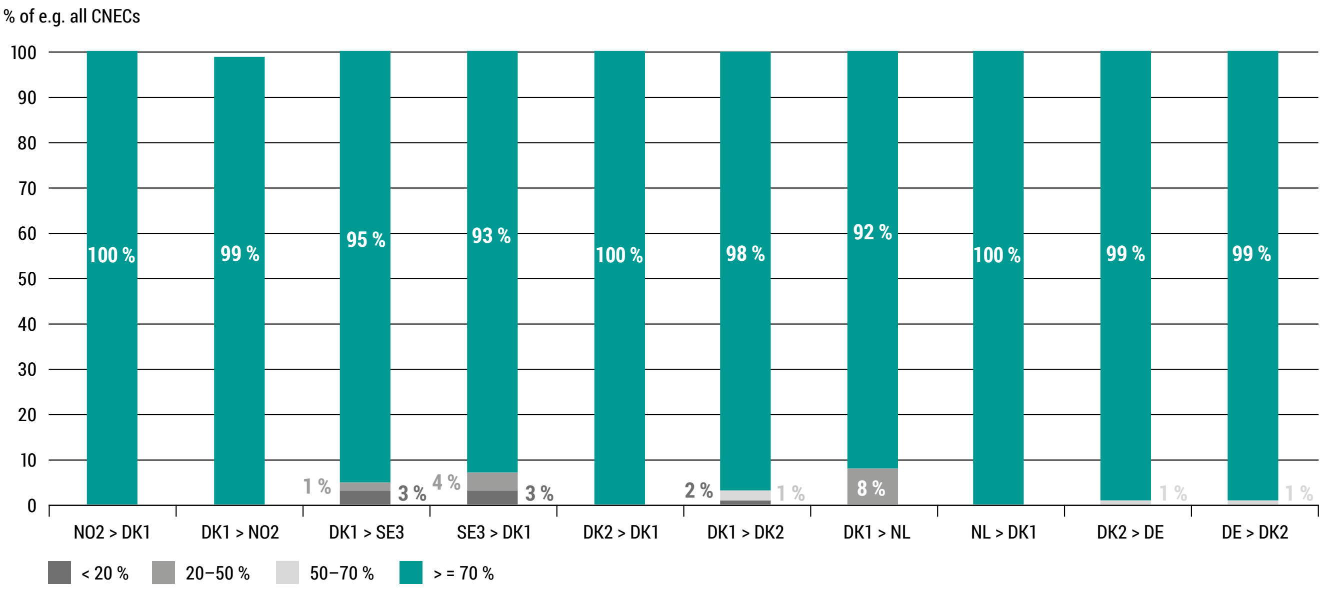



Figure 128: Relative cross-zonal trading margin of Denmark

# 7 Estonia

## 7.1 Current status of the implementation of CEP70 requirements

The 70 % rule is applied in 2020.

## 7.2 Assessment methodology

70 % rule according to Article 16(8) of Regulation (EU) 2019/943 and ACER recommendation.

| Design element | Design choice of Estonia |
|---|---|
| Border/Region | … |
| Grid elements considered | All CNECs |
| Third countries considered | No |
| Hours considered | All hours |
| Timeframes considered | DA |

Table 10: Prominent design choices of the assessment methodology of Estonia

## 7.3 Assessment results

Based on the above assessment methodology, for Estonia the following results are obtained.

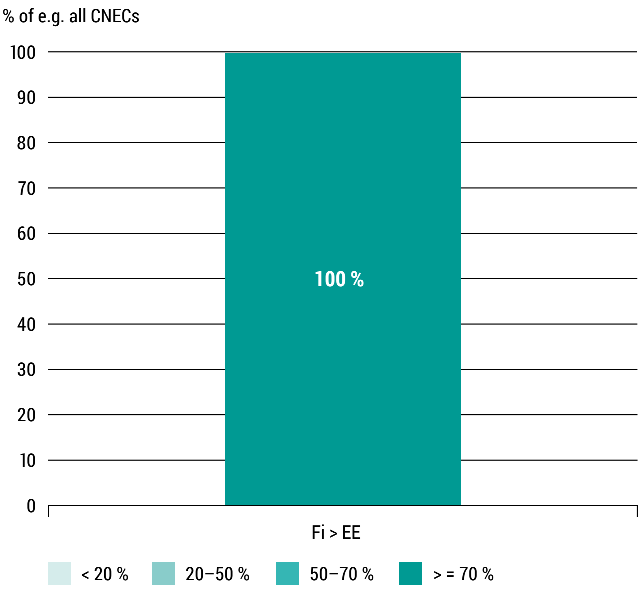



Figure 129: Relative cross-zonal trading margin of Estonia

# 8 Finland

## 8.1 Current status of the implementation of CEP70 requirements

The 70 % rule was applied in 2020.

## 8.2 Assessment methodology

For the border FI-SE1, AC tielines include 100 MW TRM as a market constraint. A value below 70 % would be reached only with lower than 240 MW NTC. For the borders FI-SE3 and FI-EE, Fingrid does not apply any market constraints to DC tielines.

| Design element | Design choice of Finland |
|---|---|
| Border/Region | … |
| Grid elements considered | All CNECs |
| Third countries considered | Yes |
| Hours considered | All hours |
| Timeframes considered | LT, DA, ID, Balancing |

Table 11: Prominent design choices of the assessment methodology of Finland

## 8.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Finland:

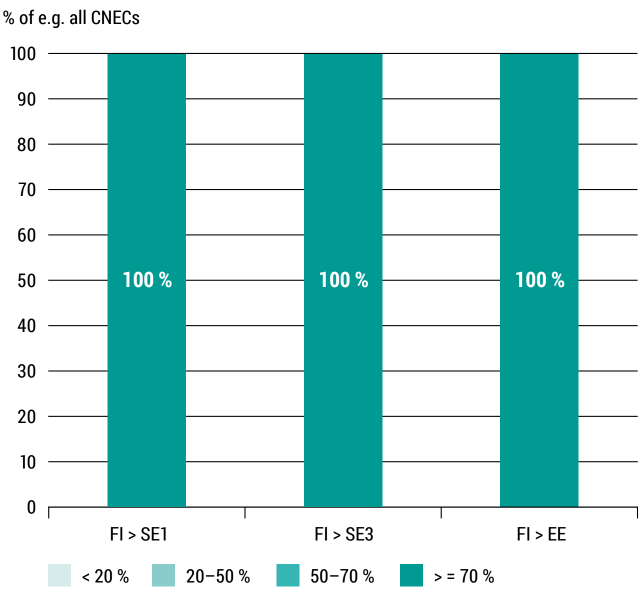



Figure 130: Relative cross-zonal trading margin of Finland

## 8.4 Additional information

Dynamic angle and voltage stability limits are considered for the border FI-SE1. Export capacity on FI-SE1 is limited by dynamic angle stability due to the long-distance transmission path between southern Finland and southern Sweden (>1,500 km). This is done to limit undamped oscillation between large production units (e.g., nuclear power plants) in southern Finland and southern Sweden via the AC network during contingencies. This phenomenon limits the transmission capacity to below the thermal limit of the cross-border line. Import capacity on FI-SE1 is limited due to voltage stability. After major production contingencies, voltage must remain at a predefined level (> 370 kV). This is quite close to the thermal limit of the cross-border lines.

# 9 France

## 9.1 Current status of the implementation of CEP70 requirements

There is no more derogation in the CWE region for 2021: We consider the CEP 70 % target already implemented for RTE. There is no more derogation in NIB for 2021. The CEP 70 % criterion is soon to be implemented in NIB, and furthermore, in the rare case where a French element is limiting, the amount of MACZT is always extremely high (above 70 % for more than 99 % of MTUs).

There is still a derogation for the SWE region in 2021. The CEP 70 % target will be implemented in this region at the end of 2021.

Thus, the situation depicted by ACER for 2021 no longer true for Franc, since two out of three CCRs do not have any derogation anymore.

## 9.2 Assessment methodology

RTE applied ACER's recommendation to determine MACZT by considering third countries. Regarding compliance with the 70 % rule, all French non-limiting CNECs and MTUs with price convergence are deemed compliant.

| Design element | Design choice of France |
|---|---|
| Border/Region | … |
| Grid elements considered | All CNECs |
| Third countries considered | Yes |
| Hours considered | All hours are considered. However, in the calculation for compliance with our derogation, the MTUs with price convergence are deemed as compliant. |
| Timeframes considered | DA |

Table 12: Prominent design choices of the assessment methodology of France

## 9.3 Assessment results

Based on the above assessment methodology, the following results are obtained for France:

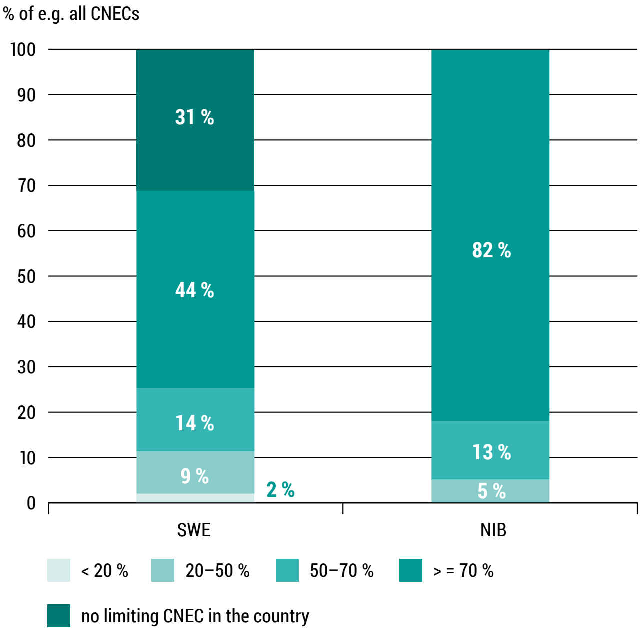



Figure 131: Relative cross-zonal trading margin of France for SWE and NIB with a minimum capacity of 70 % during 70 % of the time

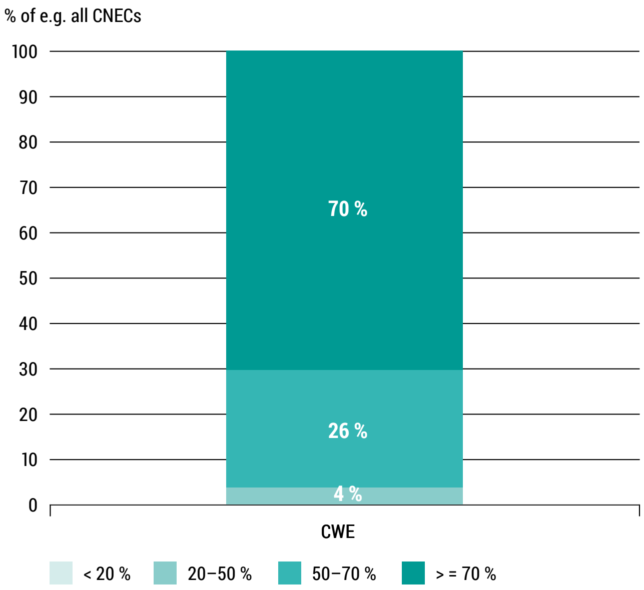



Figure 132: Relative cross-zonal trading margin of France for CWE with a minimum capacity of 20 %

## 9.4 Additional information

It would be interesting for ACER to broaden their vision and consider the relevant points raised by different NRAs all across Europe regarding compliance with the 70 % rule, by either carrying out an analysis of the timestamps with price convergence (e. g., increasing capacity would not bring any benefit for the market) or representing the timestamps without price convergence and analysing the limiting elements only (or even going a step further and restricting the analysis to the limiting market elements).

# 10 Germany

## 10.1 Current status of the implementation of CEP70 requirements

Pursuant to Art. 15 (1) of the EU Electricity Market Regulation (EU) 2019/943, EU member states with identified structural grid congestion can submit an action plan to reduce this congestion. This leads to a situation where the minimum capacity of 70 % must be achieved via a linear trajectory by 31 December 2025 (Art. 15, Para. 2). In this context, the Federal Republic of Germany – after prior consultation with stakeholders and member states – submitted the Action Plan Bidding Zone to the European Commission and the European Union Agency for the Cooperation of Energy Regulators (ACER) on December 28, 2019. The Action Plan Bidding Zone contains concrete measures through which Germany will counteract the previously identified structural bottlenecks and gradually achieve the minimum capacity for cross-bidding zone electricity trading of 70 % by December 31, 2025.

## 10.2 Assessment methodology

The applied methodology for monitoring the compliance with regard to the available margin for cross-zonal electricity trade is based on the Electricity Market Regulation (EU) 2019/943 and the specifications of the German National Regulatory Authority Bundesnetzagentur (BNetzA).

Accordingly, the available margin is determined either per critical network elements with the respective contingency (CNEC) or per net transfer capacity (NTC) and must respect the applicable minimum value (in line with the German action plan) per market time unit (MTU), i. e. in each hour, and in both directions. This minimum value defines the minimum capacity which should be made available or offered to the market.

The available margin per CNEC offered to the market consists of two components. The first is the coordinated margin, which represents the offered capacity on the analysed CNE with the respective capacity calculation region. The second component reflects the uncoordinated margin, which represents the impact of capacity offered on borders that do not participate in the capacity calculation region. In practical terms, the uncoordinated margin is calculated by multiplying the corresponding burdening power transfer distribution factors (PTDFs) with the respective NTCs in order to determine the impact of these NTCs on the respective CNEC. The total uncoordinated margin of a specific CNEC equals the sum of the individual uncoordinated margins of the different NTC borders.

More detailed information about the methodology applied and the compliance monitoring can be found in the national monitoring report.

| Design element | Design choice of 50Hertz | |
|---|---|---|
| Border/Region | DK2 > DE | DE > DK2 |
| Grid elements considered | All limiting CNECs | All limiting CNECs |
| Third countries considered | No | No |
| Hours considered | 6.199; within the remaining hours no interconnector was available due to maintenance or disturbance. | 6.244; within the remaining hours no interconnector was available due to maintenance or disturbance. |
| Timeframes considered | Only DA | Only DA |

Table 13: Prominent design choices of the assessment methodology of 50Hertz

| Design element | Design choice of 50Hertz/TenneT | |
|---|---|---|
| Border/Region | DE > PL/CZ | PL/CZ > DE |
| Grid elements considered | All limiting CNECs | All limiting CNECs |
| Third countries considered | Yes | Yes |
| Hours considered | All hours | All hours |
| Timeframes considered | Only DA | Only DA |

Table 14: Prominent design choices of the assessment methodology of 50Hertz/TenneT

| Design element | Design choice of Amprion | |
|---|---|---|
| Border/Region | CWE | ALEGrO (CWE) |
| Grid elements considered | All CNEs (Most critical contingency is determining the trading margin of the CNE per MTU) | N/A |
| Third countries considered | Yes | No |
| Hours considered | All hours except 24 MTUs in which Default Flow-Based Parameter had been applied | All hours from go-live (18/11/2020) |
| Timeframes considered | Only DA | Only DA |

Table 15: Prominent design choices of the assessment methodology of Amprion

| Design element | Design choice of TenneT Germany | | | |
|---|---|---|---|---|
| Border/Region | DE > SE4, SE4 > DE | CWE | DE > DK1, DK1 > DE | DE > NO2, NO2 > DE |
| Grid elements considered | NTC of both directions | All CNEs (Most critical contingency is determining the trading margin of the CNE per MTU) | NTC of both directions | All limiting CNECs |
| Third countries considered | No | Yes | No | Yes |
| Hours considered | All 7,748 operational hours of Baltic Cable | All hours except 24 MTUs in which Default Flow-Based Parameter had been applied | All hours | All hours since start of operation on 9 December 2020 |
| Timeframes considered | Only DA | Only DA | Only DA | Only DA |

Table 16: Prominent design choices of the assessment methodology of TenneT Germany

| Design element | Design choice of TransnetBW |
|---|---|
| Border/Region | ... |
| Grid elements considered | All CNEs (Most critical contingency is determining the trading margin of the CNE per MTU) |
| Third countries considered | Yes |
| Hours considered | All hours except 24 MTUs in which Default Flow-Based Parameter had been applied. |
| Timeframes considered | Only DA |

Table 17: Prominent design choices of the assessment methodology of TransnetBW

## 10.3 Assessment results

### 10.3.1 50Hertz

Based on the above assessment methodology, the following results are obtained for 50Hertz:

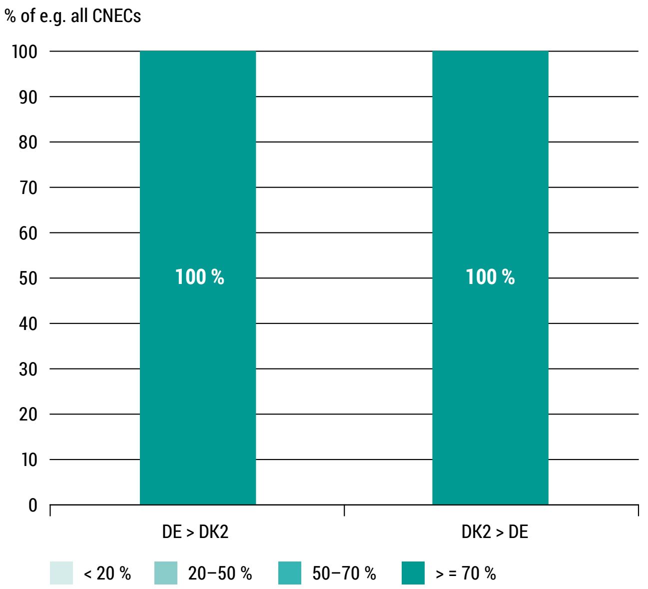



Figure 133: Relative cross-zonal trading margin of 50Hertz for DK2 > DE and DE > DK2 with a minimum capacity of 70 %

## 10.3.2 50Hertz/TenneT Germany

Based on the above assessment methodology, the following results are obtained for 50Hz and Tennet Germany on the border with PL/CZ.

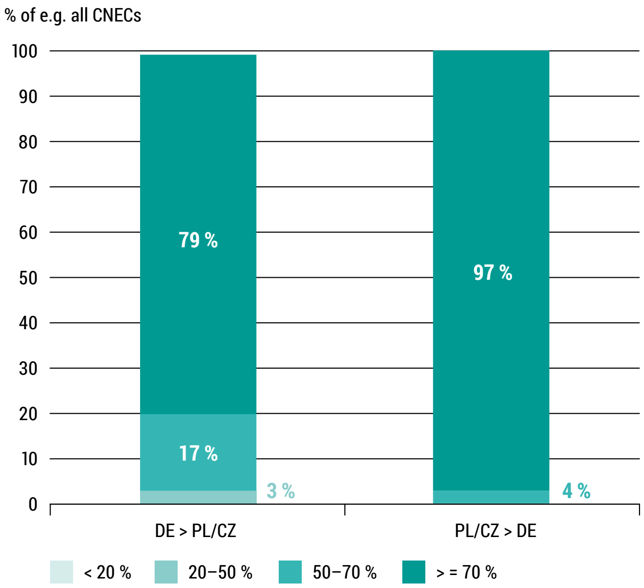



Figure 134: Relative cross-zonal trading margin of 50Hertz/TenneT Germany for DE > PL/CZ and PL/CZ > DE with a minimum capacity of 11.5 %

## 10.3.3 Amprion

Based on the above assessment methodology, the following results are obtained for Amprion:

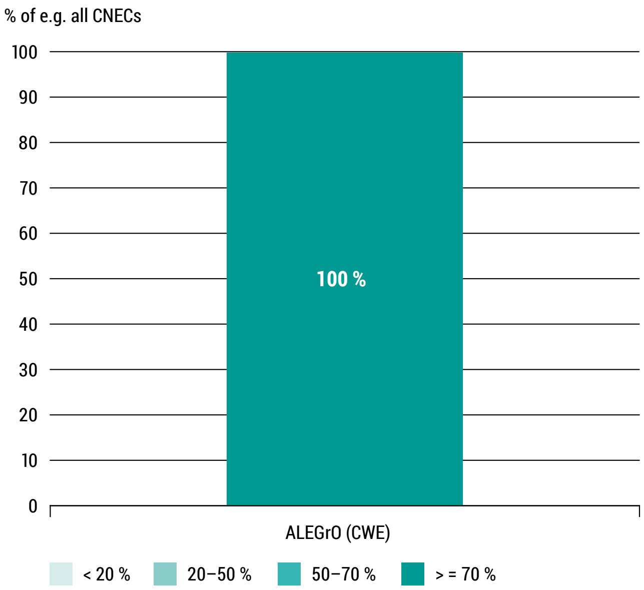



Figure 135: Relative cross-zonal trading margin of Amprion for ALEGrO (CWE)

ALEGrO (Amprion), the first interconnector between Belgium and Germany, was offered to the day-ahead market starting on 18 November 2020 in the course of the so-called stepwise 'ramp-up approach' by Elia and Amprion. At any MTU, 100 % of the technically possible ramp-up capacity was offered for cross-zonal trading.

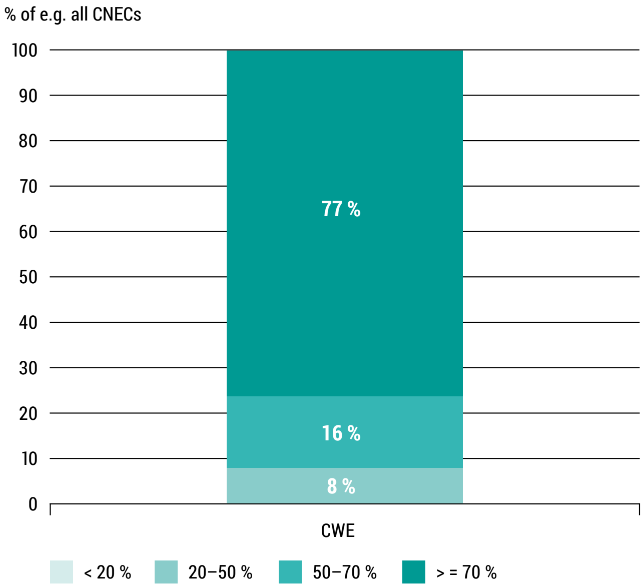



Figure 136: Relative cross-zonal trading margin of Amprion for CWE with a minimum capacity of 11.5 %

### 10.3.4 TenneT Germany

Based on the above assessment methodology, the following results are obtained for TenneT Germany:

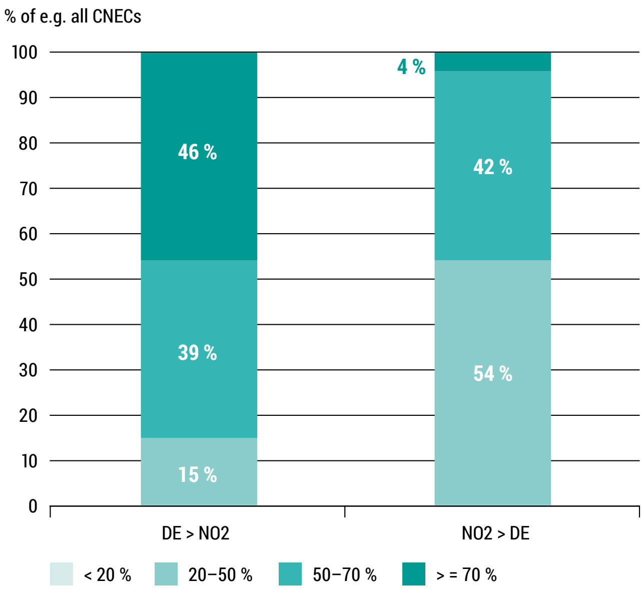



Figure 137: Relative cross-zonal trading margin of TenneT Germany for DE > NO2 and NO2 > DE

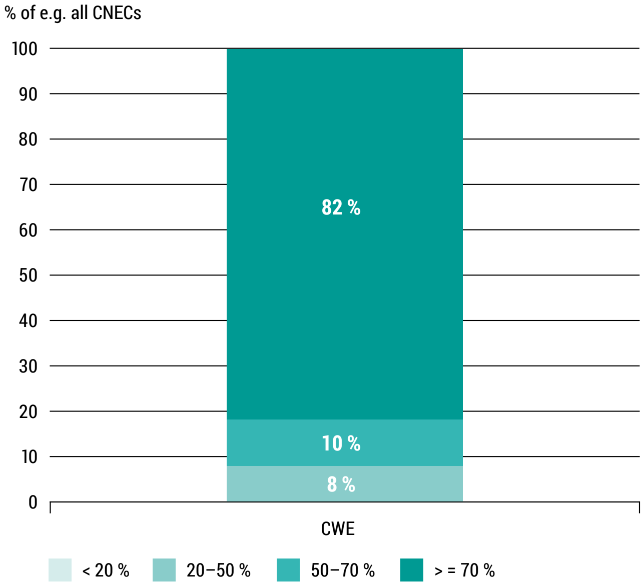



Figure 138: Relative cross-zonal trading margin of TenneT Germany for CWE with a minimum capacity of 11.5 %

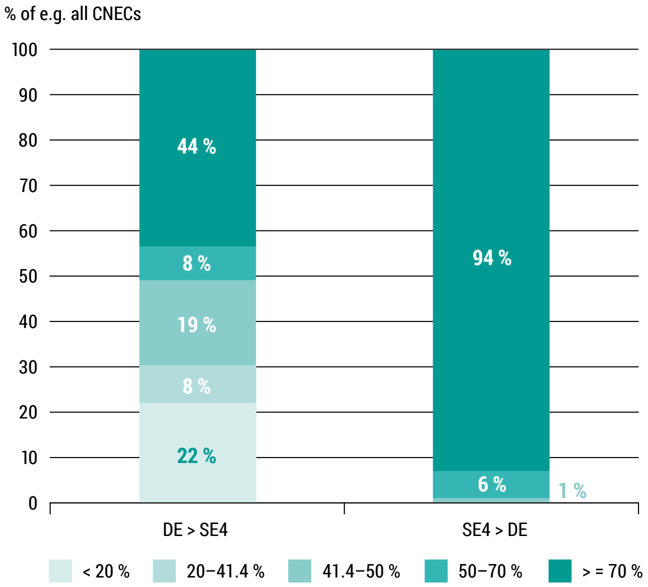



Figure 139: Relative cross-zonal trading margin of TenneT Germany for DE > SE4 and SE4 > DE with a minimum capacity of 41.4 %

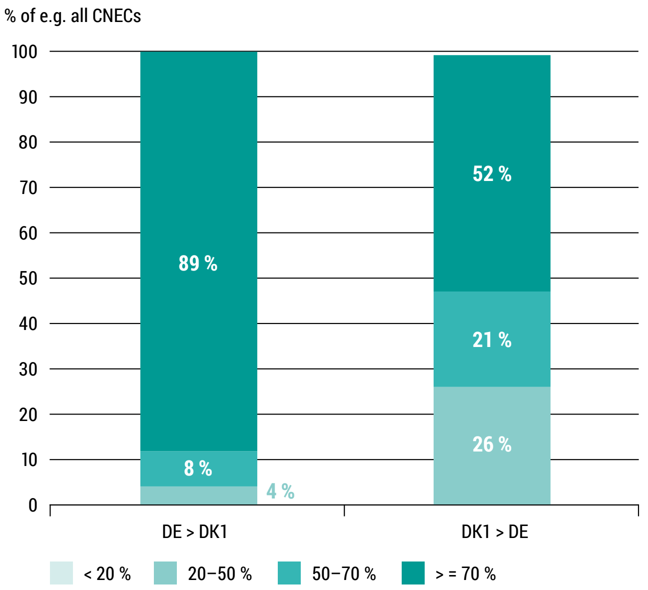



Figure 140: Relative cross-zonal trading margin of TenneT Germany DE > DK1 and DK1 > DE with a minimum NTC of 428 MW

### 10.3.5 TransnetBW

Based on the above assessment methodology, the following results are obtained for TransnetBW:

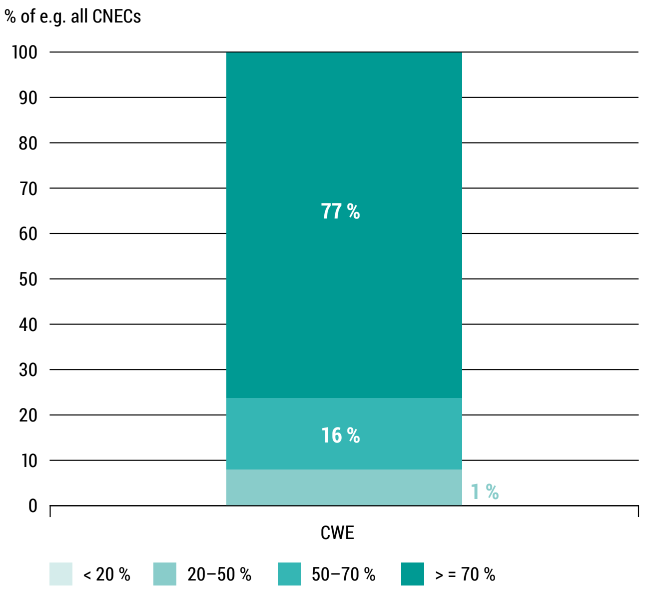



Figure 141: Relative cross-zonal trading margin of TransnetBW for CWE with a minimum capacity of 11.5 %. The percentages shown add up to more than 100 % due to rounding.

# 11 Greece

## 11.1 Current status of the implementation of CEP70 requirements

For the SEE region, as in 2020, IPTO has been granted a derogation for commercial flows from 3rd countries, insufficient potential for remedial actions and development of new processes and tools.

## 11.2 Assessment methodology

The methodology according to ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Greece | |
|---|---|---|
| Border/Region | SEE | GRIT |
| Grid elements considered | All limited CNECs provided | N/A |
| Third countries considered | Yes | Yes |
| Hours considered | All hours with the tie line BG-GR in operation | All hours with the tie line IT-GR in operation |
| Timeframes considered | DA | DA |

Table 18: Prominent design choices of the assessment methodology of Greece

## 11.3 Assessment results

Based on the above assessment methodology, for Greece the following results are obtained.

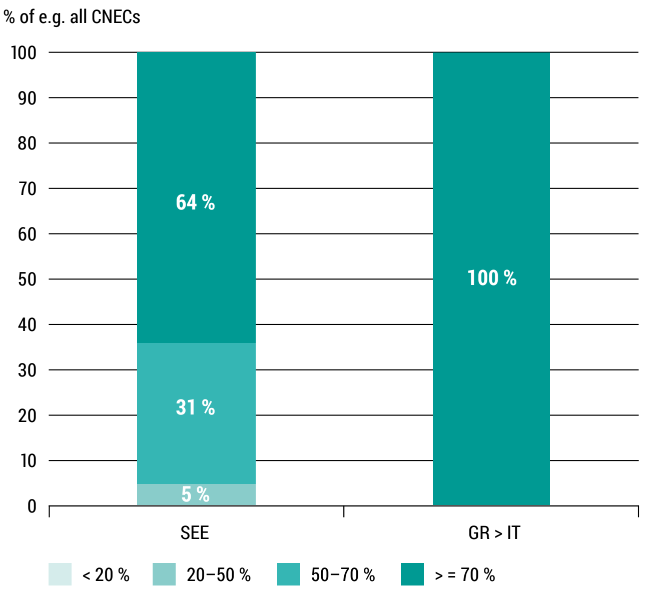



Figure 142: Relative cross-zonal trading margin of Greece

# 12 Hungary

## 12.1 Current status of the implementation of CEP70 requirements

A derogation with no minimum capacity was applied in 2020.

## 12.2 Assessment methodology

We perform our assessment by calculating PTDFs on the merged DACF models, simulating potential flows for the case when all available capacities offered to the market were scheduled in the burdening direction. This approach is not in line with ACER's recommendation, and thus cannot be the basis for the action plan. That said, we consider this approach more relevant, both from the perspective of the security of supply, since this is the worst-case scenario and from a long-term perspective, since this is closer to the results that we expect when the nearly operational Core flow-based capacity calculation goes live, where capacities will be coordinated on a regional level.

| Design element | Design choice of Hungary |
|---|---|
| Border/Region | … |
| Grid elements considered | The CNECs considered relevant during the capacity calculation were chosen. |
| Third countries considered | Yes |
| Hours considered | Yes |
| Timeframes considered | DA |

Table 19: Prominent design choices of the assessment methodology of Hungary

## 12.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Hungary.

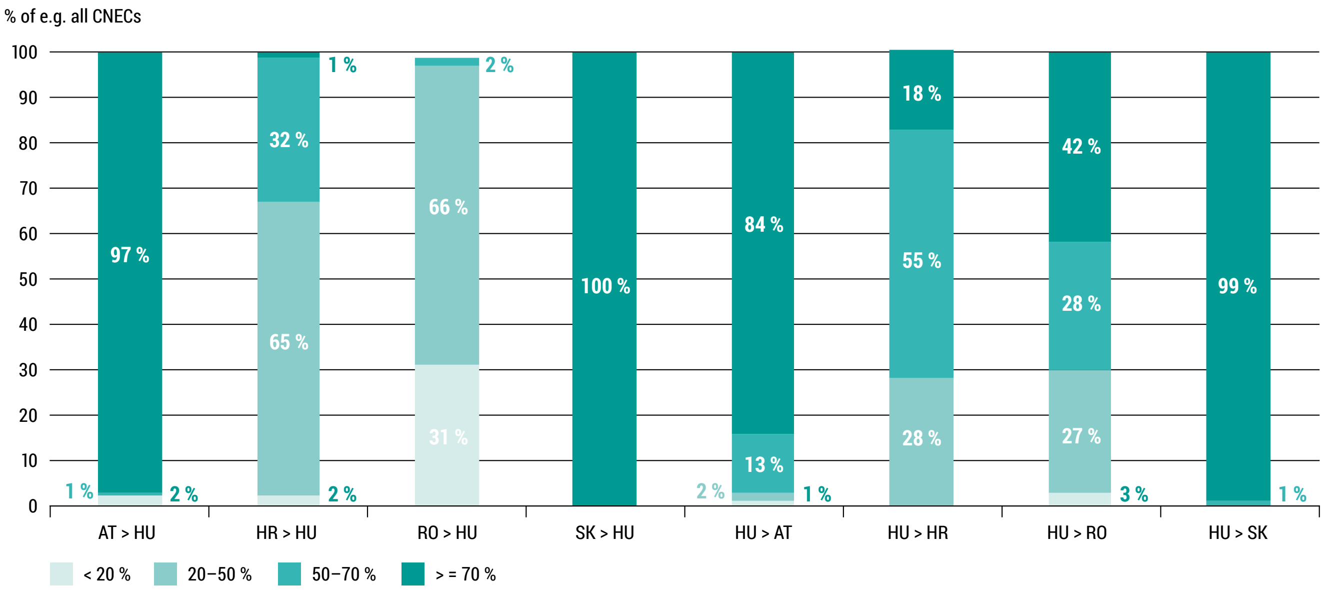



Figure 143: Relative cross-zonal trading margin of Hungary

# 13 Italy

## 13.1 Current status of the implementation of CEP70 requirements

For Italy North, based on the derogation in place for 2020, no minimum capacity target was defined.

## 13.2 Assessment methodology

For Italy North, the MACZT values are the ones calculated by ACER. For Italy-Greece, the methodology according to ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Italy | |
|---|---|---|
| Border/Region | Italy North | IT-GR |
| Grid elements considered | All CNECs | N/A |
| Third countries considered | Yes | Yes |
| Hours considered | Hours when DA capacity calculation process has been limited by at least one CNEC (788 h). Only first semester is considered. | All hours |
| Timeframes considered | DA | DA |

Table 20: Prominent design choices of the assessment methodology of Italy

## 13.3 Assessment results

Based on the above assessment methodology, for Italy the following results are obtained.

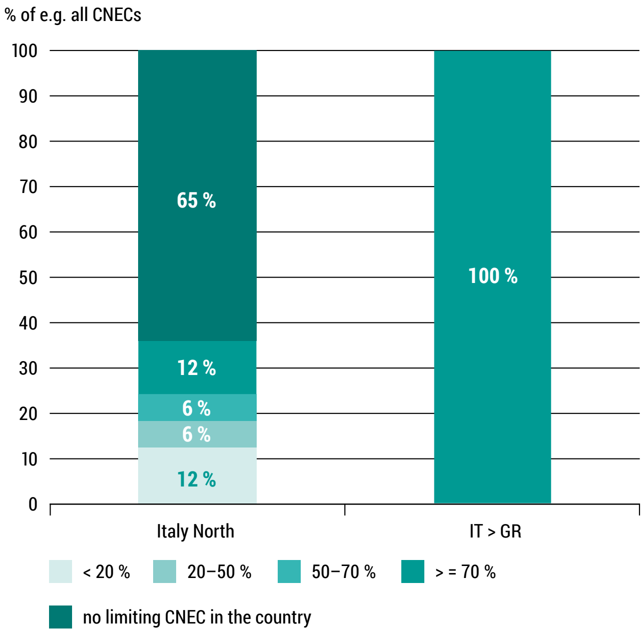



Figure 144: Relative cross-zonal trading margin of Italy

## 13.4 Additional information

Italy North is a CCR where cNTC approach is used, according to the approved methodology. The calculation is performed in a coordinated manner, considering simultaneously all the involved borders, so that a single CNEC of one TSO can limit the capacity for all the borders, differently from the flow-based approach. In light of that, the outcomes obtained by ACER are resulting from wrong assumptions and are not reflecting the capacity calculation approach in place. Compliancy to the 70 % criterion should be evaluated for the whole region and not independently for each TSO. That is why Terna provided ACER with the limiting CNECs of the region, also including non-Italian elements, and expected results for around 800 hours (and not only 276 hours).

For PTDFs computation, results are highly affected by the usage of few CGMs representative for the semester. This approach strongly impacts on the reliability of the results.

In particular for Italian elements, the line Baggio – Magenta (IBAGM12X IMAGMA2X) is always associated to PTDFs equal to zero, due to the grid configuration included in that specific grid model, which is not representative for all the days where this line is limiting.

ACER calculated MNCCs considering the scheduled exchanges of the previous day reported in ENTSO-E Transparency Platform. Two issues come from this:

- ACER uses exchange schedules that are not available when capacity calculation is performed.
- Italy North's capacity calculation process is using a specific reference day calendar. So that, for many days, especially weekends, the reference day is different than D-1.

# 14 Lithuania

## 14.1 Current status of the implementation of CEP70 requirements

The 70 % rule is applied in 2020.

## 14.2 Assessment methodology

70 % rule according to Article 16(8) of Regulation (EU) 2019/943 and ACER recommendation.

| Design element | Design choice of Lithuania |
|---|---|
| Border/Region | … |
| Grid elements considered | All CNECs |
| Third countries considered | No |
| Hours considered | All hours |
| Timeframes considered | DA |

Table 21: Prominent design choices of the assessment methodology of Lithuania

## 14.3 Assessment results

Based on the above assessment methodology, for Lithuania the following results are obtained.

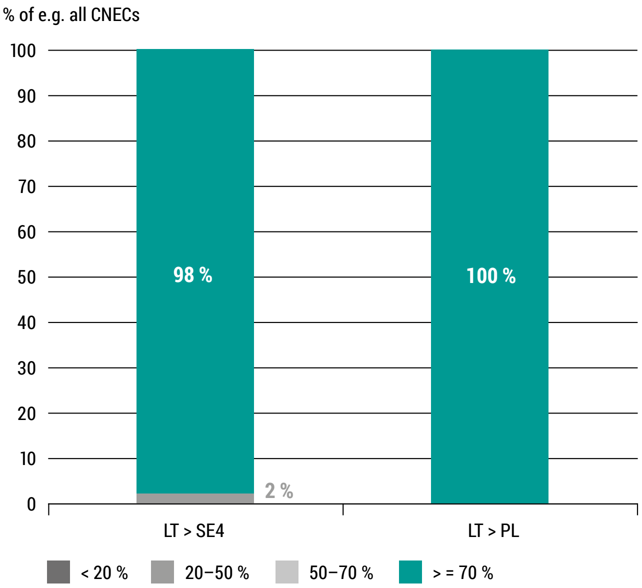



Figure 145: Relative cross-zonal trading margin of Lithuania

# 15 Poland

## 15.1 Current status of the implementation of CEP70 requirements

Poland adopted an action plan in December 2019, pursuant to Article 15 (1) of the Electricity Market Regulation (EU) 2019/943. The Polish action plan foresees several transmission investments that are to be carried out to ensure that the 70 % obligation is fulfilled by 31 December 2025. The action plan foresees that the level of cross-zonal capacities available for trade between bidding zones shall be gradually increased from 2020 through 2025 by means of a linear trajectory, until the level foreseen by Article 16 (8) of Regulation 2019/943 is met.

Additionally, Poland has obtained a derogation for 2020 based on foreseeable grounds affecting the security of system operation in accordance with Article 16(9) of Regulation 2019/943. The derogation granted covers three different reasons to deviate from the CEP70 requirement: (i) implementation of the new processes and tools for calculating cross-zonal transmission capacities (until 30 June 2020), (ii) excessive loop flows through the Polish grid and lack of coordinated redispatching and countertrading (until the end of 2020) and (iii) uncertainties in uncoordinated transits (until the end of 2020). The derogation obtained concerns all Polish bidding zone borders, though the derogation due to excessive loop flows and uncertainties in uncoordinated transits only applies to the borders belonging to the CORE CCR (synchronous AC borders: DE-PL, CZ-PL, and SK-PL).

Finally, both planned and unplanned outages in transmission elements affect the level of cross-zonal capacities that can be safely offered to the market. In case of prolonged outages of transmission elements impacting the ability to meet the CEP70 requirement, especially when they are required to perform necessary grid reinforcements or modernisation works, cases with such outages are not treated as non-compliance with Article 16(8) of the Regulation 2019/943.

## 15.2 Assessment methodology

PSE calculates cross-zonal capacities according to the NTC methodology approved by the Polish NRA. Capacity calculations are based on the D2CF file prepared by PSE using the latest available intra-day models within the CEE region. When calculating capacities to be made available for the day-ahead market, PSE carefully monitors the calculated NTC and transit flows against the required minimum capacities from the linear trajectory obligations. When the cross-zonal capacities (including transits through the Polish grid) do not fulfil the criterion of minMACZT, the offered day-ahead capacities are increased to the required minimum threshold, upon assessing the availability of remedial actions.

| Design element | Design choice of Poland | |
|---|---|---|
| Border/Region | CZ-DE-SK > PL, PL > CZ-DE-SK | PL > LT, LT > PL, PL > SE4, SE4 > PL |
| Grid elements considered | All limiting CNECs | NTC provided on the DC link |
| Third countries considered | Yes | N/A |
| Hours considered | All hours are monitored, monitoring accounts for the obtained derogations and ability to ensure secure operation (availability of redispatching potential to increase MACZT) monitoring accounts for the obtained derogations and ability to ensure secure operation (availability of redispatching potential to increase MACZT) | All hours are monitored, monitoring accounts for the obtained derogations and ability to ensure secure operation (availability of redispatching potential to increase MACZT) monitoring accounts for the obtained derogations and ability to ensure secure operation (availability of redispatching potential to increase MACZT) |
| Timeframes considered | DA | DA |

Table 22: Prominent design choices of the assessment methodology of Poland

## 15.3 Assessment results

CEP70 reporting is split into two parts, bearing in mind that in the first semester of 2020 there was a general derogation from CEP70 obligations to allow for the implementation of needed new tools and processes. The following section presents the monitoring results obtained for Poland. Hours where the minimal required MACZT levels were fulfilled are marked as fulfilled. Similarly, hours in which the minimal MACZT levels were considered as conditionally fulfilled due to legitimate reasons (outages, derogations, lack of redispatching potential) as also marked as fulfilled.

It is to be highlighted that in its assessment PSE considered the applicable market design in Poland, and in particular the application of capacity allocation constraints. Detailed information on the usage and application of capacity allocation constraints is available in the regional capacity calculation methodologies for the CORE, HANSA and BALTIC CCRs. For borders belonging to the CORE CCR, where uncoordinated NTC is applied and the allocation mechanism is based on explicit auctions, the capacities offered for the market are verified to account for allocation constraints. However, for the purpose of CEP70 monitoring, PSE checks the linear trajectory based on calculated NTC capacities that are not verified for allocation constraints. In the light of Regulation 2019/943 and the 2015/1222 Regulation (CACM), allocation constraints serve to maintain the system within operational security limits, while minimal capacity obligations consider the percentage of capacity that respects operational security limits. Hence application of allocation constraints cannot be considered to cause a reduction of the capacities offered by PSE to below the trajectory thresholds.

### 15.3.1 Assessment results for the first semester of 2020 with derogations

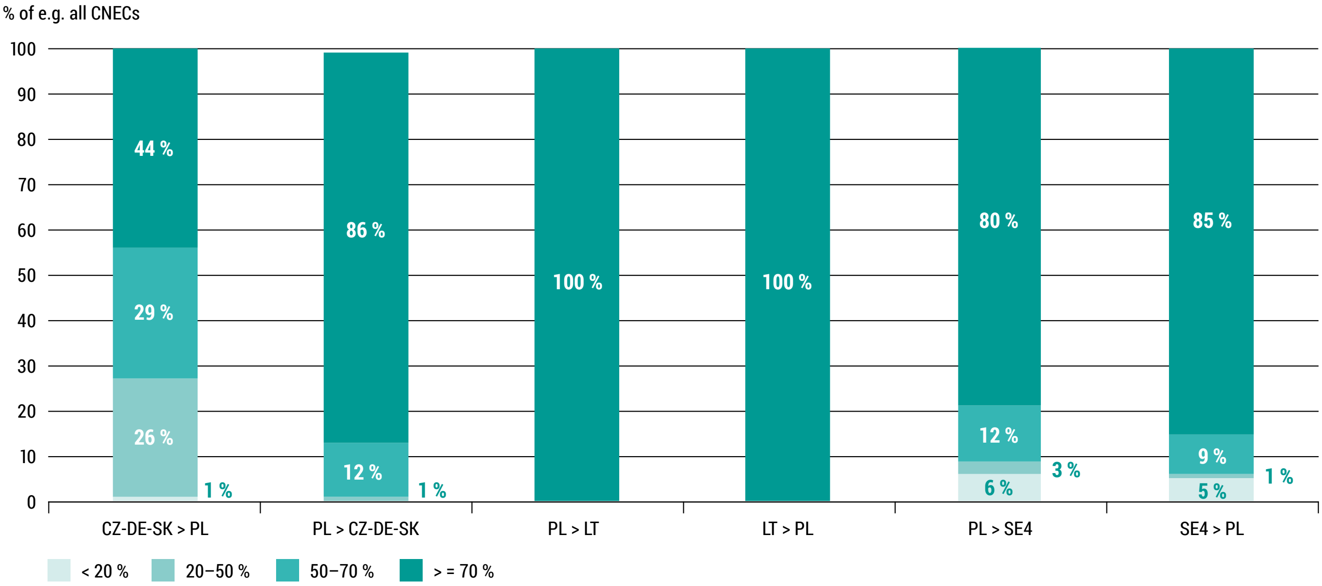



Figure 146: Relative cross-zonal trading margin of Poland for CZ-DE-SK > PL , PL > CZ-DE-SK (different minimum capacity); PL > LT, LT > PL, SE4 > PL (minimum capacity of 70 %); PL > SE4 (minimum capacity of 40 %) in the first semester of 2020

### 15.3.2 Assessment results for the second semester of 2020

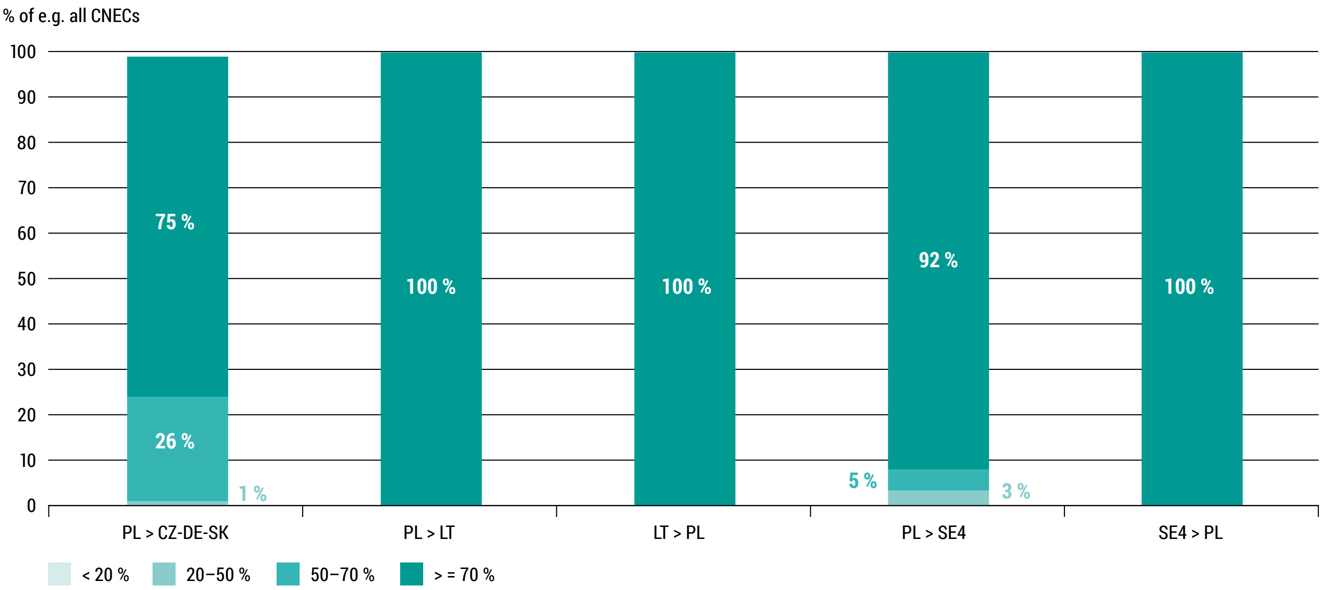



Figure 147: Relative cross-zonal trading margin of Poland for PL->CZ-DE-SK (different minimum capacity); PL > LT, LT > PL, SE4 > PL (minimum capacity of 70 %); PL > SE4 (minimum capacity of 40 %) in the second semester of 2020

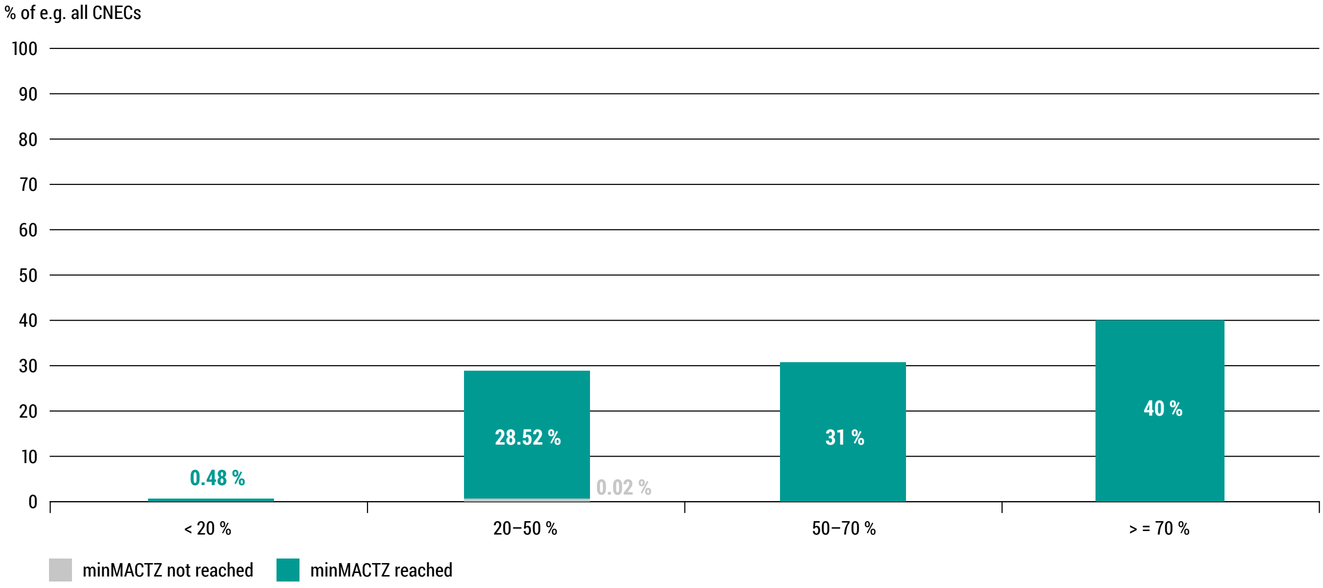



Figure 148: Relative cross-zonal trading margin of Poland for CZ-DE-SK->PL in the second semester of 2020

## 15.4 Additional information

When ensuring fulfilment of the CEP70 trajectory, PSE was guided by the methodology adopted by the Agency. However, some minor details of the monitoring calculations might differ from the ACER approach due to differences between the ex-ante operational process as applied by PSE when calculating capacities and ensuring trajectories on limiting CNECs, and the ex-post monitoring process as applied by the Agency.

However, one important difference from the approach applied by the Agency is the treatment of allocation constraints, which are 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'. Since 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 cross-zonal capacity 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 not clear since 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 is to be emphasised that for hours marked by ACER as not fulfilled, the respective DC borders were used for transits though 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.

# 16 Portugal

## 16.1 Current status of the implementation of CEP70 requirements

A derogation with no minimum capacity is applied in 2020.

## 16.2 Assessment methodology

The methodology according to ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Portugal |
|---|---|
| Border/Region | … |
| Grid elements considered | All CNECs |
| Third countries considered | No |
| Hours considered | 16 % of the time was not considered due to: IT issues, load flow divergences, etc. |
| Timeframes considered | DA |

Table 23: Prominent design choices of the assessment methodology of Portugal

## 16.3 Assessment results

Based on the above assessment methodology, for Portugal the following results are obtained.

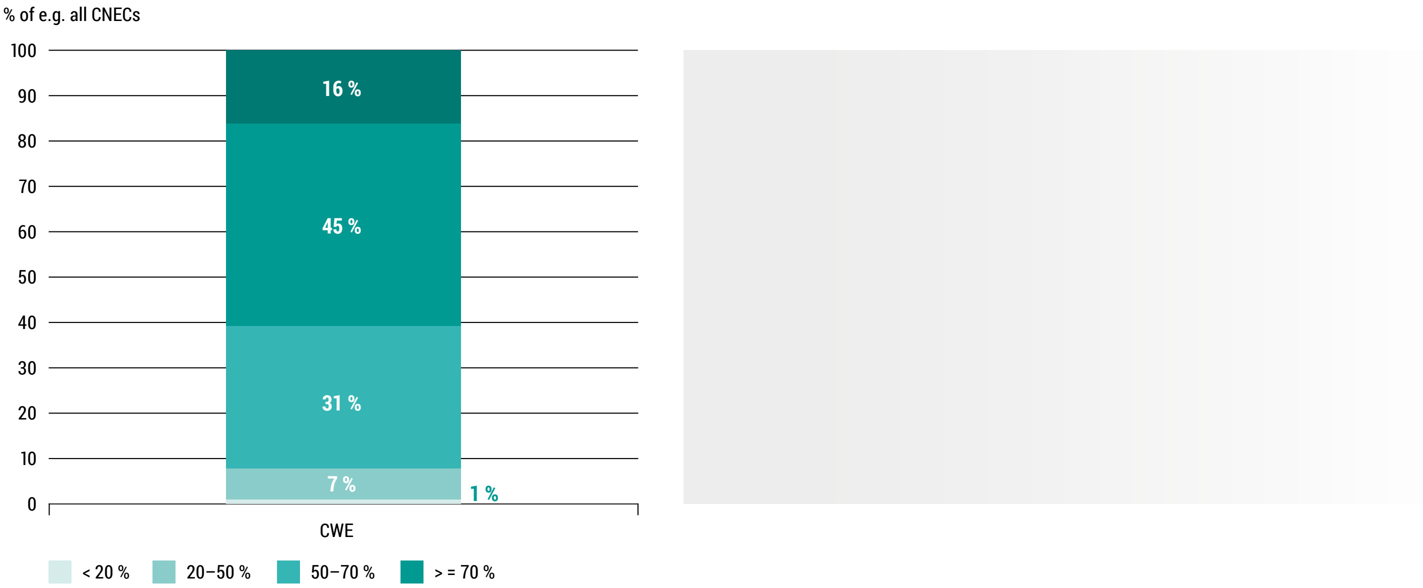



Figure 149: Relative cross-zonal trading margin of Portugal

# 17 Romania

## 17.1 Current status of the implementation of CEP70 requirements

For 2020 Transelectrica had a derogation without a minimum capacity. Starting with 2021, there is an Action Plan in order to reach the 70 % capacity. For this year, there is a minimum capacity of 33 % on RO-HU border and 25 % on RO-BG border.

## 17.2 Assessment methodology

Transelectrica applies ACER's recommendation. Third countries are included and values are given as a percentage of time for all limiting CNECs which have a positive MACZT.

| Design element | Design choice of Romania |
|---|---|
| Border/Region | … |
| Grid elements considered | All limiting CNECs |
| Third countries considered | Yes |
| Hours considered | All hours for 2020 in which positive MACZT values are considered. |
| Timeframes considered | DA |

Table 24: Prominent design choices of the assessment methodology of Romania

## 17.3 Assessment results

Based on the above assessment methodology, for Romania the following results are obtained.

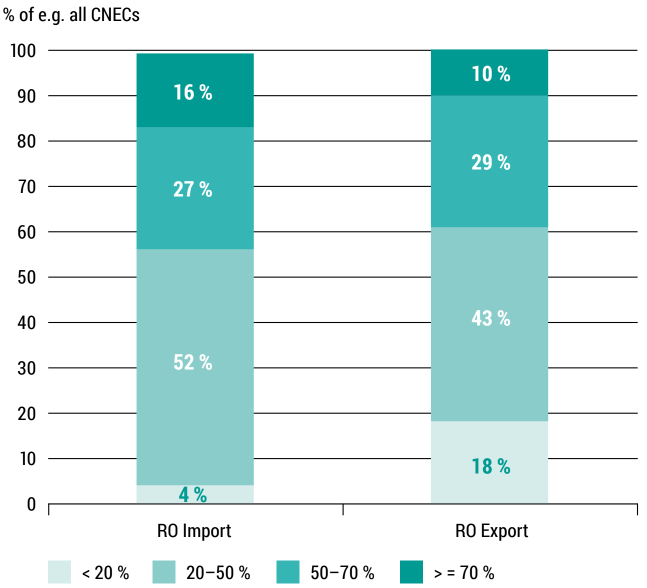



Figure 150: Relative cross-zonal trading margin of Romania. The percentages shown for RO_Import add up to less than 100 % due to rounding.

## 17.4 Additional information

Values for MNCC should be considered in absolute values in order to keep in MACZT values all the exchanges of a BZ.

# 18 Slovakia

## 18.1 Current status of the implementation of CEP70 requirements

A derogation is applied in 2020.

## 18.2 Assessment methodology

The methodology according to ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Slovakia |
|---|---|
| Border/Region | … |
| Grid elements considered | All CNECs |
| Third countries considered | Yes |
| Hours considered | All hours |
| Timeframes considered | DA |

Table 25: Prominent design choices of the assessment methodology of Slovakia

## 18.3 Assessment results

Based on the above assessment methodology, for Slovakia the following results are obtained.

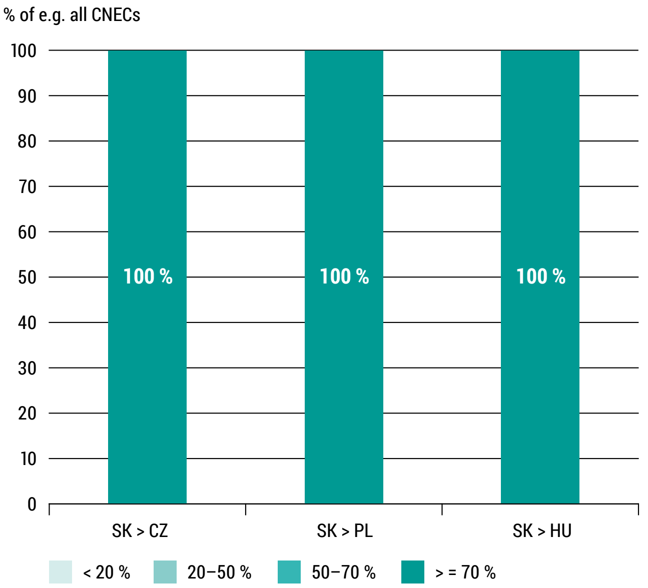



Figure 151: Relative cross-zonal trading margin of Slovakia

# 19 Slovenia

## 19.1 Current status of the implementation of CEP70 requirements

For the borders SI-AT and SI-HR, we did not perform detailed calculations due to the fact that we have no limiting elements (e.g., NTC is limited by other party).

## 19.2 Assessment methodology

For the borders SI-AT and SI-HR, we followed ACER Recommendations No 01/2019.

For the region CSE, we followed ACER Recommendations No 01/2019, the limiting elements were determined by joint DA and ID CC methodology of the region, which lead to no limiting elements on our side.

| Design element | Design choice of Slovenia | | |
|---|---|---|---|
| Border/Region | SI-AT | SI-HR | CSE |
| Grid elements considered | Limiting CNECs | Limiting CNECs | Limiting CNECs |
| Third countries considered | No | No | Yes |
| Hours considered | All hours | All hours | All hours |
| Timeframes considered | Only DA | Only DA | Only DA |

Table 26: Prominent design choices of the assessment methodology of Slovenia

## 19.3 Assessment results

Based on the above assessment methodology, for Slovenia the following results are obtained.

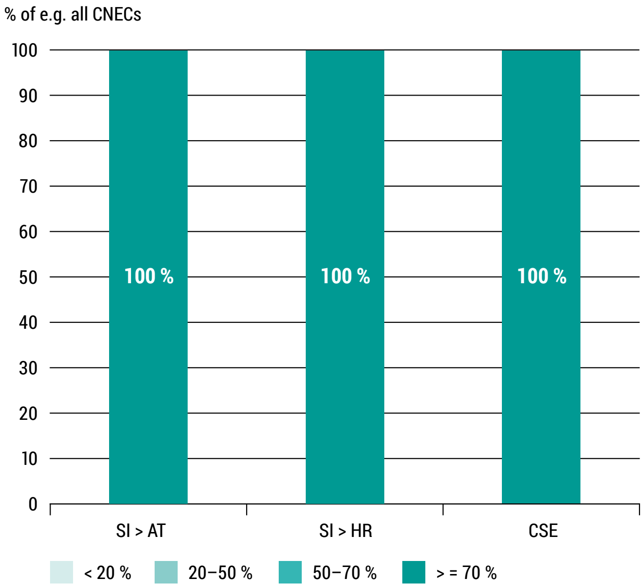



Figure 152: Relative cross-zonal trading margin of Slovenia

## 19.4 Additional information

Since the PSTs are used to increase overall capacities, PST flows can be considered as market flows, however, ACER does not consider them as such in the MACZT monitoring.

# 20 Spain

## 20.1 Current status of the implementation of CEP70 requirements

Derogation for ES in 2021. The CEP 70 % target will be implemented at the end of the year 2021 in ES within SWE Capacity Calculation roadmap.

## 20.2 Assessment methodology

The methodology from ACER's Recommendation No 01/2019 is applied.

| Design element | Design choice of Spain |
|---|---|
| Border/Region | ... |
| Grid elements considered | All limiting CNECs |
| Third countries considered | No |
| Hours considered | All hours where the limiting element is identified from 29 January 2020 to 31 December 2020 |
| Timeframes considered | DA |

Table 27: Prominent design choices of the assessment methodology of Spain

## 20.3 Assessment results

Based on the above assessment methodology, the following results are obtained for Spain:

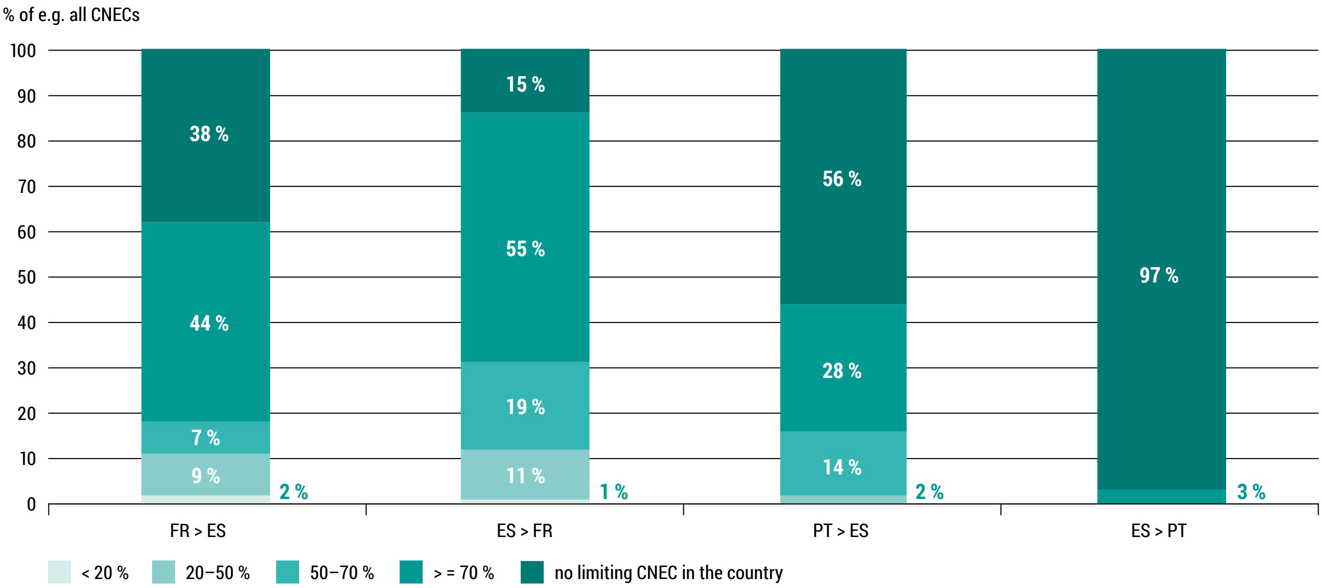



Figure 153: Relative cross-zonal trading margin of Spain

## 20.4 Additional information

For compliance with the 70 % rule, MTUs with limiting elements outside Spain are deemed compliant.

# 21 The Netherlands

## 21.1 Current status of the implementation of CEP70 requirements

For the Netherlands, an action plan and a derogation were adopted as transitory measures to reach gradually the minimum capacity margin of 70 % on the critical network elements included in CWE flow-based day-ahead capacity calculation. A detailed overview of the implementation of CEP70 requirements in the Netherlands can be found in the 2020 Assessment of available cross-zonal capacity for the Netherlands, in accordance with article 15(4) of the Electricity Market Regulation (EU) 2019/943.

TenneT Netherlands has made a separate assessment of the performance of the Dutch grid, which contains additional insight. Some insights are here presented in this report, including a graph that shows the difference between the target capacity and the capacity that was provided to the market.

## 21.2 Assessment methodology

**For region CWE:**
For each MTU, the CNEC with the lowest margin (difference between the provided MACZT and required minimum MACZT) is selected. The MTU is deemed compliant when this margin is equal to or above 0 %.

**For borders DK1–NL, NL–DK1, NO2–NL, NL–NO2:**
For each MTU, the relative capacity in a certain direction on HVDC cable is calculated (available capacity/total capacity). MTU is labeled as "no limiting CNEC in country", when the MACZT was below 70 % and the reduction was applied by a TSO other than TTN

**For borders NL–GB and GB–NL:**
Responsibility for 2020 lies with BritNed. Numbers as included in this report are from BritNed as provided by them to ACER for the ACER MACZT Report of 2020 S1 and 2020 S2.

| Design element | Design choice of The Netherlands | | |
|---|---|---|---|
| Border/Region | CWE | DK1–NL, NL–DK1, NO2–NL, NL–NO2 | NL–GB, GB–NL |
| Grid elements considered | For each MTU, compliance is based on the CNEC with the lowest MACZT margin (difference between provided MACZT and required minimum MACZT) | All CNECS included | All CNECS included |
| Third countries considered | Including third countries | N/A | N/A |
| Hours considered | MTUs from 01/04 onwards are included, with exception of 3 Business Days (4 June, 25 Oct, 4 Nov) where no data was available. Q1 2020 was excluded on basis of derogation. | All hours | S1 2020 |
| Timeframes considered | DA | DA | DA |

Table 28: Prominent design choices of the assessment methodology of the Netherlands

## 21.3 Assessment results

Based on the above assessment methodology, for the Netherlands the following results are obtained.

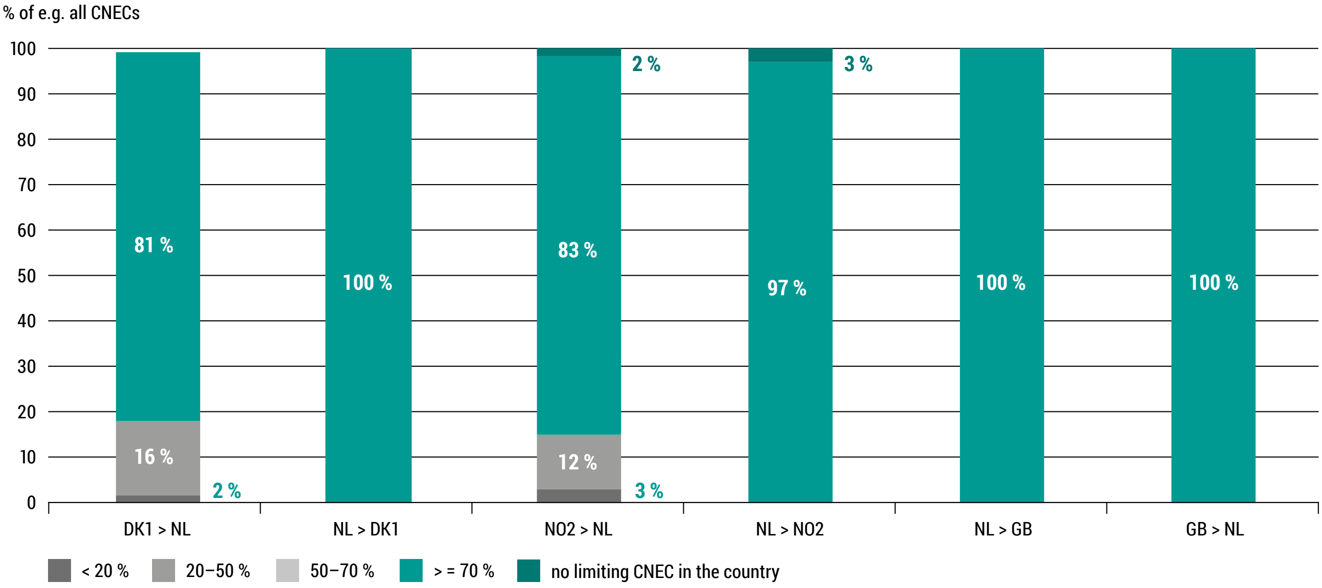



Figure 154: Relative cross-zonal trading margin of Dutch DC interconnectors

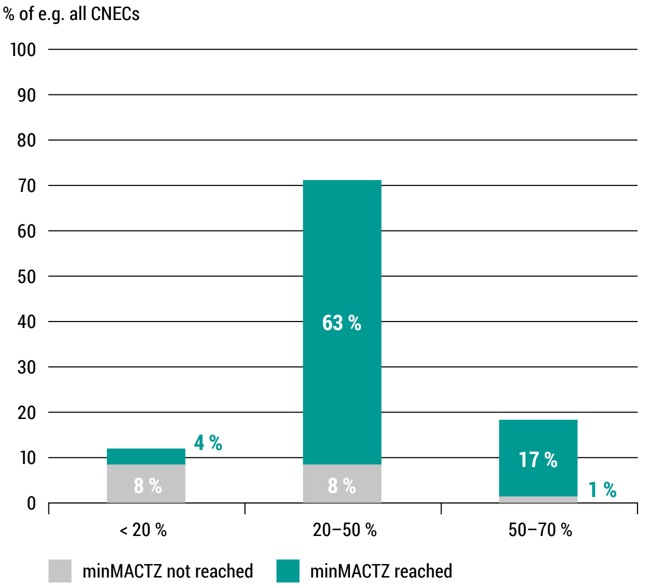



Figure 155: Relative cross-zonal trading margin of the Netherlands for CWE

## 21.4 Additional information

In accordance with article 15(4) of the Electricity Regulation, TenneT has delivered an assessment of the cross-border capacity made available in the year 2020, and whether this was in accordance with the various provisions on minimum capacities that were applicable to TenneT in the year 2020.

The figures included below are taken from the report from this assessment. For more information on this matter and a more in-depth explanation of the numbers of the Netherlands, we refer the reader to this report.

### For region CWE:

For the Netherlands, an action plan and a derogation were adopted as transitory measures to reach gradually the minimum capacity margin of 70 % on the critical network elements included in CWE flow-based day-ahead capacity calculation. Because of the interplay between action plan, derogation and CWE flow-based capacity calculation methodology, it is not straightforward to assess whether the capacity made available was in accordance with all the applicable provisions, in particular because they result in different MACZT target levels for individual CNEs.

In order to evaluate whether TenneT complied with the applicable provisions on the minimum levels of MACZT, TenneT has performed an assessment where for each MTU, the CNEC with the lowest MACZTmargin (difference between provided MACZT and required minimum MACZT) is taken and categorized to a certain range. This has led to Figure 156, which shows the percentage of time when the MACZTmargin of the least performing CNEC was above its minimum MACZT level or within a certain range below its minimum level.

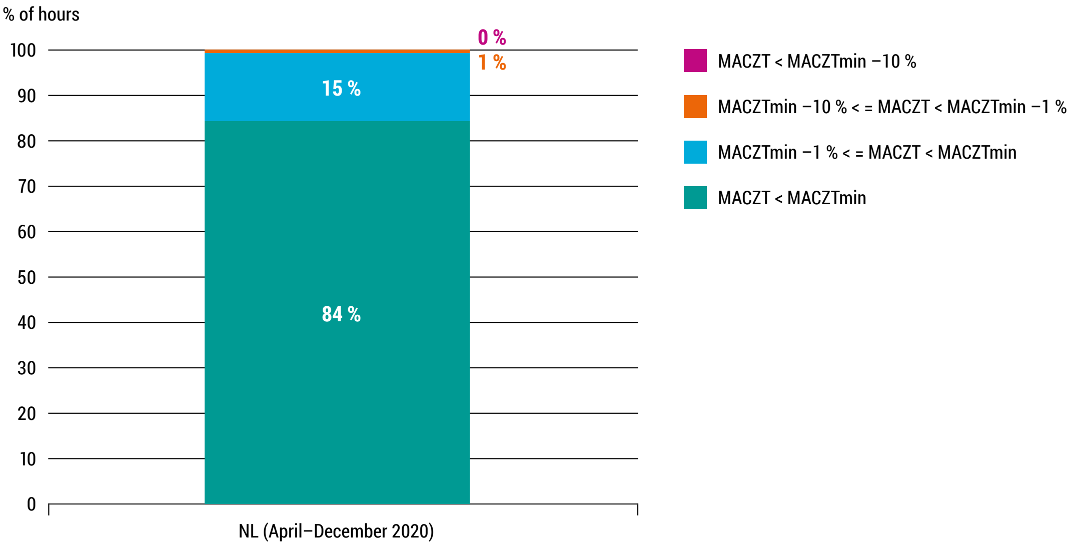



Figure 156: Percentage of time when the relative MACZT of the least performing CNEC in the coordination area of CWE is above its minimum MACZT or within a certain range below its minimum MACZT. For each MTU the CNEC with the lowest MACZTmargin was selected and categorized to one of the ranges. Period April-December 2020

The figure shows that:

- For 84 % of the time, TenneT has provided capacity margins at or above the required minimum levels on all its network elements;
- For 15 % of the time, TenneT has not provided capacity at or above the required minimum levels for a few network elements. However, the capacity margins provided on the least performing network element were very close to the required minimum levels as the deficit was only less than 1 % below its required minimum level; and
- For the remaining 1 % of the time, TenneT has offered insufficient capacity margins. However, the effect on cross-zonal trade has been almost negligible as:
  - only for four MTUs (0.06 % of the time) TenneT could have potentially had limited cross-zonal trade as the related CNEC was presolved; and
  - only for a single MTU (0.015 % of the time) cross-zonal trade was limited because the CNEC became an active constraint in day-ahead market coupling.

### For the HVDC bidding zone borders NL-DK1, NL-NO2):

Figure 154 shows that:

- For 100 % of the time for the NL–DK1 (COBRA-cable) and NL–NO2 (NorNed) bidding zone border, TenneT has provided capacity margins at or above the required minimum level of 70 %.
- For 81 % of the time for the DK1–NL and 86 % of the time for the NO2–NL bidding zone border, TenneT has provided capacity margins at or above the required minimum level of 70 %. For the remaining period of time, insufficient capacity margins were provided due to reductions by TenneT.

The reductions on NorNed and COBRAcable were for the vast majority of the time related to the fact that throughout 2020 there have been several planned long duration outages in the north of the Netherlands, related to investments of TenneT following our grid investment plan. Also, TenneT faced a long duration unplanned outage on a critical network element in the north of the Netherlands.

As a consequence of these outages insufficient capacity was available on the remaining internal Dutch network elements to accommodate the full extent of cross-zonal and internal flows. In order to respect operational security limits, TenneT had to take measures including the reduction of cross-zonal capacity on the interconnectors. TenneT regards these reductions as an unavoidable consequence in the process of upgrading its grid to be able to make more cross-zonal capacity available in the future.

# 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 |
| **CCR** | Capacity calculation region |
| **CEP** | Clean Energy Package |
| **CGM** | Common reference Grid Model |
| **CH** | Switzerland |
| **CNE** | Critical Network Element |
| **CORE** | Capacity calculation region in Central Europe |
| **CSE** | Continental South East |
| **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 |
| **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 |
| **LV** | Latvia |
| **ME** | Montenegro |
| **MACZT** | Margin available for cross-zonal trading |
| **MK** | North Macedonia |
| **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 Transformers |
| **PT** | Portugal |
| **PTDF** | Power Transfer Distribution Factor |
| **RCC** | Regional Coordination Center |
| **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 |
| **SI** | Slovenia |
| **SK** | Slovakia |
| **SO** | System Operator |
| **TSO** | Transmission System Operator |
| **TTG** | TenneT Germany |
| **TYNDP** | Ten-Year Network Development Plan |
| **UA** | Ukraine |
| **UK** | United Kingdom |

This study was produced by the ENTSO-E Technical Report Task Force.

# Drafting team:


Ana Cozea . . . . . . . . . . . . . . . . . . . . . . . . . . . Transelectrica
Ángel Francisco Herranz Herrera . . . . . . . . . . . . . . . . . . . REE
Beáta Jančik . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . SEPS
Benjamin Junghänel . . . . . . . . . . . . . . . . . . . . . . . . . 50Hertz
Christian Benten . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . APG
Dagmar Gabajova . . . . . . . . . . . . . . . . . . . . . . . . . . . . . SEPS
Dan Atsmon . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Svk
David Lorber . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Creos
Dawid Słabicki . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . PSE
Dominik Gabrys . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ČEPS
Gjorgji Shemov . . . . . . . . . . . . . . . . . . . . . . . . . . . . ENTSO-E
Gorazd Berginc . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ELES
Ivan Frković . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . HOPS
Jadranko Kučica . . . . . . . . . . . . . . . . . . . . . . . . . . . . . HOPS
Jan Hystad . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Statnett
Jim Vilsson . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Energinet
Joost Greunsven . . . . . . . . . . . . . . . . . . . . . . . . . . TenneT NL
Lenja Niesen . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Amprion
Linnea Nyman . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Svk
Luca Luzi . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Terna
Malte Drerup . . . . . . . . . . . . . . . . . . . . . . . . . . . . . TenneT DE
Marin Ivanov . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ESO
Marta Mendoza-Villamayor (Convenor) . . . . . . . . . ENTSO-E
Martins Steinbergs . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . AST
Niko Korhonen . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Fingrid
Pau Casas . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ENTSO-E
Paulo Marques . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . REN
Peter Ambrus . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . MAVIR
Philipp Dostert . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Creos
Sebastiaan Visser . . . . . . . . . . . . . . . . . . . . . . . . . . TenneT NL
Sebastian Böhm . . . . . . . . . . . . . . . . . . . . . . . . . . . . Swissgrid
Siim Imre . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Elering
Steve Van Campenhout . . . . . . . . . . . . . . . . . . . . . . . . . . . Elia
Ulrike Abert . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Transnet BW
Viktoras Palevičius . . . . . . . . . . . . . . . . . . . . . . . . . . . . Litgrid
Yaelle Klein . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . RTE



## Publisher

ENTSO-E AISBL
8 Rue de Spa | 1000 Brussels | Belgium
www.entsoe.eu | info@entsoe.eu





## Design

DreiDreizehn GmbH, Berlin | www.313.de

## Images

Title: © iStock; p. 7: © CEPS; p. 10, 41: © REE;
p. 57, 75: © Swissgrid; p. 60, 68: © Terna;
p. 71, 106: © Fingrid; p.72: © National Grid;
p. 77, 82, 91, 95, 99, 100, 179, 180, 203: © iStock

## Publishing date

October 2021

European Network of
Transmission System Operators
for Electricity

entsoe