ENTSO-E SOC StG ReC – Working Group Monitoring and Reporting

Regional Coordination Assessment Annual Report 2023 (ARTICLE 17 of SO GL)

September 2024

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ENTSO-E Mission Statement

Who we are

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the **association for the cooperation of the European transmission system operators (TSOs)**. The 39 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.

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Executive Summary

To fulfil the obligations from Article 17 of Regulation (EU) 2017 / 1485 on establishing a guideline on electricity transmission system operation (hereinafter "SO GL"), ENTSO-E publishes this annual report on regional coordination assessment. The goal of the report is to document the successful implementation and operational monitoring of the tasks of the Regional Coordination Centres (RCCs) and make this information available to the public. It contains Key Performance Indicators (KPIs) for the tasks performed by the RCCs[1]. If a legally mandated task is not fully implemented, RCCs can use this report to show whether a legacy task is in place, what this consists of and if the RCC has started working towards the task based on the regulatory framework.

For the complete reporting year 2023, the Outage Planning Coordination (OPC), Short-Term Adequacy (STA) and Common Grid Model (CGM) tasks were in operation. In the pan-European OPC sub-task, all outages on relevant assets are merged and Tie Line Inconsistencies (TLIs) are solved. In the regional OPC sub-task, the RCCs detect the Outage Planning Incompatibilities (OPIs) and recommend corresponding remedial actions (RAs) to solve them. In the regional STA sub-task, RCCs support the Transmission System Operators (TSOs) in the resolution of adequacy issues detected in the pan-European sub-task. All RCCs are continuing work on the implementation of the CGM based on the Common Grid Model Exchange Standard (CGMES), and in some regions, other models based on Union for the Co-ordination of Transmission of Electricity (UCTE) format are used. According to the requirements set out in SO GL and the CSA methodology (CSAm), the Coordinated Security Analysis (CSA) task is split into the three layers of COSA (at TSO level), CROSA (at regional level) and CCROSA (at cross-regional level). The regional CSA layers (CROSA and CCROSA) are being introduced in all Capacity Calculation Regions (CCRs), in addition to the tasks according to the Regional Operational Security Coordination methodologies (ROSCm): CGM building, regional STA and regional OPC.

There are already legacy versions of CSA (hereafter referred as SA – Security Assessment) and grid model merge tasks implemented in the operational practice, based on the voluntarily organised regional security cooperation of the TSOs. The status of the implementation of the legally mandated tasks and the best practices applied so far are described in this report.

In 2023, the CGM building process for the intraday timeframe was extended. In the first half of the year, the RCCs in rotation were performing the merging of Individual Grid Models (IGMs) 3 times per day (each of them merging the 8 coming timestamps), with a total of 24 CGMs delivered.

From July 2023, these RCCs performed the merging of IGMs on an hourly basis, each of which covered the remaining hours from the next target time to the end of the relevant business day.

No interoperability issues related to regional coordination have been identified in 2023; therefore, this report contains no proposed changes to improve effectiveness and efficiency in the system operation coordination.

1 The naming of RSCs is derived from the SO GL definition. The RSCs located in EU countries changed to RCCs according to Article 35 of Regulation (EU) 2019/943. As SCC is placed in a non-EU country, it remains an RSC. For simplicity, however, the term RCC is used throughout this report, and it shall be considered that this includes SCC as an RSC as well.

1 Introduction

Under Article 17 of SO GL, ENTSO-E has the obligation to publish an annual report on regional coordination assessment. The report aims to document the implementation and operational monitoring of the RCC tasks. The legal basis for the report is Article 17 of SO GL:

Annual Report on regional coordination assessment (Art. 17 SO GL)

1. *By 30 September, ENTSO for Electricity shall publish an annual report on regional coordination assessment based on the annual reports on regional coordination assessment provided by the regional security coordinators in accordance with paragraph 2, assess any interoperability issues and propose changes aiming at improving effectiveness and efficiency in the system operation coordination.*

2. *By 1 March, each regional security coordinator shall prepare an annual report and submit it to ENTSO for Electricity providing the following information for the tasks it performs:*

   (a) the number of events, average duration and reasons for the failure to fulfil its functions;

   (b) the statistics regarding constraints, including their duration, location and number of occurrences together with the associated remedial actions activated and their cost in case they have been incurred;

   (c) the number of instances where TSOs refuse to implement the remedial actions recommended by the regional security coordinator and the reasons thereof;

   (d) the number of outage incompatibilities detected in accordance with Article 80; and

   (e) a description of the cases where the lack of regional adequacy has been assessed and a description of mitigation actions set in place.

3. *The data provided to ENTSO for Electricity by the regional security coordinators shall cover the preceding year.*

The input data for this report were provided by the RCCs, and the report was created by ENTSO-E based on this input. Unless otherwise stated, in this report we use the terms with the definitions given in Article 3 of SO GL. A glossary of the terms used, with the relevant source of definition, is provided at the end of this report.

Some of the tasks, which the RCCs shall report on according to Article 17 of SO GL, are still under implementation according to the relevant methodologies. This report distinguishes between tasks based on the regulatory framework and legacy tasks:

- Tasks based on the regulatory framework (OPC, STA, CGM); and
- Legacy tasks, meaning tasks implemented on a voluntary basis according to operational needs (SA or regional merged model in UCTE DEF-format). This is because some RCCs have been operational even prior to the entry into force of SO GL.

Regarding the CROSA and CCROSA, the legally mandated tasks are not yet in operation but are currently in the development phase. Meanwhile, the RCCs have legacy tasks in place to various extents, supporting the TSOs in ensuring grid security during the operational planning processes. In this document, we refer to these legacy tasks as SA.

Coordinated Capacity Calculation (CCC) is one of the RCC's tasks, but it is not covered in this report because it is not part of the SO GL requirements.

The report consolidates data received from all RCCs which are subject to the SO GL, namely the Baltic RCC, Coreso, Nordic RCC, SEleNe CC and TSCNET Services (TSCNET). The Security Coordination Centre (SCC) has been included on a voluntary basis. The non-EU TSOs are not subject to the SO GL requirements but voluntarily participate in regional agreements to ensure cooperation according to the relevant methodologies.

It is also important to consider the geographical scope of the tasks. The CGM, for example, is a pan-European task, and the CGMs created will be used by other RCC tasks. The OPC and STA tasks have pan-European and regional components, whereas the CROSA task will be a regional task performed per Capacity Calculation Region (CCR), with CCROSA dealing with cross-regional aspects in the future.

2 Common Grid Model

The pan-European CGM is created by merging the IGMs of European TSOs. It is created for different time-frames[2] and will be the basis for all the other tasks subsequently described.

As a reminder, in all RCCs except the Baltic RCC and Nordic RCC, grid models based on the UCTE format are used as input to the legacy tasks. For the Nordic RCC and Baltic RCC, regional merged models based on CGMES format are used for task development purposes.

The CGM in business process will serve as the main data input for performing further analysis through the processes in the STA, OPC, CSA and CCC tasks.

During the year 2023, SEleNe CC joined the rotational schedule, in which other 4 RCCs were already involved in the CGM building task (Baltic, Coreso, SCC and TSCNET). Nordic RCC was not part of the rotational schedule in 2023.

In the reported year, due to the manual data quality intervention and incomplete implementation of the substitution and replacement strategy, the resulting CGMs may not model parts of the network (partial CGMs).

2.1 Scope: Pan-European

According to SOC decision Number 11 from 4 December 2019, the CGM is created on a rotational basis, with at least one Main and one Backup RCC performing the CGM building task for each time-frame. Furthermore, each RCC checks the quality of the IGMs of the TSOs, by which it receives the delegation of this task in order to contribute to building the CGM, enabling it to maintain the regional expertise during the process of the iterative validation of IGMs. For this reason, where relevant, KPIs presented in this report shall refer only to the Main and Backup RCC responsible for the CGM building task according to the rotational schedule.

2.2 Time-frames

During the reporting year 2023, CGMs have been built in the following time-frames:

- **D-1 (1 run of the CGM building process to provide 24 models for each day[3]); and**
- **ID (3 runs of the CGM building process to provide 24 models for each day[4])**

The Week-Ahead (W-1) time-frame was not part of the CGM building task in 2023, and related KPIs will be provided in further reports.

Year-Ahead (Y-1) is not yet fully operational compared with other time frames and is considered under the test phase conducted by the ENTSO-E Task Team Network Modelling and Forecasting Tool (NM&FT) under the Steering Group Regional Coordination. Only the Winter Peak 1 scenario, based on the 3rd Wednesday of January year 2023, 18 January 2023 at 10:30 CET, was considered. NM&FT task team is ensuring the collection of CGMES-based IGMs over OPDE, and RCC in rotation proceeds with the merge of those IGMs to get the corresponding CGM.

Despite this status for the Year-Ahead timeframe, during the test phase performed in 2023, the RCC in charge of performing the merge of the defined scenario achieved the creation of a CGM based on all the 28 IGMs published by TSOs.

2 As per SO GL, only year-ahead, week-ahead, day-ahead and intraday are considered in this report, as well as related operational tasks – CSA, OPC and STA. Any other capacity calculation time-frame as referred to in the CACM and FCA is not part of this report.

3 Or 23/25 models due to Daylight saving time.

4 Or 23/25 models due to Daylight saving time.

CGM KPIs

For the CGM task delivery, the following KPIs were agreed and approved on.

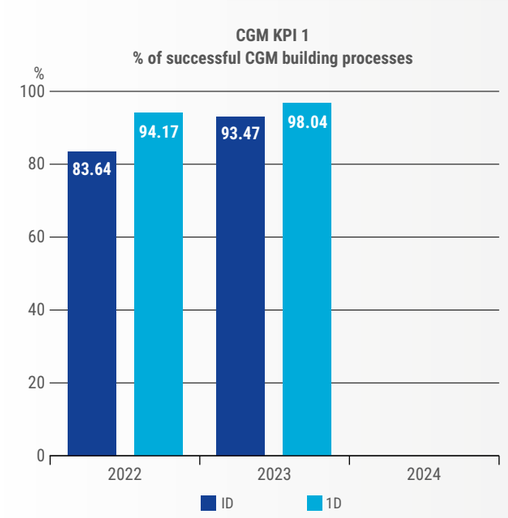

Figure 1: CGM KPI 1: Percentage of successful CGM building processes

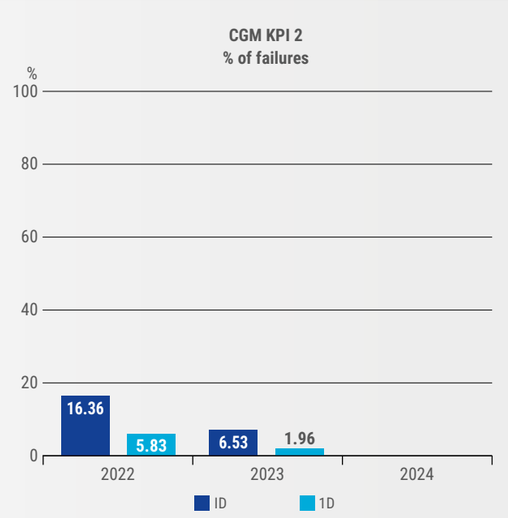

Figure 2: CGM KPI 2: Percentage of failures

CGM KPI 1: Percentage of successful CGM building processes

Description: CGM KPI1 represents the percentage of successful CGM Building processes compared to all CGM Building processes performed on a pan-European level. It represents all timestamps for which at least one RCC (Main or Backup) was able to run the CGM Building process for a specific time-frame[5] and publish the corresponding CGM.

CGM KPI 2: Percentage of failures and reasons for failures

Description: CGM KPI2 represents the percentage of missing CGMs compared to the total amount of merge processes that were scheduled to run on a pan-European level and per time-frame.[6]

We can associate with these missing CGMs the percentage of the causes, which are usually related to data quality issues, IT issues on the Service Provider (SP) side, IT issues on the RCC side or Operational Planning Data Management (OPDM) Client issues (see Table 1 for details).

The figures associated with the missing CGM building process in Table 1 below shall be applicable to CGM KPI2 for the corresponding time-frame.

The numbers show that most of the issues reported in 2023 were related to the IT issue on the RCC side for the Intraday timeframe and for the main Operators for the Day-Ahead time-frames. However, for backup Operators for Day-Ahead time-frames, most of the reported issues were related to data quality.

5 Based on the number of published CGMs during the data collection phase of this report, accounting as successful also CGMs published after gate closure time, with the implementation of manual data quality interventions.

6 Based on the number of published CGMs during the data collection phase of this report, accounting as missing CGMs those CGMs that are still not published after the implementation of manual data quality interventions.

RCCs, TSOs and ENTSO-E are working together to increase the data quality and the reliability of the IT infrastructure.

Reason for failures

Causes associated with CGM KPI 2	ID		1D	
	Main	Backup	Main	Backup
Data quality	5.94 %	23.78 %	17.44 %	41.28 %
IT issue on SP side	0.35 %	0.17 %	0.58 %	22.09 %
IT issue on RCC side	88.99 %	52.80 %	81.98 %	22.67 %
OPDM Client issue	4.72 %	23.25 %	0.00 %	13.95 %

Table 1: Reasons for failure associated with CGM KPI 2

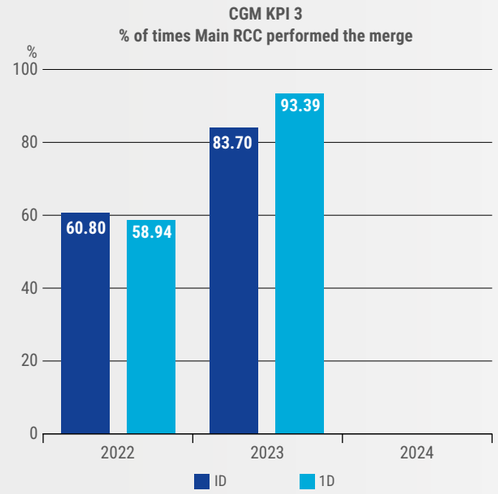

Figure 3: CGM KPI 3: Percentage of times Main RCC performed the merge

CGM KPI 3: Percentage of times Main RCC performed the merge

Description: CGM KPI3 represents the percentage of successful CGM Building processes compared to all CGM Building processes performed on a pan-European level when performed by the Main RCC for each time-frame.[7]

Figure 3 shows that the CGM Building Processes resulting from Main RCC had a high availability rate for both Intraday and Day-Ahead timeframes. The remaining CGM Building process results were covered by the Backup RCC, according to the rotational calendar.

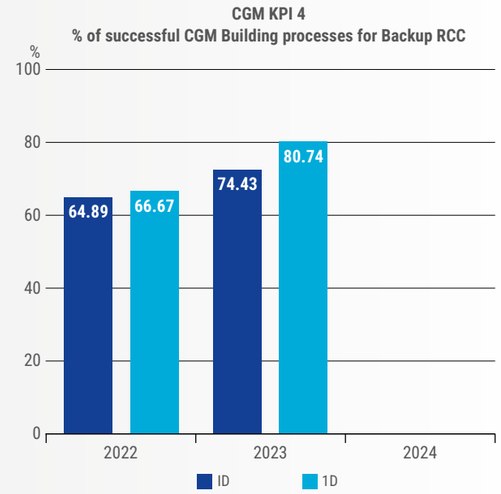

Figure 4: CGM KPI 4: Percentage of successful CGM Building processes for Backup RCC

CGM KPI 4: Percentage of successful CGM Building Processes for Backup RCC

Description: CGM KPI4 represents the percentage of successful CGM Building processes compared to all CGM Building processes performed on a pan-European level when performed by the Backup RCC for each time-frame.[8]

Figure 4 shows that the CGM Building Processes resulting from backup RCC had a high availability rate for both Intraday and Day-Ahead timeframes. The remaining CGM Building process results were covered by the main RCC, according to the rotational calendar.

7 + 8 Based on the number of published CGMs during the data collection phase of this report, accounting as successful also CGMs published after gate closure time, with the implementation of manual data quality interventions.

3 Regional Coordinated Security Analysis

The CSA task is performed to ensure grid security, meaning that operational security violations must be managed in normal operation conditions and under N-1 or even N-k conditions. The CSA task is based on the CGM input associated with additional specific CSA inputs, such as list of planned outages and available Remedial Actions (RAs). RCC operators with the support of RCC tools then run an optimisation, followed by the coordination of RAs.

3.1 Scope

The regional CSA task is composed by coordinated regional and cross-regional operational security assessment (CROSA and CCROSA, respectively), in accordance with Article 76 of SO GL and with the CSAm, which is developed in accordance with Article 75 of SO GL. Consequently, regional coordination assessment reporting (Article 17 of SO GL) is also provided per CCR. Reporting about COSA in accordance with Articles 72 – 75 of SO GL and Articles 23 – 24 of CSAm is out of the scope of this document.

3.2 Legacy Security Assessment

Even prior to the legal obligation of SO GL, TSOs have organised themselves, on a voluntary basis, to develop common security analyses, frequently including the creation of regional merged grid models in UCTE DEF format. In some areas, this coordination occurred on a bilateral basis (between 2 TSOs across a shared border) or through regional initiatives. However, these voluntary initiatives were not implemented based on a shared methodology; hence, they are not comparable with each other. In the following paragraph, we detail the currently applied processes for managing the congestions.

For instance, at TSC (TSO Security Cooperation – a voluntary cooperation of Central European TSOs) a basic security assessment process has been running since 2011. The service was designed by TSC TSOs and TSCNET, with the main objective of enhancing coordination in the TSC region, including some neighbouring TSOs. The service relies on the common tool used by the TSC TSOs, providing them with the common overview of the process results. Currently, the security assessment is performed for the Day-Ahead and intraday time-frame.

Another example is Coreso, another voluntary cooperation of European TSOs, performing Day-Ahead and intraday SA, as a legacy service of the CSA process, since 2009. The service has been designed, developed and setup in collaboration with several Coreso TSOs, considering the need for a cross-border view on security studies. These coordinated studies rely on a dedicated tool and interaction between Coreso and TSOs' operators to ensure a common overview of the process results, as well as on associated RAs.

SCC also performs an SA for the Day-Ahead and intraday time-frames, using a dedicated tool since 2015. Based on the SA results for the Day-Ahead time-frame, SCC creates regular statistical reports concerning the detected security constraints to the service user TSOs.

At SEleNe CC, the SA process was in a testing/validation phase until Q3 2022. From September 2022, the process is on a go-live mode, meaning that it is executed on a daily basis using grid models in UCTE DEF format. The process for SEE is executed in a two-step procedure. In the first step, SA is conducted considering all possible N-1 situations. From the SA, all current and voltage violations are identified. In the second phase, the coordination of RAs is performed. The coordination is achieved via an iterative process. During this process, TSOs propose RAs to solve congestion and voltage issues and SEleNe CC evaluates their impact on grid security. Only non-costly RAs are considered. The iterative process ends when all TSOs agree that the applied RAs ensure the security of their system.

3.3 Regional Coordinated Security Analysis

RCCs shall perform CROSA and CCROSA on the CGM to detect potential violations of operational security limits on cross-border relevant network elements (as defined in Article 2.8 of CSAm), requiring coordination between TSOs and RCCs. For each detected violation, RCCs are expected to recommend the most effective and economically efficient RAs. All TSOs affected by a recommended RA shall be included in the coordination process so they can evaluate the impact of the recommended RA on their grid before agreeing to activate it. If the RAs agreed within one CCR significantly impact the physical flows in other CCRs, a cross-regional coordination process between these CCRs shall be initiated to ensure that the residual violations in the overlapping zones (as defined in Article 27 of the amendment of CSAm) are addressed.

To allow RCCs to perform the CROSA task, TSOs need to provide them with several inputs – list of assessed elements, list of contingencies that need to be simulated and list of available RAs that can be used for solving identified violations.

The legal framework behind the CROSA and CCROSA tasks has been defined at 2 levels: CSAm and ROSCm. CSAm defines the high-level principles and the main steps of the CSA process, and it was amended (link) in 2021 with rules for cross-regional coordination, RA inclusion in IGMs and cross-regional cost sharing. At the regional level, each CCR has developed a ROSCm, further detailing the regional specificities while respecting the CSAm. The main points that are regionally determined are the principles for RA optimisation and coordination, and the conditions and frequency of intraday coordination. The expected go-live dates of the CSA processes at the CCRs are regularly reported to the Agency for the Cooperation of Energy Regulators (ACER) and the National Regulatory Authorities (NRAs).

In the period after the implementation of regional ROSCs and before the implementation of CCROSA, the currently applied processes of managing the residual congestions shall be kept. As the CSA task was not operational in 2023 according to the SO GL requirements, no KPIs can be calculated for the year 2023.

The sections below show the status of implementation of the SO GL compliant tasks.

3.3.1 Baltic RCC – Baltic CCR

During year 2023, the service provision was shifted from two days ahead to Day-Ahead time horizon to carry out transmission network security assessment on regional merged models, representing the case of Baltic states' synchronisation with Continental Europe.

The main developments were focused on the implementation of the remedial action coordination tool, which enables Baltic RCC and Baltic region TSOs to propose and coordinate RAs for identified violations in the transmission network. The implemented solution is based on data exchange according to the latest specification of Network Code CSA profiles, developed by ENTSO-E.

At the end of 2023, the Baltic RCC together with representatives of Baltic TSOs successfully tested the implementation of the remedial action coordination tool and scheduled the go-live date to 1 April 2024. Moreover, the preparations for service provision for intraday time horizon were performed, and it is ready to be operated together with the Day-Ahead timeframe once the input data are available.

3.3.2 Coreso and TSCNET – Core CCR, Italy North CCR

Coreso and TSCNET (together in a rotational schedule) have been appointed to perform the CROSA[9,10] processes for two CCRs – Core CCR and Italy North CCR. The timeline for implementing the regional CSA processes in each CCR is defined at the regional level, while the implementation of the cross-regional coordination follows not later than 18 months after the last among the concerned CCRs apply the implementation of the target solution of the ROSC Methodology pursuant to Article 76 of the SO GL.

In the Core CCR, a stepwise implementation of the CROSA[11] task is foreseen. The first implementation step of the Core ROSC Methodology covers the implementation of day ahead CROSA, including an RAO for at least the optimisation of redispatching resources and phase shifting transformers and the implementation of cost sharing for day-ahead CROSA pursuant to cost sharing methodology. The first implementation step may include some further simplification of the ROSC Methodology.

In the Italy North CCR, the target version as defined in Italy North ROSC Methodology will be implemented directly, skipping the intermediate 1st implementation step.

Core CCR and Italy North CCR, Coreso and TSCNET initiated the cooperative CorNet Programme to ensure efficient and effective tool development and prepare future operations.

3.3.3 Nordic RCC and TSCNET – Hansa CCR

The implementation of the Hansa ROSC process is dependent on the Nordic and Core ROSC implementations. Hence, the Hansa ROSC process go-live follows the Nordic and Core ROSC go-live dates.

For Hansa CCR, the specific CROSA processes will consist of providing relevant input (RAs, cross-border network elements etc.) to the TSOs of Core and Nordic CCRs and participating in the coordination of RAs whenever necessary. This concept will be adopted for interim and target solutions, the only difference being that for the interim solution, Nordic and Core CCRs will use different grid models (Nordic and Continental Europe regional merged models, respectively) whereas for target solutions, the CGM will be used.

For the interim solution, Hansa ROSCm foresees go-live 3 months after the Core and Nordic interim solutions' go-live. For the target solution, the go-live date is 12 months after the Core and Nordic target solutions go-live, while the implementation of the CCROSA follows not later than 18 months after the last among the concerned CCR apply the implementation of the target solution of ROSC Methodology pursuant to Article 76 of the SO GL.

9 ACER Decision 33-2020
10 CORE ROSC Methodology article 38.3
11 CORE ROSC Methodology article 37.2-3

3.3.4 Nordic RCC – Nordic CCR

Nordic RCC is implementing the CSA service in a stepwise approach by releasing versions which will gradually cover the entire scope of the CSA and NROSC methodologies. CSA version 1.0 is currently being developed and aims to deliver the core functionality of performing a day-ahead N-1 contingency analysis on a merge of Nordic IGMs in CGMES 2.4.15 format. The N-1 contingency analysis is complemented by the inclusion of System Integrity Protection Schemes (SIPS), which are largely adopted in the Nordic power systems and ensure that results reflect the expected real-time operating conditions.

This first simplified version of the CSA service is currently planned to be in operation from Q3 2024. Subsequent versions will extend the N-1 contingency analysis to the intraday timeframe in 2025, whereas the implementation of any RA optimisation will be considered in the future.

The precondition for the full implementation of the Nordic ROSC and CSA methodologies including remedial action optimisation in all time horizons is the preparation of a Nordic Remedial Action Optimisation methodology to ensure that Nordic TSOs get the maximum benefit from the execution of the CROSA and CCROSA tasks. More about the performance of the CSA task of Nordic RCC can be found in the Nordic RCC annual report.

3.3.5 SEleNe CC – SEE CCR

SEE TSOs have requested an official extension from NRAs for the implementation of the ROSC in the SEE region. The proposal for the extension has been approved by the NRAs and the new deadline for the first version of the target solution with reduced scope is expected during Q4 2025. The final target solution is planned to be implemented in July 2027.

The first version includes DA CROSA, while the final target solution includes ID CROSA and Inter-CCR.

3.3.6 SEleNe CC – GRIT CCR

The process based on ROSCm for the Day-Ahead time-frame has been performed on a daily basis since September 2022. The process is being run on regional merged models (grid models in UCTE format) to ensure the operational security limits of grid elements of both the Italian and Greek power systems. To do so, N-1 security analyses are performed to detect current and voltage limit violations in combination with a RA selection procedure. The process will be extended to the intraday time-frames in line with the implementation timeline of the regional methodology.

3.3.7 Coreso – SWE CCR

Coreso, appointed to perform the CSA process for the SWE region, mostly relies on the developments realised in the CorNet programme to deliver the 1st version of the CSA process for the Core & Italy North regions. However, due to SWE regional specificities, some of these developments require adaptation. This is why Coreso is ensuring that the SWE needs are properly onboarded into the CorNet design and implementation of the CGM and CSA modules, whereas a dedicated Remedial Action Optimiser (RAO) is going to be developed separately.

The implementation of the RAO and the other features of the CSA process has progressed in 2023, and the first version of the tool will be tested in 2024. The challenge is to absorb developments made for CorNet and for SWE and to integrate them with the RAO. The plan is to start the parallel run in 2025 after the testing of the tool containing the minimal regulatory requirements.

The readiness of the CorNet programme is one such requirement, while the input data readiness of the TSOs (following the CSA input data standard) is another. This readiness is constantly progressing, with close interaction with ENTSO-E to provide specific sets of data to be used in the process.

3.4 Non-EU SEE TSOs signatories of SAFA

The development of ROSC methodologies, and the design and implementation of the ROSC process and its daily operation, is a legal obligation of all EU TSOs in addition to their respective RCCs executed on the level of SOR, according to Regulation (EU) 2019 / 943.

In accordance with Article 75 of SO GL, all TSOs should develop a common proposal for a CSAm. In accordance with Article 76 of SO GL and based on CSAm, the TSOs of one CCR should develop a common proposal for the business process of ROSC methodology, which would be applied in the framework of the given region.

On the other hand, non-EU TSOs in the synchronous area Continental Europe who are signatories of the Synchronous Area Framework Agreement (SAFA) can participate in the listed activities above by developing the methodology and implementing and executing the ROSC process in their non-EU region. At the Ministerial Council of the Energy Community (MC-EnC) held on 15 December 2022, the incorporation of various EU regulations for application in the Energy Community was adopted *(Decision 2022/03/MC-EnC on the incorporation of Regulations (EU) 2019/942, 2019/943, 2015/1222, 2016/1719, 2017/2195, 2017/2196, 2017/1485 in the* Energy Community acquis published on 16 December 2022). This decision defines specific SOR and CCR, both named Shadow SEE, which includes West Balkan 6 (WB6) TSOs (CGES, EMS, KOSTT, MEPSO, NOSBiH and OST). It was planned that during 2023, this decision should be implemented in the national regulation in WB6 EnC Contracting Parties, but unfortunately this did not happen.

For non-EU SEE TSOs – signatories of the SAFA, who agreed to develop and implement the ROSC process – SCC is the RSC.

3.4.1 SCC

All non-EU TSOs in the synchronous area Continental Europe signed the SAFA in April 2019, thereby committing themselves to applying all the provisions of the SO GL regulation in due time.

In the beginning of 2021, in accordance with Article 76 of SO GL, the SCC and TSOs that are simultaneously SCC service users and signatories of the SAFA document (CGES, EMS, MEPSO, NOSBiH and OST) began activities aimed at the development of the SAFA West Balkan Regional Operational Security Coordination (SAFA WB ROSC) methodology.

These six entities defined three phases for establishing SAFA WB ROSC:

- **The design of SAFA WB ROSC methodology** – finalised in September 2021;
- **The creation of SAFA WB ROSC business process –** finalised in June 2022 by updating the methodology and creating an explanatory note which describes the business process and additionally explains certain requirements derived from the SAFA WB ROSC methodology; and
- **The implementation of SAFA WB ROSC methodology and business process –** in January 2023, the agreement for the implementation of the SAFA WB ROSC methodology and business process was prepared, but unfortunately this agreement was not signed by SAFA WB TSOs (CGES, EMS, MEPSO, NOSBiH and OST) and SCC.

Although SAFA WB TSOs recognise the importance of the ROSC process for the secure exploitation of the power system, due to ongoing issues with resources, they decided to wait for the implementation of Decision 2022 / 03 / MC-EnC in national regulation for all WB6 EnC Contracting Parties. Due to an unaligned implementation process in WB6 national laws, these activities could even last up to several years, so coordinated actions from the Energy Community Secretariat, ENTSO-E and even ACER could help speed up this process.

4 Outage Planning Coordination

The pan-European OPC establishes an outage planning process based on the requirements described in SO GL. The pan-European OPC tool facilitates the coordination of outages, sharing the element list and maintaining the database of the relevant assets. A coordinated procedure ensures the quality and consistency of the data, e.g. via the validation of information about the planned status of the cross-border lines of the TSOs. The pan-European OPC process is performed by all RCCs on a rotational basis.

Following the foundation of the pan-European OPC process, regional OPC processes, commonly known as regional OPI assessment processes, are also performed by RCCs. Its goal is to determine if the outage planning of the European TSOs is feasible regarding grid security. In the event it identifies potential congestions, it shall suggest RAs and validate whether the coordinated unavailability plan is feasible regarding security limits, as well as recommend the mitigation of any potential detected outage planning incompatibilities by issuing recommendations.

4.1 Scope

OPC: Pan-European

OPI: Regional

4.2 Time-frames

Both pan-EU OPC and regional OPI processes are performed for two time-frames: Week-Ahead and Year-Ahead. Year-Ahead KPIs for pan-EU OPC and regional OPC are related to the processes performed in the reported year. In this case, this is the 2023 report, so we report on the Y-1 process performed in 2023 for 2024.

Each Year-Ahead and Week-Ahead process consists of a number of sub-processes. In each sub-process, a merge of the unavailability plans from all participating TSOs for the respective time-frame is done by the pan-EU OPC Tool and the relevant procedures are performed, e.g. coordination of outages, the regional OPC process and the inclusion of proposed RAs. All outage planning incompatibilities shall be solved before the final merge.

4.3 Specificities of regional OPC processes per RCCs

As general background, it is relevant to note that the Electricity Market Regulation clearly states that *"Regional Coordination Centres should have the flexibility to carry out their tasks in the region in the way which is best adapted to the nature of the individual tasks entrusted to them"*[12]. In line with this, the different regions are subject to different interpretations of the regional OPC process, which affect certain regional KPIs.

Nordic RCC provide an expert assessment based on the planned outages in the region to avoid outage incompatibilities, covering the W-1 and Y-1 time-frames. Baltic RCC provides expert assessment for the W-1 time-frame.

The regional OPC processes have significant differences among the RCCs, according to the requirements of the TSOs and the responsibility of the corresponding RCC. The main characteristics of these OPI processes are summarised in the table below:

Regional characteristics of the OPI process

	Time-frame	Baltic RCC	Coreso	Nordic RCC	SCC	SEleNe CC	TSCNET*
Calculation method (SA)		Manual			Automatic		
RA selection method		Manual identification based on expert knowledge and operational rules					Automatic MIQCP (Mixed integer quadratically constrained program) based optimisation
What is considered OPI in this report?		OPI cases confirmed by the respective TSOs					All OPI cases identified by the OPI calculation
Number of time-stamps calculated in 2023	Week-ahead OPI	**n/a**	**52** (1/week)	**0**	**52** (1/week)	**2.184** 42 time-stamps/ week	**2.184** 42 time-stamps/ week
	Year-ahead OPI	**10**	**52** (1/week)	**5** (outage situation selected by experience)	**52** (1/week)	**52** (1/week)	**52** (1/week)

*TSCNET and SEleNe CC perform the OPI assessment sub-task in two cycles per time-frame – Initial OPI assessment and final OPI assessment. Coreso and SCC perform one cycle per time-frame and a second cycle upon request from TSOs.

Table 2: Regional characteristics of the OPI process

12 Recital 54, Regulation (EU) 2019/943

4.4 OPC and OPI KPIs

Input data are collected and considered for the time-frames Week-Ahead (W-1) and Year-Ahead (Y-1).

The KPIs for both the pan-European OPC (OPC KPI) and the regional OPC process (OPI KPI) are:

- **OPC KPI 1:** Percentage of process failures and reasons for failures;
- **OPC KPI 2:** Average merge duration per process time-frame;
- **OPI KPI 1:** Average duration of OPI calculation;
- **OPI KPI 2:** Percentage of process failures and reasons for failures; and
- **OPI KPI 3:** Percentage of times when OPI assessment results in identified outage planning incompatibilities

4.4.1 OPC KPIs

OPC KPI1: Percentage of process failures and reason for failures

Description: The percentage of failed processes compared to all processes performed on a pan-European level. These cases were classified by their cause, which are usually related to the data quality issues, the IT tool and infrastructure – anything else that does not fit into this category is covered in the 'Other' class.

Starting in 2023, a process is classified as failed when the completion time exceeds the timings provided in the following table:

Merge	Failure
W-1: 1st	After 3 h of initial scheduled time
W-1: 2nd, 3rd, 4th	After 4 h of initial scheduled time
Y-1: Pre, 1st, 2nd, 3rd, 4th	After 4 h of initial scheduled time

Table 3: Timings for classification of failed merges

Two incidents were recorded in the W-1 process 2023 due to tool and infrastructure failures (Table 3). In the Y-1 process, no incident was recorded.

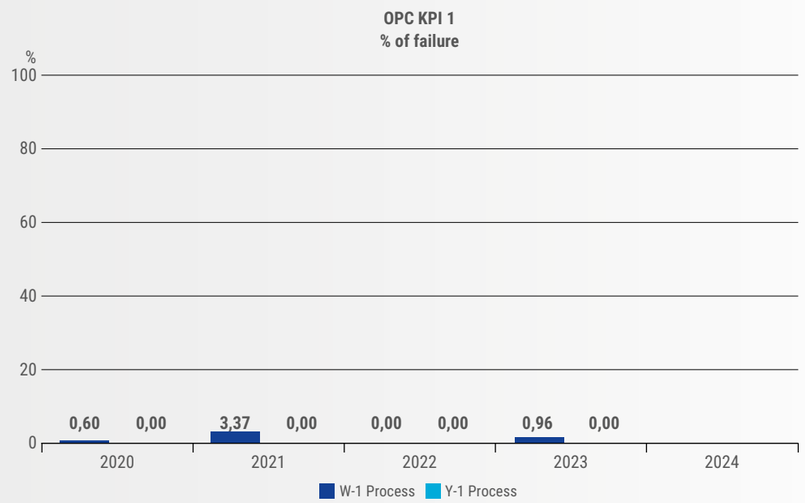

Figure 5: OPC KPI 1: Percentage of process failures per year

Reason for failures

Number of cases in 2022	Weekly process	Yearly process
Data Quality	0	0
IT – Tool	1	0
IT – Infrastructure	1	0
Other	0	0

Table 4: OPC KPI 1: Percentage of process failures per reason class

OPC KPI2: Average merge duration per process time-frame

Description: The value shows the average duration of each individual merge performed on the pan-European level in minutes.

The longer duration of the Year-Ahead merge compared to the Week-Ahead one is due to the higher number of outages due to a larger amount of elements and subsequent unavailabilities considered in the longer time-frame. The results for years 2022 and 2023 are higher due to the tool being used more actively and the greater amount of data provided compared to 2021. For details, check the Annual Assessment Report 2021.

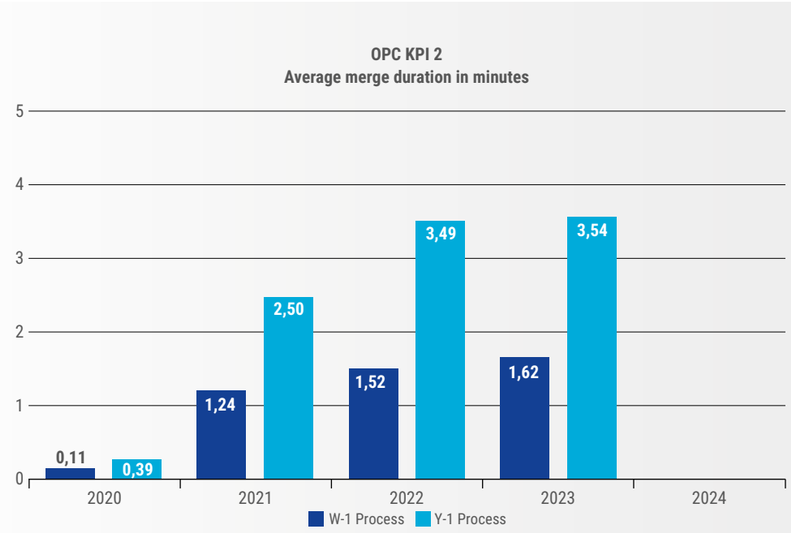

Figure 6: OPC KPI 2: Average merge duration in minutes

4.4.2 OPI KPIs[13]

OPI KPI 1: Average duration of OPI calculation

Description: The value shows the average duration of each OPI calculation at the regional level.

The regional OPC process is already performed by some of the RCCs, calculated for their shareholder TSOs, and the results are discussed with the TSOs and the RCCs on regular teleconferences. The process was provided based on the RORA (RCC Outage Responsibility Area) regions for the RCCs Coreso & TSCNET. The switch from RORA to the Outage Coordination Region (OCR) definition is currently under development by both RCCs. The differences between process durations among the RCCs originate from the different execution methods – the manual or automatic calculation method.

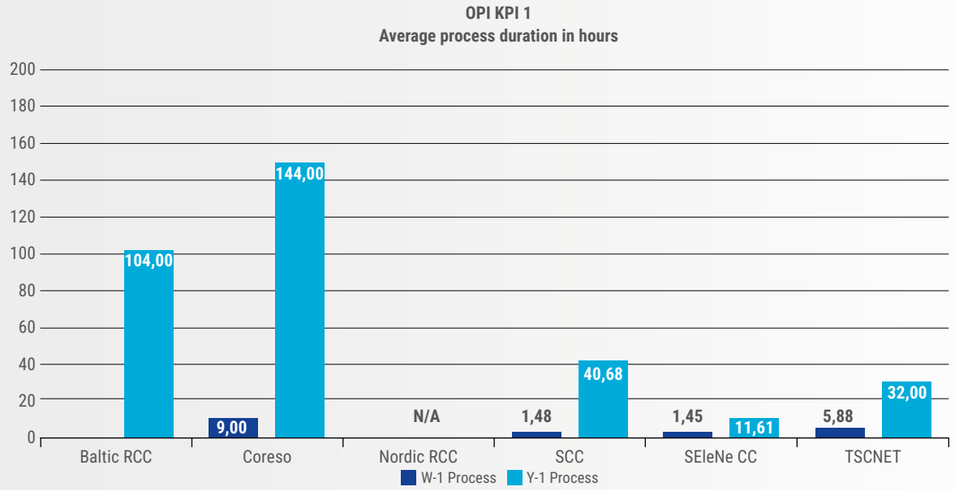

Figure 7: OPI KPI 1: Average process duration in hours

OPI KPI 2: Percentage of process failures and reason for failures

Description: The percentage of failed processes compared to all processes performed on the regional level. These cases were classified by their cause, which are usually related to the data quality issues or the IT tool or infrastructure – anything else that does not fit into this category is covered in the 'Other' class.

In 2023, some failures were observed in the OPI process in two regions, mostly caused by data quality issues. In these regions, the OPI calculation is performed using an automated method, which is more sensitive to data quality compared to the manually performed processes.

For SElеNe CC, the W-1 OPI process failed for 7 TSs due to IT issues.

For TSCNET, in the W-1 OPI process no failures were detected in 2023. In the Y-1 OPI process, there were six failed timestamps due to input data quality.

The failed timestamps do not have a significant impact on the final regional coordination, because regional coordination calls are performed for the Week-Ahead and Year-Ahead basis and manual backup procedures are available in case of the failure of the automated processes.

13 Coreso, TSCNET and SCC and SElеNe CC perform a Regional OPC assessment using input reference models in UCTE format; Baltic RCC and Nordic RCC provide an expert assessment based on the planned outages in the region to avoid outage incompatibilities

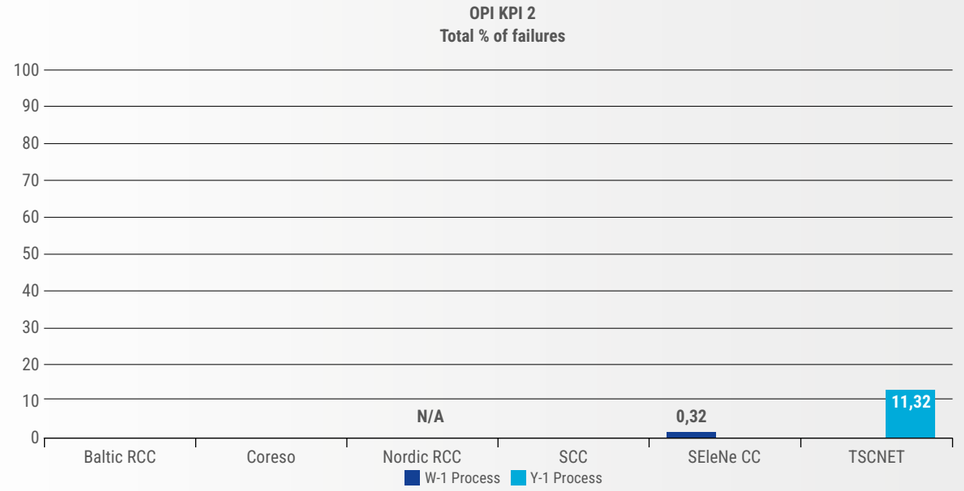

Figure 8: OPI KPI 2: Percentage of total failures

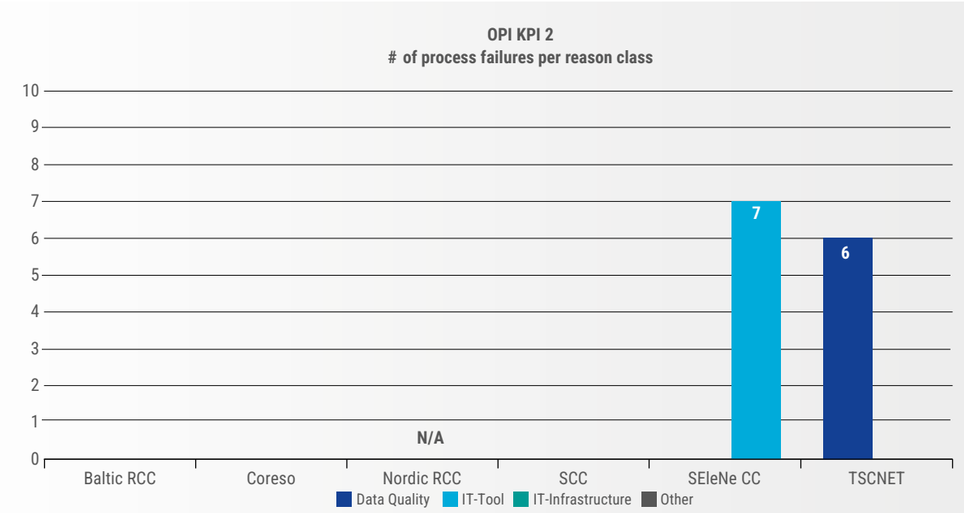

Figure 9: OPI KPI 2: Number of process failures per reason classification

Reason for failures

Number of failures in 2023	Baltic RSC	Coreso	Nordic RSC	SCC	SElеNe CC	TSCNET
Data Quality	0	0	N/A	0	0	6
IT – Tool	0	0	N/A	0	7	0
IT – Infrastructure	0	0	N/A	0	0	0
Other	0	0	N/A	0	0	0

Table 4: OPI KPI 2: Number of process failures per reason classification

OPI KPI 3: Percentage of times when OPI assessment results in identified outage planning incompatibilities

Description: The OPI assessment can result in either an OPI being detected or not for any given planned outage. The OPI KPI 3 indicates how frequently OPIs were detected during the weekly/yearly regional OPC sub-task.

The OPI process and the definition of OPI were different among the RCCs in 2023; therefore, the KPIs are hardly comparable. The principal reason for this is that Coreso, SCC and SEleNe CC reported those OPIs which were also confirmed by the TSOs, whereas the reported OPIs of TSCNET represent the identified violations which result directly from the regional security analysis.

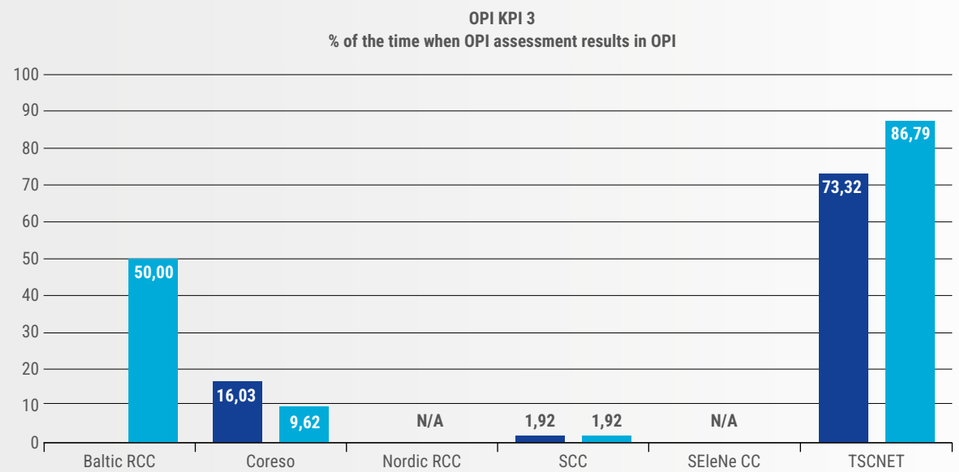

Figure 10: OPI KPI 3: Percentage of time when OPI assessment detects an OPI

5 Short-Term Adequacy

The goal of STA is to detect situations where a lack of adequacy is expected in any of the control areas or at regional level, considering possible cross-border exchanges. Based on this assessment, when a lack of adequacy is expected, the regional STA process is triggered, in which RCCs will provide recommendations to TSOs to resolve the potential adequacy issue identified.

In the pan-European STA process during 2023, calculations were monitored (and operational tasks such as communication with TSOs and the IT tool provider, data upload, etc. were performed) by five RCCs: Baltic RCC, Coreso, Nordic RCC, SEleNe CC and SCC on a rotational basis. For every two weeks, a duration of the rotation cycle, there is one Main RCC and one Backup RCC which replaces the main RCC in the event the main RCC faces an issue regarding any part of the STA process.

In the event of inadequacy on the pan-European level, the regional STA process should be performed under the leadership of the RCC who is responsible in the region where inadequacy is detected (RCC leader). Regional processes should cover the affected TSO and the neighbouring TSOs; the list of neighbouring TSOs for each affected TSO (forming a dynamic region for each specific TSO when affected) is defined based on a dynamic matrix.

5.1 Scope

Pan-European STA: Pan-European

Regional STA: Regional

5.2 Time-frames

The pan-European STA process is performed daily for the following 7 days.

The time-frame of the regional STA process is determined by the timestamp that is foreseen as the most critical one based on pan-European results. A regional STA is triggered automatically for the timestamps that are in the scope of the next 3 days. However, any TSO can trigger a regional STA process whenever it identifies the need and independently of the time-frame.

5.3 STA KPIs

The STA KPIs are:

- **STA KPI 1:** Percentage of failures of the pan-European STA process;
- **STA KPI 2:** Average STA pan-European process time; and
- **STA KPI 3:** Description of the cases where the lack of regional adequacy has been assessed and the agreed mitigation actions.

5.3.1 STA KPI 1: Percentage of failures of the pan-European STA process

Description: STA KPI1 presents the percentage of failed processes compared to all processes performed on the pan-European level. The pan-European STA process runs once every day; an additional run can be requested by any TSO(s). Thus, the total number of runs can be a maximum 365 × 2 (or 366 × 2 in leap years). The number of runs in 2023 was 389, while both calculations and the reporting part of the process failed 4 times in total.

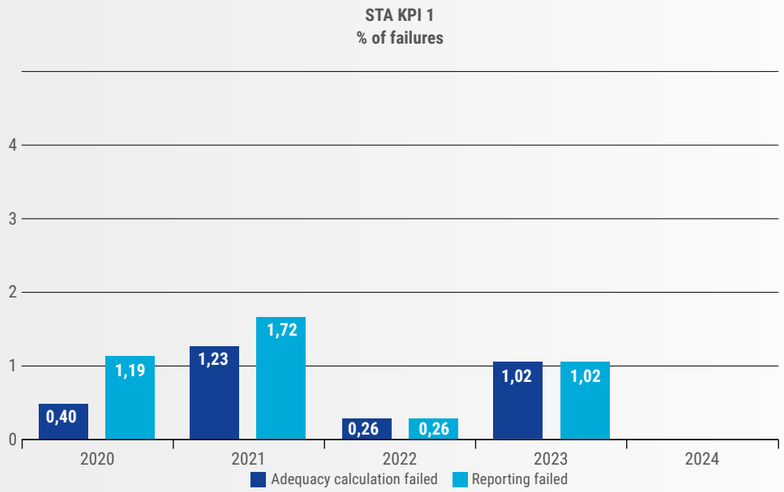

Figure 11: STA KPI 1 – Percentage of failures

5.3.2 STA KPI 2: Average STA pan-European process time

Description: STA KPI2 presents the average time of all pan-European STA computations performed during the year. Data for STA KPI 2 are obtained from the ENTSO-E STA tool.

The main reason behind the increase in the average computation time in 2023 is the consideration of the Flow-Based constraints for CORE region TSOs instead of NTC values in the D-1 time frame.

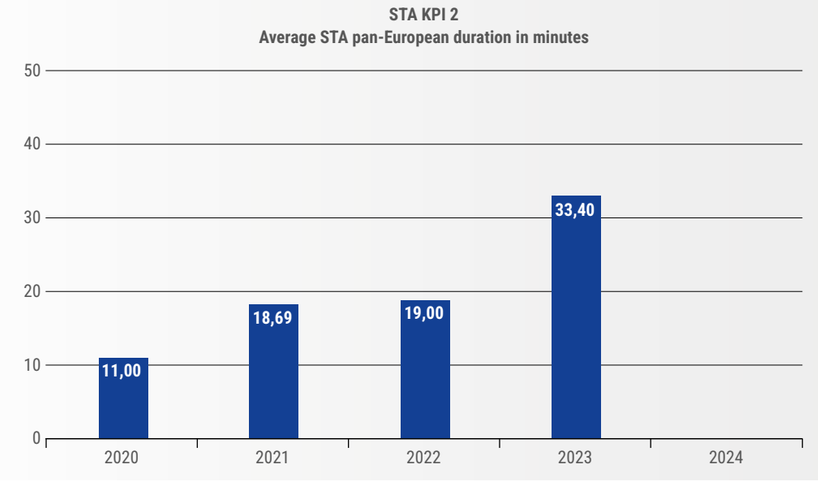

Figure 12: STA KPI 2 – Average STA pan-European process time

5.3.3 STA KPI 3: Description of regional adequacy assessments performed

In 2023, no regional STA process was triggered.

No.	Date of Assessment	Date of Event	RCC leader	No. of concerned TSOs	Inadequacy duration	ENS [MWh]	Proposed mitigation action
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

No.: Order number of inputs

Date of Assessment: Date when the pan-European[14] STA is assessed (Pan-European STA process is also referred as Cross-Regional AdequacyAssessment)

Date of Event: Date and timestamp of the case for which Regional STA process is triggered

RCC leader: RCC responsible for leading the Regional STA process

No. of concerned TSOs: No. of TSOs participating in the Regional STA process, main affected TSO (for which ENS is detected) and their neighbours that can have an impact on the main affected TSO (determined based on Dynamic matrix)

Inadequacy duration: Number of timestamps in the Week-Ahead time-frame for which the Main affected TSO is in an inadequacy situation (each timestamp corresponds to one hour)

ENS [MWh]: Amount of Energy Not Supplied in the timestamp assessed during the Regional STA process

Proposed mitigation action: List of RAs considered as a solution to the lack of adequacy (this can be one or multiple actions depending on the case assessed)

Table 6 – KPIs for Regional STA Triggers (sample). No values are available as no regional process was initiated in 2023.

14 Pan-European STA process is also referred to as Cross-Regional Adequacy Assessment

6 Conclusions

To fulfil the obligations from Article 17 of SO GL, this report contains KPIs for the tasks provided by the RCCs.

In general, no interoperability issues were raised nor were any changes proposed to improve the effectiveness and efficiency in the system operation coordination. Furthermore, no interoperability issues were reported regarding the threshold values selected by the TSOs according to Article 6.2 of CSAm.

The following scheme gives an overview of the expected reporting in the coming years. After all tasks are implemented, the enduring reporting template will be applied for all tasks.

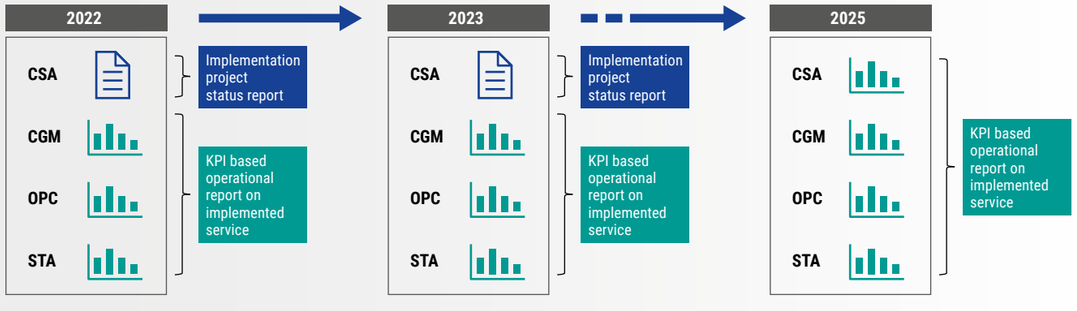

Figure 13: Overview of trajectory towards full reporting of RCC tasks according to SO GL (In the figure the reports refer to the year the reporting data were collected from, based on estimations according to the available information during the creation of the report).

Glossary

ACER	Agency for the Cooperation of Energy Regulators
CCC	Coordinated Capacity Calculation
CCR	Capacity Calculation Region as defined in Article 2.3 of CACM
CCROSA	Coordinated Cross-Regional Operational Security Assessment as defined in Article 33.1(e) of CSAm
CGM	Common Grid Model as defined in Article 3 SO GL and Article 2.2 of CACM
CGMES	Common Grid Model Exchange Standard
COSA	Coordinated Operational Security Analysis as defined in Article 72 of SO GL
CROSA	Coordinated Regional Operational Security Assessment as defined in Article 33.1(b) of CSAm
CSA	Coordinated Security Analysis as defined in Article 75 of SO GL
CSAm	Coordinated Security Analysis Methodology
EMF	European Merging Function
ENS	Energy Not Supplied
ENTSO-E	European Network of Transmission System Operators for Electricity
IGM	Individual Grid Model as defined in Article 2.1 of CACM
KPI	Key Performance Indicator
MC-EnC	Ministerial Council of the Energy Community
MIQCP	Mixed Integer Quadratically Constrained Program
MWh	Megawatt hour
NRA	National Regulatory Authority
NM & FT	Network Modelling and Forecasting Tool
OCR	Outage Coordination Region as defined in Article 3 of SO GL
OPC	Outage Planning Coordination as defined in Article 80 of SO GL
OPDE	Operational Planning Data Environment as defined in Article 3 of SO GL
OPDM	Operational Planning Data Management
OPI	Outage Planning Incompatibility as defined in Article 3 of SO GL
RA	Remedial Action as defined in Article 2.13 of CACM
RAO	Remedial Action Optimiser
RCC	Regional Coordination Centre
RORA	RCC Outage Responsibility Area
ROSC	Regional Operational Security Coordination as defined in Article 76 of SO GL
ROSCm	Regional Operational Security Coordination Methodology RSC Regional Security Coordinator as defined in Article 3 of SO GL
SA	Security Analysis
SAFA	Synchronous Area Framework Agreement
SCC	Security Coordination Centre
SIPS	System Integrity Protection Schemes
SOC	ENTSO-E System Operations Committee
SO GL	Guideline on Electricity Transmission System Operation Commission Regulation (EU) 2017/1485 of 02 August 2017 establishing a guideline on electricity transmission system operation
SOR	System Operation Region as defined in Article 36 of EMR
STA	Short Term Adequacy as defined in Article 81 of SO GL
StG ReC	Steering Group Regional Coordination (SOC)
TLI	Tie Line Inconsistencies
TSC	TSO Security Cooperation
TSO	Transmission System Operator
UCTE DEF	Union for the Co-ordination of Transmission of Electricity Data Exchange Format

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Regional Coordination Assessment Annual Report 2023 (ARTICLE 17 of SO GL)

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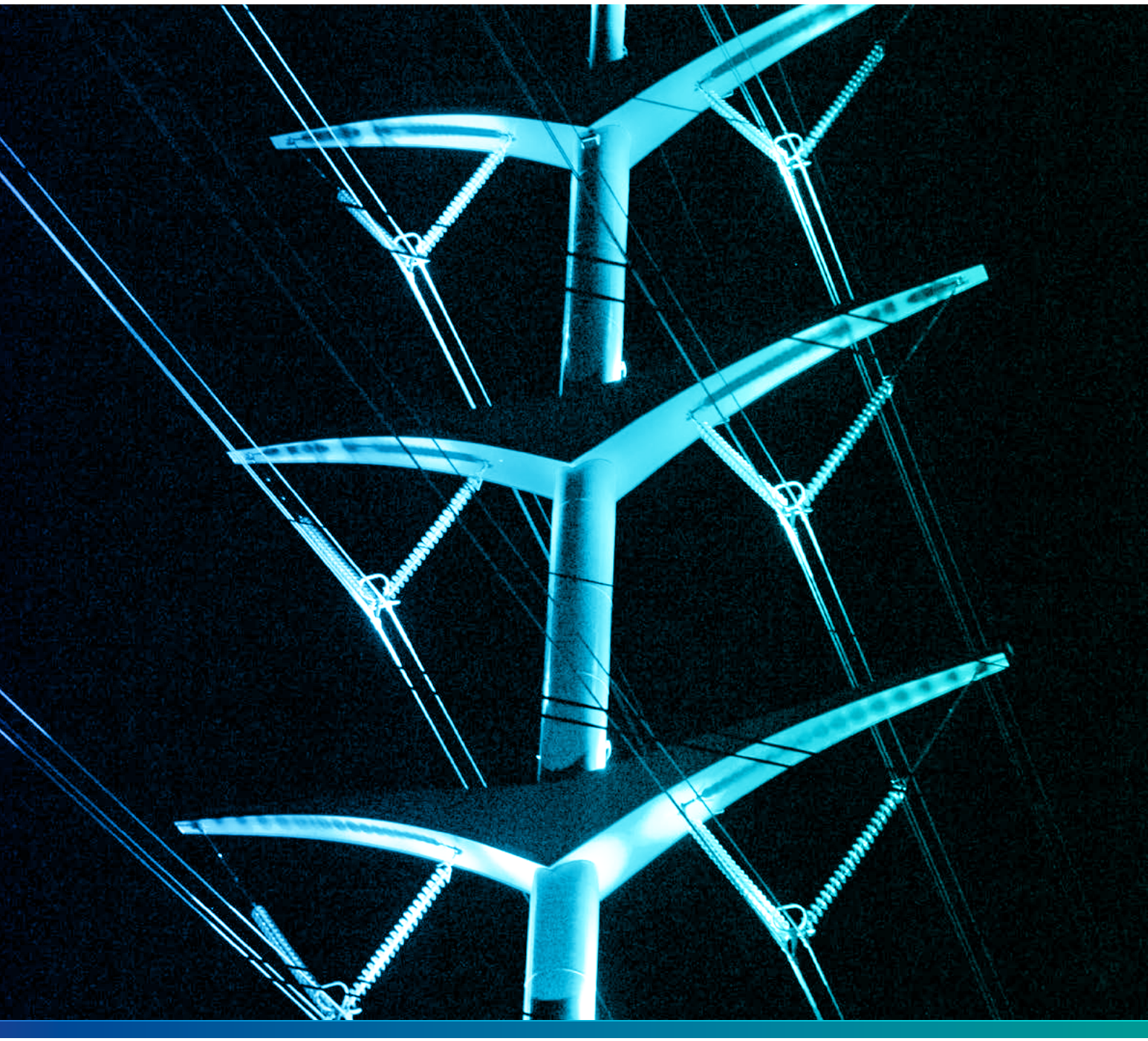

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