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

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

September 2023

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.

Table of Contents

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]. As long as 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 2022, the Outage Planning Coordination (OPC), Short-Term Adequacy (STA) and Common Grid Model (CGM) tasks were in operation. In the pan-European 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 propose solutions to solve them. In the regional STA sub-task, RCCs support 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. The Coordinated Security Analysis (CSA) task according to the requirements set out in SO GL and the CSA methodology (CSAm) is being introduced in all CCRs in addition to the tasks according to the Regional Operational Security Coordination methodologies (ROSCm).

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 Transmission System Operators (TSOs). The status of the implementation of the legally mandated tasks and the best practices applied so far are described in this report.

Regional coordination has taken another step in 2022 with the successful transition of the Regional Security Coordinator (RSCs) of the EU member states to RCCs. Since July 2022, five independent companies have been established according to Article 35 of Regulation (EU) 2019/943 and the respective RCC establishment proposals.

After the successful go-live of the CGM building process in CGMES format in December 2021, an important sign of progress in 2022 was the introduction of the merging of Individual Grid Models (IGMs) based on CGMES format in intraday and day-ahead time-frames.

No interoperability issues related to regional coordination have been identified in 2022; therefore, this report does not contain any 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 RSC services. 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, which means 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.

For the CGM, this is the first Annual Regional Coordination Assessment Report covering the CGM task based on CGMES format.

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

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 is, for example, 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 CSA task will be a regional task performed per Capacity Calculation Region (CCR), 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 other tasks subsequently described.

As a reminder, in all RCCs except Baltic RCC and Nordic RCC, grid models based on the UCTE format are used as input to the legacy tasks. For Nordic RCC and Baltic RCCs, 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 Coordinated Capacity Calculation (CCC) tasks.

During the year 2022[3], only 4 RCCs were involved in the CGM building task (Baltic, Coreso, SCC and TSCNET). SEleNe CC's European Merging Function (EMF) tool was under development in 2022. It is expected that SEleNe CC will be part of the rotational schedule for the CGM building task in 2023. Nordic RCC is evaluating the options for joining other RCCs' EMF development projects, in order to carry out the CGM building task.

2.1 Scope: Pan-European

According to SOC decision Number 11 from 04.12.2019, 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. For this reason, where relevant, KPIs presented in this report shall refer only to the Main and Backup RCC responsible according to the rotational schedule.

2.2 Time-frames

During the reporting year 2022, CGMs have been built in the following time-frames:

- **D-1 (1 run of CGM building process to provide 24 models for each day[4])**
- **ID (3 runs of CGM building process to provide 24 models for each day[5])**

Year-ahead (Y-1) and week-ahead (W-1) time-frames were not part of the CGM building task in 2022, and related KPIs will be provided in further reports.

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 in CACM and FCA is not part of this report

3 As per the Minimum Viable Solution Agreement related to CGM OPDE, the contract supporting the CGM building task started as of 10 January 2022. Therefore, the CGM KPIs reported are covering the period from 10 January to 31 December 2022

4 Or 23/25 models due to Daylight saving time

5 Or 23/25 models due to Daylight saving time

2.3 CGM KPIs

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

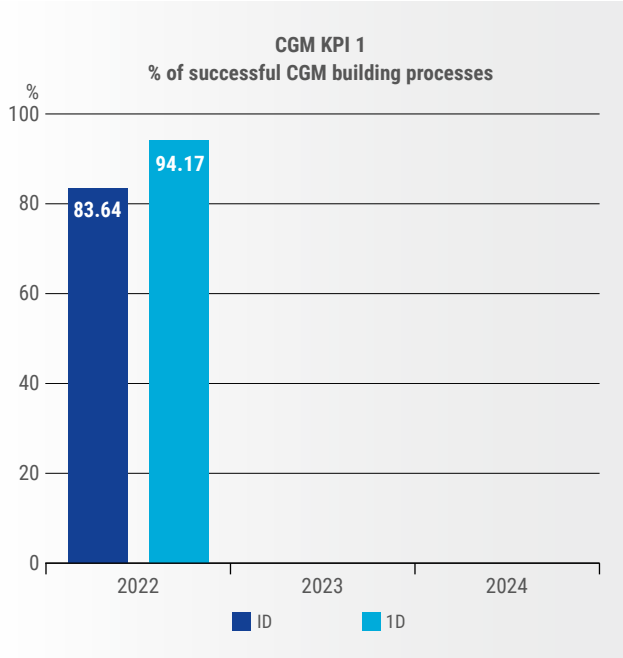


Figure 1: CGM KPI 1: Percentage of successful CGM building processes

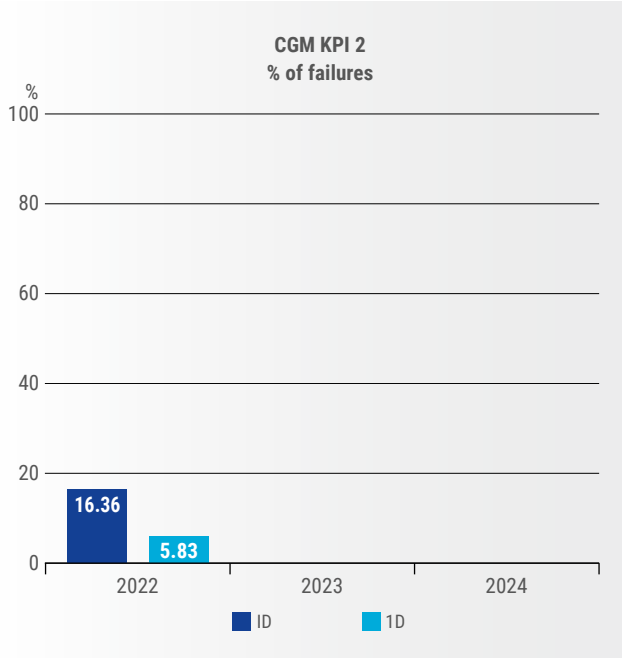


Figure 2: CGM KPI 2: Percentage of failures

CGM KPI 1: Percentage of successful CGM building processes

Description: CGM KPI 1 represents the percentage of successful CGM Building processes compared to all 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.[6]

CGM KPI 2: Percentage of failures and reasons for failures

Description: CGM KPI 2 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.[7]

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 on the following page for details).

6 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.

7 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.

The figures associated with the missing CGM building process in Table 1 below shall be applicable to CGM KPI 2 for the corresponding time-frame.

The numbers show that most of the issues reported in 2022 were related to data quality for the Intraday timeframe, and to IT infrastructure for the Day-Ahead timeframe. 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	49.28 %	77.97 %	17.87 %	56.43 %
IT issue on SP side	12.45 %	0.86 %	45.58 %	14.86 %
IT issue on RCC side	4.22 %	2.00 %	7.43 %	0.60 %
OPDM Client issue	34.05 %	19.17 %	29.12 %	28.11 %

Table 1: Reasons for failure associated with CGM KPI 2

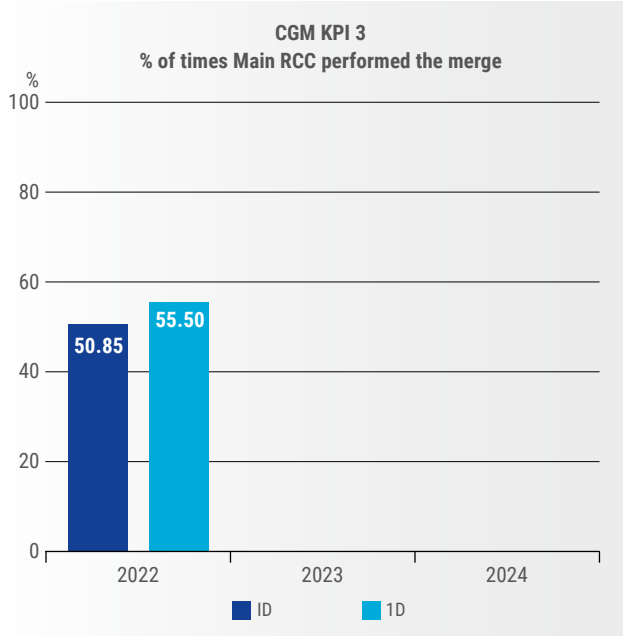


Figure 3: CGM KPI 3: Percentage of times Main RCC performed the merge

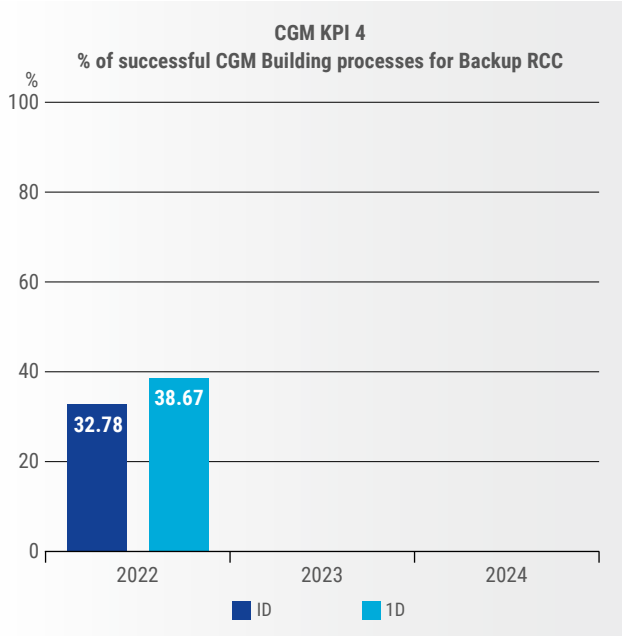


Figure 4: CGM KPI 4: Percentage of successful CGM Building processes for Backup RCC

CGM KPI3: Percentage of times Main RCC performed the merge

Description: CGM KPI 3 represents the percentage of successful CGM Building processes compared to all processes performed on a pan-European level when performed by the Main RCC for each time-frame.[8]

Figure 3 explains that for more than half of the CGM Building Processes, the result from Main RCC were available for both Intraday and Day-Ahead timeframes. For the remaining half of the processes, the Backup RCCs results were necessary, according to the rotational calendar.

CGM KPI4: Percentage of successful CGM Building Processes for Backup RCC

Description: CGM KPI 4 represents the percentage of successful CGM Building processes compared to all processes performed on a pan-European level when performed by the Backup RCC for each time-frame.[9]

8 + 9 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. 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 a 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 in accordance with Article 75 of SO GL. Consequently, regional coordination assessment reporting (Article 17 of SO GL) is also provided per CCR.

3.2 Legacy Security Assessment

Even before 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.

For instance, at TSC (TSO Security Cooperation – a voluntary cooperation of Central European TSOs) a basic security assessment process has been running for the last decade. The service was designed by TSC TSOs and TSCNET, with the main objective to enhance 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 TSOs, considering the need for 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 on 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 on 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, 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 Coordinated Security Assessment – according to SO GL requirements

RCCs shall perform SA 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 CSA 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 CSA task 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 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 an 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 ACER and the National Regulatory Authorities (NRAs).

Until the implementation of ROSC methodologies, RCCs continue to provide the current legacy SA tasks. As the CSA task was not operational in 2022 according to the SO GL requirements, no KPIs can be calculated for the year 2022.

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

3.3.1 Baltic RCC – Baltic CCR

CSA development process, procedures and main requirements were defined in the Baltic ROSC. According to the regional detailed CSA implementation plan, the task implementation is divided into two development phases: Phase 1 is an interim solution to test the CSA task provision based on the D-2 time-frame. The Baltic RCC gathers Baltic TSOs' IGMs from OPDE and performs regional merging, including other relevant TSO's models, to get a regional merged model in CGMES format (hereinafter – RMM). This RMM is used to perform CSA by running a contingency analysis and determining RA (hereinafter – RA) in case of violations were identified. Phase 1 was finalised on 30 December 2022.

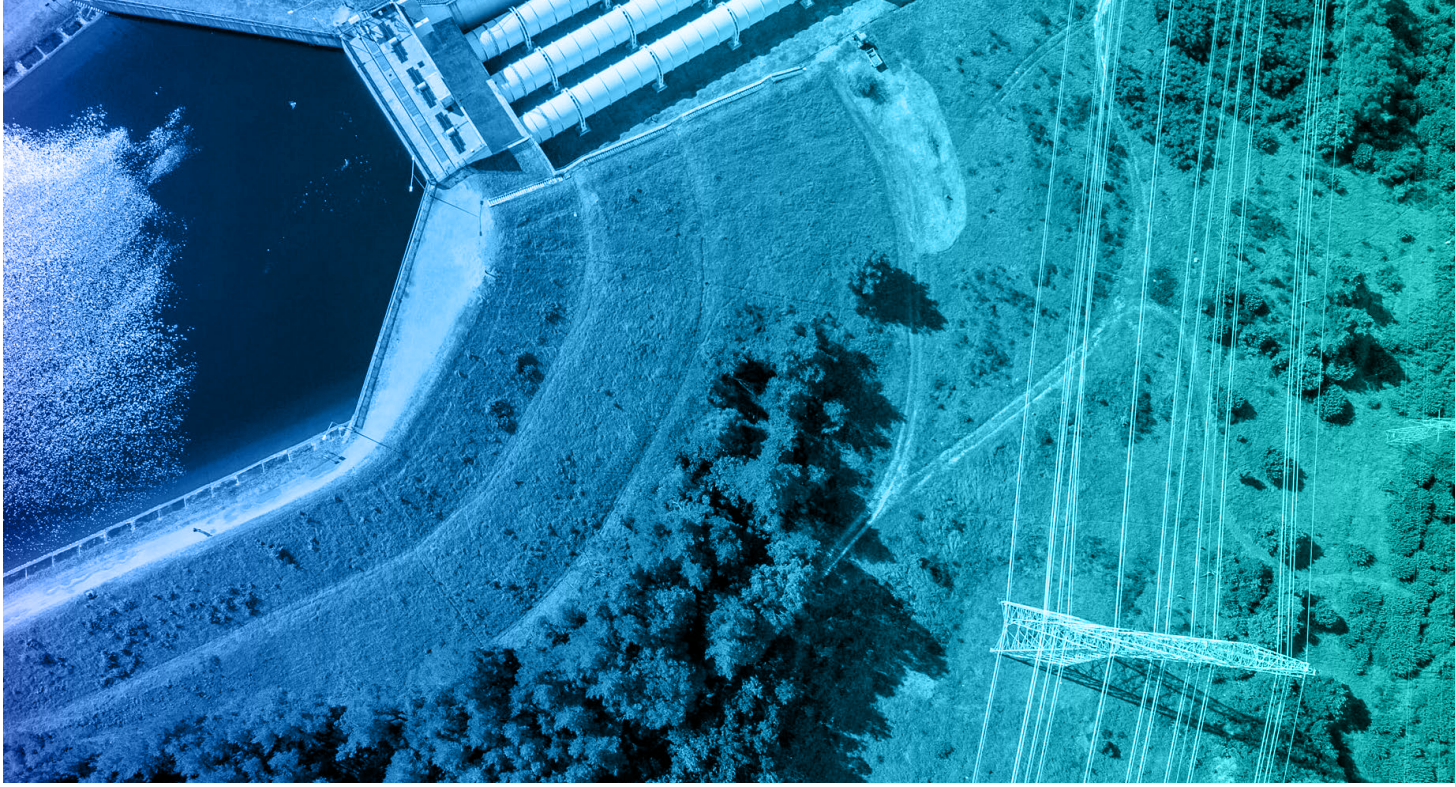
Phase 2 implementation scope includes the SA on day-ahead RMM considering the N-1 criterion to identify potential thermal and voltage violations and coordination RAs among Baltic SOR TSOs and Baltic RCC. If a constraint is detected, the Baltic RCC shall recommend to the relevant TSO the most effective and economically efficient RA. The Baltic RCC also coordinates the preparation of RAs with and among TSOs to enable the coordinated activation of RAs. The go-live of Phase 2 is expected in Q1 2024.

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 CSA processes for two CCRs – Core CCR and Italy North CCR. The timeline for implementing the CSA process in each CCR is defined at the regional level.

In the Core CCR, a stepwise implementation of the CSA task is foreseen. In April 2024 (expected postponements approved by Core TSOs to Q2 2025 if go-live is only for DA CROSA and to Q4 2025-Q2 2026 if go live includes ID CROSA), the first version of the target solution with reduced scope is expected while the final target solution is planned to be implemented in June 2025 (expected postponement approved by Core TSOs to Q4 2026).

In the Italy North CCR, the target version will be implemented in early 2026 (possible postponement to Q3/Q4 2026 or Q1/Q2 2027). To exploit the synergies in the 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 CSA 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 ROSC 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.

3.3.4 Nordic RCC – Nordic CCR

The simplified first version of the CSA task has been performed by Nordic RCC since April 2022 when Nordic TSOs agreed to introduce operators on duty to assess the results of the CSA analysis. The process starts every day at 18:00 by initiating a contingency analysis which covers the day-ahead time-frame, and it delivers a subset of results to operators no later than 20:00, when an online meeting is held to discuss them between TSO and RCC operators.

The CSA consists of simulating a large number of fault scenarios where one or more elements are disconnected, and the resulting cross-border impact is assessed. The focus of the first version of the process is to identify potentially overloaded elements in the network and ensure operators gain insight in the process.

The calculations are based on the D-1 regional merged model in CGMES format, which contains updated grid topology as well as generation and load setpoints derived by the day-ahead market clearing. Furthermore, the additional data necessary to perform an SA includes: a list of outage scenarios to be simulated, Power Transfer Corridors (PTC) with associated limits and system integrity protection schemes (SIPS), which describe automatically triggered responses to specific system states.

CSA calculations are based on D-1 RMMs, and the validity and trustworthiness of results are directly related to the quality of the input data. This partly explains why, in February 2023, the Nordic TSOs decided to discontinue the task temporarily to allow for data quality improvements.

Subsequent versions of the task will include the suggestion of optimal RAs to either act pre-emptively or ensure cost-effective measures are in place should the outage scenario occur during operation.

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

Concerning ROSC, SEE TSOs requested an official extension from NRAs until the end of 2025. In the meantime, high level business process documents have been prepared by SEleNe CC, describing in detail operational issues regarding ROSC implementation. Technical requirement and specification documents have also been created.

3.3.6 SEleNe CC – GRIT CCR

The process based on ROSC 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 program 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 of the CSA modules, whereas a dedicated Remedial Action Optimiser (RAO) is going to be developed separately.

The go-live has been postponed to April 2025 after a change request from TSOs to the NRAs.

The input data readiness of the TSOs (following the CSA input data standard) is constantly progressing and enhancing, paving the way to the provision of specific data.

The design and the developments of the RAO and the other features of the CSA process are about to be launched in Q2 2023 and are expected to deliver by early 2024 to enable the start of parallel runs and to ensure the deadline is met.

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 the 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 is expected that during 2023, this decision will be implemented in national regulation in WB6 EnC Contracting Parties.

For non-EU SEE TSOs – signatories of SAFA, who agreed to develop and implement 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, SCC and TSOs that are simultaneously SCC service users and signatories of the SAFA document (CGES, EMS, MEPSO, NOSBiH and OST) began activities towards 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** – Project Group consisted of technical experts from SAFA WB TSOs and SCC was established in October 2021, which finalised its work 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 August 2022, the existing Project Group was expanded with lawyers and high-level representatives of SAFA WB TSOs, with a goal to prepare the Agreement for the implementation of SAFA WB ROSC methodology and business process (aka Agreement for SAFA WB ROSC project).

This expanded Project Group created proposal of the Agreement, including 3 annexes of the Agreement which describe SAFA WB ROSC project in details: terms of reference, project management structure and project budget. It is expected that the SAFA WB ROSC project will begin during 2023, when all entities approve the proposed Agreement.

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 the RCCs on a rotational basis. With SEleNe CC joining the rotation from September 2022, all RCCs are involved in the pan-European OPC task.

On 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 case it identifies potential congestions, it shall suggest RAs and validate if the coordinated unavailability plan is feasible in terms of security limits, as well as recommend to mitigate any potential detected outage planning incompatibilities with the issuing of 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 2022 report, so we report on the Y-1 process performed in 2022 for 2023.

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 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 a 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"* [10]. In line with this, the different regions are subject to different interpretations of the regional OPC process, which affect certain regional KPIs.

In the SEE region, both the pan-European OPC task and Regional OPC task covering W-1 and Y-1 time-frame went live on Q3/2022.

Baltic RCC and 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.

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 2022	Week-ahead OPI	**n/a**	**52** (1/week)	**0**	**52** (1/week)	**672** 42 time-stamps/ week, 16 weeks after go-live	**2.184** 42 time-stamps/ week
	Year-ahead OPI	10	52 (1/week)	5 (outage situation selected by experi-ence)	52 (1/week)	104 (2/week)	104 (2/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

10 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
- **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 2022, a process failure was recorded only if the interruption of task delivery took more than one hour to resolve. The KPI value for 2021 was reviewed accordingly. No such incident was recorded in 2022.

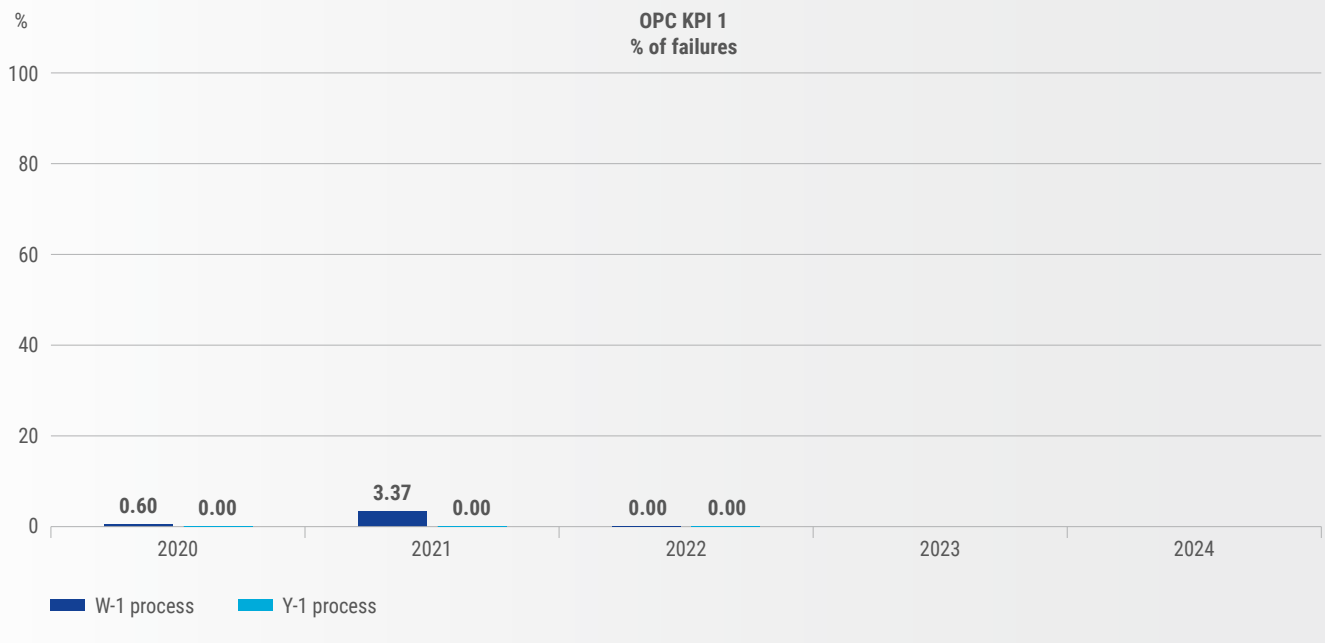


Figure 5: OPC KPI 1: Percentage of process failures per year

Reason for failures

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

Table 3: 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 2022 results 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.

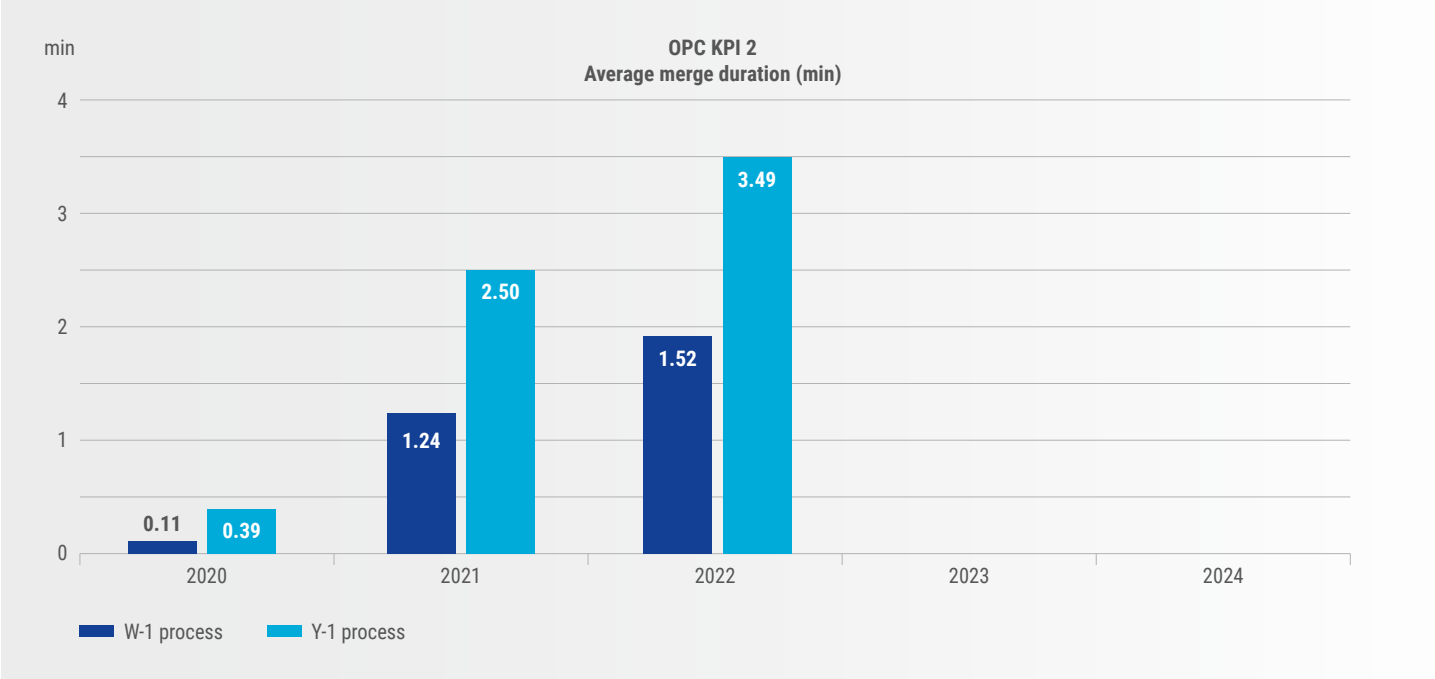


Figure 6: OPC KPI 2: Average merge duration in minutes

4.4.2 OPI KPIs[11]

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.

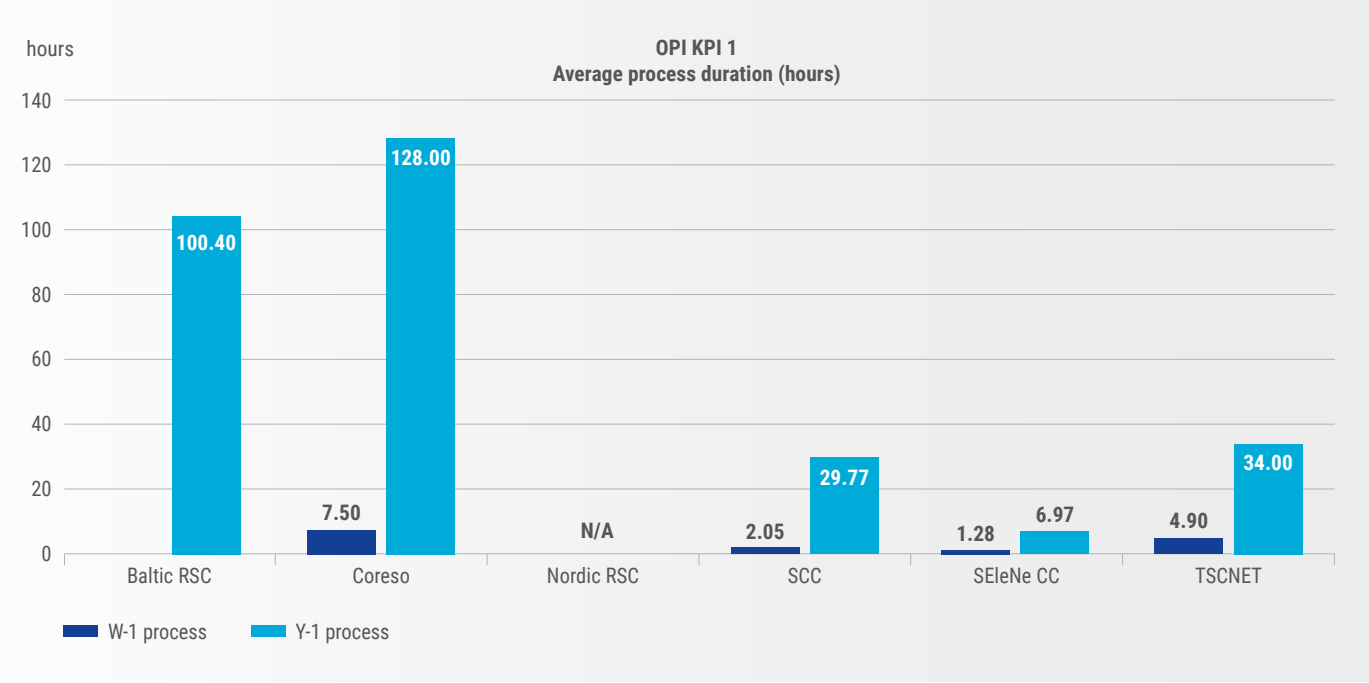


Figure 7: OPI KPI 1: Average process duration in hours

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 2022, 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 SEleNe CC, the W-1 OPI process failed once due to IT issues.

For TSCNET, the W-1 OPI process failed three times due to input data quality issues and once due to IT issues. In the Y-1 OPI process, there were three 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 on weekly and yearly basis and manual backup procedures are available in case of failure of the automated processes.

11 Coreso, TSCNET and SCC and SEleNe 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

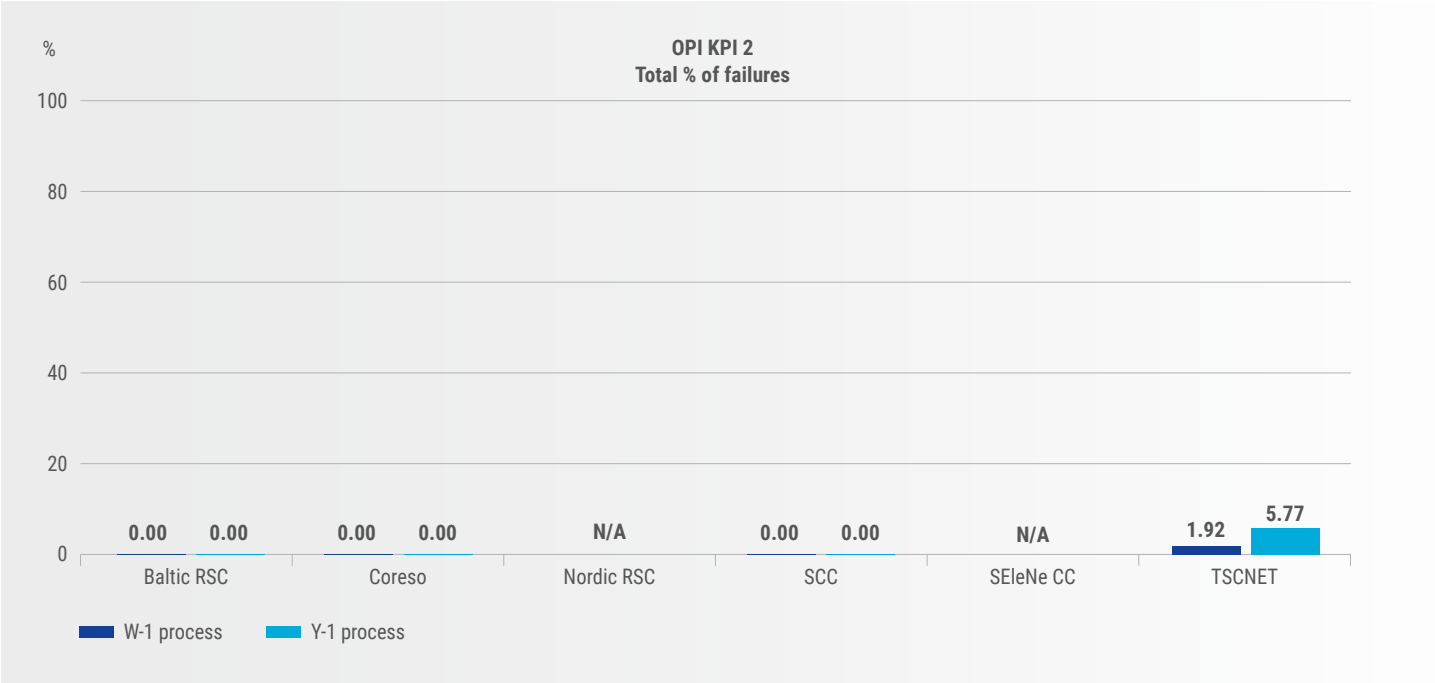


Figure 8: OPI KPI 2: Percentage of total failures

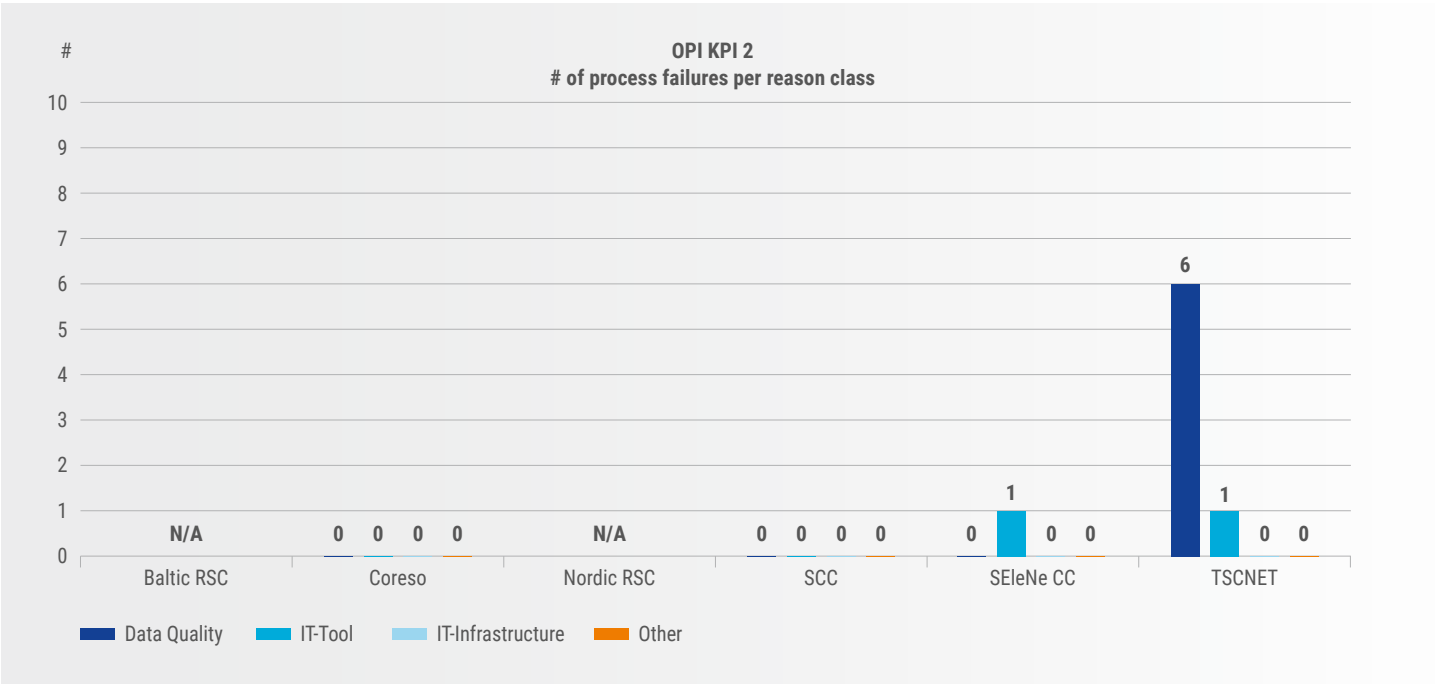


Figure 9: OPI KPI 2: Number of process failures per reason classification

Reason for failures

Number of failures in 2022	Baltic RSC	Coreso	Nordic RSC	SCC	SEleNe CC	TSCNET
Data Quality	0	0	N/A	0	0	6
IT – Tool	0	0	N/A	0	1	1
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 2022; 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.

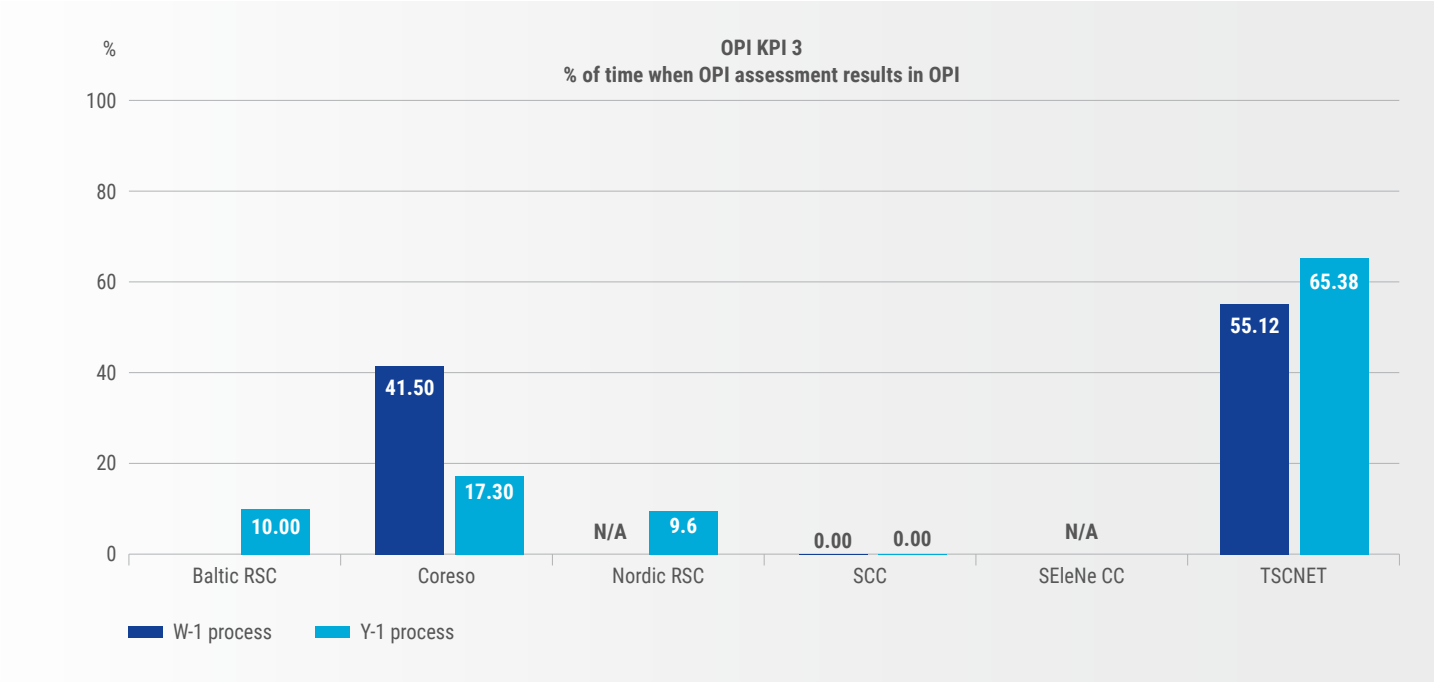


Figure 10: OPI KPI 3: Percentage of time when OPI assessment detects an OPI

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 and operational security limits. Based on this assessment, RCCs will provide recommendations to TSOs to achieve overall adequacy.

In the pan-European STA process during 2022 until July, calculations were monitored (and operational tasks such as communication with TSOs and IT tool provider, data upload etc. were performed) by five RCCs, Coreso, TSCNET, SCC, Nordic RCC and Baltic RCC, taking responsibility on a rotational basis. Since September 2022 SEleNe CC joined the task provision of the pan-European STA task . For each week there is one main responsible RCC and one Backup RCC, activated in case 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.

At SEleNe CC, the regional STA is currently executed (when necessary) for ESO (Bulgaria) and IPTO (Greece) on a regional level. The go-live for the regional STA was on 1 January 2022.

After internal agreement, Nordic TSOs and RCC will join the Regional STA process in a 2-step approach:

1. **Nordic TSOs and RCC will join the initial teleconference if requested by neighbouring TSOs, proposing possible RAs to relieve the situation and support the other TSOs.**

2. **In the near future, Nordic TSOs and RCC will join the entire Regional STA process when triggered and if the adequacy issue is detected in the Nordic bidding zones. This means that at that time, the Nordic RCC will take the responsibility of being the RCC leader.**

During 2022 the first step was performed, while the second step is planned for the near future with no concrete date of implementation currently. Accordingly, no regional KPI is collected for the Nordic RCC for 2022.

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 would be maximum 365*2 (or 366*2 in leap years). The number of runs in 2022 was 388, while both calculations and the reporting part of the process failed once each.

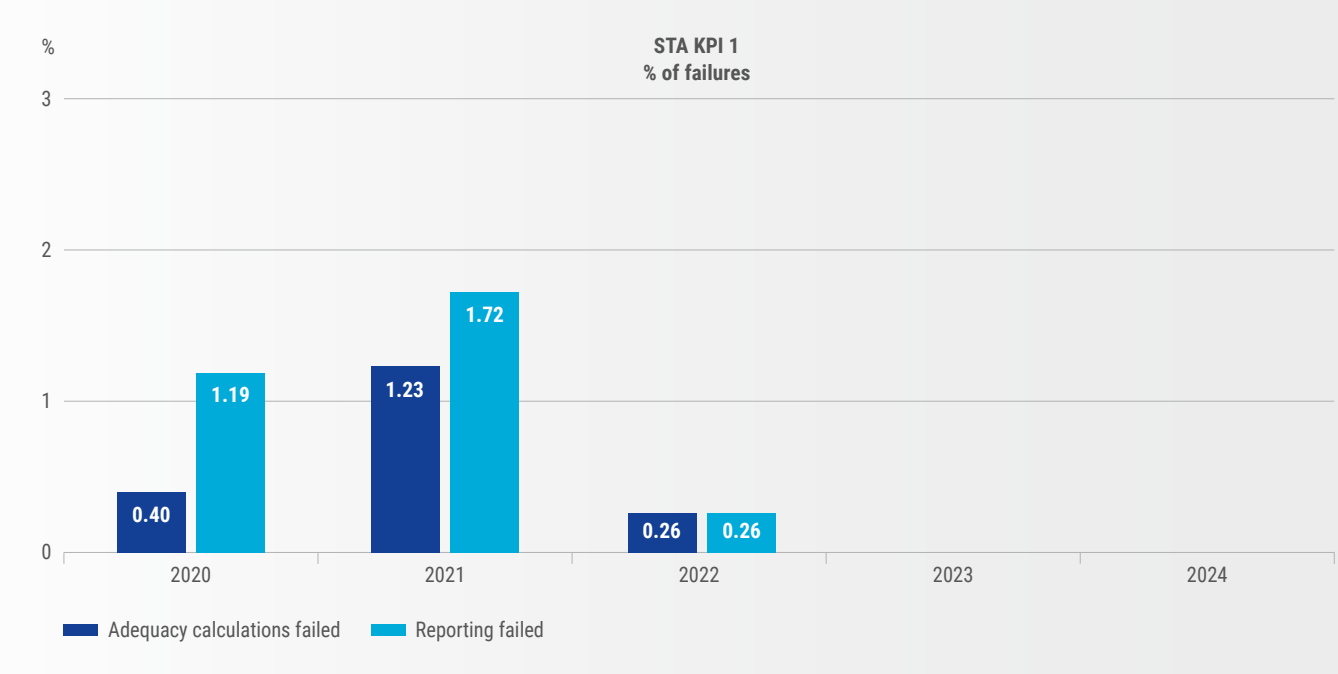


Figure 11: STA KPI 1 – Percentage of failures

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. In addition, from 2021 the cross-regional STA process increased from 500 scenarios in the probabilistic calculation to 10,000 scenarios, which is why in 2021 it was on average longer regarding 2020. During 2022 there was not such a change that would affect calculation duration, so the average duration in 2022 is the same as the average duration in 2021.

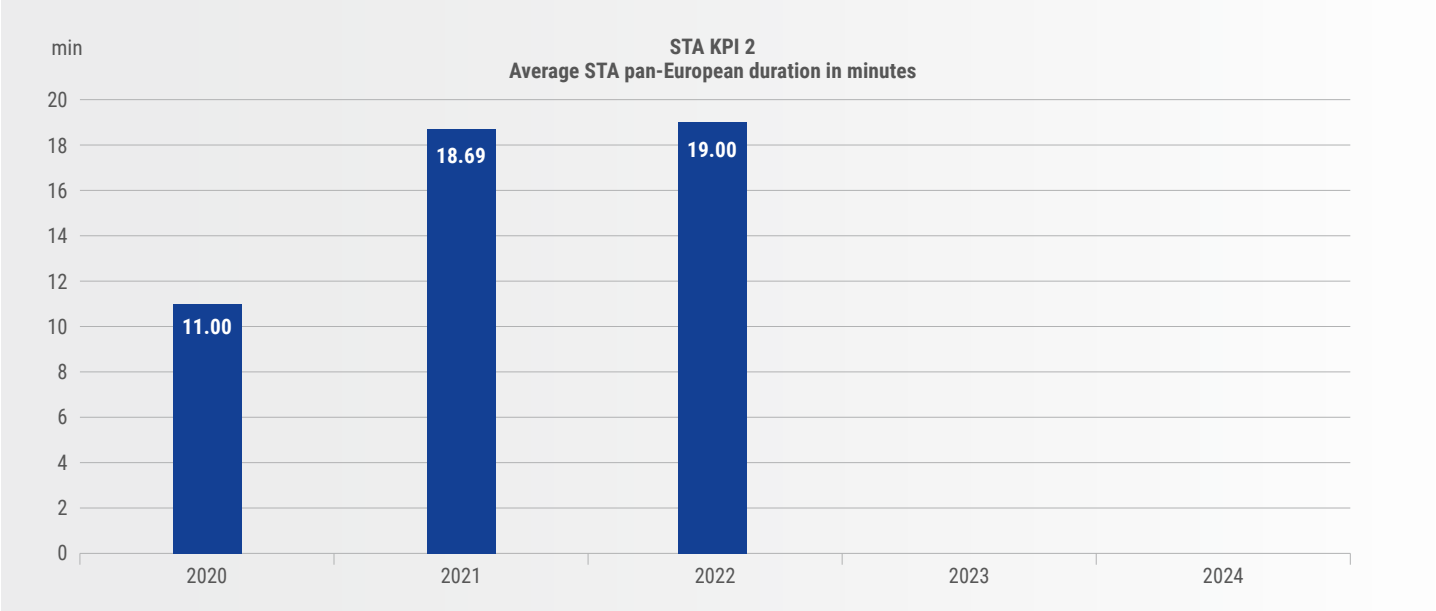


Figure 12: STA KPI 2 – Average STA pan-European process time

5.3.3 STA KPI 3: Description of regional adequacy assessments performed

Description: The following table presents the details of the launched regional STA process in 2022.

Regional STA process launched in 2022

No.	Date of Assessment	Date of Event	RCC leader	No. of concerned TSOs	Inadequacy duration	ENS [MWh]	Proposed mitigation action
1	2022-04-01	2022-04-04	Coreso	7	3	1.196	Increase of Generation & Increase of Transmission Capacity

No.: Order number of inputs

Date of Assessment: Date when the pan-European 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 Main affected TSO is in 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 5: Regional STA process launched in 2022

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 list of implemented tasks was extended with the CGM task in this report.

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.

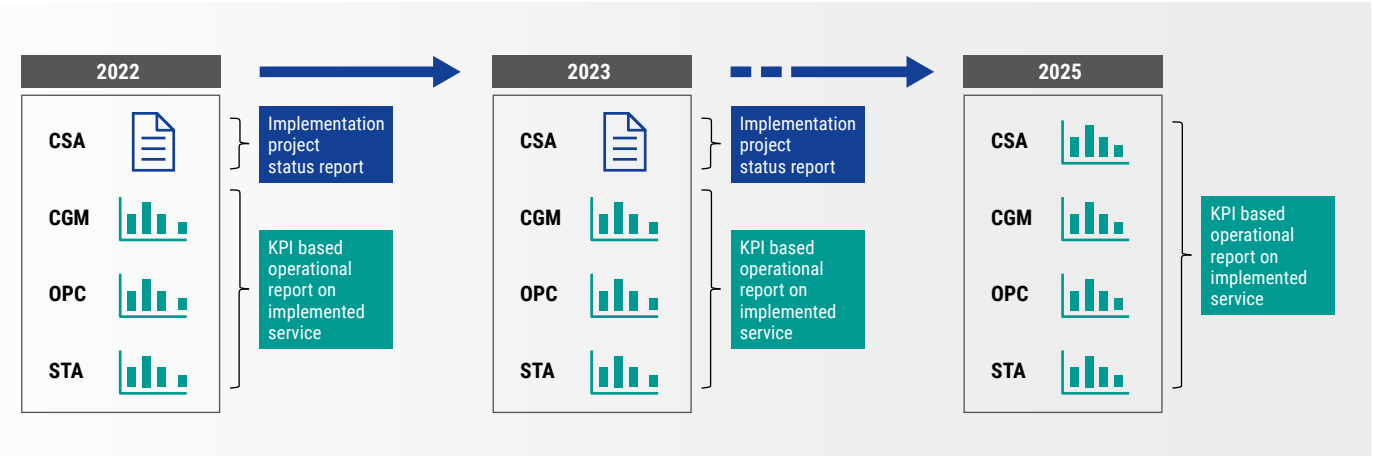


Figure 13: Overview of trajectory towards full reporting of RCC tasks according to SO GL (In the figure the reports refer to the year the reporting data were collected from, based on estimations according to the available information during the creation of the report).

Glossary

ACER	Agency for the Cooperation of Energy Regulators
CACM	Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management
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
CROSA	Coordinated Regional Operational Security Assessment as defined in Article 33.1(b) of CSAm
COSA	Coordinated Operational Security Analysis as defined in Article 72 of SO GL
CGM	Common Grid Model
CGMES	Common Grid Model Exchange Standard
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
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
PTC	Power Transfer Corridor
RA	Remedial Action as defined in Article 2.13 of CACM
RAO	Remedial Action Optimiser
RCC	Regional Coordination Centre
RMM	Regional Merged Model
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

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

Cover: Courtesy of TenneT Germany
p. 11: Courtesy of PSE Operator
p. 12: Courtesy of Fingrid, © Matti Immonen
p. 14: Courtesy of EMS
p. 20: Courtesy of Amprion
p. 24: Courtesy of SEPS

Publishing date

September 2023

European Network of
Transmission System Operators
for Electricity

entsoe