

ENTSO-E Annual Report

2021 Edition



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.

Foreword

We are honoured, as President and Chair of the Board, to present to you the ENTSO-E Annual Report 2021. This report lists all the achievements of the European TSO community during the last year.

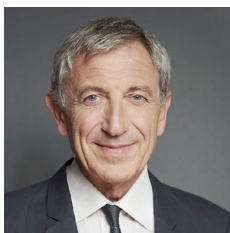
The European TSOs share the paramount objective of ensuring system security of the interconnected electricity system in Europe. They also are responsible for enabling the optimal functioning and development of interconnected markets and of the European Power Grid, both of which are the cornerstones of the integration of renewable energy sources and emerging technologies.

The Annual Report aims to inform our stakeholders about the many activities and solutions developed by TSOs to complete the Internal Energy Market, foster the required onshore/offshore grid developments, increase cooperation with DSOs and other relevant stakeholders, and accelerate innovation in European energy systems.

This year's report shows once again the commitment of TSOs as key enablers of the climate neutrality objective by 2050.

In this spirit, ENTSO-E is developing a new comprehensive Vision of the European power system by 2050. ENTSO-E will look beyond expected trends, identify key building blocks of the future power system, and propose a Vision 2050 that will contribute to a fully climate-neutral European economy.

President

A stylized, handwritten signature in blue ink.

Hervé Laffaye
ENTSO-E

Chair of the Board

A handwritten signature in blue ink, appearing to read 'J. Vanzetta'.

Joachim Vanzetta
ENTSO-E

Introduction

ENTSO-E in 2021

This Annual Report covers the period January to December 2021. It focuses on the legal mandates given to ENTSO-E and on the Pan European All TSOs tasks, facilitated by ENTSO-E. The activities covered in this report were performed thanks to the 42 members of ENTSO-E¹ who provide its financial resources and whose staff provides expertise to the Association. The successful implementation of these activities also relies on the input provided by stakeholders via ENTSO-E's Independent Advisory Council, the Network Codes European Stakeholder Committees and other stakeholders groups, and via the public consultation processes.

This Annual Report was submitted for stakeholders' views in a public consultation from 16 May to 13 June 2022. The consultation results and responses were duly examined and the Annual Report was subsequently submitted to ACER for opinion.

While ENTSO-E and TSOs are still implementing the Third Package, 2021 also saw the implementation of several legal mandates stemming from the Clean Energy Package (CEP): e. g. the go-live of the Common Grid Model (CGM), the signature of the Memorandum of Understanding with the EU Distribution System Operators Entity (DSO), etc.

In addition, while delivering legally mandated tasks, ENTSO-E also aims to support policy objectives, in particular the Green Deal, on a pan-European level. This ambition concerns all aspects of ENTSO-E's work as the increase of variable renewable generation and the electrification of several sectors, among others, impact all the activities of Transmission System Operators (TSOs). Concretely, this evolution has led, for example, TSOs to enhance the forecast, planning

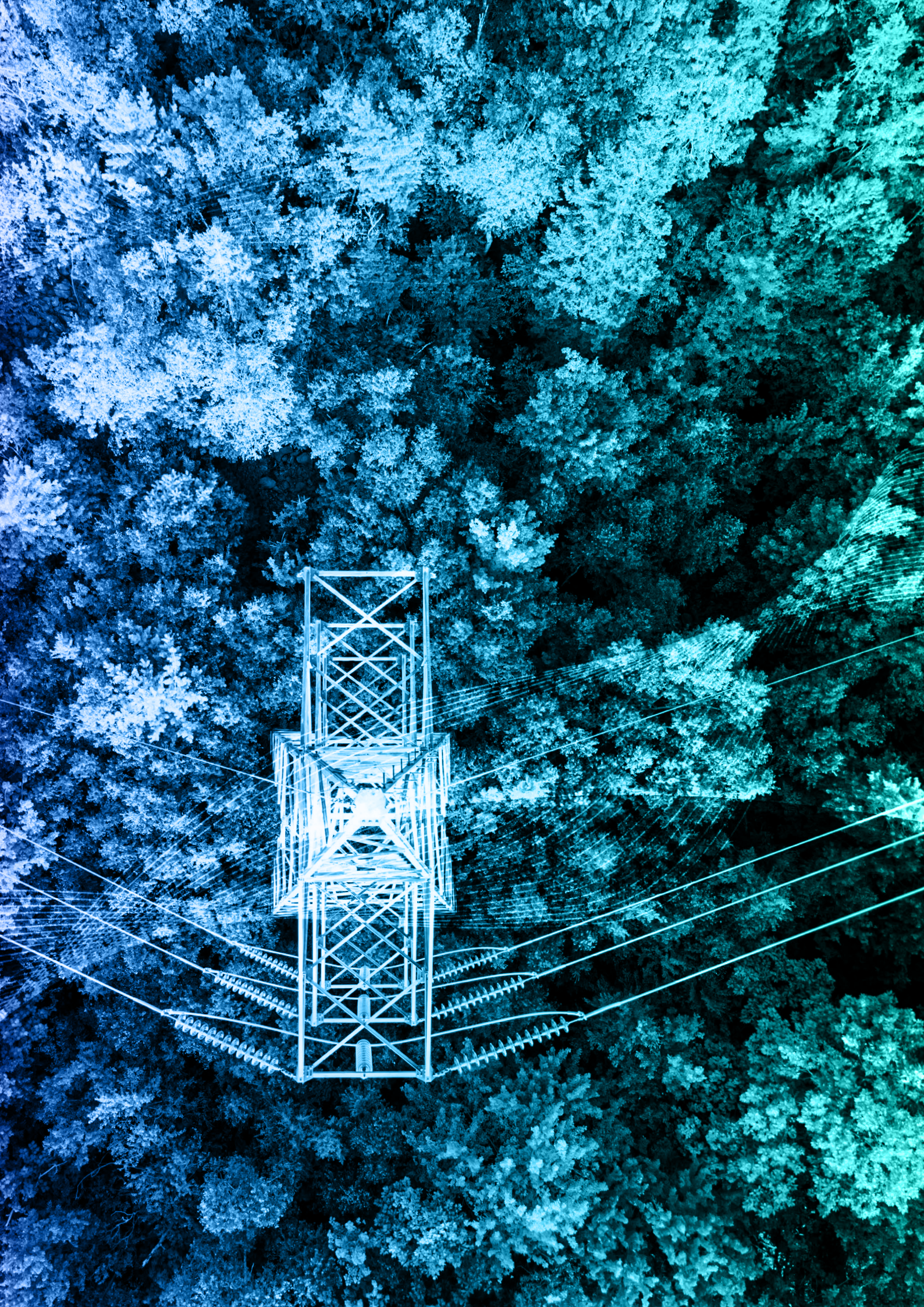
and regional coordination of real time operations. It has also pushed the introduction of new products to the energy markets as well as enhanced coordination with Distribution System Operators (DSOs) to develop new flexibility services. With both the planning and the research and development sides, ENTSO-E and TSOs anticipate the impact of achieving a carbon-neutral Europe an energy system by 2050. Examples of ENTSO-E and TSOs' contribution towards this objective are highlighted in green boxes throughout this document.

ENTSO-E's positions on these topics are detailed in various publications (e.g., the Proposals for amendments to TEN-E, offshore papers, etc.) and also presented in several events organised throughout the year (the ENTSO-E Conference held in November 2021 above all).

¹ UK TSOs who left ENTSO-E at the end of 2021 contributed to ENTSO-E activities that are in the scope of the Annual Report 2021. As of 2022, ENTSO-E consists of 39 Members from 35 countries (SONI – System Operator for Northern Ireland – is still part of ENTSO-E).

Report structure

- › **Chapter 1** describes the implementation of System Operation legal mandates tasks, aimed at improving operations and securing electricity supply with increasing volumes of variable renewable energy sources (RES). Many deliverables under the System Operation Guideline have been submitted, and activities stemming from the Emergency and Restoration Code were carried out in 2021. The chapter also outlines activities carried out in the field of regional development as well as the Common Grid Model (CGM) and ENTSO-E Awareness System (EAS).
- › **Chapter 2** covers the Market legal mandates tasks. TSOs are instrumental in the progressive harmonisation of electricity market rules, which enables the entry of increasing numbers of RES producers and thus contributes to a more sustainable energy system. In 2021, ENTSO-E and TSOs developed and submitted several Capacity Allocation and Congestion Management (CACM), Forward Capacity Allocation (FCA) and balancing methodologies and also delivered several monitoring tasks.
- › **Chapter 3** provides an overview of all system development activities related to future scenarios, long-term planning and adequacy assessments. These deliverables aim to support investment decisions by various actors of the electricity market with a view to achieving a carbon-neutral European energy system by 2050. In 2021, ENTSO-E and the European Network of Transmission System Operators for Gas (ENTSOG) published their draft joint TYNDP 2022 Scenario Report and the first ever European Resource Adequacy Assessment (ERAA).
- › **Chapter 4** describes the development of the Transparency Platform (TP) for various transparency requirements stemming from legal mandates, as well as the review of the Manual of Procedures (MoP). Publicly and freely available data allow the share of technologies in the generation mix of different geographical areas to be transparently followed.
- › **Chapter 5** describes the creation of the ENTSO-E Research, Development and Innovation (RDI) Implementation Report 2021–2025 in 2021, the publication of several position papers (three of which are on offshore development), the ENTSO-E Technology Factsheet, and its participation in European Technology and Innovation Platform Smart on Networks for Energy Transition (ETIP SNET). The main driver is to identify the necessary innovation milestones for TSOs to reach the EU Green Deal policy objectives, thus achieving the green transition.
- › **Chapter 6** details cybersecurity and data exchange & the interoperability activities carried out in 2021. Whereas cybersecurity activities have been carried out under the Connecting Europe Facility (CEF) project, ENTSO-E also participated in the drafting team of the Network Code on Cybersecurity. The chapter also describes data exchange and interoperability activities to support network code implementation, the update of the Common Grid Model Exchange Standard (CGMES), and the work on the Harmonised Electricity Market Role Model. The transition towards a more sustainable society implies the electrification and digitalisation of sectors such as transport or heating. To work efficiently, this evolution will require more data protection and more interoperability standards to facilitate cross-border exchange.
- › **Chapter 7** describes the activities carried out in the framework of the TSO–DSO cooperation. With the constant increase of renewable generation, DSOs and TSOs must strengthen their coordination to facilitate the deployment of distributed flexibilities and operate their networks securely.



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1 System Operation

The System Operation Guideline

The Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SOGL) sets out harmonised rules on how to ensure system security through efficient grid operation in a variable renewables paradigm.

The implementation of the SOGL and the related methodologies entails several challenging tasks for TSOs at the pan-European, synchronous area and regional levels. Work at the pan-European level is facilitated by ENTSO-E, whereas

synchronous areas' activities are decided by TSOs in the respective regional groups. The following SOGL implementation activities were carried out in 2021:

SOGL deliverables in 2021	Key documents and dates
Art. 75.1: Methodology for coordinating operational security analysis	14 Jun 2021: ACER approval ² of the amendment
Art. 76.1: Italy North TSOs' common provisions for regional operational security coordination	10 Jun – 11 Jul 2021: Public consultation 20 Dec 2021: NRA approval of the amended proposal
Art. 141.2: All TSOs' proposal for amending the determination of LFC blocks for the Synchronous Area Continental Europe with regard to LFC Area Denmark West	22 Feb – 21 Mar 2021: Public consultation Each TSO submitted proposal separately to respective NRA
Art. 156.10: Nordic TSOs' proposal on minimum activation period to be ensured by FCR providers	14 Dec 2020 – 25 Jan 2021: Public consultation Dec 2021: Submission to relevant NRAs
Art. 156.11: All Continental Europe TSOs' proposal for the definition of a minimum activation time period required for limited energy reservoirs to remain available during alert state	7 Oct 2021: Submission to relevant NRAs 3 Aug – 12 Sep 2021: Public consultation
Art. 137.3-4: Nordic TSOs' proposal for ramping restrictions for active power output	21 Jan – 22 Feb 2021: Public consultation Feb 2021: NRAs approval

Table 1 – SO GL implementation activities in 2021

In addition, on 15 December 2021 ENTSO-E published the first biennial progress report on the development of the Probabilistic Risk Assessment methodology pursuant to the methodology for coordinating operational security analysis (hereafter CSAM), specifically Article 44 (1) and 44 (2).

Last but not least, ENTSO-E launched an Active Library which provides public information regarding specific SOGL Articles

that are to be implemented at national level such as the field of data exchange (SO GL Article 40.6) and load frequency control (related agreements and information on frequency quality).

ENTSO-E provided regular updates to stakeholders on these topics and other system operation issues via the System Operation European Stakeholders Committee.

2 ACER approved the Proposal subject to the amendments set out in [Annex I](#) to Decision 07/2021.

Implementation monitoring

Between July and September 2021, ENTSO-E released three important annual implementation monitoring reports: the Annual Report on Incident Classification Scale (ICS) 2020 (Art. 15 SOGL), the Annual Report on Load-Frequency Control 2020 (Art. 16 SOGL) and the all TSOs' scenario definition and scenario description for the year 2022 (Art. 65 SOGL). Moreover, the publication of the 2021 Biennial Progress Report on Operational Probabilistic Coordinated Security Assessment and Risk Management of December 2021 provided a view on TSOs' progress on the development of the Probabilistic Risk Assessment Methodology (PRA)³ to be completed by 2027.

KEY DATES & DOCUMENTS

15 July 2021	Publication of the " All TSOs' scenario definition and scenario description for the year 2022 "
30 Sep 2021	Publication of the " Incident Classification Scale 2020 " annual report
30 Sep 2021	Publication of the " Load-Frequency Control " Annual Report 2020
12 Dec 2020	Publication of the 2021 Biennial PRA Report

The Emergency and Restoration Code

The Emergency and Restoration Network Code (NC ER) sets out harmonised rules on how to deal with emergency situations and restore the system as efficiently and as quickly as possible. It entered into force on 18 December 2017 and is primarily subject to implementation at a national or TSO level. Implementation should be completed by December 2022 (Art. 55 NC ER). In 2021, ENTSO-E has monitored the national implementation of the network code (Art. 52.1 NC ER). The implementation of the NC ER was also discussed with stakeholders during meetings of the System Operation European Stakeholder Committee that took place in 2021.

Every semester, ENTSO-E provided an overview of the national implementation of the Emergency & Restoration Network Code to ACER and NRAs via the System Operation Coordination Group.

KEY DATES & DOCUMENTS

15 July 2021	Publication of the "Final report on the separation of the Continental Europe power system on 8 January 2021"
12 Nov 2021	Publication of the "Factual Report on the Separation of the Continental Europe Synchronous Area on 24 July 2021"
6 Dec 2021	Publication of the "Frequency stability in long-term scenarios and relevant requirements" study

Frequency stability

Following the separation of the Continental Europe Synchronous Area of 8 January 2021, the Expert Panel⁴ issued its [final report](#) in July 2021. The report includes a comprehensive analytical overview of the incident and proposes 22 recommendations to prevent and mitigate the consequences of similar future events. In November 2021, the ENTSO-E Task Force published the Factual Report on the Continental Europe Synchronous Area Separation that took place on 24 July 2021. It contains the timeline of events and includes the assessment of the incident based on the ICS Methodology.

The Factual Report will serve as the basis for further investigation by an Expert Panel which, according to the ICS Methodology, shall prepare a Final Report to be published in 2022. In December 2021, ENTSO-E published a study assessing the impact of the reduction of inertia on the frequency stability of the Continental Europe synchronous area. Based on the TYNDP2018 long-term scenarios and market studies, the report investigates – under a set of assumptions – a very large set of possible combinations of system split cases between market nodes in the synchronous area of Continental Europe.

³ The PRA allows TSOs to assess the probability, and subsequently the impact, of the failure of the power system, in order to establish the operational security limits.

⁴ The Expert Panel was composed of representatives of the affected TSOs, ENTSO-E, regional security coordinators (RSCs), national regulators and ACER, and was established on 4 March 2021 to carry out the investigation in accordance with the SOGL and the ICS Methodology.



Common Grid Models

The CGM is a pan-European cooperation programme that enables European electricity TSOs to seamlessly share operational planning data through a secure digital and communications network infrastructure. The legal basis for CGM is found in three of the Network Codes: the SOGL (Art. 64), the CACM Regulation (Art. 17) and the FCA Regulation (Art. 18). CGM is a prerequisite for several services harmonised in the Network Codes, including coordinated capacity calculation, operational

security analysis, outage planning coordination and adequacy analysis. A CGM compiles the Individual Grid Model (IGM) of each TSO, covering timeframes from one year before real time to one hour before real time. TSOs' IGMs, after following a quality assessment and pan-European alignment process, are picked up by RSCs, who merge them into a pan-European CGM and feed the merged CGM back into the system.

Achievements and Challenges

The CGM Programme was mandated to establish the CGM Build Process among ENTSO-E, TSOs and RSCs. CGM went live on 8 December 2021, delivering a full data exchange system and IT infrastructure, comprising:

- › The Physical Communication Network (PCN), a pan-European private communications network
- › The Operational Planning Data Environment (OPDE), a data exchange platform enabling IGMs and CGMs to be shared between TSOs and RSCs

KEY DATES & DOCUMENTS

8 Dec 2021	CGM go-live
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- › Definition of a standardised structure for IGMs and CGMs
- › Validation rules required to ensure the completeness and quality of IGMs and CGMs
- › Systems required to combine IGMs into a CGM, via RSCs.

ENTSO-E Awareness System

The EAS provides a real-time pan-European view of the state of transmission systems. All TSOs input a number of measurements including frequency and cross-border exchange. These measurements are then merged to provide an overall European view of each TSO on the platform.

ENTSO-E has been monitoring the maintenance of the EAS to ensure its continuous operations within TSO business Service-Level Agreements (SLAs).

The following evolutions were introduced during 2021: improvements in Generation map, addition of EAS on-line data quality check, accession of TEIAS, introduction of a security plan for EAS, study report on the evolution of EAS integrating the recommendations of the technical report on 8 January 2021 system split, and the start of the Wide Area Monitoring System (WAMS) integration into the EAS project.

Regional Coordination

Cooperation at the regional level is a key building block for ensuring security of supply and implementing the internal energy market. The development of intermittent generation and increased interconnections render regional coordination among TSOs more important than ever.

ENTSO-E supports regional tasks by providing a platform for coordinating regional deliverables which affect neighbouring regions and where addressing the matter at the pan-European level is more efficient than doing so bilaterally.

RSCs are entities owned and appointed by TSOs to fulfil six tasks: security analysis, capacity calculation, outage coordination, adequacy forecast, emergency and restoration planning, and the CGM creation. The SOGL formalised the role of the RSCs and made it legally binding for TSOs to procure at least the five core tasks from one of the RSCs. Through their recommendations to TSOs, RSCs contribute to increasing efficiency

in system operation; minimising the risks of wide-area events such as brownouts or blackouts; and lowering costs through ensuring the maximised availability of transmission capacity to market participants.

SEIeNe CC announced the official start of services provision to its stakeholders in June 2021. Moreover, to fulfil the monitoring obligations stemming from Art. 17 SOGL, in July 2021 ENTSO-E published its Annual Report on Regional Coordination Assessment. It contains key-performance indicators for the services provided by the RSCs.

KEY DATES & DOCUMENTS

26 July 2021

Publication of the "[Annual Report on Regional Coordination Assessment](#)"

6 RSCs

- Coreso (2008)
- TSCNET (2008)
- SCC (2015)
- Nordic RSC (2016)
- Baltic RSC (2016)
- SEIeNe CC (2020)

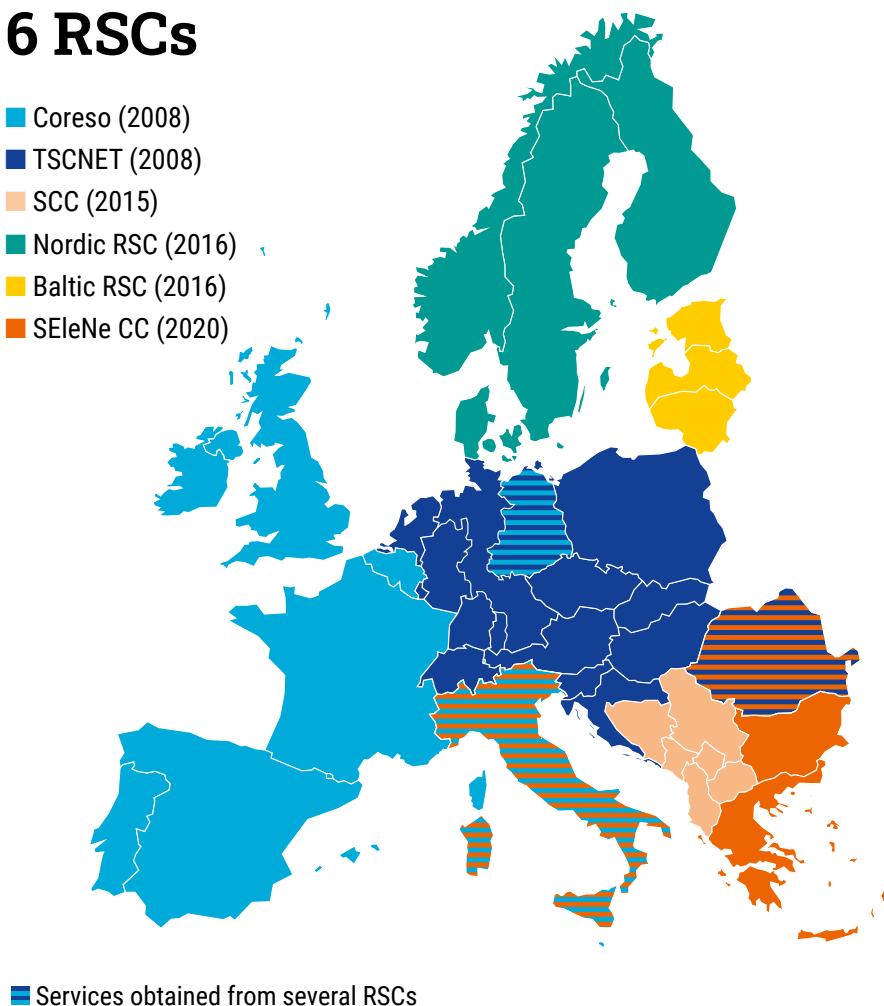


Figure 1 – RSC map

Regional Coordination in the Clean Energy Package

The CEP establishes an enhanced framework for regional cooperation through the establishment of Regional Coordination Centres (RCCs). Art. 35 of Regulation (EU) 2019/943 (the “Electricity Regulation”) requires that TSOs of System Operation Regions (SORs) develop a proposal for the establishment of the RCCs of their region. These should be operational by 1 July 2022 and will replace existing RSCs, adding new tasks for the RCCs⁵.

ACER and ENTSO-E have continued their exchange on the definition of the SORs in 2021. The latest ACER Decision No 13/2021 was published in October 2021. In 2022 the exchange will continue in order to determine a final definition of the SORs taking into account all technical and legal aspects in the best suitable way.

During 2021, ENTSO-E supported the transition from RSCs to RCCs and worked on the proposals for new RCC tasks according to Art. 37 of the Electricity Regulation and consulted with stakeholders.

KEY DATES & DOCUMENTS

19 Oct 2021	ACER Decision regarding the definition of the SORs
13 Jul – 10 Sep 2021	Public consultation on the Proposal for Regional Coordination Centre Post-Operation and Post-Disturbances Analysis and Reporting Methodology
6 Oct – 19 Nov 2021	Public consultation on the proposal for Regional Coordination Centre Training and Certification methodology

Other regional developments

ENTSO-E is ensuring the IT operations and evolutions of Outage Planning Coordination (OPC) and Short-Term Adequacy Assessment Process (STA) pan-European IT Tools. The OPC pan-European IT Tool, live since end of March 2020, allows five RSCs and 38 TSOs to coordinate outage planning on a weekly basis. Based on generation and demand forecasts provided by all ENTSO-E Member TSOs, the STA pan-European IT tool, launched in May 2020, enables RSCs and TSOs to perform daily calculations which identify adequacy levels for the week ahead.

In 2021, ENTSO-E coordinated with RSCs and TSOs over the implementation of major evolutions on OPC and STA Pan European tools covering the following new legally mandated features: introduction of High Voltage Direct Current Connections (HVDC) and generation tripping in STA forecasts, relevant asset outage coordination, generation outages integration from ENTSO-E Transparency Platform.

Tasks for Synchronous Areas

Depending on the specific arrangements within each Regional Group corresponding to Synchronous Areas (SAs), ENTSO-E supports on an ad-hoc basis or serves the Region on a continuous basis. ENTSO-E supports the Regional Group Continental Europe with implementation processes, as well as the synchronisation project between the Baltic TSOs and the SA Continental Europe and also the synchronisation project

between Ukraine/Moldova and the SA Continental Europe. In addition, work continues on the coordination of short- and long-term measures to mitigate the frequency deviations in Continental Europe, notably the deterministic frequency deviations related to the change of scheduling programmes at the early morning and late evening hours.

The vast majority of the System Operation tasks aim to improve operations and secure electricity supply by enhancing forecast, planning and regional coordination to cope with higher and higher volumes of variable RES and with the gradual phase out of conventional power plant in the system. This is key to achieving a carbon-neutral European energy system by 2050.

⁵ Article 37 of the Electricity Regulation mentions 10 new tasks in addition to the ones provided for by SOGL and the NC ER as adopted on the basis of Regulation 714/2009.



2 Market

The Capacity Allocation and Congestion Management Regulation

The rules set by the CACM Regulation provide the basis for the implementation of a single energy market across Europe. They set out the methods for allocating capacity in day-ahead (DA) and intraday (ID) timescales and outlines how capacity

will be calculated across the different zones. Implementing harmonised cross-border markets in all timeframes will lead to a more efficient European market and benefit customers.

Single day-ahead and intraday coupling

According to Art. 10 CACM, TSOs cooperate with Nominated Electricity Market Operators (NEMOs) to organise the day-to-day management of the single DA and ID coupling. ENTSO-E facilitates the discussion. This work helps jointly organise the further development of the market coupling by defining the responsible bodies and classifying the decisions to be taken by each body, as well as helping to define the criteria for prioritising the functionalities to be developed. NEMOs and TSOs have successfully established the Market Coupling Steering Committee which handles the development and the operation of the DA and ID market coupling.

The TSOs, supported by ENTSO-E, continued the implementation of the 15 minutes products in ID and DA, in accordance with Art. 8.4 of the Electricity Regulation.

All TSOs reviewed the scheduled exchange methodology from the Single Day-Ahead Coupling (SDAC) in line with Art. 43.4 and 56.4 CACM. The SDAC Interim Coupling solution went live in June 2021, allowing for DA cross-zonal capacity (CZC) on 6 new borders⁶. With the inclusion of Bulgaria in SDAC and the launch of market coupling operations for the Bulgarian-Romanian border, the Southeast Europe (SEE) region is now fully integrated in SDAC.

In 2021, Single Intraday Coupling (SIDC) parties confirmed the successful third wave go-live integrating Italy, which joined SIDC in September 2021. ID trading is now extended across 23 countries coupled through SIDC.

KEY DATES & DOCUMENTS

11 May 2021	Extension of SDAC to Bulgaria
16 Jun 2021	Review of scheduled exchange methodology from SDAC
17 Jun 2021	Go-live of SDAC Interim Coupling Project
21 Sep 2021	Inclusion of Italy into SIDC
27 Oct 2021	Inclusion of the Bulgarian-Romanian border into SDAC

⁶ The Interim Coupling solution refers to the following borders: PL-DE, PL-CZ, PL-SK, CZ-DE, CZ-AT, HU-AT.

Capacity Calculation Regions

In accordance with Art. 15.1 CACM, in May 2021 ACER approved the all TSOs' proposal on the determination of Capacity Calculation Regions (CCRs)⁷. Following the approval of the CACM Regulation by the Norwegian Parliament in June 2021, the CACM Regulation was made binding in the internal legal order in Norway with entry into force on 1 August 2021. Consequently, ENTSO-E, on behalf of All EU TSOs, consulted with stakeholders in end 2021 on a new proposal for the amendment of the determination of CCRs that allocates the Norwegian bidding zone borders to the relevant CCRs, namely CCR Nordic and CCR Hansa. In addition, in December 2021 ACER approved the all TSOs' proposal for the amendment of the congestion income distribution methodology (CIDM), in accordance with Art. 19.4 of the Electricity Regulation.

Moreover, in 2021 CCRs delivered, in accordance with the CACM Regulation, robust and timely fallback procedures (Art. 44), DA and ID capacity calculation methodologies (Art. 20.2), and methodologies for coordinated redispatching and countertrading (Art. 35.1).

KEY DATES & DOCUMENTS

7 May 2021	ACER approval of the all-TSOs proposal for the determination of CCRs
10 Nov – 10 Dec 2021	Public consultation on the all TSOs proposal for amendment of the determination of CCRs
17 Dec 2021	ACER approval of the all TSOs' proposal for CIDM (subject to the amendments as set out in Annex I to Decision 16/2021)

	DA and ID CapCalc (Art. 20.2)	RD and CT (Art. 35.1)	Robust and timely fallback procedures (Art. 44)
Core	NRAs' approval of the DA methodology 10 May 2021 Public consultation on the ID methodology 21 Oct – 21 Nov 2021	Already approved	ACER approval 30 Mar 2021 (subject to the amendments set out in Annex I to Decision 02/2021)
SWE	Public consultation 28 May – 28 Jun 2021 Submission of the amendment to relevant NRAs in July 2021 ⁸	Already approved	Already approved
Hansa	Public consultation 3 Dec 2020 – 10 Jan 2021 Submission 2 nd amendment 19 Feb 2021	Public consultation 3 Dec 2020 – 10 Jan 2021 NRAs' approval 17 May 2021	Approved Feb 2021

Table 2 – CACM Capacity Calculation methodologies in 2021

⁷ ACER approved the proposal as set out in [Annex I](#) to Decision 04/2021.

⁸ The amended proposal was approved in January 2022. These developments are outside the scope of this Report and will be covered in the Annual Report 2022, to be drafted next year.

Implementation monitoring

The CACM Cost Report 2020 submitted to all NRAs in June 2021 in accordance with Art. 80(1) of the CACM Regulation includes the costs of the coordinated activities of all NEMOs and/or all TSOs, and the costs incurred for activities performed by NEMOs or by TSOs and NEMOs in a certain region, in relation to single day-ahead and intraday market coupling.

In July 2021, ENTSO-E released two important market monitoring reports: the ENTSO-E Market Report 2021 and the Capacity Calculation and Allocation Report 2021. The ENTSO-E Market Report 2021 examines the progress and potential problems in implementing the DA and ID coupling and FCA. For the second time, the report also covers the implementation of the EB Regulation.

In addition, this is the first time ENTSO-E Market Report 2021 presents an overview of the TSO's implementation of the CEP's 70 % minimum capacity target. The Capacity Calculation and Allocation Report 2021, published in accordance with

Art. 31(2) of the CACM Regulation and with Art. 26(2) of the FCA Regulation, provides an update of the capacity calculation methodologies implementation that the CACM and FCA Regulations prescribe at the eight CCR, as determined by the recent ACER decision No 04/2021.

KEY DATES & DOCUMENTS

30 Jun 2021	Publication of the CACM Cost Report 2020
19 Jul 2021	Publication of the Capacity Calculation and Allocation Report 2021 and of the ENTSO-E Market Report 2021
14 Sep 2021	Webinar on Market Report 2021 and Capacity Calculation and Allocation Report 2021



The Forward Capacity Allocation Regulation

The FCA Regulation, which entered into force on 17 October 2016, sets out rules regarding the type of long-term transmission rights (LTTRs) that can be allocated via explicit auction, and the means by which holders of transmission rights are compensated in the event their right is curtailed.

The overarching goal is to promote the development of liquid and competitive forward markets in a coordinated manner across Europe and provide market participants with the ability to hedge their risk associated with cross-border electricity trading.

FCA Methodologies

Regarding the implementation tasks at the regional level, some CCRs delivered proposals for common capacity calculation methodologies for long-term time frames (Art. 10.1 FCA). All TSOs have submitted the proposal for harmonised allocation rules for LTTRs (Art. 51.1 and 52.3 FCA). Moreover, ENTSO-E provided views to ACER's hearing on the all TSOs' proposal for the methodology for sharing costs incurred to ensure firmness and remuneration of LTTRs pursuant to Art. 61 (FCA) following the appeal from PSE S.A. (the Polish TSO). The amended methodology was approved by ACER in October 2021.

KEY DATES & DOCUMENTS

3 May – 3 Jun 2021	Public consultation on the all TSO's proposal for amendment of the harmonised allocation rules for LTTRs
29 Nov 2021	ACER approval of the all TSO's proposal for amendment of the harmonised allocation rules for LTTRs (subject to the amendments set out in Annex I to Decision 15/2021)

	LT timeframes (Art. 10.1)	Harmonised allocation rules for LTTR (Art. 52.3)
Hansa	Amendment submitted 16 Mar 2021 Public consultation 19 Jan – 19 Feb 2021	Approved 12 Oct 2021
Core	Approved 3 Nov 2021 (subject to the amendments as set out in Annex I to Decision 14/2021)	Approved 2 Dec 2021
Greece-Italy	Already approved	Approved 1 Nov 2021

Table 3 – CCR methodologies in 2021

The Electricity Balancing Regulation

Efficient balancing markets, in which all resources are empowered to participate on a level playing field, shall ensure operational security at the lowest cost and can deliver environmental benefits by reducing the need for a back-up generation. The Electricity Balancing Regulation (EB Reg.) sets a framework for common European rules and European platforms for cross-border balancing markets.

Ongoing or planned implementation activities include the development of several methodologies by all TSOs, with ENTSO-E acting as facilitator, as well as the implementation of the European balancing platforms.

Slovenia and West Denmark joined the common procurement in the Frequency Containment Reserve (FCR) Cooperation in mid-January 2021, while ČEPS joined the FCR Cooperation as an observer in November 2021.

The European balancing platforms

The European platform for replacement reserves – Trans-European Replacement Reserves Exchange (TERRE) – was made operational in January 2020, and six⁹ TSOs were operational as of April 2021 (Art. 19.5 EB Reg.).

The European platform for imbalance netting – International Grid Control Cooperation (IGCC): in 2021, there were twenty¹⁰ operational members that continued the implementation of the platform (Art. 22.5 EB Reg.); among these, ADMIE became operational in June 2021 and Tranelectrica in December 2021. The platform was officially established in June 2021.

KEY DATES & DOCUMENTS

16 Mar 2021	TERRE stakeholder workshop
22 Jun 2021	Start of operational participation of ADMIE in IGCC
24 Jun 2021	Launch of the European imbalance netting platform
2 Dec	MARI–PICASSO workshop
17 Dec 2021	Start of operational participation of Tranelectrica in IGCC

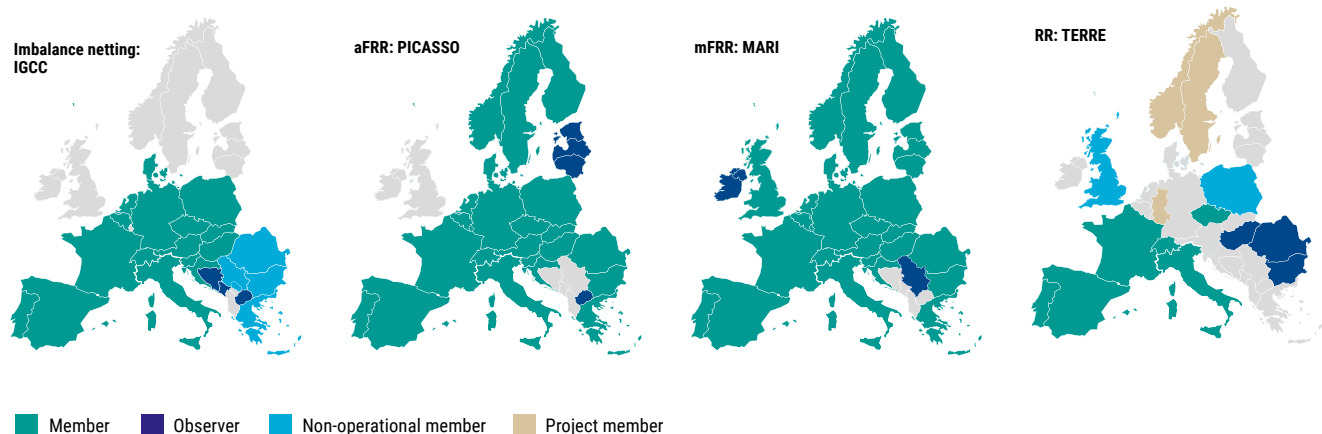


Figure 2 – Balancing Implementation Projects Status¹¹

European platform for the exchange of mFRR and aFRR energy – Manually Activated Reserves Initiative (MARI) and Platform for the International Coordination of Automated

Frequency Restoration and Stable System Operation (PICASSO): the implementation of the platforms continued throughout 2021 (Art. 20.6 and 21.6 EB Reg.).

⁹ ČEPS (Czech Republic), REE (Spain), REN (Portugal), RTE (France), Terna (Italy) and Swissgrid (Switzerland).

¹⁰ 50Hertz (Germany), Amprion (Germany), APG (Austria), ČEPS (Czech Republic), HOPS (Croatia), Elia (Belgium), Energinet (Denmark), ELES (Slovenia), MAVIR (Hungary), PSE (Poland), REE (Spain), REN (Portugal), RTE (France), SEPS (Slovak Republic), Swissgrid (Switzerland), TenneT NL (the Netherlands), TransnetBW (Germany), TenneT DE (Germany), Terna (Italy) and ADMIE (Greece).

¹¹ It is worth clarifying that this figure represents the status of projects as of today.

All TSOs and ENTSO-E Methodologies

A public consultation was conducted between June and August 2021 on an amendment of the Pricing Methodology to introduce a significantly lower maximum price for balancing energy than the one set by ACER in the initially approved Pricing Methodology. A public consultation was also conducted on the proposal for the amendment of the mFRR, aFRR and IN Implementation Framework between October and December 2021. In addition, ENTSOE organised a public consultation on the RCC task facilitating the

regional procurement of balancing capacity and for the RCC task of regional sizing of reserve capacity and facilitation of the regional procurement of balancing capacity between December 2021 and January 2022. Furthermore, an all TSOs implementation impact assessment for the Methodology for a Co-Optimised Allocation Process of Cross-Zonal Capacity for the Exchange of Balancing Capacity or Sharing of Reserves was published on 17 December 2021.

Further EB Reg. all TSOs and ENTSO-E deliverables in 2021	Key documents and dates
Art. 20, 21, 22: proposal for amendment of mFRR, aFRR, IN Implementation Framework	19 Oct – 19 Dec 2021: Public consultation 16 Nov 2021: Stakeholder Workshop
Art. 30.1: proposal for pricing balancing energy and CZC used for the exchange of balancing energy (RR, FRR, IN)	26 Aug 2021: Amendment submission to ACER
Art. 40.1: All TSOs' Proposal for a methodology for a co-optimised allocation process of CZC for the exchange of balancing capacity or sharing reserves	17 Dec 2021: Publication of the implementation impact assessment
Art. 3.3 (Annex I ACER Decision 01/2020): proposal for amendment of Pricing methodology	2 Jun-2 Aug 2021: Public consultation 15 Jun 2021: Stakeholder workshop
Art. 37.1 (Electricity Reg.): RCC sizing and procurement proposals	17 Dec 2021 – 31 Jan 2022: Public consultation

Table 4 – Further EB Reg. all TSOs and ENTSO-E deliverables in 2021

Regional Methodologies

Regarding the implementation tasks at the regional level, some CCRs delivered methodologies for market-based CZC allocation (Art. 41.1 EB Reg.) and for the allocation of CZC

based on an economic efficiency analysis (Art. 42.1 EB Reg.) on a voluntary basis.

	CZC for the exchange of balancing capacity or sharing of reserves (Art. 41.1)	Allocation of CZC based on an economic efficiency analysis (Art. 42.1)
Hansa	Withdrawal on 12 May 2021 of the 1 st amended proposal	Has never been submitted.
Core	ACER approval ¹² on 13 Aug 2021	Withdrawal on 24 May 2021 of the 1 st amended proposal
Baltic	ACER approval ¹³ 13 Aug 2021	Has never been submitted.
Greece – Italy	Relevant NRAs' approval 22 Jun 2021	Relevant NRAs' approval 22 Jun 2021
Italy North	Relevant NRAs' approval 1 Jun 2021	Withdrawal on 27 May 2021 of the 2 nd amended proposal

Table 5 – EB GL Capacity Calculation Methodologies in 2021

12 ACER approved the Proposal subject to the amendments set out in [Annex I](#) to Decision 11/2021.

13 ACER approved the Proposal subject to the amendments set out in [Annex I](#) to Decision 10/2021.



Further EB Reg. Regional deliverables in 2021

Further EB Reg. deliverables in 2021	Key documents and dates
Art. 33.1: TSOs' proposal for the establishment of common and harmonised rules and processes for the exchange and procurement of Balancing Capacity for FCR	25 May – 25 Jun 2021: public consultation
Art. 51.1: CE proposal for settlement of unintended exchange of energy TSO–TSO (FSkar ¹⁴)	1 Jun 2021: Go-live of the process

Table 6 – Further EB Reg. deliverables in 2021

Implementation monitoring

In June 2021, All TSOs published the Electricity Balancing Cost Report 2020, in accordance with Art. 23(1) of EB Regulation, which includes costs (for 2020) and forecasts (for 2021) of establishing, amending and operating the European balancing energy platforms for the exchange of balancing energy from frequency restoration reserves and replacement reserves and for the imbalance netting process. Moreover, in accordance with Art. 59 of EB Regulation, the implementation of the EB Regulation is also part of the content of the Market Report 2021, covering European platforms for the exchange of balancing energy, cross-zonal capacity allocation and balancing capacity cooperation, imbalance settlement harmonisation and the market development indicators 2020.

KEY DATES & DOCUMENTS

30 Jun 2021 **Publication** of the Electricity Balancing Cost Report 2021

¹⁴ As explained in the Introduction, FSKar stands for “Financial Settlement of frequency control error ($K\Delta f$), area control error (ACE) and ramping period”. The area control error is the sum of the power control error (ΔP) – that is the real-time difference between the measured actual real time power interchange value (P) and the control program (P^0) of a specific LFC area or LFC block – and the frequency control error ($K \times \Delta f$) – that is the product of the K-factor and the frequency deviation of that specific LFC area or LFC block, where the area control error equals $\Delta P + K \times \Delta f$.

Transparency of capacity calculation by TSOs

The CEP introduces a new regulatory framework for CZC. Specifically, Article 16.8 of the EU Electricity Regulation demands that at least 70 % of the interconnection capacity shall be made available for cross-zonal electricity trading (respecting the operational security limits of internal and cross-zonal critical network elements and considering contingencies). The remaining 30 % of the total capacity of each

critical network element can be used for the reliability margins, loop flows and internal flows.

The ENTSO-E Technical report 2021 and the Market Report 2021¹⁵ presents an overview of the TSO's implementation of the CEP 70 % minimum capacity target.

Bidding zone Technical Report

The ENTSO-E Bidding Zone Technical Report 2021 report provides transparent and factual information for the whole EU on congestions, flows scheduled outside the market and the costs of these congestions. It also provides indications on the likely evolution of congestions over the next ten years. The ENTSO-E Bidding Zone Technical Report is an important input to an assessment of the efficiency of the current bidding zone configuration performed by ACER every three years. What is new in the 2021 edition is that it also includes the CEP's 70 % minimum capacity assessment.

KEY DATES & DOCUMENTS

18 Nov 2021

[Publication](#) of the Bidding Zone Technical Report 2021

Capacity Mechanisms

In 2021, ENTSO-E followed up on the ACER approval of the technical specifications for cross-border participation in capacity mechanisms (Art. 26.11 of the Electricity Regulation). ENTSO-E also established and made operational the registry

of capacity providers, a tool used for the storage, exchange and management of the data used in capacity mechanisms relevant to cross-border participation processes.

¹⁵ The ENTSO-E Market Report 2021 has already been mentioned by this Annual Report in the CACM implementation monitoring paragraph.



Inter Transmission System Operator Compensation

The Inter Transmission System Operator Compensation (ITC) Agreement is a multiparty agreement concluded between ENTSO-E on the one hand and ENTSO-E members and TSOs that comply with the Union legislation in the field of electricity or with the previous agreement on ITC, also referred to in this context as “ITC Parties”, on the other. It offers a single framework wherein European TSOs compensate each other for costs associated with hosting transit flows (i.e. facilitating the transfer of electricity between two countries). This mechanism aims to incentivise the hosting of cross-border flows and thereby facilitate an effectively competitive pan-European electricity market.

The ITC mechanism is governed by Art. 49 of Reg. (EU) 943/2019. The ITC mechanism is further specified by Reg. (EU) 838/2010 on laying down guidelines relating to the inter-transmission system operator compensation mechanism and a common regulatory approach to transmission charging.

The ITC Agreement provides for an annual process in which the parties are required to provide and check the values for the calculation of the annual perimeter fee. Based on the preliminary data, the transit flows, also including the perimeter flows, are calculated (i.e. imports and exports of electricity to and from third countries).

KEY DATES & DOCUMENTS

16 Sep 2021 [Publication](#) of the “ITC Transit Losses Data Report 2020

According to Reg. (EU) 838/2010, ENTSO-E is mandated to determine the amount of losses incurred on national transmission systems by calculating the difference between: (1) the amount of losses actually incurred on the transmission system during the relevant period; and (2) the estimated amount of losses on the transmission system which would have been incurred on the system during the relevant period if no transit of electricity had occurred. In September 2021, ENTSO-E published the ITC Transit Losses Data Report 2020.

ACER publishes an annual monitoring report on ITC. To this end, ENTSO-E provides ACER with information on both quantitative data (preliminary and final data) and descriptive information (e.g. explanations for capacities not allocated according to Guidelines).

TSOs are instrumental in the progressive harmonisation of electricity market rules, which leads to a vast increase of electricity exchanges across countries, stimulates competition and increases liquidity in wholesale markets.

This delivers benefits to society and enables the entry of an increasing number of market participants, including producers of renewable energy, thus contributing to a more sustainable energy system.



3 System Development

The Ten-Year Network Development Plan: Building Europe's future power system

The TYNDP is the outcome of a two-year process, starting with the development of scenarios outlining how the European energy system might evolve towards 2050.

Imagine and model future electricity and gas systems scenarios

Scenarios are a first key step and a crucial outcome of the TYNDP process. It is a deliverable that is also increasingly used for other studies on future aspects of the energy system.

ENTSO-E and ENTSOG published their final TYNDP 2022 Scenarios Storyline Report in April 2022 and their Joint Draft Scenario Report for TYNDP 2022 in October 2021. Supply and demand data collected from both gas and electricity TSOs are used to build “*National Trends*”, the central policy-based scenario, reflecting Member States’ present energy and climate policies; the plan is that these will evolve to meet EU climate targets. The “*Global Ambition*” and “*Distributed Energy*” Scenarios are developed as full-energy scenarios (not limited to gas and electricity) and built in line with the Paris Agreement target, the EU climate law and binding targets of the EU-27 to reduce Greenhouse Gas (GHG) emissions by 55 % by 2030 and to net-zero by 2050.

› The scenarios utilise new sector-integration methodologies and dedicated modelling tools, both to optimise overall system efficiencies and flexibility use and to better capture the interactions and new dynamics at the interfaces between various end-use sectors, at various geographical scales and with other carriers. It is also the first time that

the scenarios have modelled the hydrogen system and electrolysis configuration at the pan-European scale.

› The scenario storylines aim to sufficiently differentiate the scenarios with its key drivers for the purpose of infrastructure needs identification and project assessments within the gas and electricity TYNDPs 2022 in a fully coordinated manner. Figure 3 on the following page provides an overview of storyline differentiation based on high-level drivers.

KEY DATES & DOCUMENTS

26 Apr 2021	Publication of the final TYNDP 2022 Scenarios Storyline Report
7 Oct 2021	Publication of the draft Joint Scenario Report for TYNDP 2022
20 Oct 2021	Online workshop to present the draft TYNDP Joint Scenarios 2022
7 Oct – 18 Nov 2021	Public consultation on the draft TYNDP Joint Scenarios 2022

TYNDP 2022 – Two top-down scenarios

Global Ambition pictures a pathway to achieving carbon neutrality by 2050 and at least a 55 % emission reduction in 2030, driven by a fast and global move towards the Paris Agreement targets. This translates into the development of an extremely wide range of technologies (many of which are centralised) and the use of global energy trade as a tool to accelerate decarbonisation.

Distributed Energy pictures a pathway to achieving EU-27 carbon neutrality by 2050 and at least a 55 % emission reduction by 2030. The scenario is driven by the willingness of society to achieve energy autonomy based on widely available European renewable sources. It translates into both a way-of-life evolution and a strong decentralised drive towards decarbonisation through local initiatives by citizens, communities and businesses, supported by authorities.

Green Transition		At least –55 % reduction in 2030, climate neutral in 2050
Driving force of the energy transition	Distributed Energy Higher European autonomy with renewable and decentralised focus	Global Ambition Global economy with centralised low carbon and RES options
	Transition initiated on local / national level (prosumers)	Transition initiated on a European / international level
Energy intensity	Aims for EU energy autonomy through maximisation of RES and smart sector integration (P2G/L)	High EU RES development supplemented with low carbon energy and imports
	Reduced energy demand through circularity and better energy consumption behaviour	Energy demand also declines, but priority is given to decarbonisation of energy supply
Technologies	Digitalisation driven by prosumer and variable RES management	Digitalisation and automation reinforce competitiveness of EU business.
	Focus of decentralised technologies (PV, batteries, etc) and smart charging	Focus on large scale technologies (offshore wind, large storage)
	Focus on electric heat pumps and district heating	Focus on hybrid heating technology
	Higher share of EV, with e-liquids and biofuels supplementing for heavy transport	Wide range of technologies across mobility sectors (electricity, hydrogen and biofuels)
	Minimal CCS and nuclear	Integration of nuclear and CCS

Figure 3 – Storylines differentiation based on high-level drivers

Sector integration is also one of the key aspects of the ENTSO-E position on the Review of the Trans-European Networks for Energy (TEN-E) Regulation, published in April 2021. In this respect, emphasizes the need for a long-term holistic vision on energy infrastructure planning and for a framework that allows to integrate and coordinate various coupling solutions for different infrastructures.

KEY DATES & DOCUMENTS

23 Apr 2021	Publication of the TEN-E Regulation review – ENTSO-E Proposals for amendments
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The Ten-Year Network Development Plan

The TYNDP is a pan-European long-term vision of the power system. As a legal mandate deliverable (Article 30(1), Regulation 943/2019), published by ENTSO-E every two years, it is the foundation of European coordinated grid planning and the

basis on which transmission projects may apply for “Projects of Common Interest” (PCI) status. The elaboration of each TYNDP is a two-year process, as described in Figure 4.

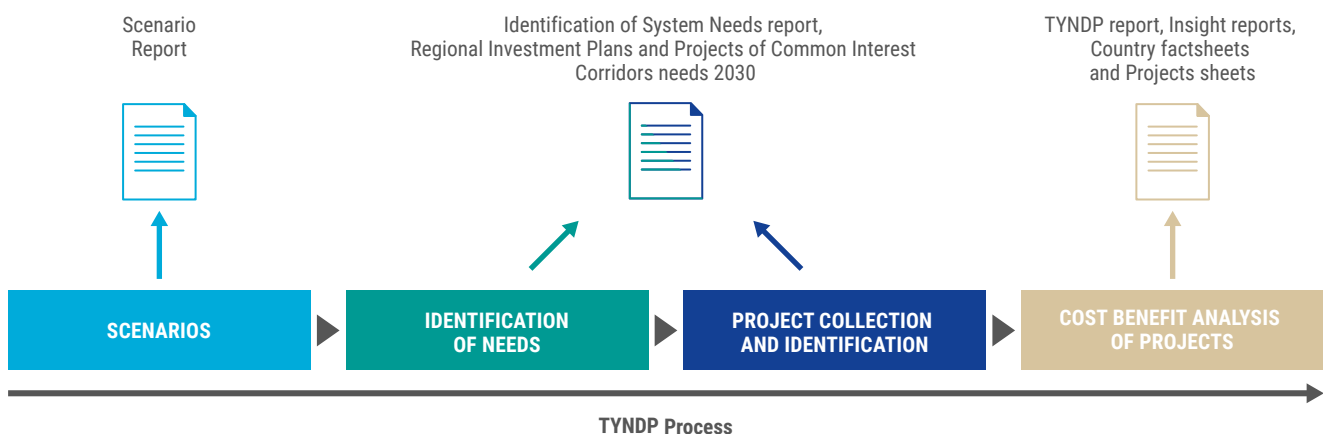


Figure 4 – TYNDP two-year process

Each scenario’s impacts on energy markets and networks are analysed via a suite of tailored modelling tools. Thanks to the models, ENTSO-E can explore various system needs and the options which could address these needs. These studies make transparent and better explain which parts of the network infrastructure are fit for purpose and which need to be reinforced or supported by alternative solutions or technologies. The main role of TYNDP is thus to identify where investments in various technical solutions in the electricity system would help to release the expected system constraints, and by doing so provide a fit-for-purpose infrastructure across diverse scenarios. This is done in two stages: performing a system needs analysis that identifies a high-level overview of constraint relief options to allow

the decarbonisation of the EU power system at the lowest cost, followed by a call for transmission and storage projects (under different stages of development) across Europe, complemented by a cost benefit analysis (CBA) of their impacts under different scenarios.

The draft TYNDP 2020 was submitted to ACER for opinion in February 2021 and finally released in September 2021. During this period, work on TYNDP 2022 intensified.

KEY DATES & DOCUMENTS

10 Sep 2021 [Publication](#) of the final TYNDP 2020

TYNDP 2022

141 pan-European electricity transmission projects and 23 storage projects will be assessed in TYNDP 2022 as a result of the project submission by promoters between September and October 2021. ENTSO-E will perform a CBA and will release the draft TYNDP 2022 for public consultation in 2022. Selection in the TYNDP is a pre-condition for transmission and storage projects to apply for European Projects of Common Interest status, a process led by the European Commission. The criteria and process for submitting a project to TYNDP 2022 are specified in the Guidance for transmission and storage projects, updated in August 2021 and consulted with stakeholders.

In October 2021, ENTSO-E organised a public workshop to collect stakeholders' views on the proposed improvements to the methodology of the Identification of System Needs study to be published in the summer of 2022.

A common element of all future energy scenarios is that electricity will become the leading energy carrier (up to 65 %) and that the European electricity grid will be the backbone of the decarbonisation of all energy sectors. This is why infrastructure planning for the future power system will require a multi-sectorial approach.

KEY DATES & DOCUMENTS

7 Jun – 18 Jul 2021	Public consultation on the guidance for projects to apply to the TYNDP 2022
18 Aug 2021	Publication of the Guidance for transmission and storage projects
14 Oct 2021	Workshop on the identification of system needs in TYNDP 2022
16 Sep – 15 Oct 2021	Project submission to the TYNDP 2022

The cost–benefit analysis methodology

The assessment of infrastructure and storage projects performed in the TYNDP uses a cost–benefit analysis (CBA) methodology drafted by ENTSO-E, in consultation with stakeholders. The methodology is proposed to ACER and the European Commission for, respectively, an opinion as well as further recommendations and a final decision. The CBA results are also used as the basis of the PCI selection process by policy makers. The main objective of the CBA methodology is to provide a common basis for the assessment of projects with regard to their value for European society, in line with Europe's energy goals.

ENTSO-E developed a third version of the CBA methodology, which improves on the previous versions in its consideration of security of supply, socioeconomic welfare and storage.

The draft CBA 3.0 was submitted to EC for approval in March 2021. ENTSO-E is also reviewing the CBA Implementation Guidelines that specify in further detail how the CBA methodology will be implemented in TYNDP 2022.

KEY DATES & DOCUMENTS

30 Nov 2021 – 7 Jan 2022	Public consultation on the TYNDP 2022 CBA Implementation Guidelines
3 Dec 2021	Online workshop on the TYNDP 2022 CBA Implementation Guidelines



Ensuring resource adequacy

Resource adequacy can be defined as the continuous balance, including storage and demand side response, between supply on the one hand and demand levels on the other. Assessing the ability of a power system to cover demand in all conditions is part of the TSOs' tasks, and, consequently, one of ENTSO-E's most important mandates.

Due to the increasing level of variable RES, new demand patterns and ever stronger integration of energy markets across the European power system and the associated challenges for system development and operation, a pan-European analysis of resource adequacy has become ever more important. Cooperation across Europe is necessary to accelerate the development of common methodological

standards, i.e. a common "language" is required to perform these studies. Resource adequacy requires advanced methodologies to capture and analyse rare events with adverse consequences for the supply of electric power. Europe's efforts give leading examples worldwide of how to undertake advanced assessments at a large geographic perimeter.

Resource adequacy and the Clean Energy Package

The CEP places resource adequacy in a central position in the European energy policy context. ENTSO-E published its first ERAA in November 2021. The ERAA is a pan-European projection of power system resource adequacy of up to 10 years ahead and extends vastly the scope of the earlier ENTSO-E Mid-Term Adequacy Forecasts (MAF). It is based upon state-of-the-art methodologies and probabilistic assessments, aiming to model and analyse possible events which can adversely impact the balance between supply and demand of electric power. This analysis is a valuable tool for policymakers, system operators, and other electricity stakeholders on the important path towards climate neutrality. The ERAA 2021 is a key milestone and first step towards a more advanced target methodology to be reached in coming years as new pilot methodologies are tested and discussed with stakeholders.

The ERAA 2021 shows that planning, coordination and, where necessary, targeted intervention in Europe's power system is essential to provide secure electricity, even in the face of an unprecedented transition.

KEY DATES & DOCUMENTS

12 Oct 2021	Webinar on ERAA key assumptions and scenarios
23 Nov 2021	Publication of the ERAA 2021 and public webinar
23 Nov 2021 – 7 Jan 2022	Public consultation on the ERAA 2021

The Seasonal Outlooks

ENTSO-E's Seasonal Outlooks (Article 30(1)f, Regulation 943/2019) are pan-European, system-wide analyses of risks to electricity security of supply. Analyses are performed twice a year to ensure a good view regarding the summer and winter and to present aligned TSOs' views on the risks to security of supply and the countermeasures they plan for the coming season, either individually or in cooperation. Each outlook is accompanied by a review of what occurred during the previous season.

The outlooks are performed with extensive data collected from TSOs and using a common methodology. Moreover, ENTSO-E uses a common database in its assessment, the Pan-European Climate Database (PECD), to determine the levels of solar and wind generation at a specific date and time. ENTSO-E analyses the effect on system adequacy of climate conditions, evolution of demand, demand management, evolution of generation capacities, and planned and forced outages.

ENTSO-E published the Summer Outlook 2021 at the end of May 2021 and the Winter Outlook 2021/2022 in November 2021.

Since 2020, and in line with the CEP, ENTSO-E has applied a probabilistic approach to its seasonal adequacy assessments – using a set of possible scenarios for each variable which enables it to detect more risks. This is in line with the methodology used in the ERAA.

KEY DATES & DOCUMENTS

31 May 2021	Publication of the Summer Outlook 2021
2 June 2021	Summer Outlook 2021 Webinar
30 Nov 2021	Publication of the Winter Outlook 2021/2022
1 Dec 2021	Winter Outlook 2021/2022 Webinar

Connection codes: Integrating renewables

The objectives of the three Connection Network Codes (CNCs) – Demand Connection Code (DCC), Requirements for Generators (RfG), and HVDC – are to ensure the integration of decentralised RES and the increased demand response into the power system while simultaneously maintaining security of supply and resilience at all times, and to facilitate the internal electricity market by levelling the playing field of grid users in different member states.

The implementation of connection codes is the responsibility of each EU member state. In this context, ENTSO-E acts as a platform to maintain and eventually amend CNCs; share information, guidance and best practices for national implementation processes; and monitor their progress, especially through the development and delivery of non-binding written guidance – Implementation Guidance Documents (IGDs) – to its members and other system operators. The development of IGDs is fuelled by discussions with stakeholders from the drafting phase onward, via dedicated expert groups and the Grid Connection Stakeholder Committee. From December

2020 to January 2021, ENTSO-E launched a consultation on the revision of several IGDs. These IGDs were revised and published in June 2021.

KEY DATES & DOCUMENTS

2 Dec 2020 – 31 Jan 2021	Public consultation on several revised IGDs
Jun 2021	Publication of several revised IGDs

Implementation monitoring

ENTSO-E monitors the implementation activities in each country via its [Active library](#), examining in particular divergences in national implementation. The “Monitoring report on Connection Network Codes Implementation” was published in December 2021.

In accordance with Art. 59(2) RfG and 76(2) HVDC, ENTSO-E shall provide ACER with the information required to monitor the implementation of these two network codes. In response to ACER’s requests, ENTSO-E maintains summary tables for each Member State, clarifying the type of information that needs to be collected by the TSOs and DSOs.

The information will then be aggregated and submitted to ACER by 30 June each year.

KEY DATES & DOCUMENTS

2 Dec 2021	Publication of the “ Monitoring report on connection network codes implementation ”
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Long term planning and resource adequacy assessments provide mid-term monitoring as well as long term visions to achieve a carbon-neutral European energy system by 2050. This aims to support strategic orientations by authorities and investment decisions by various actors of the electricity market.



4 Transparency Regulation

ENTSO-E's Transparency Platform (Art. 3, Regulation 543/2013) centralises data relating to the generation, transportation and consumption of electricity at the European level. The data are collected from data providers, including TSOs and other qualified third parties. Depending on the users' needs, these data can serve various purposes, such as market analysis, research or trading. The TP is also instrumental for the monitoring and regulation of power markets. Start-ups and new players increasingly use the TP's wealth of data for delivering more value to customers, for example through shedding light on life-CO₂ emissions by country, wind generation and more.

ENTSO-E reviewed the Manual of Procedures (MoP) and the Memorandum of Understanding (MoU) data quality requirements and consulted stakeholders on the amendments to the MoP v3r3. The amendments were submitted to ACER in October 2021.

In 2021, the TP was also amended for further publications and data collections, some of which are used only with a limited number of parties:

- › Transparency requirements from Art. 12 EBGL and Title 11 SOGL
- › Transparency requirements by the implementation frameworks of the European balancing platforms
- › Information to be made available to ACER for monitoring activities according to the list of information of Art. 82 CACM and Art. 63 FCA.

Finally, ENTSO-E also developed the TP for FSkar purposes and is carrying out the TP architectural study to respond to the ever-growing publication requirements.

KEY DATES & DOCUMENTS

7 Jul – 13 Aug 2021	Public consultation on the amendments to the MoP v3r3
Oct 2021	Submission of the amendments to the MoP v3r3 to ACER

Publicly and freely available data play an important role in bringing transparency into the market. The datasets provide an easy opportunity to transparently follow the share of generation technologies of the different geographical areas.



5 Research, Development and Innovation

ENTSO-E promotes and supports TSOs' innovation activities to transform the European energy system into an integrated one, with an emphasis on sector integration, enhanced grid usage, market development and digitalisation to allow for the integration of vast amount of renewable energy and to enable the development of a system of integrated systems. The sections below describe ENTSO-E activities in the field of RDI that occurred in 2021, as well as the key messages of the ENTSO-E Vision 2050 for the future power system.

Research, Development and Innovation Implementation Report 2021–2025

KEY DATES & DOCUMENTS

4 Jun – 13 Sep 2021	Public consultation on the RDI Implementation Report 2021 – 2025
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ENTSO-E consulted stakeholders on the RDI Implementation Report between June and September 2021¹⁶. The Report is a guiding instrument for collaborative research programmes of TSOs in the coming five years. The report prioritises the goals outlined in the ENTSO-E RDI Roadmap 2020 – 2030, based on which it presents 13 RDI project concepts that would pave the way for the TSOs' progress towards the EU climate goals.

Offshore Position papers

KEY DATES & DOCUMENTS

3 Nov 2021	Publication of the Position Paper on Offshore Development: Assessing Selected Financial Support Options for Renewable Generation
5 July 2021	Publication of the Position Paper on Offshore Development: System Operation & Governance
25 Jan 2021	Publication of the Position Paper on Offshore Development: Interoperability

Offshore wind energy will provide a key contribution to reaching the objectives of the EU Green Deal and of the Fit for 55 Package. The EC's offshore RES strategy anticipates the integration of 300 GW offshore wind generation capacity into the energy system by 2050. The magnitude of this transition

will raise new challenges for the European electricity system. In a series of papers begun in 2020, ENTSO-E is assessing possible solutions to contribute to the realisation of the EC's Offshore strategy.

In 2021, ENTSO-E published three position papers on offshore development:

- › **"Assessing Selected Financial Support Options for Renewable Generation"**: This shows that re-allocating a share of congestion income from TSOs to wind farm developers faces several challenges;
- › **"System Operation & Governance"**: This explains that the current regulatory setup is suitable for facilitating efficient offshore system operation during the expected stepwise and organic development of offshore grid infrastructure;
- › **"Interoperability"**: This argues that, for the cost-efficient and scalable development of the HVDC grid infrastructure, the single-vendor approach must evolve towards multi-vendor and multi-purpose capabilities for offshore HVDC systems.

¹⁶ ENTSO-E published its RDI Implementation Report in February 2022. These developments are outside the scope of this Report and will be covered in the Annual Report 2022, to be drafted next year.

Other RDI publications and activities

Position papers and reports

2021 saw an intense production of position papers on research, development and innovation topics by ENTSO-E. In December, ENTSO-E published a report and a position paper on the future flexibility needs of the EU power system. Reflecting the European regulatory effects on TSO assets, in November ENTSO-E published a position paper on the use of lead in power cables, drawing attention to the lack of alternatives for lead-free offshore cables in the extra-high voltage range. This followed the work co-authored with T&D Europe, the "Position Paper on SF6 transition times", to propose a joint view towards a realistic transition to SF6-gas free equipment. The ENTSO-E, T&D Europe and WindEurope joint report on "The development of multi-vendor HVDC systems and other power electronics interfaced devices" investigates technology options to deliver multi-terminal, multi-purpose HVDC systems integrating multiple converter stations from a variety of technology providers. The position paper "Grid-Forming Capabilities: Ensuring system stability with a high share of renewables", published in April 2021, outlines the progress made in recent years in the field of grid forming converters that will ensure the stable operation of interconnected transmission systems with a high penetration of non-synchronous power generation modules. ENTSO-E developed its first position paper on electric vehicle integration into power grids, analysing the challenges but also the numerous opportunities of this evolution for TSOs and providing key recommendations.

Technology Factsheets

ENTSO-E has gathered in a report all the Technology Factsheets taken from the [ENTSO-E Technopedia tool](#)¹⁷. The Factsheets allow you to keep up with state-of-the-art technologies in power transmission, ranging from asset management to digital and flexibility solutions. The Factsheets provide detailed information on each technology, including their technology readiness level (TRL), indicating their level of maturity, their fields of research and advantages.

KEY DATES & DOCUMENTS

2 Dec 2021	Publication of the Position Paper and Report on the Future Flexibility Needs
30 Nov 2021	Publication of the Position Paper on the use of lead in power cables
2 Nov 2021	Publication of the joint Position Paper on Transition Times from SF6 to alternative technologies for HV and EHV applications
21 June 2021	Publication of the joint Position Paper on the Development of multi-vendor HVDC systems and other power electronics interfaced devices
2 April 2021	Publication of the Position Paper on EV integration into power grids
1 April 2021	Publication of the Position Paper on Grid-Forming Capabilities

KEY DATES & DOCUMENTS

23 Mar 2021	Publication of the Technology Factsheets
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17 The ENTSO-E Technopedia went live in November 2020.

Cooperation with policy makers and stakeholders in research and innovation

ENTSO-E also maintained strong cooperation with policy makers and stakeholders in research and innovation. ENTSO-E participates in the European Technology & Innovation Platform on Smart Networks for Energy Transition (ETIP SNET) Platform under the umbrella of the European

Commission's Strategic Energy Technology (SET), as well as the Horizon2020 calls. In 2021, ENTSO-E continued to facilitate proposals for the Horizon Europe calls and to foster TSO participation.

ENTSO-E is involved in the following EU-funded projects:

- 1. INTERFACE (2019 – 2023)**, which gathers 42 partners – TSOs, DSOs, aggregators and IT providers – to conceive a digital solution to support new flexibility markets. Participating TSOs are Elering, AST, Fingrid, ESO, Transelectrica, ELES and REN
- 2. OneNet (2020 – 2023)**, the largest project of its kind with 72 partners, of which 14 are TSOs. The main objective of the project is to develop an open and flexible architecture to make the European electricity system smarter and more efficient. The two above mentioned projects aim to investigate how the local flexibility markets could be most efficiently connected to the wholesale markets, with a strong focus on the TSO – DSO coordination. OneNet picks up the work done in the INTERFACE and CoordiNet projects, bringing closer the flexibility platforms' deployment into the business environment.
- 3. BD4NRG (2021 – 2024)**, which consists of 34 partners, the TSOs among which are ELES and REN. The project aims to evolve, upscale and demonstrate an innovative energy-tailored Big Data Analytics Toolbox.

In addition, on [4](#) and [11](#) June 2021 ENTSO-E organised, jointly with E.DSO, the 10th InnoGrid edition "Living the transition". The online event brought together participants from the industry, associations, EU institutions, regulators, academic world and Member States, highlighting the paramount role of networks in the energy transition and of the EU funded projects that contribute to the transition by developing innovative solutions to renewables' integration, digitalisation, flexibility and new market opportunities.

Towards a Vision 2050

Following the success of its Vision 2030, during the Conference held in November 2021 ENTSO-E presented a roadmap with preliminary messages leading "Towards a Vision 2050", outlining the European TSOs' vision for a carbon-neutral energy system by 2050. Around 30 speakers (and 500 participants) contributed to discussions on the upcoming challenges and opportunities of offshore development, energy system integration (with a more inclusive system planning) and unlocking demand-side flexibility.

KEY DATES & DOCUMENTS

26 Nov 2021	ENTSO-E Conference "Net-Zero: An Energy System for a Climate-Neutral Europe by 2050"
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The main driver for the development of the ENTSO-E research plan (RDI Roadmap 2020 – 2030) was to identify the necessary innovation milestones for TSOs to reach the EU Green Deal policy objectives, thus achieving the green transition. Without neglecting the need for grid expansion, the innovation building blocks to achieve this are: deep electrification; smart sector coupling; and the integration of a massive deployment of RES, including offshore, through a reliable and secure cyber-physical system. Moreover, existing assets, markets and services should ensure both horizontal and vertical integration of energy resources with an eye towards optimisation as new types of services for customers emerge. All the activities stemming from this legally mandated document underline this purpose, as do the Horizon2020 projects.



6 Cybersecurity, Interoperability and Data

The current framework for digital activities in ENTSO-E is provided by its IT Strategy, which was approved in 2017. The ENTSO-E IT Strategy has clearly identified interoperability and cybersecurity as two of the founding capabilities for ENTSO-E's information systems. This has led to the development of an ENTSO-E Cybersecurity Strategy that was approved in the first quarter of 2019. In this context, relevant activities are steered as detailed in the following paragraphs.

Cybersecurity

Protecting TSOs' systems and network operation tools against cyber-attacks is of paramount importance for system security. For several years now, ENTSO-E has been acting as a platform for the sharing of best practice between TSOs. The entry into force of the CEP tasked ENTSO-E with the mandate to promote cyber security and data protection in cooperation with relevant authorities and regulated entities (Art. 30.1.n Reg. 943/2019).

Under the framework of the Connecting Europe Facility (CEF) project, ENTSO-E carried out the following cybersecurity activities:

Activity 1: Cybersecurity design:

1. ISO 27001 TSO Scope & Secure Software Development Lifecycle (SSDLC)
2. Risk Impact Matrix & Data Classification
3. Supply Chain security & procurement
4. Tech. & operation cybersecurity standards

Activity 2: Identify requirements for a cybersecurity testing facility

Activity 3: Identify requirements for a Cyber Security Operations Centre

Moreover, ENTSO-E performed cyber risk assessments on the main ENTSO-E legally mandated IT platforms: CGM, EAS, Transparency Platform and OPC/STA. Regarding the latter, ENTSO-E performed external penetration testing to confirm the effectiveness of the overall security.

KEY DATES & DOCUMENTS

19 Feb 2021	Publication of the Recommendations for the European Commission on a Network Code on Cybersecurity
22 July 2021	Publication of the ACER's Framework Guideline
12 Nov – 10 Dec 2021	Public consultation on the Network Code on Cybersecurity

ENTSO-E also participated in the informal drafting team of the [Network Code on Cybersecurity](#) (composed of TSOs and DSOs under the EC leadership), which culminated in the publication of the "Recommendations for the European Commission on a Network Code on cybersecurity" in February 2021. Following the publication of the Framework Guideline by ACER, the formal drafting process of the Network Code on Cybersecurity started on 27 July 2021. The Network Code on Cybersecurity was co-drafted by ENTSO-E and the EU DSO Entity and, between November and December 2021, ENTSO-E conducted a public consultation on the Network Code proposal and organised two public workshops¹⁸.

In October 2021, ENTSO-E, together with E.DSO and ENCS, hosted the 4th edition of their [Cybersecurity event "Enhancing our grid resilience"](#) discussing the challenges of increasing volume and the sophistication of malicious acts towards the European energy grid and how the Network Code on Cybersecurity will enhance our grid resilience.

¹⁸ ENTSO-E and the EU DSO Entity submitted the final proposal for the Network Code on Cybersecurity on 14 January 2022. These developments are outside the scope of this Report and will be covered in the Annual Report 2022, to be drafted next year.

Data exchange standards: Ensuring pan-European interoperability

Standards facilitate cross-border exchange and allow for the efficient and reliable identification of different objects and parties relating to the internal energy market and its operations. Standards also support the implementation of network codes in various ways, and several of ENTSO-E's IT tools and data environment, such as the OPDE, rely on standards. In accordance with Art. 30.1.k of the Electricity Regulation (943/2019), ENTSO-E should contribute to the establishment of interoperability requirements and non-discriminatory and transparent procedures for accessing data.

ENTSO-E develops and maintains an Electronic Data Interchange library to enable interoperability between actors in the electrical industry in Europe.

The main standardisation activities in 2021 included the development of the Common Information Model (CIM) and implementation guides to support data exchanges required from the Network Codes, work on international standards, updating the CGMES, maintaining the harmonised role model, following-up on the implementing acts on data and interoperability, implementing Art. 55(2)(a, b, c) of the IEM regulation and Art. 24 of the IEM Directive, and training activities for the TSO-RSC community.

In June 2021, CGMES was published as an International Standard by the International Electrotechnical Commission (IEC).

KEY DATES & DOCUMENTS

4 Jun 2021	Publication of the CGMES as an International Standard (Part 1 – Part 2)
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The transition towards a more sustainable society implies the electrification of sectors such as transport (e.g. electric vehicles) or heating. To work efficiently, this evolution will require more data to be collected, e.g. about individual behaviours and preferences. Cybersecurity will be the key to building the required trust for all stakeholders to embrace this evolution.

7 TSO–DSO partnership and demand-side flexibility

The energy transition corresponds to a change from a centralised system to a more complex integrated electricity system, with decentralised and centralised co-existing. The new system also sees new actors, such as aggregators, active customers, energy communities and other Distributed Energy Resources (DERs). This chapter describes ENTSO-E’s activities concerning the TSO–DSO partnership and demand-side flexibility.

Integration of distributed flexibilities

A key area for TSO–DSO cooperation is active system management and the coordinated use of distributed flexibility. Storage, distributed generation and customer participation through demand-side response have the potential to provide new services for the grid and the system. These are known as distributed flexibilities, and their integration in the operation and market process will be key to efficient management of the electrical system of the future.

ENTSO-E pursued its cooperation with the EU DSO Entity on this topic with the approval of a Joint Roadmap on Distributed Flexibility describing the common system operators’ perspective on new rules enabling demand-side flexibility. The report investigates and provides recommendations for the

evolution of the regulatory framework regarding four areas: market access and rules for aggregation, product design and procurement, T&D coordination processes, and finally measurement, validation and settlement of flexibility services. Stakeholders were consulted during the development and the final deliverable was shared with the European Commission and ACER.

In complement to this top-down regulatory analysis, ENTSO-E and Frontier Economics have published a report which investigates the ownership and operating models of eight platforms where flexibilities can be traded and that facilitate dispatch and/or settlement of energy or system services between TSOs, DSOs and DERs.

Memorandum of understanding

The Assemblies of ENTSO-E and the EU DSO Entity both approved in 2021 a MoU which provides a framework for the two Associations to fulfil their legal obligations as per article 30(1) and 55(2) of Regulation (EU) 2019/943¹⁹. It covers the following areas: development and amendments of network codes and guidelines, cooperation on the monitoring of network codes and guidelines, promotion of best practices related to the planning and operation of transmission and

distribution systems, as well as provisions to facilitate institutional cooperation between the two Associations.

KEY DATES & DOCUMENTS

10 Nov 2021

[Publication](#) of the Review of Flexibility Platforms

¹⁹ The MoU was effectively signed and entered into force in January 2022.

Other areas of cooperation

ENTSO-E cooperated with the DSOs associations on TYNDP 2022 (and notably on the common scenario building a new approach to prosumers modelling. The Association also contributed to the editorial team set up by the European

Commission under the Task Force Smart Grids for the development of recommendations on the implementing acts for data interoperability and access, alongside DSOs experts.

With the constant increase of renewable generation, storage and active customers largely connected to the distribution grid, DSOs and TSOs must strengthen their coordination and exchange the necessary information for operating their networks securely while ensuring distributed flexibilities are used when and where they provide the most value to the whole electricity system.



Annexes

Annex 1 – Network Codes and Clean Energy Package: Focus on implementation

The Network Codes and Guidelines and the CEP represent a large part of the legislative framework under which ENTSO-E operates. The implementation of the Network Codes/Guidelines and of the CEP represent a substantial effort, which ENTSO-E as an association is prioritising.

All codes & guidelines have entered into force, and ENTSO-E is now focused on their implementation and the monitoring thereof.

What is ENTSO-E's role in the implementation?

The implementation of European legislation is done on national, regional, and pan-European levels, frequently in combination. TSOs, as well as DSOs, market participants and regulators at the EU, regional and national levels are involved in various ways. In some cases, Network Codes or

primary legislation define clear and detailed roles for specific bodies/entities; in others, legal provisions are less detailed and require an additional layer of text to define roles and processes.

Implementation responsibility in Network Codes and Guidelines

TASK ATTRIBUTED TO ...	RESPONSIBILITY	APPROVAL ²⁰
ENTSO-E	ENTSO-E tasks	ACER
Pan-European "All TSOs"	All TSOs	ACER
Regional "All TSOs"	TSOs of the region	NRAs of the region. ACER to make the final decision if NRAs cannot agree ²¹
National	Depending on national legislation (TSO, DSO...) (ENTSO-E may provide supporting documents and guidance)	National NRAs

"All TSOs" refers to the TSOs of all EU countries (pan-European "All TSOs"), or to the TSOs of a specific EU region (regional "All TSOs").

Table 7 – Entities responsible for pan-European, regional and national tasks

Monitoring the implementation

ENTSO-E is responsible for the monitoring of the implementation of Network and Guidelines, as defined by the legal provisions of the latter. To fulfil this obligation, ENTSO-E elaborates monitoring plans and publishes reports. It also collects data, (termed "lists of information"), and designs and implements interfaces for data collection. Based on new provisions under Regulation (EU) 2019/943, ENTSO-E will further cooperate with the future EU DSO entity on the monitoring of the implementation of possible new Network Codes and Guidelines.

These will be adopted pursuant to this Regulation and are relevant to the operation and planning of distribution grids and the coordinated operation of the transmission and distribution networks.

ENTSO-E and ACER have signed an agreement for data collection and provision to ACER. This agreement is currently being used initially for the monitoring of the CACM and should then be extended to other network codes and guidelines.

20 In accordance with the CEP provisions of the Electricity Regulation 2019/943.

21 In accordance with Art. 5(3) of ACER Regulation 2019/942.

Annex 2 – Governance

In 2021, ENTSO-E was governed by an Assembly representing 42 TSOs²² and by a Board consisting of 12 elected members.

President



Hervé Laffaye
RTE,
France

Vice-President



Zbyněk Boldiš
ČEPS a.s.,
Czech Republic

Chair of the Board



Joachim Vanzetta
Amprion GmbH,
Germany

Vice-Chair of the Board



Liam Ryan
Eirgrid,
Ireland

Board Members



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50Hertz Transmission
GmbH, Germany



Damian Cortinas
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France



Maurice Dierick
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Italy



Frank-Peter Hansen
TenneT TSO B.V.,
Netherlands



**Søren Dupont
Kristensen**
Energinet, Denmark



Robert Paprocki
PSE S.A.,
Poland



Eduardo Prieto
REE SAU,
Spain



Taavi Veskimägi
Elering AS,
Estonia



Dimitar Zarchev
ESO EAD,
Bulgaria

Committee Chairs



Kjell A. Barmsnes
*Market Committee
Chair*
Statnett SF,
Norway



Håkon Borgen
*Research, Develop-
ment & Innovation
Committee Chair*
Statnett SF,
Norway



Fokke Elskamp
*Legal and Regulatory
Group Chair*
TenneT TSO B.V.,
Netherlands



Gerald Kaendler
*System Development
Committee Chair*
Amprion GmbH,
Germany



Tahir Kapetanovic
*System Operations
Committee Chair*
Austrian Power Grid
AG, Austria

22 As of 2022, ENTSO-E consists of 39 Members from 35 countries (SONI – System Operator for Northern Ireland – is still part of ENTSO-E).

Annex 3 – Cooperation with UK TSOs

On 31 December 2020, the United Kingdom (UK) officially left the European Union (EU) with a Trade and Cooperation Agreement (TCA) signed on the same date.

The TCA foresees that:

- › ENTSO-E and the UK TSOs shall prepare under the guidance of the Specialised Committee on Energy a framework for cooperation not involving, or conferring a status comparable to, membership in ENTSO-E by UK TSOs;
- › EU and UK TSOs shall prepare technical procedures once requested by the Specialised Committee on Energy.

As a result, ENTSO-E and the UK TSOs elaborated in 2021 – with the guidance of the EC and the UK Government – Working Arrangements (WAs) setting out an efficient and inclusive framework for cooperation. The Working Arrangements were finalised and submitted for approval to the EC and the UK Government in early July 2021.

EU TSOs and UK TSOs have also been working in 2021 at the request of the parties to the TCA on the elaboration of technical procedures on (i) Multi-Regional Loose Volume Coupling and (ii) Capacity Calculation. The work on technical procedures is still ongoing.

Annex 4 – Resources

Budget

ENTSO-E AISBL²³ is a non-for-profit organisation under Belgian law.

ENTSO-E's budget is covered by membership fees as well as other revenues and incomes. For 2021, the budget of ENTSO-E totalled EUR 48.5 million, funded by TSO member fees of EUR 34.3 million, self-financing of EUR 1.2 million via ENTSO-E reserves and by other revenues of EUR 13.0 million (H2020 grants and additional TSO funding).

Staff

Our human resources include permanent staff and secondment from TSOs as well as outsourced "on site" services (such as IT support services). This is in addition to the numerous TSO staff members who bring their expertise to the Association via its numerous bodies (Assembly, Board, Committees and subgroups).

At the end of 2021, ENTSO-E had 120 employees.

23 International not-for-profit association (Association internationale sans but lucratif)

List of abbreviations

Abbreviation	Definition
ACER	Agency for the Cooperation of Energy Regulators
aFRR	Automatic Frequency Restoration Reserves
AISBL	Association Internationale Sans But Lucratif (International Not-For-Profit Association)
CACM	Capacity Allocation and Congestion Management
CBA	Cost–Benefit Analysis
CCR	Capacity Calculation Region
CEF	Connecting Europe Facility
CENELEC	European Committee for Electrotechnical Standardisation
CEP	Clean Energy Package
CGM	Common Grid Model
CGMES	Common Grid Model Exchange Standard
CIDM	Congestion Income Distribution Methodology
CIM	Common Information Model
CNC	Connection Network Code
CNEC	Critical Network Element
CoNE	Cost of New Entry
CSAM	Methodology for Coordinating Operational Security Analysis
CZC	Cross-Zonal Capacity
DA	Day Ahead
DCC	Demand Connection Code
DERs	Distributed Energy Resources
DSO	Distribution System Operator
EAS	ENTSO-E Awareness System
EB Reg.	Electricity Balancing Regulation

Abbreviation	Definition
ENTSOG	European Network of Transmission System Operators for Gas
ERAA	European Resource Adequacy Assessment
ETIP SNET	European Technology and Innovation Platform Smart on Networks for Energy Transition
EU	European Union
FCA	Forward Capacity Allocation
FCR	Frequency Containment Reserve
FSKAR	Financial Settlement of KΔf, ACE and ramping
GHG	Greenhouse Gases
GL	Guideline
GRIT	Greece–Italy
GUI	Graphical User Interface
HAR	Harmonised Allocation Rules
HVDC	High Voltage Direct Current
iAC	Independent Advisory Council
ICS	Incident Classification Scale
ID	Intraday
IEC	International Electrotechnical Commission
IGCC	International Grid Control Cooperation
IGDs	Implementation Guidance Documents
IGM	Individual Grid Model
IN	Imbalance Netting
ITC	Inter Transmission System Operator Compensation
JAQ	Joint Allocation Office
KORR	Key Organisational Roles and Responsibilities
LTTR	Long-Term Transmission Rights
MAF	Mid-term Adequacy Forecast

Abbreviation	Definition
MARI	Manually Activated Reserves Initiative
mFRR	Manual Frequency Restoration Reserves
MoP	Manual of Procedures
MoU	Memorandum of Understanding
NC ER	Emergency and Restoration Network Code
NECP	National Energy and Climate Plan
NEMO	Nominated Electricity Market Operator
NRA	National Regulatory Authority
OPC/STA	Outage Planning Coordination/Short Term Adequacy Assessment Process
OPDE	Operational Planning Data Environment
PCI	Project of Common Interest
PCN	Physical Communication Network
PECD	Pan-European Climate Database
PEVF	Pan-European Verification Platform
PICASSO	Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation
PRA	Probabilistic Risk Assessment
Prosumers	Neologism that designates producers and consumers
RCC	Regional Coordination Centre
RDI	Research, Development and Innovation
RES	Renewable Energy Source
RfG	Requirements for Generators
RGCE	Regional Group Continental Europe
RR	Replacement Reserves
RSC	Regional Security Coordinator
SAFA	Synchronous Area Framework Agreement

Abbreviation	Definition
SAT	Site Acceptance Test
SDAC	Single Day-Ahead Coupling
SEE	South-East Europe
SEleNe CC	South East electricity Network – Coordination Center
SET	Strategic Energy Technology
SIDC	Single Intraday Coupling
SLA	Service-Level Agreement
SOC	System Operation Committee
SOGL	System Operation Guideline
SOR	System Operation Region
SO	System Operation
SSDLC	Secure Software Development Lifecycle
TCA	Trade and Cooperation Agreement
TERRE	Trans-European Replacement Reserves Exchange
TP	Transparency Platform
TRL	Technology Readiness Level
TSO	Transmission System Operator
TYNDP	Ten-Year Network Development Plan
VoLL	Value of Lost Load
WA	Working Arrangement
WAMS	Wide Area Monitoring System

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