ENTSO-E

Regional Coordination Assessment Annual Reporting

July 2021

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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 42 member TSOs, representing 35 countries, are responsible for the **secure and coordinated operation** of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

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

Our mission

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

Our vision

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

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

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

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

Our values

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

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

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

Our contributions

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

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

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

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

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

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Executive Summary

To fulfil the obligations from Art. 17 of the 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. It contains key-performance indicators (KPIs) for the services provided by the Regional Security Coordinators (RSCs). As long as a service is not fully implemented, RSCs agree on a statement together regarding whether a legacy service (i.e. a service implemented by RSCs on a voluntary basis prior to the legal requirements) is in place, what it consists of and if the RSC has started working towards an enduring service.

In the reporting for the year 2020, the pan-European Outage Planning Coordination (OPC) and Short-Term Adequacy (STA) services operated according to the methodology approved by the regulatory authorities. The Outage Planning Incompatibility (OPI) service is partly in operation in some RSCs, whereas the Coordinated Security Analysis (CSA) and Common Grid Model (CGM) services, according to the requirements set in SO GL and the respective methodologies (CSAms, Regional Operational Security Coordination methodologies [ROSCms] and CGMms), are still at different stages of implementation. It is important to note that, on a regional level, and based on the voluntarily organised regional security cooperation of the Transmission System Operators (TSOs), there are already CSA and CGM processes implemented in daily operational practice. This report describes the current status of the implementation of the legally compliant services and the good practices applied so far. The next big step is expected in 2021 with the implementation of the pan-European CGM service.

In total, the regional coordination assessment shows well established RSCs with high-quality performance and good cooperation in cross-regional issues.

1. Introduction

Under Art. 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 Art. 17 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. […]"

Some of the services, which the RSCs shall report on according to Art. 17 SO GL, are still under implementation according to the methodology approved by the regulatory authorities. However, following discussions which took place in the context of the System Operation Coordination Group, ACER and NRAs highlighted the need for a report to be produced in September 2021, even if it does not cover all services. This report distinguishes between legally compliant services and legacy services:

- Legally compliant services are services fully implemented according to legal requirements; and
- Legacy services are services implemented on a voluntary basis prior to the legal requirements from the methodologies approved by the regulatory authorities. This is because RSCs have been operational even prior to the entry into force of the existing legal framework.

Currently, OPC and STA are legally compliant services. For the Common Grid Model (CGM) and Coordinated Security Analysis (CSA), although they are not yet legally compliant services, there is progress, whereas different RSCs have legacy services in place to varying degrees.

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

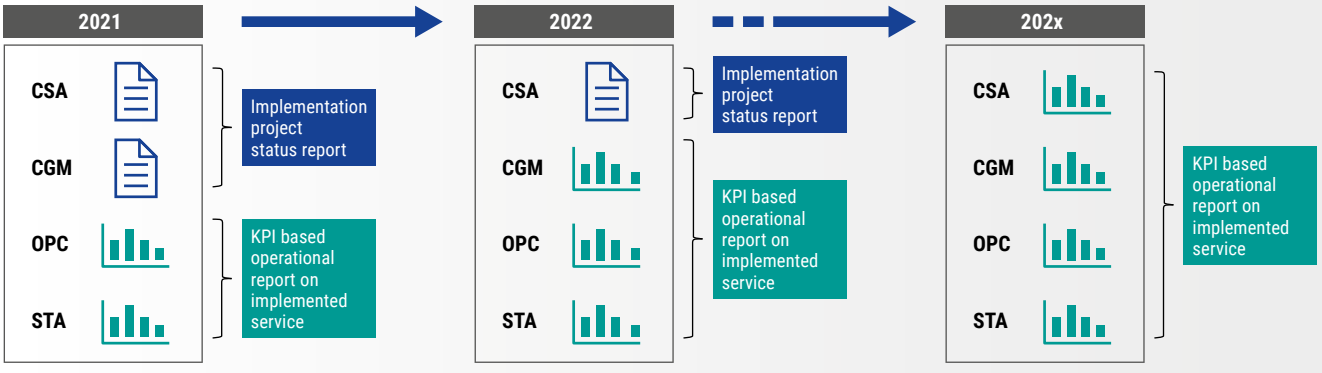

Figure 1: Overview on the trajectory towards the full implementation of RSC services

Certain points of the required data can be generalised for all services and provide an overview of the performance of the RSCs, which demonstrates how successful and reliable the provision of the different services is. These are derived from Art. 17 (2) (a) SO GL. The KPIs in the report, which can be clearly connected to a specific service, are derived from Art. 17 (2) (b) – (e) SO GL. Specifically, Art. 17 (2) (b) and 17 (2) (c) refer to CSA, Art. 17 (2) (d) refers to OPC, and Art. 17 (2) (e) refers to STA. It is important to note that this report consolidates data received from all RSCs which are covered by the SO GL, namely the Baltic RSC, Coreso, Nordic RSC, Selene CC and TSCNET Services, as well as the South-east Europe RSC (SCC).

2. Common Grid Model

In the CGM Build Process, RSCs merge Individual Grid Models (IGMs) provided by TSOs into a pan-European CGM as set out in various Network Codes including the SO GL. The IGMs cover timeframes spanning from one year before real time to one hour before real time. The CGM Build Process is a prerequisite for several services harmonised in the Network Codes, including short- and long-term Capacity Calculation (CC), CSA, OPC, and STA, and the basis for pan-European system operation services.

The legally mandated scope of the CGM Build Process includes the year-ahead (Y-1), two-day ahead (D-2), one-day ahead (D-1) and intraday (ID) timeframes. The week-ahead (W-1) timeframe can be added to the legally mandated scope. The CGM is created on a rotational basis, with at least one leading and one backup RSC performing the merge for each timeframe. The CGM from the leading and backup RSC shall both be according to legal requirements and to the same standard. As the Minimum Viable Solution Go-Live of the CGM Build Process is scheduled for end of 2021, the capability for the pan-European exchange of network model data between TSOs and RSCs will be in operation only beyond 2020. With the Go-Live of the Minimum Viable Solution of the CGM Build Process, quality and statistical indicators will be available and provided in the 'Annual report on regional coordination assessment', in accordance with Article 17 SO GL.

The collaboration of ENTSO-E, TSOs and RSCs is key for the successful implementation of the CGM Build Process. RSCs are actively participating in the CGM Operational Preparation and the user testing to ensure the transition from delivery to operations of the CGM Build Process. For the operation of the CGM Build Process beyond 2021, IGMs and CGMs need to comply with the Common Grid Model Exchange Standard (CGMES) and need to be exchanged over ENTSO-E's Operational Planning Data Environment (OPDE). For successfully merged CGMs, the timely and quality delivery of IGMs is a prerequisite. The official CGM creation process is not running in all RSCs, but some RSCs have legacy services in place, such as the creation of a Continental Europe merged model in the former data format UCTE-def. All RSCs are actively participating in the go-live testing organised by ENTSO-E to ensure the go-live of the CGM programme by end of 2021. The Minimum Viable Solution Go-Live of the CGM Build Process will enable the migration of services to the CGMES and ENTSO-E's OPDE.

3. Coordinated Security Analysis

CSA is performed in Day-Ahead and ID timeframes to ensure the security of the grid: meaning that all operational security violations must be managed in N situation and also in N-k situation (normally N-1, but sometimes "k" can differ from 1; N-k situation is defined in the regional CSA methodologies). This CSA process is based on the CGM input associated with additional specific CSA input, such as the list of outages and available Remedial Actions (RAs). RSC tools and operators then run an optimisation per Capacity Calculation Region (CCR), followed by a coordination of RAs. The CSA Process shall be refined from the day-ahead process in ID when updated information is available, such as updated ID IGMs / CGMs.

Depending on the ROSCms (Art. 76 of SO GL), either every constraint is associated to every RA and it is not possible to differentiate the cost for solving a dedicated constraint, or a mapping process exists and allows a cost to be associated with a constraint for solving it.

CSA is performed per CCR, in accordance with the ROSC methodology of the CCR (developed in accordance with SOGL Art. 76) and the CSA methodology (developed in accordance with SOGL Art75). Consequently, regional coordination assessment reporting (SOGL Art. 17) is also provided per CCR, even if the process for coordinated actions is eventually to be decided per SOR (Art. 42(1) of Regulation (EU) 2019/943).

The CSA service was not fully operational according to the SO GL requirements in the year 2020. Therefore, no common KPIs can be calculated for the year 2020. To enable RSCs to perform the CSA service, the CSA process requires TSOs to provide RSCs with different inputs:

- Their IGMs that will be merged into a CGM
- The list of their assessed elements
- The contingencies that need to be simulated
- The available RAs

Due to the missing CGM model, as of this year the RSCs are providing the coordinated security analysis to their TSOs using the existing grid models for day ahead and ID timeframes. The process consists of running a security analysis to identify potential congestions on high voltage grid elements situated in the interest and observability area. RAs are coordinated to relieve the constraints, according to TSOs' operational criteria. Contact with TSO's operators is established to validate the RAs proposed by the RSC for the specific grid situation.

The timeline for implementing the CSA process in each CCR has been defined in the ROSCms of each CCR. However, this is also dependent on the availability of the CGM service as a basis. All RSCs already have something in place, ranging from semi-manual or even semi-automatic coordination to approximately 10-year professional experience with individually developed CSA analysis tools and services.

4. Outage Planning Coordination

OPC establishes a common medium- and long-term outage planning process based on the requirements predefined in SO GL. The main advantage of the process is the common database of the planned outages, with a coordinated procedure of ensuring the quality of the data, e. g. by the validation of information about the planned status of the cross-border lines of the TSOs. The OPC Process has been performed on the Pan-European Tool since 31 March 2020; this means that European TSOs and RSCs use the Pan-European Tool to provide OPC services at the pan-European level. This tool was designed to calculate the KPIs defined in Article 17 SO GL.

Following the foundation of the pan-European OPC process, regional Outage Planning Incompatibility (OPI) processes are also performed by some RSCs as per the methodology document derived from SO GL Art. 80. The goal of this process is to detect and solve regional outage planning incompatibilities. This means the state when the combination of the availability status of one or more relevant grid elements, relevant power generating modules, and / or relevant demand facilities, as well as the best estimate of the forecasted electricity grid situation, leads to a violation of operational security limits considering the non-costly RAs at the TSO's disposal. The RSCs shall ensure that the KPIs defined in this document are calculated by their tool. The regional OPI processes are not completely comparable and display some significant differences among the RSCs, according to the affected TSOs' requirements. The table below summarises the main characteristics of these OPI processes:

		Coreso	SCC	TSCNET
Calculation method		Manual	Semi-automatic *Note: Application of outages and security analysis are performed in an automatic manner, whereas RA function is performed manually.*	Automated (more complex process: automated optimisation, to be scalable for more timestamps)
RA selection method		Manual identification based on expert knowledge and operational rules No explicit guarantee of optimality and limited reproducibility	Manual identification based on expert knowledge and operational rules No explicit guarantee of optimality and limited reproducibility	Automated MIQCP based optimisation MIQCP is a general framework which guarantees the optimality within the MIQCP modelling limits and reproducibility
Number of timestamps calculated in 2020	**Weekly OPI**	53 (1 / week)	53 (1 / week)	107 (7 / week, 1 / week until November 2020)
	Yearly OPI	53 (1 / week)	53 (1 / week)	53 (1 / week)
What is considered OPI in this report?		OPI cases confirmed by the respective TSOs.	OPI cases confirmed by the respective TSOs.	All OPI cases identified by the OPI calculation.

Table 1: Regional characteristics of the OPI process

Input data are collected and considered for the timeframes W-1 and Y-1. The KPIs for both the pan-European OPC and the regional OPI service are:

- **OPC KPI 1:** % failures and reasons for failures
- **OPC KPI 2:** Average merge duration per process timeframe
- **OPI KPI 1:** Average duration of OPI calculation
- **OPI KPI 2:** failures and reasons for failures
- **OPI KPI 3:** % of times when OPI assessment results in identified OPIs

4.1 OPC KPIs

OPC KPI 1: % of process failures and reason for failure

Description: The ratio of failed processes compared to all processes performed at a pan-European 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 not fitting into this category is covered in the "Other" class.

In 2020, almost all of the OPC merges provided results until the expected deadline. In one case, the weekly merge interfered with the non-mandatory monthly merge and therefore failed. That process was rescheduled manually and was performed successfully one hour later.

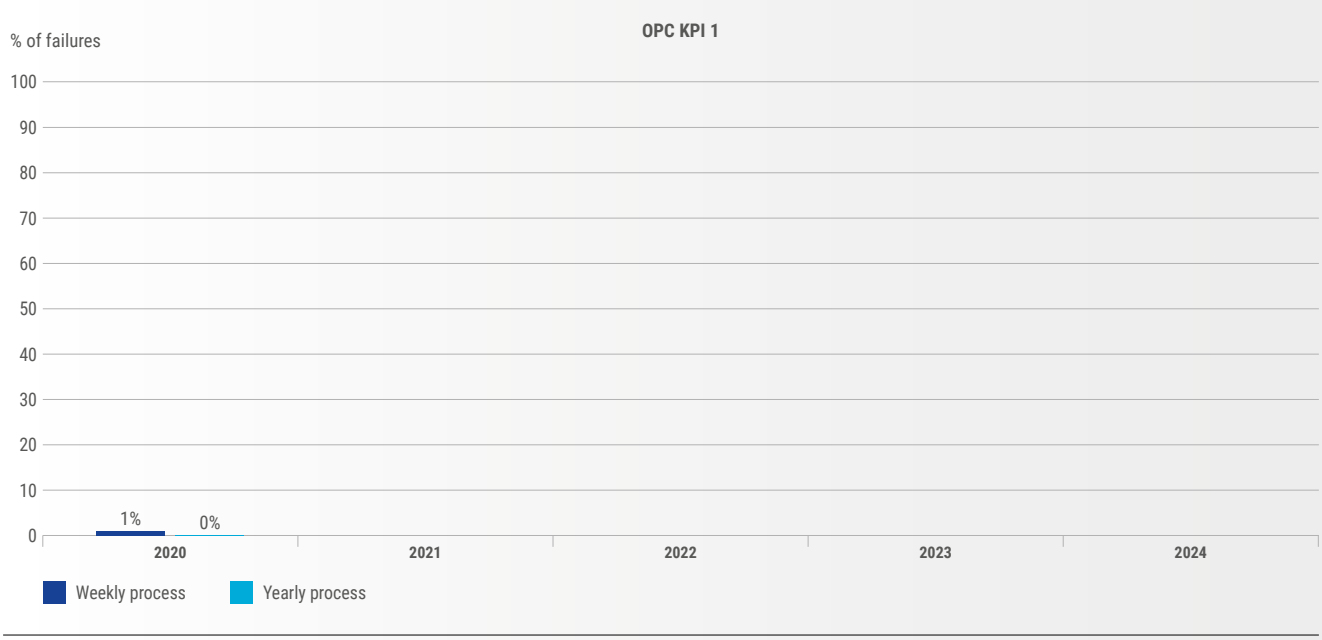

Figure 4.2: OPC KPI 1 – % of process failures per reason class

Reason for failures

Number of cases in 2020	Weekly process	Yearly process
Data Quality	0	0
IT – Tool	0	0
IT – Infrastructure	0	0
Other	1	0

Table 2: OPC KPI 1 – % of process failures per reason class

OPC KPI 2: Average merge duration per process timeframe

Description: the value shows the average duration of each individual merge performed at the pan-European level in seconds. The processes are differentiated by the timeframe covered: the weekly processes are performed every week covering the next week, and the yearly processes are performed during the yearly planning period for the whole year.

The longer duration of the yearly merge is compared to the weekly due to the higher number of outages to be considered.

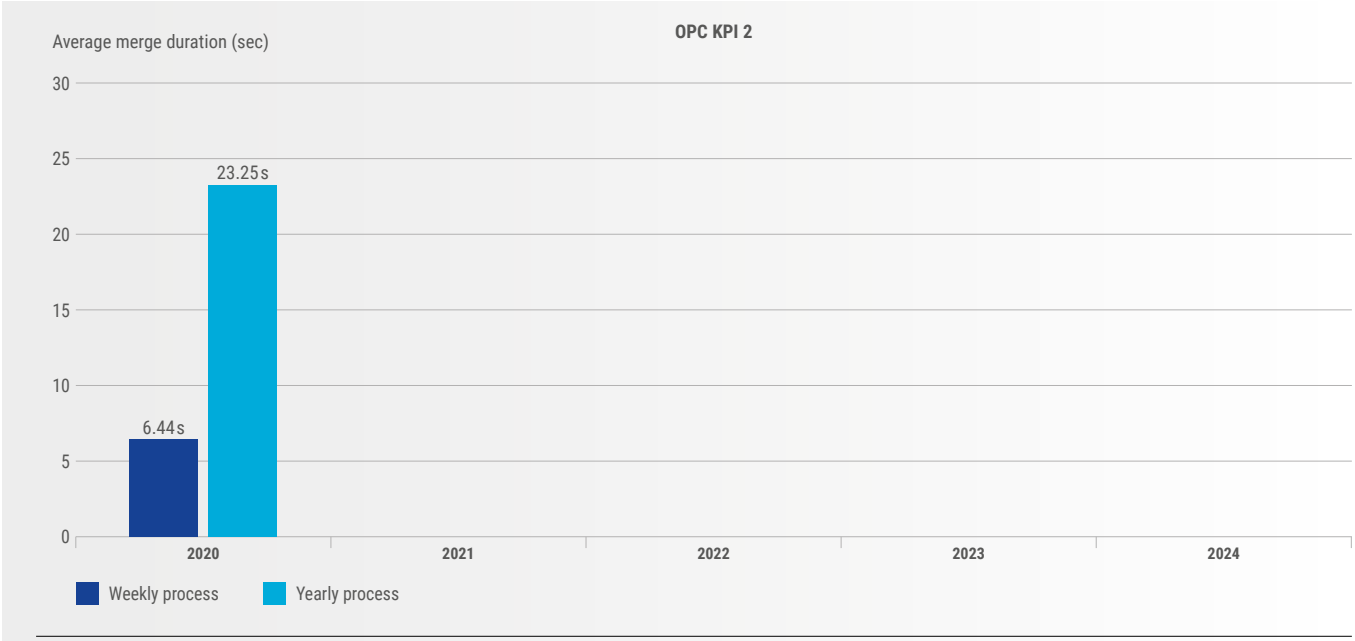

Figure 4.3: OPC KPI 2 – average merge duration in seconds

4.2 OPI KPIs[1]

OPI KPI 1: Average duration of OPI calculation

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

The OPI process is already performed by some of the RSCs, calculated for their shareholder TSOs, discussing the results with the TSOs and the RSCs on regular teleconferences. These services were provided based on the RSC Outage Responsibility Area (RORA) regions. It is foreseen that by 2023, the services will be provided according to the OCR (Outage Coordination Region) definition.

The RSCs perform the OPI calculations according to the requirements in the SO GL. Nevertheless, as shown in Table 1, there are some differences in the practical implementation (regionally agreed with the respective TSOs), which is also visible in the resulting OPI KPIs. The duration of the calculation is strongly influenced by the fact that some RSCs perform the calculations manually for selected timestamps, whereas others use automated calculation and optimisation methods. The number of timestamps considered are not same as it is also regionally agreed with the respective TSOs; therefore, the average duration of the calculation is more for information purposes than a true basis of comparison.

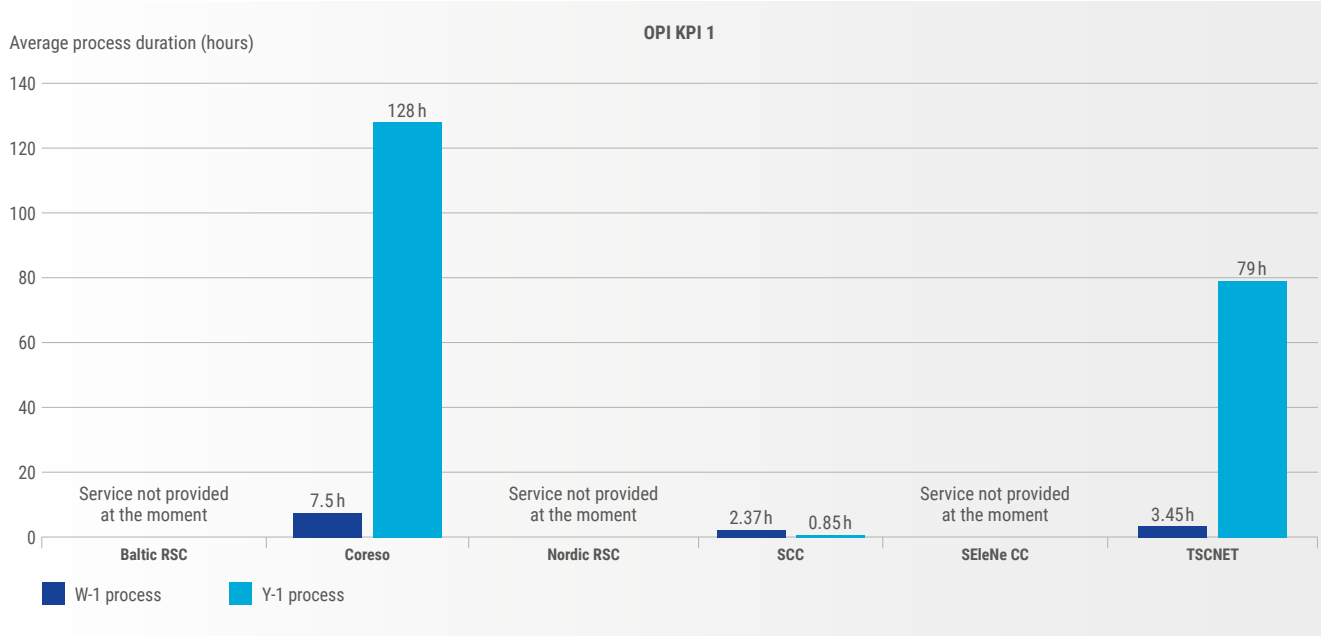

Figure 4.4: OPI KPI 1 – average process duration in hours

OPI KPI 2: % of process failures and reason for failure

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

In 2020, some failures were observed in the OPI process in one region, mostly caused by data quality issues. In this region, the OPI calculation is performed using an automated method which is more sensitive to data quality compared to the manually performed processes.

1 Coreso, TSCNET and SCC perform a Regional OPI assessment using input reference models in UCTE format; however, Baltic and Nordic RSCs do not perform Regional OPI assessment at the moment as CGMES models are not yet available.

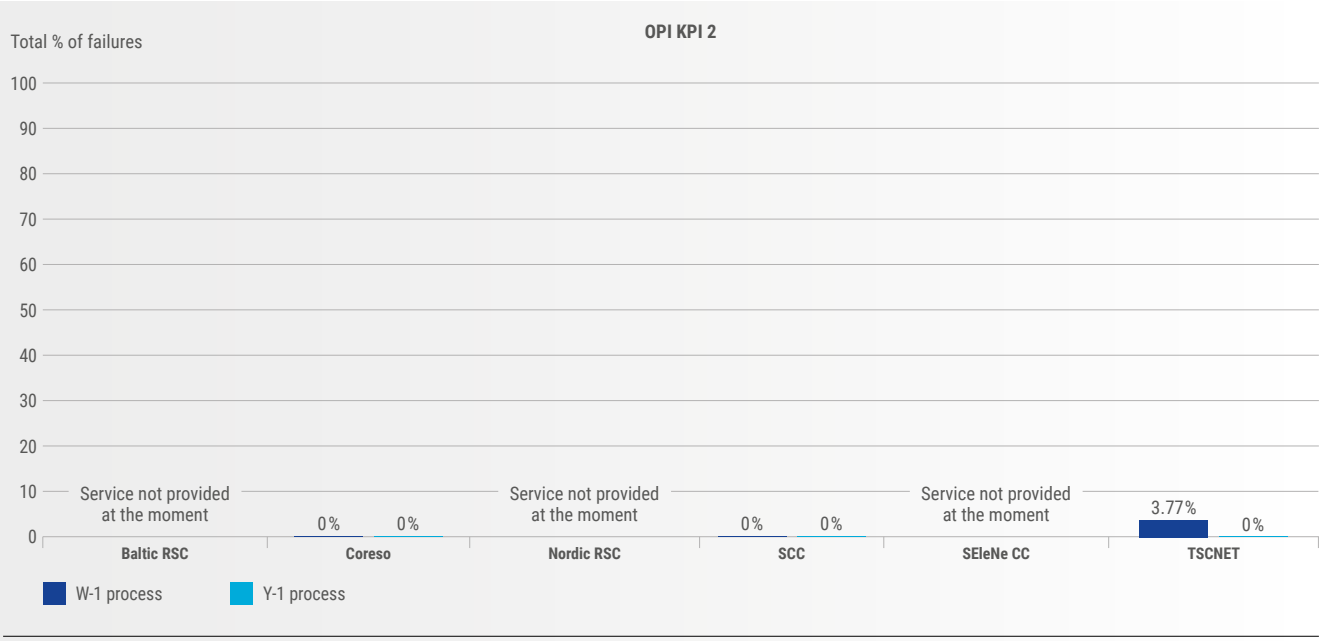

Figure 4.5: OPI KPI 2 Percentage of total failures

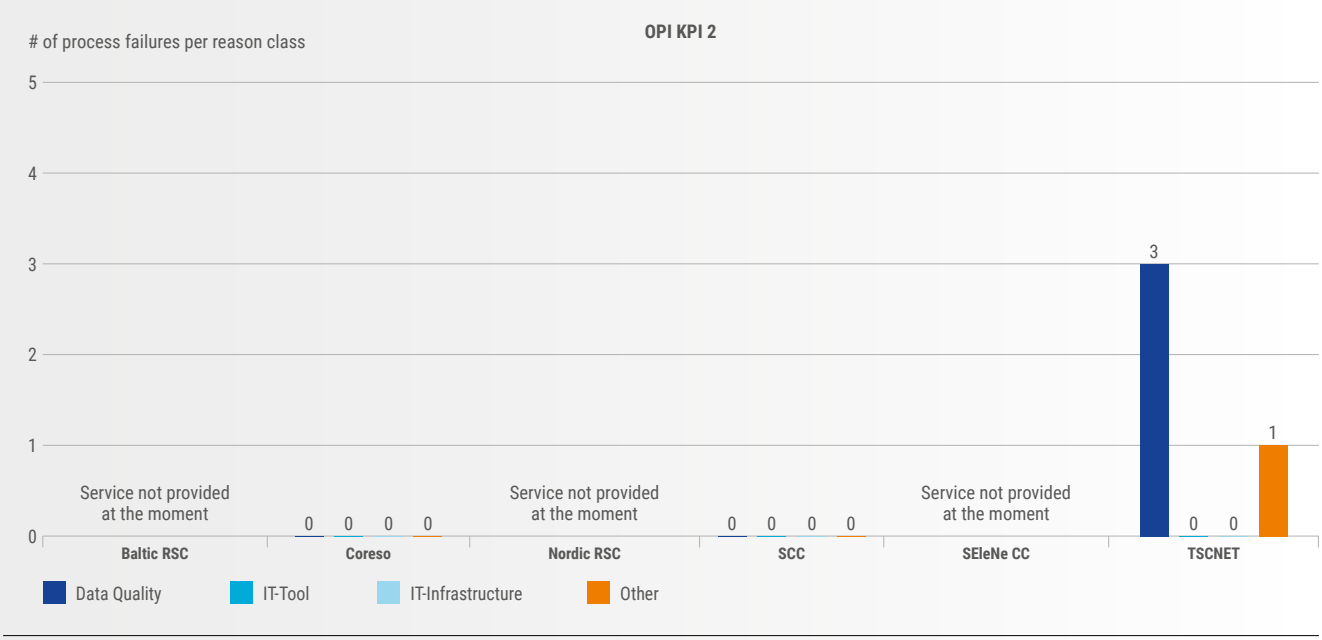

Figure 4.6: OPI KPI 2 – Number (#) of process failures per reason classification

Number of failures in 2020	Baltic RSC	Coreso	Nordic RSC	SCC	SEleNe CC	TSCNET
Data quality	N/A	0	N/A	0	N/A	3
IT – Tool	N/A	0	N/A	0	N/A	0
IT – Infrastructure	N/A	0	N/A	0	N/A	0
Other	N/A	0	N/A	0	N/A	1

Table 3: OPI KPI 2 – Number of process failures per reason classification

OPI KPI 3: % of time when OPI assessment results in identified incompatibilities

OPI means that an overload on a branch element cannot be resolved by non-costly RAs, potentially resulting in the cancellation of a planned outage. The OPI result is binary – either an OPI is identified or it is not. The OPI KPI 3 indicates how frequently OPIs were detected during the weekly / yearly planning where costly RAs may be necessary to maintain the security of the grid. OPI is more of a hint for real-time operators to ensure their awareness of these situations. The OPI process is only one part of the rolling operational planning process, which covers all required timeframes and continuously improves the quality of forecasts throughout the process and time period (i. e. Y-1, W-1, Day-ahead, ID).

The definition of OPI was not completely consistent among the RSCs in 2020; therefore, these KPIs differ significantly. The main reason for this is that Coreso and SCC reported those OPIs which were also confirmed by the TSOs, whereas the numbers for TSCNET, with 84 % and 44 % of OPI ratio for the weekly and yearly calculation, represent the pure results of the RSC's security assessment. However, the forecasted security violations are not necessarily realistic due to the following reasons:

1. Currently, there are no dedicated weekly CGMs for OPI assessment purposes, representing a realistic forecast of the expected load- and generation pattern. The RSCs use improved Y-1 ENTSO-E seasonal models instead, with an updated net position for weekly OPI assessment. Therefore, the grid model used as an input for the OPI assessment is not always a realistic representation of the expected situation of the power system[2].

2. Unlike the processes for the D-1 or ID timeframe, preparing a realistic Y-1 and W-1 forecast is challenging and has more uncertainties due to the limitations in weather and renewable forecasts.

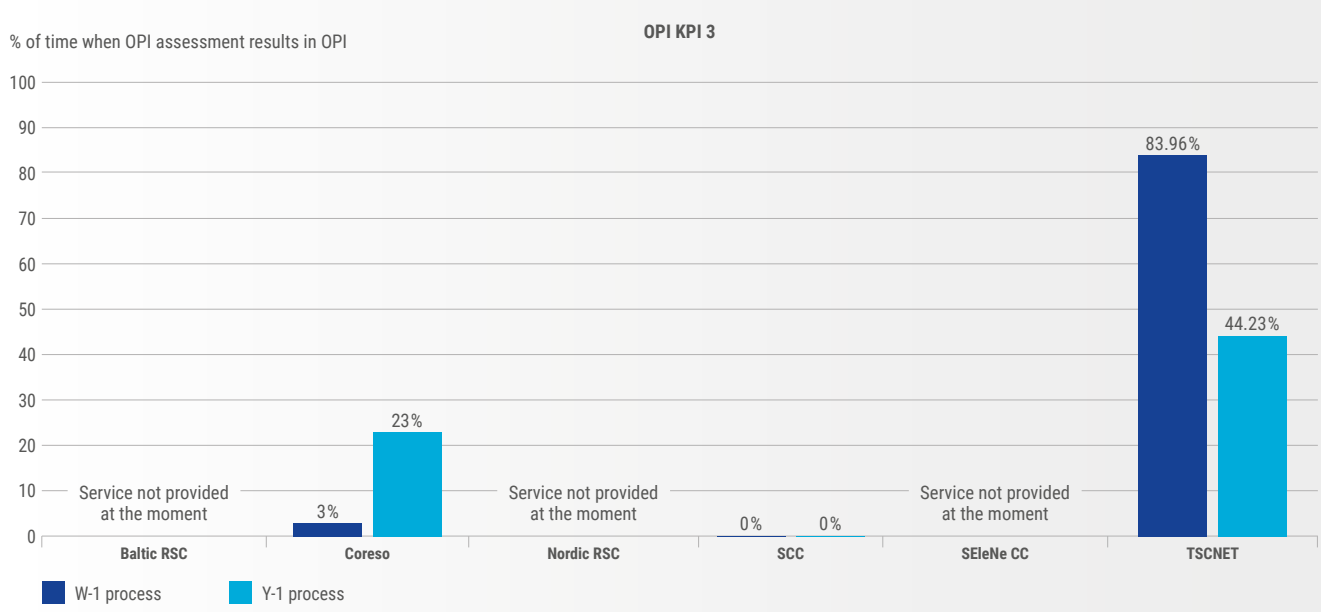

Figure 4.7: OPI KPI 3 – Percentage (%) of time when OPI assessment results in OPI

2 As per the SO GL Art. 69 creation of W-1 individual and CGMs are optional. Currently, TSOs are in discussion about establishing a dedicated W-1 CGMs as per the SO GL Art. 69.

5. Short-Term Adequacy

The goal of STA is to allow RSCs to perform regional short-term adequacy diagnosis, confronting local adequacy inputs and cross-border exchanges. Based on this diagnosis, RSCs provide recommendations to TSOs to achieve overall adequacy. The STA service is performed at a pan-European level daily for the following seven days. Calculations are monitored by five RSCs (Coreso, TSCNET Services, SCC, Nordic RSC and Baltic RSC) who are responsible on a rotational basis; for each week there is one main responsible RSC and one backup RSC, activated in case the main RSC faces an issue regarding any part of the STA process.

In the event of an unsatisfied adequacy at the pan-European level, the regional STA process should be performed under the leadership of the corresponding RSC. Regional processes should cover the affected TSO(s) 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 within the STA project. The timeframe of the regional process is determined by the timestamp foreseen as most critical based on pan-European results.

RSCs and TSOs use the same STA tool owned by ENTSO-E for all pan-European STA-related activities: the delivery of STA input data & quality check, monitoring of STA calculation process, and the creation and downloading of STA reports. The expectation is that regional STA processes will come into force during 2021. For now, the regional STA processes will not use the functionalities of the ENTSO-E STA tool.

Regarding the pan-European STA process, after each process, the relevant data for KPI creation is automatically generated by the ENTSO-E STA tool. Regarding the regional STA processes, the corresponding RSCs who led the regional STA processes should deliver manually data for the KPI creation. Input data are collected and considered for the timeframe W-1.

The STA KPIs are:

- **STA KPI 1:** % of failures
- **STA KPI 2:** Average STA pan-European process time

STA KPI 1: % of failures

STA KPI1 presents the percentage of failed processes compared to all processes performed at 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 is a maximum of 365*2 (or 366*2 in leap years).

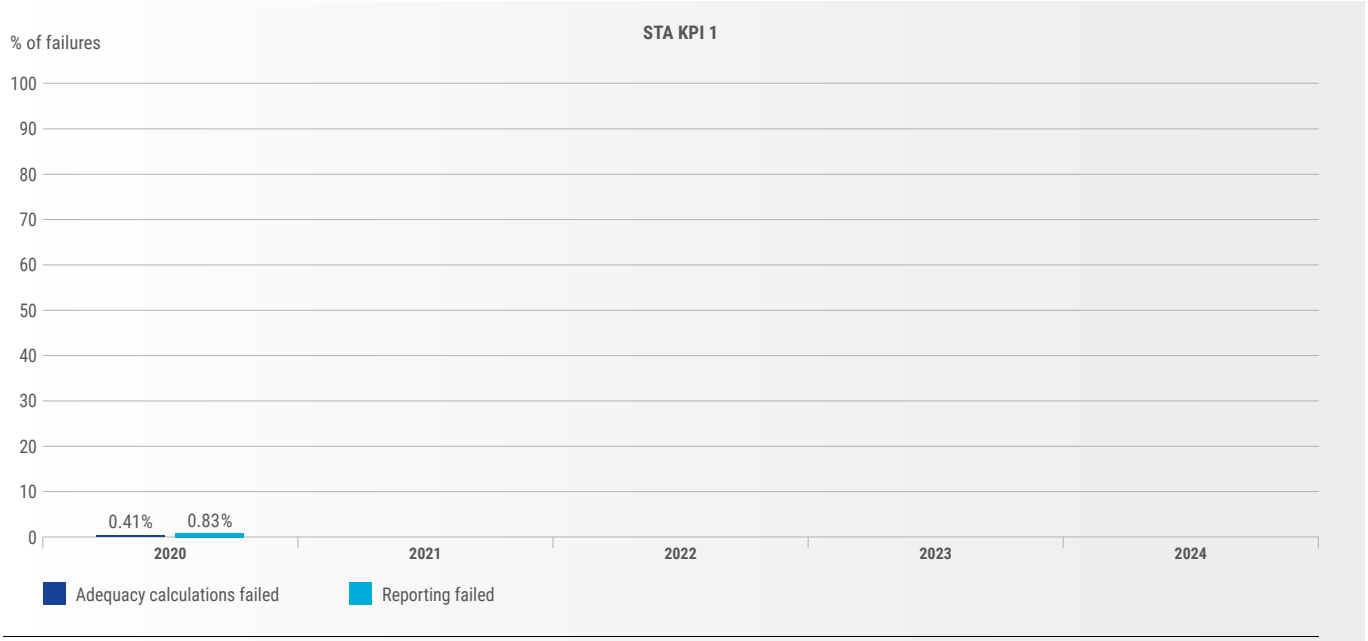

Figure 5.1: STA KPI 1 – Percentage of failures

STA KPI 2: Average STA pan-European process time

STA KPI 2 presents the average time of all pan-European STA computations performed during the year.

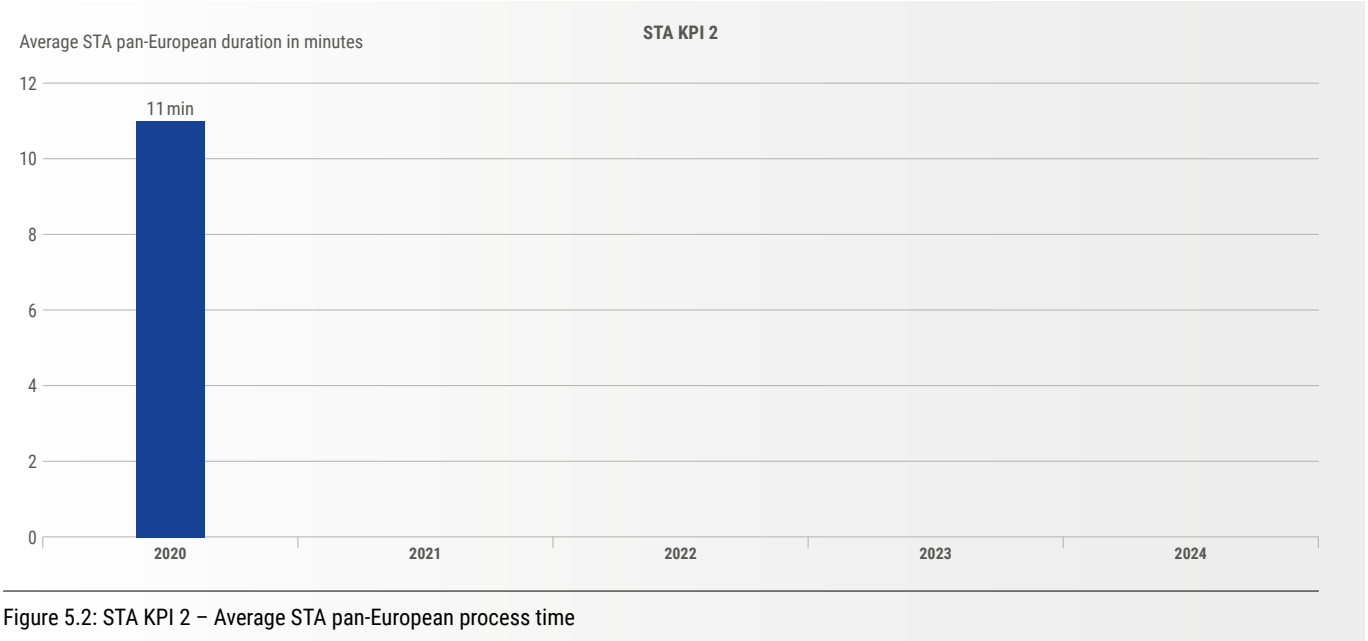

Figure 5.2: STA KPI 2 – Average STA pan-European process time

6. Conclusions

To fulfil the obligations from Article 17 SO GL, this report contains KPIs for the services provided by the RSCs. Full implementation of all services is expected from the year 2025 on. In total, the regional coordination assessment shows well-established RSCs with high-quality performance and good cooperation in cross-regional issues.

Glossary

Art.	Article
CC	Capacity Calculation
CCR	Capacity Calculation Region
CGM	Common Grid Model
CGMES	Common Grid Model Exchange Standard
CSA	Coordinated Security Analysis
D-1	One-Day Ahead
D-2	Two-Day Ahead
ENS	Energy Not Supplied
ID	Intraday
IGM	Individual Grid Model
KPI	Key Performance Indicator
MW	Megawatt
NRA	National Regulatory Authority
OCR	Outage Coordination Region
OPC	Outage Planning Coordination
OPDE	Operational Planning Data Environment
OPI	Outage Planning Incompatibility
RA	Remedial Action
RORA	RSC Outage Responsibility Area
ROSC	Regional Operational Security Coordination
RSC	Regional Security Coordinator
SOC	ENTSO-E System Operations Committee
SO GL	Guideline on Electricity Transmission System Operation
SOR	System Operation Region
STA	Short-Term-Adequacy
StG OF	Steering Group Operational Framework (ENTSOe)
TSO	Transmission System Operator
W-1	Week-Ahead
Y-1	Year-Ahead

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ENTSO-E AISBL
8 Rue de Spa
1000 Brussels
Belgium

www.entsoe.eu
info@entsoe.eu

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