ENTSO-E Annual Report

2022 Edition | Version 20 June 2023

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ENTSO-E Mission Statement

Who we are

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the **association for the cooperation of the European transmission system operators (TSOs)**. The 39 member TSOs*, representing 35 countries, are responsible for the **secure and coordinated operation** of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

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

Our mission

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

Our vision

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

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

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

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

* The new Observer Membership Agreements signed with Ukrenergo and with TEİAŞ (Turkish Electricity Transmission Corporation) were formalised on 26 April and 13 December 2022, respectively.

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 2022. This report aims to inform our stakeholders about the many activities and products developed by ENTSO-E Member to complete the Internal Energy Market, foster required onshore/offshore grid developments, increase cooperation with Distribution System Operators (DSOs) and other relevant stakeholders as well as accelerate innovation in the European energy systems.

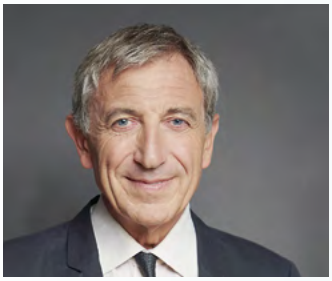
In 2022 we encountered many deliverables including reports, methodologies, amendments and on other crucial activities. While delivering on our numerous legal mandates ENTSO-E and its member TSOs completed also a comprehensive internal strategy programme and ensured a continuous strategy implementation monitoring of the latter.

2022 has been an intense year for the TSO community. In January was signed the Memorandum of Understanding (MoU) between ENTSO-E and the EU DSO Entity. Following the invasion of Ukraine, Continental Europe TSOs decided to synchronise Continental Europe with the power systems of Ukraine and Moldova. In April, the Observership Agreements with Ukrenergo was signed and in December with Turkish Electricity Transmission Corporation (TEİAŞ). Also in December, the go-live of the PICASSO and MARI platforms and the signature of the Declaration of Intent on the digitalisation of the energy system with the EU DSO entity are just a few examples of great achievements.

Overall, 2022 has proven the resilient capabilities demonstrated by the interconnected electricity system during the winter crisis, especially in the last months of the year. Solidarity, which is a core ENTSO-E value should be highlighted, and also the role of the electrical interconnections which have been decisive to ensure the EU system adequacy.

During the past year we have also witnessed an unprecedented electricity price crisis in all European markets, mainly driven by the increase of global gas prices. The sharp reduction of gas supply from Russia affected electricity generation, resulting in tight security of supply margins, high and volatile wholesale prices, and excessive burden on consumers. ENTSO-E and TSOs have worked closely with European institutions and national authorities, as well as ENTSOG, to monitor adequacy, to implement emergency policy measures (e. g. helping Member States achieving mandatory demand reduction targets), and to partly alleviate the impact of electricity bills on consumers (e. g. by using congestion income to lower transmission tariffs) In this regard the role of the interconnected electricity transmission system has allowed individual Member States to be more resilient and ensure lower bills to customers. Moreover, the Winter Outlook 2022 provided relevant information on measures ENTSO-E and Member TSOs have taken to address adequacy concerns over the past winter.

This year's report again shows the TSOs' commitment as key enablers of the carbon-neutral economy, and fostering innovation according to the milestones designated by the Research, Development and Innovation Roadmap. This ambition is reflected in the "ENTSO-E Vision: A Power System for a Carbon Neutral Europe", published in October 2022. A growing share of variable renewable generation, flexibility resources, stronger infrastructure, electrification and cooperation among key actors in the energy sector will enable the decarbonisation of our economy and bring benefits to our societies.



President
Hervé Laffaye
ENTSO-E

Chair of the Board
Joachim Vanzetta
ENTSO-E

Introduction

ENTSO-E in 2022

This Annual Report covers the period from January to December 2022. It focuses on the legal mandates given to ENTSO-E and on the Pan-European All TSOs tasks, which are facilitated by ENTSO-E. The activities covered in this report were performed thanks to the 39 members of ENTSO-E's who provide funding and expertise to the Association.

The successful implementation of these activities also relies on the input provided by stakeholders through the 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 will be submitted for stakeholders' views in a public consultation from 29 June to 19 July 2023. The consultation results and responses will be considered and the Annual Report will be subsequently submitted to the Agency for the Cooperation of Energy Regulators (ACER) for opinion.

What's new

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 ambition culminated in the publication of the "ENTSO-E Vision: A Power System for a Carbon Neutral Europe". The Vision presents three essential requirements for a sustainable, resilient and affordable power system: carbon-neutral energy sources, system flexibility resources and a strong power grid. ENTSO-E's positions on these and other topics are detailed in various publications and were also presented in several events organised throughout the year i. e. "Flexibility from Power to Hydrogen (P2H2)"; "Stability Management in Power Electronics Dominated Systems" and ENTSO-E Vision Event in October 2022.

Several other achievements can be highlighted: the enhancement of our cooperation with the distribution system operators that led to the signature of the Memorandum of Understanding (MoU) between ENTSO-E and the EU DSO Entity as well as the Declaration of Intent to jointly develop the Digital Twin of the EU electricity grid; the synchronisation of Continental Europe with the power systems of Ukraine and Moldova; the Observership Agreements signed with Ukrenergo and TEİAŞ; the go-live of the PICASSO and MARI balancing platforms; and the additional efforts to assess adequacy risks in 2022.

In the context of the electricity prices crisis, ENTSO-E and TSOs also supported European and national policy makers in identifying and implementing emergency measures in electricity markets (in particular Council Regulation (EU) 2022/1854 on an emergency intervention to address high energy prices) to ensure security of supply and to partially alleviate the burden of high prices on consumers.

The ENTSO-E's independent Advisory Council in 2022 provided advice to ENTSO-E's Board on a wide range of work products and European policy priorities, namely the RePower EU, energy scarcity, the Seasonal Outlooks, the Market Design Reform and the European Resource Adequacy Assessment and the Ten-Year Network Development Plan for 2022.

ENTSO-E has also adopted it first Diversity & Inclusion roadmap (D&I) that will be implemented in its values, attitudes, culture, beliefs, ethnic background, sexual orientation, gender identity, skills, knowledge, life experiences and physical ability or disability of each individual. ENTSO-E has aligned the definitions and objectives with the target set by the European Commission. The D&I roadmap will focus in the coming years on 3 areas which are: "ENTSO-E as a D&I organisation", "attracting talent and resources by fostering D&I" and "monitoring our D&I key performance indicators (KPIs)".

Report structure

› **Chapter 1** describes the implementation of tasks related to the implementation of the System Operation legal mandates, which aim to improve operations and secure the electricity supply with ever increasing volumes of variable renewable energy sources (RES). Many deliverables under the System Operation Guidelines have been achieved, and activities stemming from the Emergency and Restoration Code were carried out in 2022. The chapter also outlines activities conducted in the field of regional development as well as the Common Grid Model (CGM) and the ENTSO-E Awareness System (EAS).

› **Chapter 2** covers the tasks related to the implementation of the Market legal mandates. TSOs are instrumental in the progressive harmonisation of electricity market rules, which enables the entry of increasing numbers of Renewable Energy Sources (RES) producers and thus contributes to a more sustainable energy system. In 2022, ENTSO-E and TSOs developed and submitted several Capacity Allocation and Congestion Management (CACM), Forward Capacity Allocation (FCA) and balancing methodologies and delivered several monitoring tasks according to the electricity market regulation.

› **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 in the electricity market with a view to achieving a carbon-neutral European energy system. In 2022, ENTSO-E and the European Network of Transmission System Operators for Gas (ENTSO-G) published their joint TYNDP 2022 Scenario Report and the second edition of the European Resource Adequacy Assessment (ERAA).

› **Chapter 4** describes the development of the Transparency Platform (TP) for various transparency requirements stemming from legal mandates, and the review of the Manual of Procedures (MoP). The platform enables the sharing of data relating to the general state of the European electricity market.

› **Chapter 5** describes the creation in 2022 of the ENTSO-E Research, Development and Innovation (RDI) Implementation Report 2021 – 2025, the publication of several position papers and technical reports, the signature of the Declaration of Intent with the EU DSO Entity and ENTSO-E's participation in several EU-funded projects in 2022. The main driver is to pool the vision, needs and innovations of TSOs with the surrounding ecosystems, policy experts and other stakeholders to reach the EU Green Deal policy objectives, especially in terms of decarbonisation and digitalisation targets, thus achieving the green transition.

› **Chapter 6** details cybersecurity, data exchange and the interoperability activities carried out in 2022. ENTSO-E co-led the drafting phase of the Network Code on Cybersecurity. The chapter also describes data exchange and interoperability activities to support the Network Code implementation, the development of the Common Information Model (CIM), 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 performed within 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.

ENTSO-E Vision: A Power System for a Carbon Neutral Europe

In October 2022, ENTSO-E published its long-term Vision, which identifies what would be necessary to achieve a power system fit for a carbon-neutral Europe. It builds on our previous ENTSO-E Vision 2030, on the TYNDP scenarios and the RDI Roadmap, and it includes the TSOs' common intelligence on trends, scenarios, challenges, technology and innovation.

The Vision is based on the assumption that electricity will play a central role in the achievement of a carbon neutral energy system because of the higher efficiency of electrical end uses versus synthetic green fuels, and because of the maturity of renewable electricity generation technologies. Electricity is therefore the most versatile and efficient energy carrier, and it requires coupling with other energy sectors when direct electrification is not feasible or efficient.

KEY DATES & DOCUMENTS

10 Oct 2022	Publication of the **ENTSO-E Vision: A Power System for a Carbon Neutral Europe**

Three elements are essential to realise a sustainable, resilient and affordable power system:

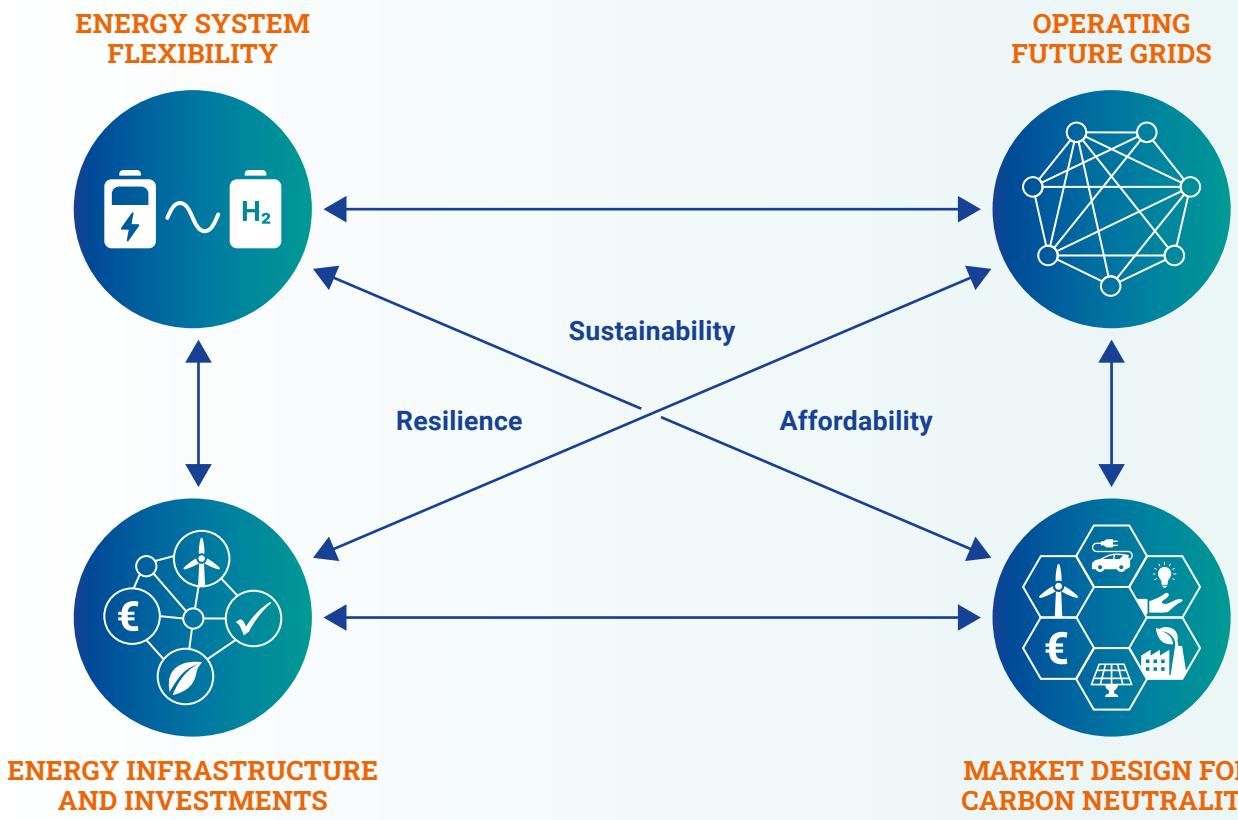
- **Carbon neutral energy sources**, which for the most part will be weather-dependent;
- **System flexibility resources**, to efficiently complement the variability of generation and consumption, and to address the increasing complexity of the system;
- **The power grid**, connecting generators, consumers and flexibility resources across Europe, and enabling a fully integrated European Energy Market.

The future power system in Europe will be a System of Systems, which will require strong cooperation between transmission and distribution and amongst different energy systems. All operators will be key enablers and facilitators in making this future energy system work. At the same time, it will be both more European and more local with TSOs providing a critical interface between these dimensions.

We argue that four key elements will need to change to make this reality possible:

- The development of significant system **flexibilities**, both short and long duration, that will need to be timed with the future system needs and the gradual phase-out of fossil fuel generation.
- An **operation** of the system that will rise up to the challenge of this much more dynamic System of Systems, including the management of a wide portfolio of flexibilities, through innovation and cooperation.
- A regulatory framework, with planning and permitting procedures that will facilitate the timely deployment of the necessary **investments**, and encourage efficiency and innovation.
- A **market design** as a key enabler, that must evolve to allocate value where and when it will be most needed for the energy system, while reflecting different consumers' needs and preferences.

entsoe VISION



After eighteen months, this work culminated in the presentation of Thethe "ENTSO-E Vision: A Power System for a Carbon Neutral Europe" in a series of webinars held between 10 and 12 October 2022 that reached almost 1,000 participants.

To transform this vision into reality as soon as possible, a strong cooperation across the whole energy industry, and a permanent dialogue with consumers, stakeholders and public authorities at European, national and local level, will be needed.

Edwin Haesen, Head of ENTSO-E System Development; Miguel de la Torre, Red Eléctrica Manager of System Development; Peter Vermaat, EU DSO Secretary General; Antonella Battaglini, Renewables Grid Initiative CEO; Diederik Peereboom, T&D Europe Secretary-General; Danny Klaar, Advisor, TenneT

Vincenzo Ranieri, EU DSO President; Damian Cortinas, Co-Chair of the Transmission and Distribution Interface.

Entso-E Work on Ukraine Synchronisation

Synchronisation with Ukraine and Moldova

Following Russia's invasion of Ukraine on 24 February 2022, the TSOs of Continental Europe received an urgent request from Ukrenergo, the Ukrainian TSO, for an emergency synchronisation of the Ukrainian power system, including the Burshtyn island, with the continental European power system. This was followed by the Moldovan TSO Moldelectrica who also submitted a request for emergency synchronisation in line with the Ukrenergo request.

On 16 March 2022, the TSOs of Continental Europe agreed to proceed with the emergency synchronisation of the Ukrainian-Moldovan power system with Continental Europe. This decision also initiated a call for energy assistance to Ukrenergo, where necessary. The preparation of the synchronisation process had been ongoing since 2017 and the acceleration of its implementation was only possible thanks to the studies previously carried out and the adoption of risks mitigation measures.

ENTSO-E is proud that in April 2022, Ukrenergo also became an observer member, reinforcing essential and effective cooperation and contributing to the security of the interconnected power system.

> *…Ukraine's power sector and civil infrastructure have been under Russia's deliberate and targeted attacks. But Ukraine has resisted and rebuilt. The joint operation to synchronise Ukrainian and Moldovan electricity networks in record time meant that Ukraine avoided lasting blackouts and an escalation of the already critical conditions that millions of citizens faced. The synchronisation process, in which ENTSO-E paid a crucial role, is a demonstration of true European unity in action.*
>
> *European Commissioner for Energy Kadri Simson*

Further emergency support

One year on after the successful synchronisation of the continental European power system with the Ukrainian and Moldovan power systems, the European TSOs together with Ukrenergo confirmed the basis for an essential and effective cooperation contributing to the security of the interconnected power system. With the support of TSOs, Ukrenergo has been able to increase the stability of the grid and maintain the security of its power system through the most difficult periods. In particular, it contributed to minimising the incidents of having to reduce or turn off the supply of electricity to its businesses and citizens in the winter and also to ensuring a faster recovery time for system restoration following the significant attacks and damage to Ukrainian energy infrastructure.

TSOs of continental Europe agreed on 27 March 2023 to increase the maximum import capacity for electricity trading from continental Europe to Ukraine and Moldova from 700 megawatts (MW) to 850 MW for all hours.

How TSOs have helped Ukraine and Moldova to keep the lights on

The synchronisation played an important role in managing the challenging winter. With the onset of Russian attacks on Ukraine's energy infrastructure, it allowed Ukraine and Moldova to import electricity during the most difficult periods. On the other hand, by opening the possibility of Ukrainian electricity exports in June 2022, the synchronisation demonstrated the significance of the interconnection for commercial exchanges between the EU and Ukraine.

ENTSO-E TSOs are committed to supporting Ukrenergo and Moldelectrica in maintaining a strong and resilient network, reinforcing and expanding existing power lines, and providing assistance when necessary. ENTSO-E recognizes the exceptional efforts of Ukrenergo to operate and maintain the power system in these difficult times and will continue to support their efforts.

Celebration Ceremony Ukrenergo Observer, April 2022

Contents

The core activity of every TSO, embracing operational security and enabling of market activities, system operation today more than ever facilitates energy transition and RES integration; European TSOs, supported by Regional Coordination Centers and ENTSO-E deliver secure and resilient system operation around-the-clock, all-year-long, to the benefit of all Europeans.

Tahir Kapetanovic, Chair of the ENTSO-E System Operations Committee

1 System Operation

1.1 The System Operation Guideline

The Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing guidelines 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 2022:

SOGL deliverables in 2022	Key documents and dates
Art. 75.1: Methodology for coordinating operational security analysis	Formal amendment procedure to be launched in 2023.
Art. 156.11: All Continental European TSOs' proposals for the definition of a minimum activation time period required for limited energy reservoirs to remain available during alert state	2 December 2022: Continental Europe's National Regulatory Authority request for amendment

Table 1: SOGL implementation activities in 2022

In 2021, following the publication of the first biennial progress report on the Probabilistic Risk Assessment (PRA) methodology pursuant to the methodology for coordinating the operational security analysis (hereafter CSAM), specifically Article 44 (1) and 44 (2), ENTSO-E devoted 2022 to improving the PRA data collection platform[1]. In 2022, ENTSO-E also developed the first assessment of the implementation of the SOGL data exchange framework and the methodology on Key Organizational Roles and Responsibilities Requirements.

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

Implementation monitoring

Between July and September 2022, ENTSO-E released three important annual implementation monitoring reports: the "Annual Report on Incident Classification Scale (ICS) 2021" (Art. 15 SOGL), the "Annual Report on Load-Frequency Control 2021" (Art. 16 SOGL) and the "All TSOs' Scenario Definition and Scenario Description for the Year 2023" (Art. 65 SOGL).

KEY DATES & DOCUMENTS

15 July 2022	Publication of the **All TSOs' scenario definition and scenario description for the year 2023**
30 Sep 2022	Publication of the **Incident Classification Scale 2021** Annual Report
30 Sep 2022	Publication of the **Load-Frequency Control** Annual Report 2021

1 The progress made towards the development of the PRA methodology will be further explained in the next biennial report due in December 2023.

1.2 The Emergency and Restoration Code

The Emergency and Restoration Network Code (NC ER) sets out harmonised rules on how to respnd to 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.

In 2022, ENTSO-E monitored the national implementation of the network code Art. 4.2, proposals to be submitted by TSOs to relevant regulatory authorities and Art. 35-36 NC ER on market suspension rules. ENTSO-E provided updates every semester on the national implementation of the NC ER to stakeholders on the System Operation European Stakeholder Committee. On ACER's request and following a **dedicated report** published in 2020, ENTSO-E performed a deep-dive analysis of national frameworks for market activities suspension, including views on the potential for harmonisation. It presented high-level conclusions to the Market European Stakeholders Committee in December 2022. The NC ER experts also investigated elements of cross-border relevance related to load shedding procedures, which are nationally determined, in the context of the energy crisis in winter 2022 – 23.

1.3 Frequency stability

Following the separation of the Continental Europe Synchronous Area on 24 July 2021, the Expert Panel issued its **final report** in March 2022. The report includes a comprehensive analytical overview of the incident and proposes five recommendations to prevent and mitigate the consequences of similar future events. Those recommendations complemented the list published in the **final report** on 8 January 2021 system separation.

Moreover, in March 2022 ENTSO-E published a **final report** developed by a dedicated Expert Panel following the 17 May 2021 ICS Scale 2 grid incident. The report contains the timeline of events and includes the assessment of the incident based on the ICS Methodology. Two recommendations have been drawn from this incident.

KEY DATES & DOCUMENTS

18 Mar 2022	Publication of the **Final report on the local power grid incident in Rogowiec (Poland) substation on 17 May 2021**
28 Mar 2022	Publication of the **Final report on the power system separation from Continental Europe on 24 July**

1.4 Common Grid Models

The Common Grid Model (CGM) and Operational Platform for Data Exchange (OPDE) are critical enablers of the operational coordination and the security of supply on a European level. Ensuring greater visibility and insight into pan-European interconnection flows, is a critical step in the broader effort to strengthen grid security, ensure cost-efficient operation, and increase cooperation and collaboration amongst the European TSOs and Regional Coordination Centres. The CGM and OPDE development and implementation are led by Steering Group Regional Coordination at the ENTSO-E level.

The legal basis for CGM and OPDE is found in three of the Network Codes: the SOGL (Art. 64), the CACM Regulation (Art. 17) and the FCA Regulation (Art. 18). The 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 with the Individual Grid Model (IGM) of each TSO, covering timeframes from one year before real-time to one hour before real-time. After a quality assessment and pan-European alignment process, TSOs' IGMs are picked up by RSCs, that merge them into a pan-European CGM and feed the merged CGM back into the system.

Achievements and Challenges

Following the go-live of the CGM Programme at the end of 2021, in January 2022 the Regional Coordination Centres (RCCs) started to merge IGMs provided by TSOs into CGMs for intraday (ID), day-ahead (DA), two days-ahead and year-ahead time frames.

The CGM merge is performed by two RCCs in the role of merging agents to ensure redundancy, and the rotation is ensured on a regular basis between four RCCs taking part in the merge process.

The CGM merge success rate of the RCCs has been close to one hundred per cent in 2022.

One of the main challenges is ensuring that all TSOs can deliver IGMs via the central Operational Planning Data Environment to increase the number of IGMs included in CGMs. Several initiatives have been undertaken at the end of 2022 to support the TSOs to increase the levels of submission and publication of IGMs and their inclusion in CGMs.

1.5 ENTSO-E Awareness System (EAS)

The EAS provides a real-time pan-European view of the state of transmission systems. All TSOs input several measurements indicators 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 in 2022:

- The Wide Area Monitoring System (WAMS) integration into the EAS project was initiated following the recommendation from the 'Technical Report on System Separation' of 8 January 2021.

  Through the phasor measurement unit (PMU) data integration into EAS, the project will provide enhanced frequency maps, voltage maps and angle difference visualisation in the European grid. Specifications and procurement phases were completed in 2022 and implementation is ongoing with a go-live planned for 2023.

- The IT, security and contractual prerequisites for access to EAS by RCCs are being addressed and aim to enable the RCCs' access in 2023.

- Integrating relevant MARI, PICASSO and TERRE balancing platforms data into EAS to concentrate information in one place for operators (EAS imbalance map) is being investigated and implementation is planned for 2023.

Quarterly EAS user tests are being performed with TSO operators to test and train operators on EAS functionalities. EAS user webinars are organized twice a year with TSO operators to introduce new EAS features.

The first self-assessment on compliance with the EAS Security Plan has been performed with all TSOs and Service Providers to improve cybersecurity measures on the EAS system.

1.6 Regional Coordination

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

ENTSO-E provides a platform to coordinate deliverables to support regional cooperation across neighbouring regions. and where addressing the matter at the pan-European level is more efficient than doing so bilaterally.

The 'Annual Report on Regional Coordination Assessment 2022' was published by ENTSO-E on 26 September 2022.

KEY DATES & DOCUMENTS

26 Sep 2022	Publication of the **Regional Coordination Assessment Annual Reporting**

From Regional Security Coordinators to Regional Coordination Centres

Regional Security Coordinators (RSCs) are entities owned and appointed by TSOs to fulfil a number of tasks in support of TSOs mission including inter alia: security analysis, capacity calculation, outage coordination, adequacy forecast and CGM creation. The SOGL formalised the RSCs' role and made it legally binding for TSOs to procure at least these five core tasks from one of the RSCs. Through their recommendations to TSOs, RSCs contribute to increasing efficiency in operational planning, reducing the risks of incidents and supporting optimised utilisation of transmission capacity by market participants.

The Clean Energy Package (CEP) defines 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) establish the RCCs in their region. In 2022, ENTSO-E supported the transition from RSCs to RCCs including by contributing to the definition of the tasks for these new RCCs as Art. 37 of the Electricity Regulation. In this work, the Steering Group Regional Coordination (Art 30.1 e Electricity Regulation was consulted and the RCCs were established on 1 July 2022.

ENTSO-E is supporting the proposals for the development and implementation for new RCC tasks according to Art. 37 of the Electricity Regulation in the Steering Group Regional Coordination which is established as per Art 30.1 e) of the Electricity Regulation since end of 2021. The main purpose of the Steering Group Regional Coordination (StG ReC) is to facilitate, coordinate and develop regional coordination, most notably amongst RCCs and TSOs. The Steering Group Regional Coordination framework is used to ensure a platform for efficient, transparent, and smooth collaboration between RCCs, TSOs, the regions (CCRs/SORs), ENTSO-E as well as external stakeholders.

For the RCC tasks, where a pan-European or cross-regional approach is legally required or requested by TSOs, the StG ReC steers the business requirements, business development, implementation, rollout and operation of the tasks to the extent legally required or requested by TSOs. For the RCC tasks at regional level, the StG ReC shall facilitate cooperation and coordination among the regions and RCCs and monitor the performance of those tasks.

KEY DATES & DOCUMENTS

1 Apr 2022	ACER approval of the **RCC Post-Operation and Post-Disturbances Analysis and Reporting Methodology**
3 Nov – 9 Dec 2022	Public consultation of the **Proposal for the RCC task facilitating the regional procurement of balancing capacity**

The implementation of the RCC services from SOGL is still ongoing:

- STA and OPC are in operation but will continue to be updated.
- CGM is live, and IGMs are provided by TSOs over OPDE into pan-European CGMs.
- The implementation of CSA and CCC in the regions according to regional methodologies will be pursued.
- Consistency assessment of system defence plans and restoration plans (Art.6 of NC ER) is established already.

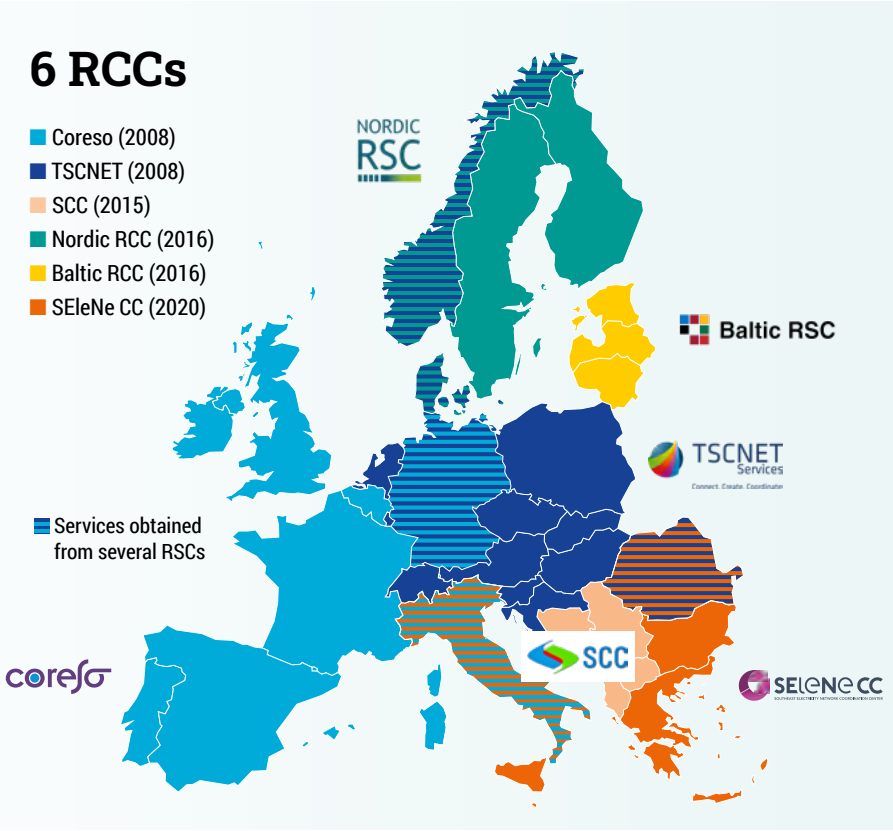


Figure 1 – RCC map. Norway and Denmark are serviced by both NRCC and TSCNET; One of the four TSOs in Germany is serviced by both TSCNET and Coreso; Italy is serviced by both Coreso and Selene-CC; Romania is serviced by both Selene-CC and TSCNET.
(Kosovo borders are indicated in the RCC services map as KOSTT signed the Connection Agreement with ENTSO-E in 2020. This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence. Kosovo is as of yet not serviced by an RCC.)

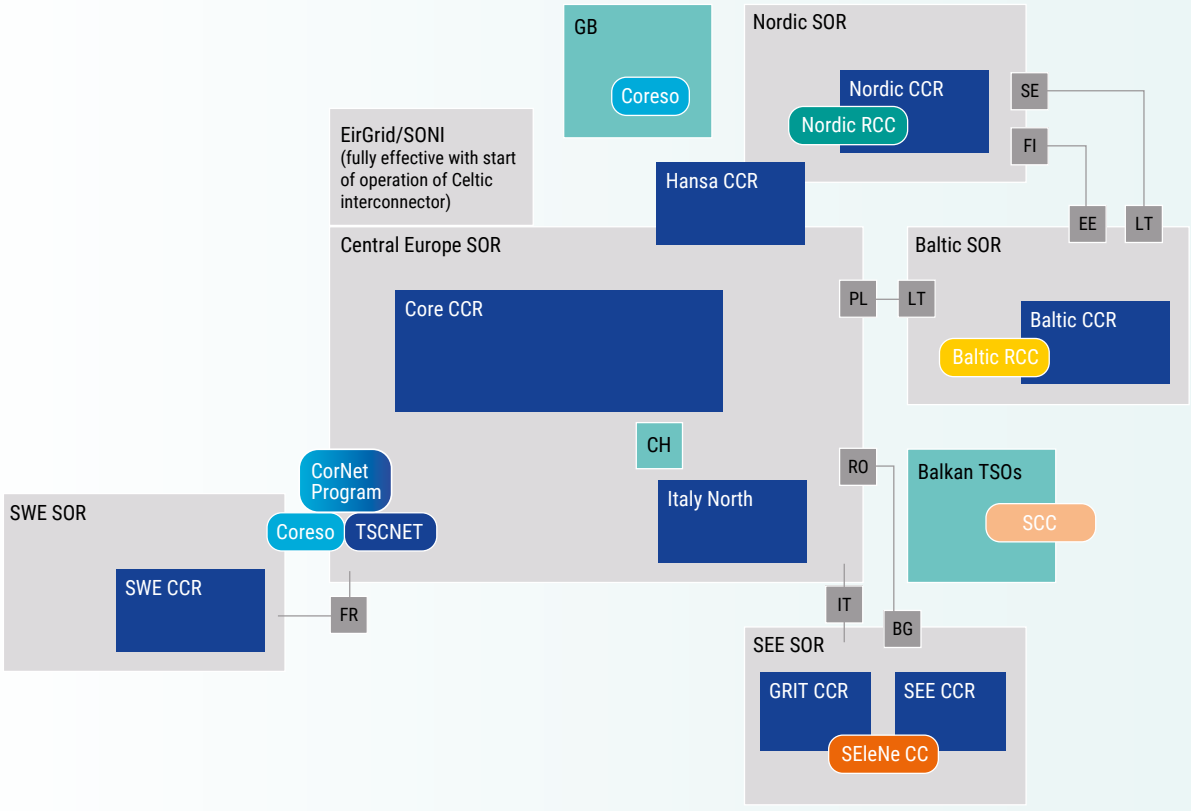


Figure 2 – Map of CCR, SOR and RCCs established by that SOR

ENTSO-E is actively involved in various aspects of the STA (Art.81 SO GL), OPC (Art.80 SO GL) and CGM services, while the CC (Art.25 CACM Regulation) and CSA (Art.75 SO GL) services are mainly implemented in the regions. IEM The Electricity Regulation (Recital 59, Art.30(1)(e) and Art.30(2)) stipulates that ENTSO-E will have a more active role in monitoring and coordinating the implementation of regional services.

In addition to the original services defined in the network codes and guidelines, new RCC tasks are defined in Art. 37(1) of Electricity Regulation. ENTSO-E shall prepare proposals for the new tasks, which are not already covered in the Network Codes or Guidelines.

Specifically, on the implementation of the new RCC tasks, ENTSO-E needs to work across committees as the RCC services are wider in nature than the original RSC services. The RCC framework will ensure this collaboration with the other committees on finalization of the proposals and StG ReC will lead or monitor the implementation where relevant:

- Art.37(1)(g) – Training and Certification: the proposal has been submitted to ACER; implementation phase has started and is expected to last until 2024, after which execution phase is expected to last until 2026.

Tasks of Regional Coordination Centres

Task as per Article 37(1)	Methodology development	Robust and timely fallback procedures (Art. 44)
a) Coordinated capacity calculation	CCMs done	Partially done
b) Coordinated security analysis	ROSCs done; CSAm done; Regional Cost sharing methodologies done; Regional Re-dispatching and Countertrading methodologies done	On track
c) CGM	ROSCs done; CGMm done	Partially done; service is live but continuous improvement ongoing to meet CGM requirements
d) Support assessment of defence and restoration plans	N/A	Done
e) Short-term adequacy	ROSCs done; Short-term and Seasonal Adequacy methodology done	Partially done; Continuous improvements ongoing for methodology compliance.
f) Regional outage planning coordination	ROSCs done; RCOP investigation ongoing; WA CGMm done	Pan-EU level done; Regional almost done, improvements ongoing
g) Training and certification	Done	On track
h) Supporting regional restoration	On track	–
i) Post-operation and post disturbance analysis and reporting	Done	Done
j) Regional sising of reserve capacity	On track	–
k) Facilitating procurement of balancing capacity	On track	–
l) Support optimisation Inter TSO settlement	Done	If requested by CCR TSOs
m) Crisis scenarios	N/A	N/A
n) Seasonal adequacy	N/A	N/A
o) Maximum entry capacity for CMs	Done	On track
p) Supporting needs for new infrastructures	Ongoing	–

Table 2 – Tasks of Regional Coordination Centres

- Art.37(1)(h) – Supporting restoration: a proposal is expected to be submitted by Q3 2023, and implementation to start in Q4 2023 or Q1 2024.
- Art.37(1)(j) and Art.37(1)(k) – Sizing and procurement of balancing capacities: implementation by RCCs is expected to finish in 2024in the coming years.
- Art.37(1)(l) – Inter-TSO settlement: implementation will be done where applicable, if requested by TSOs.
- Art.37(1)(o) – Maximum Entry Capacity: the ERAA methodology has been approved by ACER; Industrialised tool will be developed in 2023, go-live for MEC calculation is pending availability of ERAA data with flow-based capacity calculation which is expected 2024.
- Art.37(1)(p) – Needs for new infrastructures, which is related to system development: a proposal is expected to be submitted to ACER in November Q4 20232; implementation is expected to start for next applicable the TYNDP 2026 release.

Other regional developments

ENTSO-E supports the IT operations and evolutions of Outage Planning Coordination (OPC) and the Short-Term Adequacy Assessment Process (STA) for the pan-European IT Tool. The OPC pan-European IT Tool, operational since the end of March 2020, allows all RCCs and TSOs to coordinate weekly outage planning on the regional level. Based on generation and demand forecasts provided by all ENTSO-E Member TSOs, the STA pan-European IT Tool, launched in May 2020, enables RCCs and TSOs to perform daily calculations that identify adequacy levels for the week ahead. ENTSO-E supports RCCs with the further developments of the OPC and STA IT tools to improve the service delivery according to TSO and RCC requirements. ENTSO-E also supports TSOs and RCCs with further improving the Common Grid Model (CGM) operational performances and initiated the development project for the Maximum Entry Capacity (MEC) calculation tool.

Tasks for synchronous areas

Depending on the specific arrangements within each Regional Group corresponding to synchronous areas, ENTSO-E provides support on an ad-hoc basis or serves the synchronous area on a continuous basis. ENTSO-E supports the Regional Group Continental Europe (RGCE) with implementation processes and supports the synchronisation project between the Baltic TSOs and Continental Europe and the synchronisation project between Ukraine and Moldova and Continental Europe. Following an urgent request by Ukrenergo and Moldova for emergency synchronisation and based on a technical feasibility analysis, on 16 March 2022 the TSOs of Continental Europe agreed to start a trial synchronisation of the Continental European Power System with the power systems of Ukraine and Moldova[2]. 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 in the early morning and late evening hours.

This year, 2022, will be remembered as the year where we achieved, following an urgent request by Ukrenergo and Moldovan TSOs immediately after Russian invasion, the emergency synchronisation of the electricity systems of those countries with Continental Europe. The interconnection of the transmission grids happened on 16 March 2022 – 17 days after request and more than 1 year before planned.

This acceleration of the synchronisation project, ongoing since 2017, has been possible thanks to the previous studies carried out and the adoption of risks mitigation measures. Continental Europe TSOs are now supporting the stability of the Ukrainian-Moldovan power system and at the same time making available interconnection capacity to allow export or import of energy as needed by Ukraine and Moldova.

This was a significant milestone for the Continental Europe TSOs working in cooperation with Ukrenergo and Moldelectrica that are operating their respective power systems under extremely difficult circumstances.

The extraordinary will of cooperation and help of all CE TSOs (also for humanitarian reasons) was key for the success of the work of the Task Force that was put in place the day after Russian invasion. This is an outstanding example of what cooperation between TSOs inside ENTSO-E can achieve.

Albino Marques, Convener of the ENTSO-E Regional Group Continental Europe

2 This acceleration of the synchronisation project has been ongoing since 2017 and has been possible thanks to previous studies and the adoption of risk mitigation measures

The development of a well-functioning European electricity market is at the heart of the energy transition. Enabling seamless electricity trade across borders and at different time frames allows us to use the European grid to its full capacity and strengthens the power system security in a context of high variability.

Kjell Barmsnes, Chair of the ENTSO-E Market Committee

2 Market

2.1 The Capacity Allocation and Congestion Management Regulation (CACM)

The rules set by the CACM Regulation provide the basis for the implementation of a single energy market across Europe. They set the methods for allocating capacity in the day-ahead and intraday time frames and outline how capacity will be calculated across the different zones. Implementing harmonised cross-border markets in all time frames will lead to a more efficient European market and benefit customers.

All the Terms and Conditions deriving from the CACM Regulation have been submitted, and the implementation of these Terms and Conditions is ongoing.

2022 saw a major milestone in the implantation journey with the **Go-live of the Core flow-based coupling** (8 June 2022) enhancing the price convergence in the Core Region[3]. The flow-based capacity calculation developed by the TSOs of the Core Region laid the foundations for the Core Flow-Based Market Coupling Project, which is an excellent example of pan-European cooperation delivering social welfare benefits by improving grid utilisation and reducing the overall cost for customers. The continuous improvement and evolution of the market couplings led to the amendment of the following methodologies in 2022:

On 13 October 2022, all TSOs submitted to ACER the amendment of the **Capacity Calculation Region definition** definition (CACM Art.15) to include the bidding zones and the TSO from Norway following the adoption of the CACM Regulation by the Norwegian state.

On 19 December 2022, all TSOs submitted to all NRAs the amendment to the Day-Ahead Scheduled Exchanges Methodology (CACM Art. 43) for optimising the Nominated Electricity Market Operators (NEMO) trading hub flows calculation.

KEY DELIVERABLES

8 Jun 2022	Go-live of the **Core flow-based coupling**
13 Oct 2022	**Capacity Calculation Region** definition (CACM Art.15) for including the bidding zones and the TSO from Norway submitted to ACER
19 Dec 2022	All TSOs submitted to all NRAs the amendment to the Day Ahead Scheduled Exchanges Methodology (CACM Art.43) for optimising the NEMO trading hub flows calculation

In the context of the EC public consultation on reasoned amendments to the CACM Regulation, all TSOs provided a detailed answer and published advocacy reports. The first one focused on the Market Coupling Operation and the second one focused on the capacity calculation and topics related to system operation.

Single day-ahead and intraday coupling

According to CACM Art. 10, 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 as well as define the criteria for prioritising the functionalities to be developed. NEMOs and TSOs have successfully established the Market Coupling Steering Committee (MCSC), which handles the development and operation of the DA and ID market coupling.

Among its numerous tasks and the implementation of additional functionalities, in 2022 the MCSC continued to work on the implementation of two major projects: the implementation of the 15-minute products in day-ahead and intraday and the development of the Intraday Auctions in accordance with ACER's decision on intraday capacity pricing (CACM Art. 55.3).

3 Core is one of the Capacity Calculation Regions (CCRs). Article 2 of CACM Regulation defines CCRs as those "geographic areas in which a coordinated capacity calculation is applied". For more info see **https://www.entsoe.eu/network_codes/ccr-regions/**

All TSOs provided **their views** on the amendment proposal from ACER on the Harmonised Maximum and Minimum Clearing Prices methodologies (CACM Articles 41 and 54) advocating for stricter rules on triggering the price-limit increase and for a mechanism to decrease the price limit.

The TSOs also recommended providing sufficient time for implementation if the methodologies are amended to perform the needed tests on the algorithm and also for the market participants to adjust to the new processes.

Capacity Calculation Regions

	DA and ID CapCalc (Art. 20.2)	RD and CT (Art. 35.1)	Robust and timely fallback procedures (Art. 44)
Core	Intraday 19 Apr 2022: ACER's **decision** on first amendment 9 Aug 2022: TSOs **submission** of second amendment		3 Mar 2022: TSOs **submission** of the second amendment 21 Mar 2022: NRA **approval** of the second amendment
Hansa			28 Feb 2022: TSOs amendment **submission**
Italy North			4 Jan 2022: TSOs **submission** 18 Mar 2022: NRA **approval**
SEE	16 Dec 2022 – 23 Jan 2023: Public **consultation**	9 Dec 2022 – 16 Jan 2023: Public **consultation**	
SWE	17 Jan 2022: NRAs' **approval**		

Table 3 – CACM Capacity Calculation methodologies in 2022

Implementation monitoring

On 30 June 2022, ENTSO-E published its "Annual Market Report 2022". In accordance with CACM Art. 82 and Art. 63 of the Forward Capacity Allocation (FCA) Regulation, the implementation of the CACM and FCA are part of the "Annual Market Report 2022"; and in accordance with Art. 59 of the Electricity Balancing (EB) Regulation, the implementation of the EB Regulation is also part of the "Annual Market Report 2022" (e. g. on the European platforms for the exchange of balancing energy, cross-zonal capacity allocation, balancing capacity cooperation and imbalance settlement harmonisation). The report outlines the work achieved by European TSOs in cooperation with their stakeholders in implementing the CACM Regulation, the FCA Regulation and the EB Regulation. These regulations are aimed at integrating the European electricity wholesale and balancing markets.

The "2021 CACM Cost Report" was published on 30 June 2022 and provided fact sheets on the most important developments of the Single Day-Ahead Coupling and Single Intraday Coupling and their associated costs. TSOs and NEMOs organised two workshops with the NRAs on this report to provide an overview and details about the projects' expenditures.

KEY DATES & DOCUMENTS

30 Jun 2022	Publication of the **Annual Market Report 2022**
30 Jun 2022	Publication of the **2021 CACM Cost Report**

2.2 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 how holders of transmission rights are compensated in the event their rights are curtailed. The overarching goal is to promote the coordinated development of liquid and competitive forward markets across Europe and to provide market participants with the ability to hedge their risk associated with cross-border electricity trading.

All the Terms and Conditions deriving from the FCA Regulation have been submitted, and the implementation of these Terms and Conditions is ongoing.

On 28 September 2022, all TSOs submitted to ACER three methodologies they developed that represent an important pillar in the implementation of the flow-based allocation for long-term capacities.

The **high-level design** of the long-term flow has been published and several workshops have been co-organised with ACER, providing market participants with a forum to discuss the upcoming changes and implementation plans.

KEY DATES & DOCUMENTS

28 Sep 2022	All **TSOs' proposal** for the FCA Congestion Income Distribution methodology submission
	All **TSOs' proposal** for the FCA Firmness of remuneration costs submission
	All **TSOs' proposal** for the FCA SAP Proposal submission

Aside from this activity and following the ACER opinion to allow Fingrid and Elering to issue LTTRs between Finland and Estonia, three methodologies (the SAP methodology, the methodology for sharing costs of establishing, developing, and operating the single allocation platform and the methodology for sharing congestion income from forward capacity allocation) have been resubmitted and approved by ACER during the summer. Fingrid and Elering worked on the implementation and the auction process for 2023 was made available on 1 December 2022.

2.3 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 back-up generation. The EB Regulation 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 the facilitator, as well as the implementation of the European balancing platforms.

KEY DATES & DOCUMENTS IN 2022

25 Jan 2022	Interactive Stakeholder Workshop on Co-optimisation
31 Mar 2022	The **mFRR** (and **technical mFRR**), **aFRR**, **IN** Implementation Framework Amendments submitted to ACER; the **RR Implementation Framework Amendments** (RRIF) submitted to RR NRAs
12 May 2022	EB stakeholders group meeting
1 June 2022	Successful go-live of PICASSO
17 Jun 2022	**All TSOs Proposal for updating the Common set of requirements for the price coupling algorithm** submission to NEMOs
22 Jun 2022	Successful first exchange of aFRR via PICASSO
30 Jun 2022	ENTSO-E **Balancing Report 2022** and **EB Cost Report** published and submitted to ACER
5 Oct 2022	Successful go-live of MARI and first exchanges
27 Oct 2022	EB stakeholders group meeting
2 Dec 2022	MARI – PICASSO go-live celebratory event in Brussels
7 Dec 2022	Updated Balancing Performance Indicators submitted to ACER
8 Dec 2022	Balancing platforms stakeholders' workshop
16 Dec 2022	All TSOs Proposal for **Cross-zonal Capacity Allocation (CZCA) Harmonised Methodology** submitted to ACER

The European balancing platforms

The Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO) was successfully made operational on 1 June 2022, with the successful accession of ČEPS. The PICASSO go-live took place almost two months ahead of the legal implementation deadline set by the EB Regulation on 24 July 2022. The launch of the PICASSO platform marked the beginning of a European-wide coupling of national balancing markets for frequency restoration reserves with automatic activation (aFRR) by the deployment of, for example, a standard product, harmonised gate closure times, a common merit order list, a central activation optimisation function, merit order activation and a harmonised pricing of balancing energy. On 22 June 2022, the German TSOs (50 Hertz, Amprion, TenneT Germany and TransnetBW) and APG, the Austrian TSO, successfully accessed the platform and exchanged with ČEPS the first balancing energies from frequency restoration reserves with automatic activation.

KEY DATES & DOCUMENTS	
1 Jun 2022	PICASSO launch
5 Oct 2022	MARI launch

The Platform for the Manually Activated Reserves Initiative (MARI) was successfully made operational on 5 October 2022 with the accession of five TSOs. The launch of the MARI platform marked the beginning of a European-wide coupling of national balancing markets for frequency restoration reserves with manual activation (mFRR) by the deployment of, for example, standard products, harmonised balancing energy gate closure times, a common merit order list, a central activation optimisation function, merit order activation and a harmonised pricing of balancing energy. ČEPS and the German TSOs (TenneT Germany, 50 Hertz, Amprion and TransnetBW) accessed the new platform as the first TSOs, thereby connecting the respective national markets for balancing energy to MARI in accordance with the EB Regulation. With this first accession, interchanges of balancing energy from mFRR also began.

The European platform for replacement reserves – Trans-European Replacement Reserves Exchange (TERRE) – was made operational in January 2020. Currently, the TERRE project consists of 8 TSOs, including operational and non-operational members and observers. It is expected that, in the future, additional TSOs using the RR product will join the project as well. In addition, 3 TSOs are TERRE project members. The term "project member" was intentionally distinguished from TERRE members. Project members joined the TERRE project for the sole purpose of participating in the development operation and management of the IT solution (LIBRA software) and obtaining the intellectual property rights of the IT solution in order to make use of and continue to develop it as part of a regional project in the case of the Nordics TSO, or as part of the MARI project.

The European platform for imbalance netting – International Grid Control Cooperation (IGCC) – was officially established in June 2021. IGCC was launched in October 2010 as a regional project and has grown to cover 24 countries (27 TSOs) across Continental Europe, including all those that need to implement the IN-Platform according to the EB Regulation. IGCC member TSOs are either operational members, also known as participating TSOs (i.e. those physically connected to the IGCC through communication lines that perform the imbalance netting process via the platform), or non-operational members (i.e. those actively taking part in IGCC decision-making but not yet performing the imbalance netting process). There are 21 operational TSOs and three non-operational TSOs. In addition, three TSOs are IGCC observers.

Balancing Implementation Projects Status

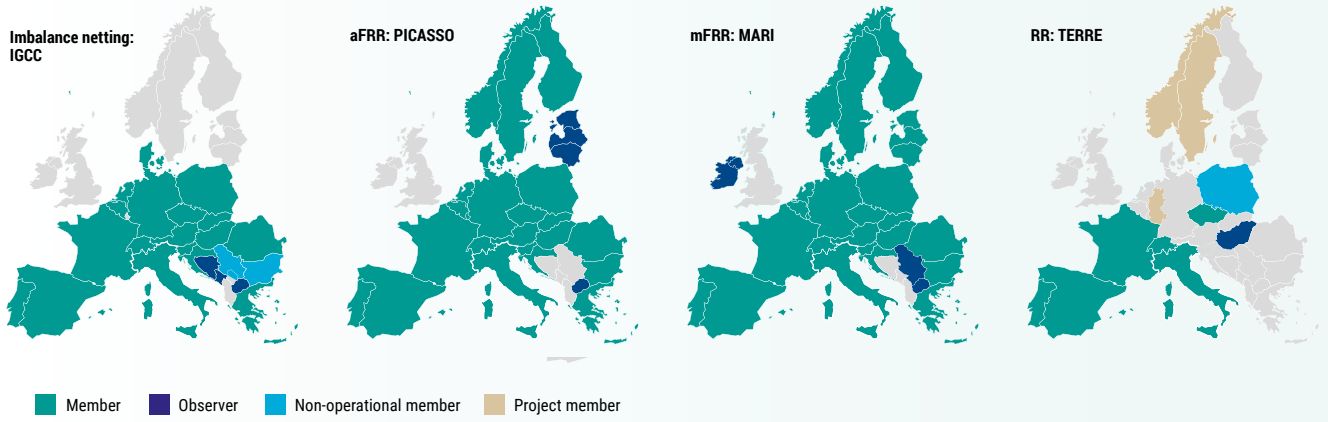


Figure 3 – Balancing Implementation Projects Status. The figure represents the status of projects as of the date of publication of this report.

All TSOs and ENTSO-E Methodologies

On 31 March 2022, all RR TSOs submitted the Replacement Reserves Implementation Framework (RRIF) amendment proposal, its explanatory document and public consultation answers to Replacement Reserves (RR) National Regulatory Authorities (NRAs). The mFRR, aFRR and IN implementation framework amendment package, including the external efficiency study, were also submitted to ACER by the same deadline.

In accordance with Art. 13(3) of the ACER Decision 12-2020 of 17 June 2020, and following the publication and submission for information of the Co-optimization Implementation Impact Assessment (IIA) Report to ACER on 15 December 2021, all TSOs submitted the 'All TSOs Proposal for updating the Common set of requirements for the price coupling algorithm' to NEMOs.

A public consultation was conducted between 29 June and 29 August 2022 on the Cross-zonal Capacity Allocation (CZCA) Harmonised Methodology in accordance with Art. 38(3) of the EB Regulation. The CZCA Harmonised Methodology was submitted to ACER on 16 December 2022.

In addition, ENTSO-E's Proposal for the Regional Coordination Centres' task 'Facilitating the regional procurement of balancing capacity' ('RCC Procurement Proposal') was submitted for public consultation between 3 November and 9 December 2022.

Further EB Reg. all TSOs and ENTSO-E deliverables in 2022	Key documents and dates
Art. 19 of EB Regulation	31 Mar 2022: **RR Implementation Framework Amendments** submitted to RR NRAs
Art. 20, 21 and 22 of EB Regulation	31 Mar 2022: **mFRR** (and **technical mFRR**), **aFRR**, **IN** Implementation Framework Amendments submitted to ACER 30 Sep 2022: ACER decision on **mFRR**, **aFRR** and **IN** Implementation Framework Amendments
Art. 13(3) of the ACER Decision 12-2020 of 17 June 2020	17 Jun 2022: **All TSOs Proposal for updating the Common set of requirements for the price coupling algorithm** submission to NEMOs
Art. 38(3) of EB Regulation	29 Jun – 29 Aug 2022: **Public Consultation** 16 Dec 2022: the **Cross-zonal Capacity Allocation (CZCA) Harmonised Methodology** submission to ACER
Article 37(1)(k) of the Electricity Regulation (EU) 2019/943	3 Nov – 9 Dec 2022: Public Consultation of the ENTSO-E's Proposal for the Regional Coordination Centres' task **Facilitating the regional procurement of balancing capacity** ("RCC Procurement Proposal")

Table 4 - Further EB Reg. all TSOs and ENTSO-E deliverables in 2022

Regional Methodologies

Regarding implementation at the regional level, Capacity Calculation Regions (CCRs) delivered methodologies for cross-zonal capacity calculation within the balancing timeframe for the exchange of balancing energy or for operating the imbalance netting process in accordance with Article 37.3 of the EB Regulation

	Methodology for calculating CZC for balancing timeframe (per CCR) (Art. 37.3.)
Core	**Submission** to NRAs, 16 December 2022
Hansa	**Submission** to NRAs, 30 November, 2022
Greece–Italy	**Submission** to NRAs, 13 December 2022
Italy North	**Submission** to NRAs, 17 December 2022
Nordic	**Submission** to NRAs, 16 December 2022
SEE	**Submission** to NRAs, 14 December 2022
SWE	**Submission** to NRAs, 16 December 2022

Table 5 – EB GL Capacity Calculation Methodologies in 2022

Implementation monitoring

On 30 June 2022, all TSOs published the **Electricity Balancing Cost Report**, in accordance with Art. 23(1) of the EB Regulation, which includes the detailed reporting on 2021 while keeping an overview of cumulative costs since the previous reports (i. e., 2018–2020).

On 30 June 2022, ENTSO-E published its second edition of the biennial Balancing Report. The **Balancing Report 2022** includes the latest developments in European balancing that have occurred since the publication of the first edition in June 2021 and also includes the developments that took place until May 2022 with minor exceptions. The performance indicators listed in this report are calculated considering the data available for the period from January to December 2021. Furthermore, the TSOs' executive summaries, related to their biennial report, cover the two years from 2020 – 2021.

KEY DATES & DOCUMENTS

30 Jun 2022	Publication of the **Electricity Balancing Cost Report**
30 Jun 2022	Publication of the **Balancing Cost Report 2022**

2.4 Transparency of capacity calculation by TSOs

The Clean Energy for all Europeans (CEP) package introduces a new regulatory framework for cross-zonal capacity calculation. 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. ENTSO-E provides an overview of this target every year in the Market Report and fulfils the legal obligation set in the CEP every three years in the Technical Report (the next Technical Report is foreseen in 2024).

2.5 Bidding Zone Review

A major element in the design of the European electricity market is the delineation of bidding zones. As defined by Regulation (EU) 543/2013 (the 'Transparency Regulation'), these are the largest geographical areas within which market participants can exchange energy without capacity allocation. The entry into force of Article 14(3) of the Electricity Regulation triggered a bidding zone review (BZR) process.

In line with Article 11 of Annex I of the ACER Decision No. 29/2020, ENTSO-E and the TSOs delivered to ACER the Locational Marginal Pricing (LMP) results in March 2022, which were used by ACER to define alternative BZ configurations for both the Continental EU and the Nordics.

This was the first time that a nodal simulation study of this size and complexity was performed in Europe. TSOs of the Continental European and Ireland Bidding Zone Review Regions (BZRRs) carried out a LMP simulation with a model that included around 25,000 active generators, 22,000 lines, 25,000 active nodes and 25,000 critical network elements and contingencies and solved a security-constrained economic dispatch problem for 168 days for the region. TSOs of the Nordic BZRR carried out a similar LMP simulation to the grid including all 220 and 400 kV nodes in Norway, Sweden, Finland and Eastern Denmark. For the Nordic BZRR, the simulations included the hours of the whole target year and considered three different climate years.

In June 2022, for transparency, ENTSO-E published **Report on the Locational Marginal Pricing (LMP) Study**, providing insights into the methodology, assumptions and results of the LMP analysis for the Continental European, Ireland and Nordic BZRRs delivered to ACER.

KEY DATES & DOCUMENTS

30 Jun 2022	Publication of the **Report on the Locational Marginal Pricing (LMP) Study**

The report provides information on:

- The assumptions applicable to all the BZRRs that performed LMP calculations;
- The market and grid assumptions, simulation chain and the results of the LMP calculations as performed for the Continental European and Ireland BZRRs;

› The market and grid assumptions, simulation chain and the results of the LMP calculations as performed for the Nordic BZRRs.

Following **ACER's decision on the alternative BZ configurations** adopted on 8 August 2022, the formal BZR process started. ENTSO-E and the TSOs are now assessing the BZ alternative configurations as proposed by ACER in its decision, based on a wide variety of indicators including overall economic efficiency and social welfare, market liquidity, transition costs and the ability to maintain the grid's operational security. The BZ review study will continue in 2023[4].

2.6 Capacity Mechanisms

Regulation (EU) 2019/943 on the internal market for electricity introduced in Article 26 an obligation for Capacity Mechanisms (other than strategic reserves) to include open, direct, cross-border participation of capacity providers located in Member States with direct network connections to the Member State applying the mechanism. Article 26 also required ENTSO-E to develop common rules, methodologies and an EU-wide register of capacity providers to facilitate the implementation of cross-border participation in Capacity Mechanisms. As such, ACER approved **technical specifications for cross-border participation in Capacity Mechanisms** in December 2020 and the **registry of capacity providers** went live in November 2021. Based on registry data and according to the technical specification, ENTSO-E shall report yearly information to ACER on eligible capacity providers and furnish an overview of relevant Capacity Mechanisms rules. In 2022, ENTSO-E collected relevant data and information from TSOs operating Capacity Mechanisms and from TSOs where eligible capacity providers are located. This information will be included in the first yearly report for ACER due in 2023. The smooth operation of the registry was also ensured in 2022, allowing the registration of the first eligible capacity providers.

The energy transition will also mean that sustainability is the most affordable, attractive and convenient choice for people. Electricity transmission system operators play an important role in integrating greener power into the energy system while leveraging the potential from different flexible demand sources.

The ENTSO-E Independent Advisory Council delivered on good exchanges between stakeholders working towards the same interest to decarbonise the European energy system.

Monique Goyens, Director General of the Bureau Européen des Unions de Consommateurs (BEUC)

2.7 High Energy Prices and Emergency Measures

After years of relatively stable and low wholesale electricity prices, in 2022 we have witnessed a sharp increase of both short-term volatility and of average prices in all European markets and timeframes (forward, day-ahead, intraday, balancing). This has been driven almost entirely by the increase of global gas prices (as a result of the invasion to Ukraine and cut of gas supply by Russia) and to a lesser extent by that increasing coal and CO_2, as well as lower nuclear power availability.

4 The work on the BZ Technical Report will start in 2023, and published in 2024.

To address the effect of high prices on industries, business, and household consumers, a number of policy measures have been implemented at both European and national level in the course of 2022. Some of these measures, such as, for instance, achieving demand reduction targets during peak hours (via either voluntary or market-based measures), have been facilitated by TSOs. High energy prices have also impacted TSOs activities, for example the procurement costs of energy losses and of balancing capacity and energy. At the same time, congestion income collected by TSOs in 2022 has allowed to lower transmission tariffs for end-consumers, as defined at national level by NRAs in line with the objectives of Article 19 of Regulation (EU) 943/2019. Lastly, ENTSO-E has shared best practices among TSOs in the implementation of the new Council Regulation (EU) 2022/1854 on an emergency intervention to address high energy prices.

2.8 Inter-Transmission System Operator Compensation

The Inter-Transmission System Operator Compensation (ITC) Agreement is a multiparty agreement concluded between ENTSO-E, ENTSO-E members and TSOs that comply with the Union legislation in the electricity field or with the previous agreement on ITC, also referred to in this context as 'ITC Parties'. It offers a single framework wherein European TSOs compensate one another 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 the Electricity Regulation. The ITC mechanism is further specified by the Regulation on establishing 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, including the perimeter flows, are calculated (i. e. imports and exports of electricity to and from third countries). Given the extraordinary market conditions in 2022, ENTSO-E has initiated discussions with ITC parties as well as with ACER on possible options to improve the functioning of the ITC Mechanism, with particular attention to the fair and non-discriminatory valuation of losses.

According to the Regulation on establishing guidelines relating to the inter-transmission system operator compensation mechanism and a common regulatory approach to transmission charging, ENTSO-E is mandated to determine the number of losses incurred on national transmission systems by calculating the difference between (1) the number of losses incurred on the transmission system during the relevant period; and (2) the estimated number 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 December 2022, ENTSO-E published the 'ITC Transit Losses Data Report 2021'.

KEY DATES & DOCUMENTS

30 Dec 2022	Publication of the **ITC Transit Losses Data Report 2021**

In December 2002, ACER published its annual monitoring report on ITC. To this end, ENTSO-E provided ACER with information on both quantitative data (preliminary and final data) and descriptive information (e. g. explanations for capacities not allocated according to guidelines, an overview of the annual ITC Audit and explanations for non-EU countries).

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.

A decarbonised energy system requires further integration across voltage levels and across energy sectors, with the transmission grid as the backbone of such an integrated energy system. That is why we, transmission system operators, promote a system of systems approach for grid planning.

Gerald Kaendler, Chair of the ENTSO-E System Development Committee

3 System Development

3.1 The Ten-Year Network Development Plan (TYNDP): 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 the first key step and a crucial outcome of the TYNDP process. They are a deliverable increasingly used in other studies on future aspects of the energy system.

After a one and a half year-long process, the final TYNDP 2022 scenarios were published in April 2022. Work started on building the TYNDP 2024 scenarios.

KEY DATES & DOCUMENTS

11 Apr 2022	Publication of the **Joint TYNDP 2022 Scenario Report**

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), Electricity Regulation), it is published by ENTSO-E every two years.

TYNDP is the foundation of the European coordinated grid planning and the basis on which transmission projects may apply for 'Projects of Common Interest' (PCI).

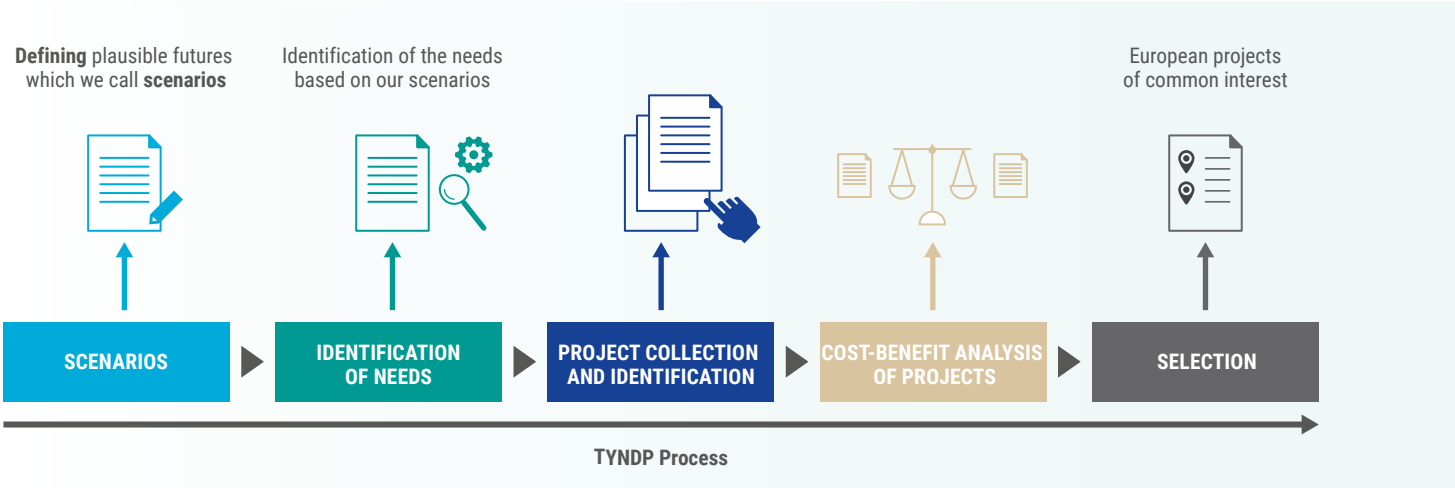


Figure 4 – The TYNDP two-year process. It feeds into the European Projects of Common Interest, led by the European Commission.

Each scenario's impacts on energy markets and networks are analysed via a suite of tailored modelling tools. The main role of the TYNDP is 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 accomplished in two stages: first, by 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.

If we want to achieve our renewable and decarbonisation targets, we need grids. We need to speed up deployment of RES, in particular wind and solar, large scale and also distributed. We need to deploy flexibility options. But without grids it will be impossible to reach decarbonisation in time to reduce climate change impacts.

RGI believes that it is possible to build energy infrastructure and at the same time protect and restore nature. All efforts should be channeled to do both, and we should not play one against the other. Our work with ENTSO-E continues to be extremely valuable in finding the solutions for a sustainable and timely grid development.

Antonella Battaglini, CEO of the Renewables Grid Initiative

TYNDP 2022 found that opportunities for improving Europe's power system exist across Europe. Between 2025 and 2030, the study found that 64 GW of additional capacity on over 50 borders would be economically efficient, a 55 % increase over the 2025 grid. In 2040, there is space for 88 GW of cross-border capacity increase after 2025 (a 75 % increase) on over 65 borders, for 41 GW of storage in 19 countries and 3 GW of CO_2-free peaking units in 4 countries. The study's findings are even more relevant in the context of uncertainty over the natural gas supply from Russia and rising gas prices. One of the main benefits of addressing system needs is to replace gas-based power generation with renewables, thus reducing Europe's dependence on gas. Gas-based generation would decrease by 75 TWh per year in 2040 (equivalent to 14 % of the electricity generation from gas in the EU in 2021), while the avoided curtailment of renewable energy reaches 42 TWh per year in 2040. A more efficient use of the European generation mix translates into a significant reduction in CO_2 emissions of 31 Mton / year in 2040, helping Europe to achieve its Green Deal objectives. It also reduces generation costs by 9 billion euros/year in 2040, with a direct impact on consumers' electricity bills.

All possible solutions should be considered by project promoters and policymakers when opportunities turn into projects. Coordinated planning will be needed across sectors. Identified needs can be addressed in multiple ways, including with infrastructure (new or upgraded transmission infrastructure, electricity storage, power-to-gas or hybrid infrastructure) and non-infrastructure solutions such as dynamic line rating.

ENTSO-E held an open call for transmission and storage infrastructure projects. Promoters proposed 141 transmission and 23 storage projects. ENTSO-E assessed how these projects will impact the future power system in 2030 and 2040 if they are developed in terms of socio-economic welfare, reduction of CO_2 emissions and other GHG gases, integration of renewables and security of supply. The results of the assessment are presented for each project separately in the **TYNDP 2022 online project sheets**.

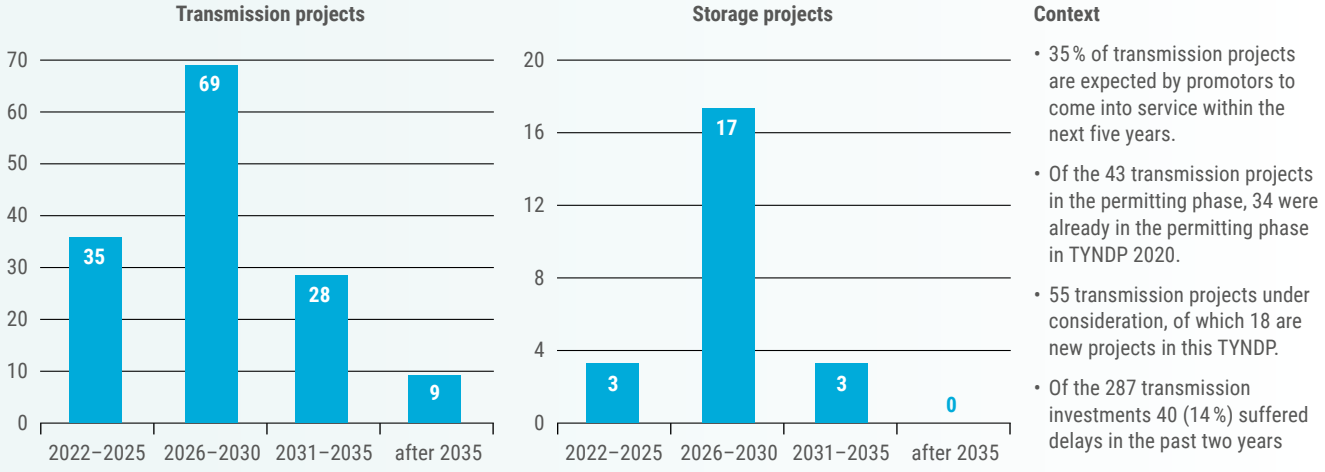


Figure 5 – Expected commissioning years of projects included in the TYNDP 2022 project portfolio. Information provided by project promoters.

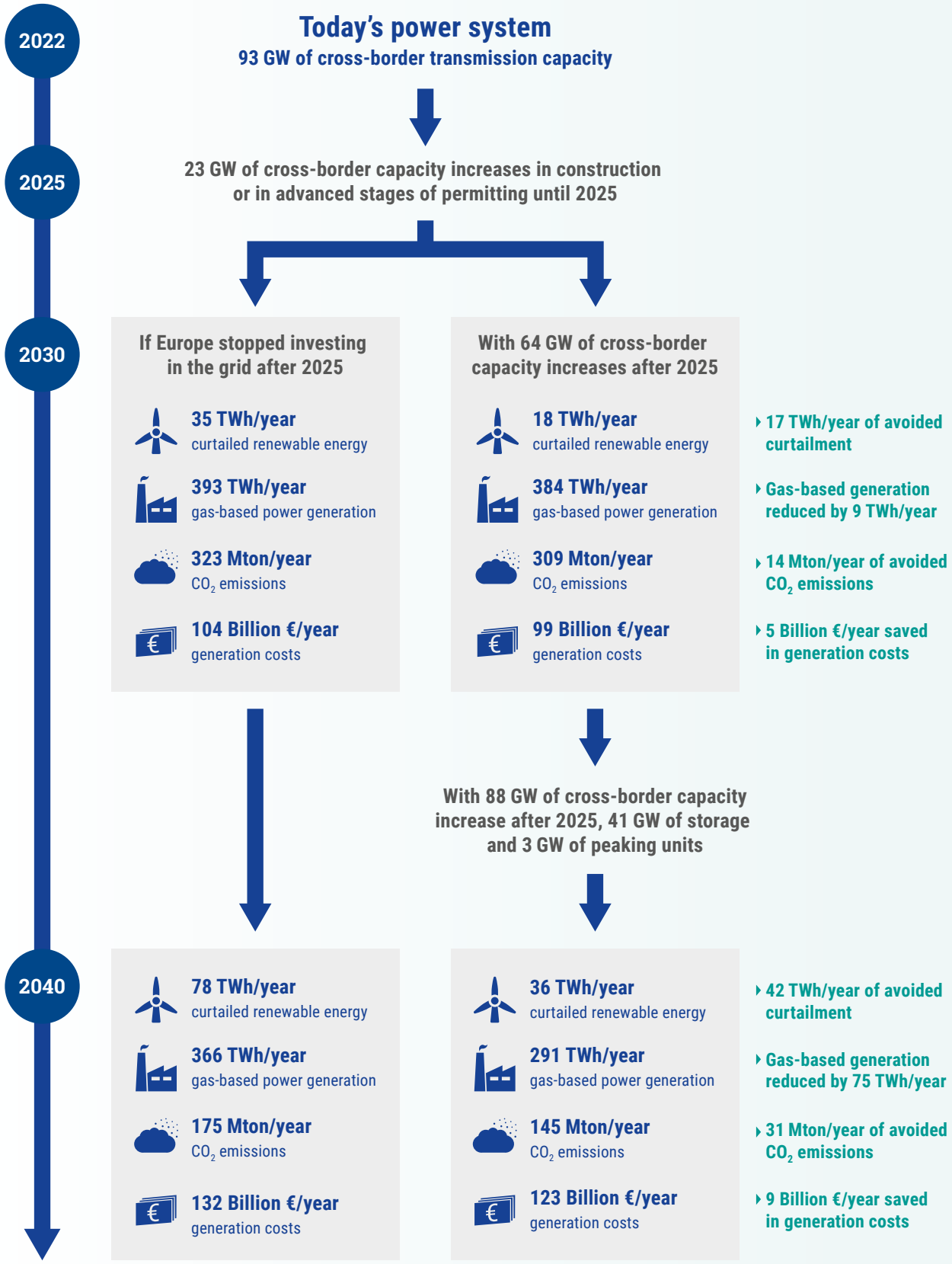


Figure 6 – Key findings of the TYNDP 2022 system needs study

The cost–benefit analysis methodology

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

Following the revised TEN-E Regulation (EU) 2022/869, including the requirements for the content of the methodology for the system-wide CBA, ENTSO-E's 3rd CBA Guideline has been updated to a fourth version to comply with the new requirements. The 4th CBA Guideline aims to provide guidance on how to perform an energy system-wide CBA. The Guideline describes ENTSO-E's criteria for performing a cost–benefit analysis along with the common principles and methodologies to be used in the necessary network studies, market analyses and interlinked modelling methodologies.

ENTSO-E released a draft version of CBA 4.0 for public consultation in December 2022. Among the novelties included in CBA 4.0 are an explanation of how the Energy Efficiency First principle is considered, additional sensitivity studies and a new methodology for the 'Contribution to Energy Union Targets' (all three are requirements of the TEN-E regulation).

KEY DATES & DOCUMENTS

15 Dec 2022 – 15 Feb 2023	**Public consultation** on the CBA 4.0 methodology

After considering stakeholders' feedback, the draft CBA 4.0 will be submitted to ACER by the legal deadline of 24 April 2023.

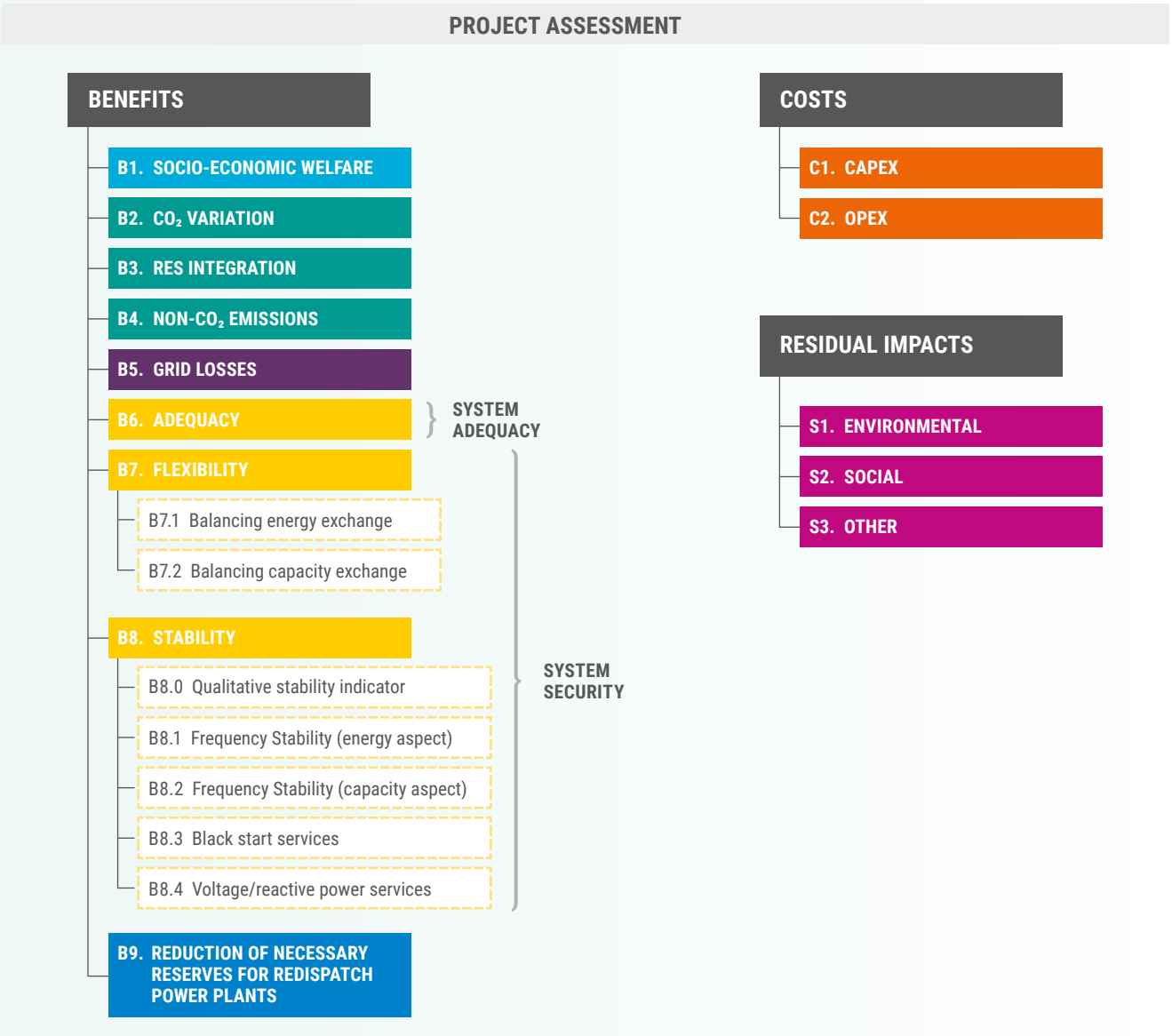


Figure 7 – TYNDP Project assessment framework in CBA 4.0

3.2 Ensuring resource adequacy

Resource adequacy can be defined as the continuous balance between supply and demand levels, including storage and the demand-side response. 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 increasingly important. Cooperation across Europe is necessary to accelerate the development of common methodological standards; in other words, 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 provide leading examples worldwide of how to undertake advanced assessments at a large geographic perimeter.

Resource adequacy and the Clean Energy Package (CEP)

The CEP places resource adequacy in a central position in the European energy policy context. ENTSO-E's yearly European Resources Adequacy Assessment (ERAA) investigates whether the electricity system has sufficient resources to meet demand – also referred to as power system resource adequacy – in the coming decade, which sets us on a net-zero pathway. The report is built upon models and analyses of possible events that could adversely impact the balance between the supply and demand of electric power.

The ERAA 2022, published for consultation in December 2022, follows the methodologies approved by ACER in October 2020. It shows that in the given scenario and methodological framework, high volumes in the fossil-fuel capacity are at risk of becoming economically non-viable in the mid-term. In that context, the right incentives and/or targeted intervention will be needed to avoid adequacy risks, especially in the countries of central Europe.

KEY DATES & DOCUMENTS

15 Dec 2022 – 15 Feb 2023	**Public consultation** on the ERAA 2022

Among the key findings, the report identifies various measures to be implemented to ensure sufficient capacity that is capable of responding quickly to sudden variations in demand and supply. In this context, regional coordination is also important, particularly when discussing assumptions and investment capacity, which taken in one country will influence the neighbouring area.

The Seasonal Outlooks

ENTSO-E's Seasonal Outlooks (Article 30(1)f, Regulation 943/2019) are pan-European, system-wide analyses of risks to the security of the electricity supply. Analyses are performed twice a year to ensure a comprehensive view regarding the summer and winter and to present aligned TSOs' views on the security risks to the supply and the countermeasures they are planning 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 of climate conditions on system adequacy, evolution of demand, demand management, the evolution of generation capacities, and planned and forced outages.

Summer Outlook 2022 and Winter review 2021/2022: The report identified no adequacy risk except for close monitoring needed in Ireland. The adequacy risk identified in Ireland at the beginning of summer is driven by generation planned outages, whereas risks at the end of the summer season are driven by the planned outage of interconnection with Great Britain. The Summer Outlook is accompanied by a retrospective of winter 2021/2022, during which the weather conditions were rather favourable.

The Summer Outlook 2022 showed a major change in its methodology. This new methodology is described in the 'Methodology for Short-term and Seasonal Adequacy Assessments'. It was developed by ENTSO-E in line with the Clean Energy for all Europeans package and the Regulation on Risk Preparedness in the Electricity Sector (EU) 2019/941, and it received formal approval from ACER. Although the methodology's complete implementation will require further work in the coming years, Summer Outlook 2022 is the first seasonal outlook to implement the shift from a weekly snapshot based on a deterministic approach to the well-proven, state-of-the-art, sequential, hourly Monte Carlo probabilistic approach.

KEY DATES & DOCUMENTS

16 Jul 2022	Publication of the **Summer Outlook 2022**
1 Dec 2022	Publication of the **Winter Outlook 2022/2023**

Winter Outlook 2022/2023: The report provides an assessment of the security of the electricity supply for the winter season across Europe. Findings showed that the European electricity system is under higher pressure than in previous years due to exceptional circumstances mainly related to the sharp reduction of gas supply from Russia. Anticipatory measures taken by Member States before winter have helped to mitigate the impact on the adequacy situation in Europe. The electricity system remains highly dependent on gas; however, favourable weather conditions may relieve this reliance in the power system.

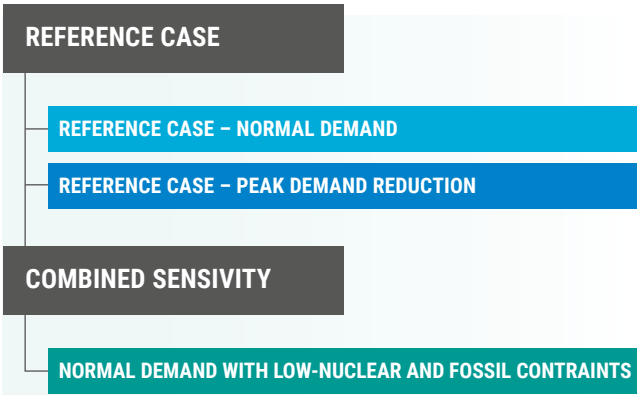


Figure 8 – Scenarios assessed in the Winter Outlook 2022/2023

The Winter Outlook 2022/2023 investigates a reference scenario and four sensitivities, each in a probabilistic methodology, and together they provide an overview of how the situation might unfold in Europe. Sensitivities were identified based on joint TSO input and extensively discussed with the European Commission and national authorities via the Electricity Coordination Group. They include the prolonged unavailability of nuclear plants in France, Sweden and Finland and further constraints on the availability of fossil fuels (coal in Poland and Germany). An additional sensitivity investigates the impact of reduced demand for electricity with the reduction of gross electricity consumption by 10 % and the reduction of demand by 5% at peak hours. These two measures entered into force on 8 October 2022 in the Council Regulation (EU) 2022/1854 for an emergency intervention to address high energy prices. The report informs on measures ENTSO-E and the TSOs are taking to prepare for the winter and coordinate at all levels to build resilience to the uncertainties and risks for the power system in the current context of energy scarcities. Electricity TSOs are taking measures at the national level and tightly coordinating at regional and pan-European levels via short-term adequacy forecasts and operational cooperation between TSOs and RCCs. Cross-border exchange capacities and efficient market operation are crucial to efficiently maintaining adequacy.

3.3 Connection Network Codes: The evolution of the regulatory framework

The objectives of the three Connection Network Codes (CNCs) – "Network Code on Requirements for Grid Connection of Generators", "Network Code on Demand Connection" (NC DC) and "Network Code on Requirements for Grid Connection of High Voltage Direct Current Systems and Direct current-connected Power Park Modules". (HVDC) – are to ensure the integration of decentralised RES and synchronous generation as well as the increased demand response into the power system while simultaneously maintaining the 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.

Amendment Process of Connection Codes

In 2022, ACER and the European Commission initiated the process to amend NC RfG and NC DC. Based on Article 60 of the Electricity Regulation, proposals for amendments may be submitted by ENTSO-E, the EU DSO entity, NRAs, system users and consumers. In recent years, ENTSO-E has analysed present and future system needs and taken TSOs' and experts groups' feedback into consideration on the recommended improvements in the current CNCs. In November 2022, ENTSO-E submitted the draft proposals to ACER by participating in its dedicated public consultation while intensifying its collaboration with stakeholders in the Grid Connection European Stakeholders Committee and thematic ACER workshops and bilateral discussion with stakeholders.

Implementing Connection Codes

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.ENTSO-E monitors the national implementation of the NC; the Implementation Guidance Documents (IGDs) give guidance for the national implementation and further explanation on certain issues of the NCs – 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. In 2022, ENTSO-E developed two draft IGDs, Compliance Verification – Using Electrical Simulation Models and Compliance Verification – Compliance Monitoring after final operational notification. Both draft IGDs were released for public consultation between January and February 2023 before their finalisation planned at the end of May 2023, in accordance with Art. 58 RfG.

KEY DATES & DOCUMENTS

16 Jan – 16 Feb 2023	**public consultation** on the draft IGDs

Implementation monitoring

ENTSO-E regularly publishes the implementation activities and related results in each country via its **Active library**, examining divergences in national implementation, and this is being enhanced through the new **Implementation Monitoring Platform (IMP)**. ENTSO-E has spent additional effort for improvement of the IMP and meanwhile released version 2 of the IMP with additional functionalities and benefit for the users. This tool promotes ENTSO-E's transparency and allows stakeholders to easily consult relevant implementation data, as the national values of the parameters are non-exhaustively defined in the Connection Codes. 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 is automatically aggregated by the before mentioned IMP which offers a visualisation tool for any significant deviation of provided data. This approach significantly eases the process of data gathering, improves and eases the quality check before submission to ACER each year by 30th June.

Long-term planning and resource adequacy assessments provide mid-term monitoring as well as long-term vision to achieve a carbon-neutral European energy system by 2050. This aims to support strategic orientations by authorities and investment decisions by various actors in the electricity market.

We develop and maintain tools that bring transparency into the market. Public and freely available data create confidence among different stakeholders and thus is a pre-condition for a well-functioning energy market.

Peter Scheerer, Vice-Chair of the ENTSO-E Market Committee

4 Transparency Regulation

ENTSO-E's **Transparency Platform** (TP) (Art. 3, Regulation 543/2013) centralises data relating to the generation, transmission 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 serve various purposes, such as market analysis, research or trading. The TP is also instrumental in monitoring and regulating power markets. Start-ups and new players increasingly use the TP's wealth of data to deliver more value to customers, for example by highlighting live-CO_2 emissions by country, wind generation and more.

The ENTSO-E Memorandum of Understanding (MoU) was revisited to update the existing data quality requirements, to include new quality requirements (mainly for data stemming from Balancing Implementation Frameworks (Ifs)) and to facilitate amendments relevant to Brexit[5]. Moreover, ENTSO-E started the implementation of the TP Manual of Procedures (MoP v3r3), which was updated in 2021.

In 2022, the TP was also amended for further publications and data collections, some of which are used only with a limited number of parties:

- The data publications stemming from SOGL were implemented with new rich and standard data items that replaced and updated the existing SOGL data publications.
- The TP was enhanced and went live with the IFs of European balancing platforms' data publications.
- The work on transforming the TP into an Inside Information Platform (IIP) was initiated. A subset of TSOs chose to use the TP as an IIP.
- A new Graphical User Interface (GUI) TP project has progressed and delivered the first implementation stream. This stream also included the launch of **Day-ahead Prices** with tabular, graphical and map views. The work on the GUI project is ongoing and will go live in Q3 2023. Information will be made available to ACER for monitoring activities according to the list of information in Art. 82 CACM.

KEY DATES & DOCUMENTS

21 Jul 2022	Go-live of TP implementation to receive Implementation Framework (IFs) of European balancing platforms data publications
12 Oct 2022	Go-live of New TP GUI stream 1
14 Dec 2022	Go-live of SOGL v2 with new rich and standard data items

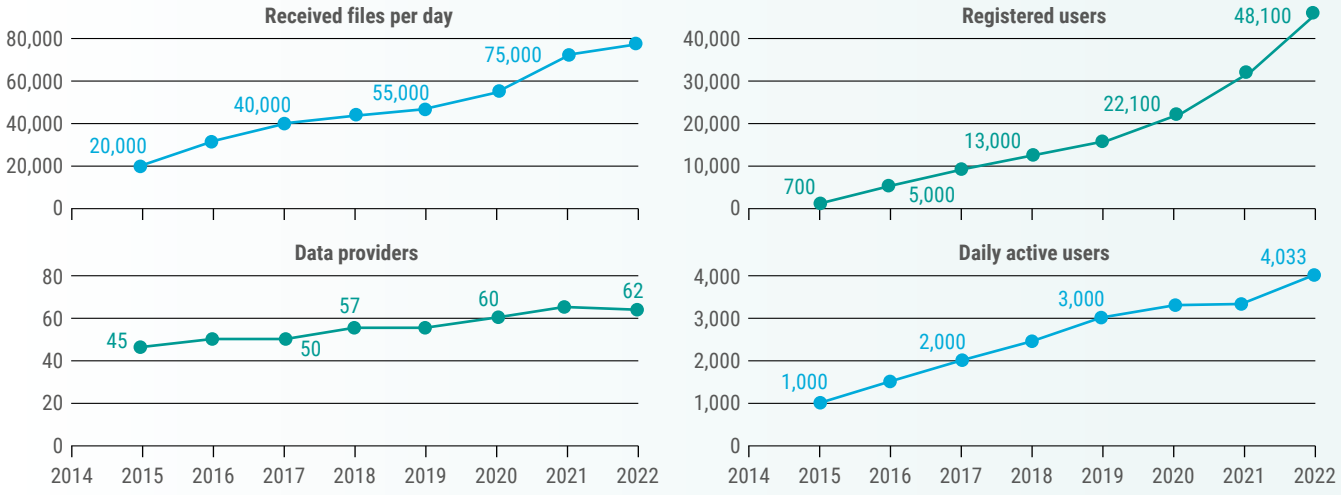


Figure 9 – Transparency Platform number of users increase.

The datasets provide an easy opportunity to transparently follow the share of generation technologies in the different geographical areas.

5 The MoU update process is still ongoing and is foreseen to be finalised in Q2 2023.

Innovation is key to accelerate the energy transition towards Net Zero. TSOs tirelessly look for better solutions to fulfil their mission and improve people's lives.

Håkon Borgen, Chair of the ENTSO-E Research, Development and Innovation Committee

5 Research, Development and Innovation

ENTSO-E promotes and supports the TSOs' innovation activities to transform the European energy system into an integrated one, with an emphasis on smart 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 following sections describe ENTSO-E activities in the field of Research Development and Innovation (RDI) that occurred in 2022, as well as the key messages of the ENTSO-E Vision for the future power system.

5.1 Research, Development and Innovation Implementation Report 2021–2025

On 3 February 2022, ENTSO-E published the "RDI Implementation Report 2021 – 2025". The Report is a guiding instrument for TSOs' collaborative research programmes in the coming five years. Through the definition of 13 project concepts, this strategic document prioritises the goals for the next three years outlined in the ENTSO-E RDI Roadmap 2020–2030 that pave the way for the TSOs' progress towards the EU climate goals .

KEY DATES & DOCUMENTS

3 Feb 2022	Publication of the **RDI Implementation Report 2021–2025**

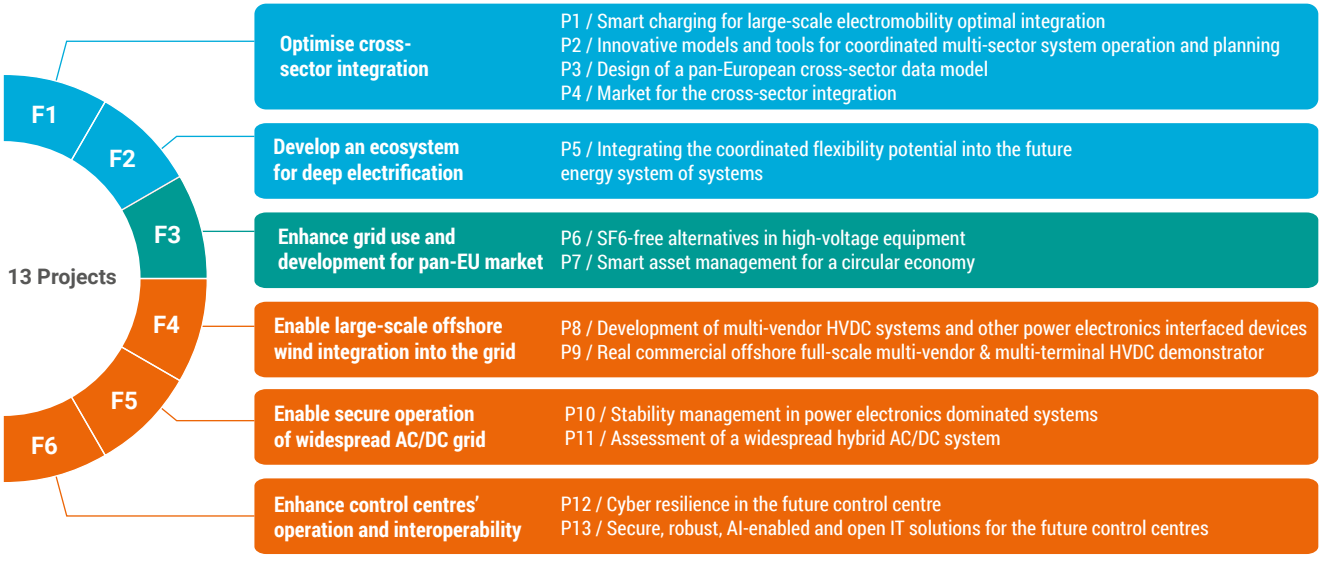


Figure 10 – RDI Implementation Report 2021–2025: 13 project concepts

5.2 Other RDI publications and activities

Position papers and reports

In 2022 ENTSO-E continued to produce position papers on various RDI topics.

First, "Stability Management in Power Electronics Dominated Systems" aimed to raise awareness of how the number of electronically coupled devices in the energy system will increase significantly (growing electrification and the renewable generation share) while conventional inertia devices (synchronous generators) in the system will be reduced. Consequently, the system behaviour will change significantly, creating a high impact on system stability. Likewise, this paper sets out key recommendations and actions, which call on stakeholders to collaborate and contribute to keeping the system stable through innovative risk assessment methodologies and tools.

The position paper "Innovation uptake through Regulation" presented the perspective of potential regulatory incentives and how they can support the deployment of innovative technologies for the TSOs. Based on this, the paper provided a toolkit for regulators consisting of potential regulatory tools across a broad spectrum, from regulatory experimentation to financial incentives.

KEY DATES & DOCUMENTS

21 Jun 2022	Publication of the **Position Paper – Stability Management in Power Electronics Dominated Systems**
28 Jun 2022	Publication of the **Position Paper – Innovation uptake through Regulation**
28 Jun 2022	Publication of the **Report – Potential of Power-to-Hydrogen technologies to provide system services**
12 Dec 2022	**DNV** independent analysis Lead Diffusion from High Voltage Cables

The third study, "Potential of Power-to-Hydrogen technologies to provide system services" assessed the role that electrolysers play not only as consumers of electricity but also in providing enhanced flexibility to power grids. Besides looking into the technological challenges of the use of hydrogen, the study explored potentially viable business models as well as geographical factors.

The independent study commissioned to DNV builds on the position paper on lead in cables published in 2021, ENTSO-E, together with partners, has published an independently prepared report assessing the risk of lead diffusion of power cables in normal operation.

ENTSO-E has also been finalising a study related to the power and heat sectors and kicked off an analysis on the electrification of the heavy-duty segment, both due in 2023.

InnoGrid 2022

In addition, in June 2022 ENTSO-E organised the 11th InnoGrid "Mission: Acceleration" jointly with E.DSO. The online event brought together around 300 participants on site and online from the industry, associations, EU institutions, regulators, the 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 increase the value of the grid, the value of flexibility and the value for customers.

5.3 Projects and cooperations

In 2022, ENTSO-E continued to strengthen its network of key external stakeholders on multiple levels. ENTSO-E has been part of two new Horizon Europe–funded projects that started in 2022. READY4DC will create and engage a community of experts that will assess and provide recommendations on the major technical and legal aspects of designing and building an interoperable multi-vendor DC grid. One major objective will be to prepare the ground for the development of the first multi-terminal, multi-vendor HVDC project in Europe. The second project, Int:Net, aims to develop, test and deploy interoperable energy services to further pave the way to a carbon-free European society in 2050. With these new additions, ENTSO-E's participation in Horizon-funded projects increased to six (with the current projects INTERRFACE, OneNet, BD4NRG and SPRING) in 2022.

Digital technologies will be instrumental to optimise resources and implement decarbonization, electrification, sector integration and the decentralisation of the energy system. Pan-European standards and cybersecurity create a secure environment in which data is exchanged seamlessly.

Radek Hartman, Chair of the ENTSO-E Information & Communication Technologies Committee

6 Cybersecurity, Interoperability and Data

In 2017, the ENTSO-E Board approved a framework for digital activities, which clearly identified interoperability and cybersecurity as the two foundations for ENTSO-E's information systems. This led to the approval of the ENTSO-E cybersecurity strategy in 2019.

6.1 Cybersecurity

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

In 2022, the ENTSO-E Board approved the cybersecurity improvement implementation plan and it was executed with the help and assistance of experts from specialist third-party companies. The plan covered three main areas:

1. **Information Security Management System (ISMS)** process improvements, the definition of controls and actions that ENTSO-E needs to implement to ensure the protection of confidentiality, availability, and integrity of the ENTSO-E data and assets from cyber threats and vulnerabilities, and a continuous improvement in the reduction of cyber risk. ENTSO-E now has management approved information security policies covering, for example, the acceptable usage of ENTSO-E assets, cyber incident management, and asset and infrastructure security change management.

2. **Deployment of a Secure Software Development Life Cycle (SSDLC)**, applying the ENTSO-E custom SSDLC roadmap delivered in 2020 as part of the CEF project. A security test lab is now operational and all ENTSO-E application source code is kept up to date in a secure code repository, where it is regularly tested for security vulnerabilities and other weaknesses. Our software suppliers are then notified about such vulnerabilities, which must be fixed under new contractual terms and conditions.

3. A **leadership and governance stream** which clearly defines the roles and responsibilities of all stakeholders, including ENTSO-E Application Project Managers, Application Security Centres, the Information & Communication Technologies Committee (ICTC), other committees, such as the Systems Operations Committee (SOC) IT & Tools, the Cyber Security Working Group (CSWG), the Cyber Security Task Force and Risk Management.

KEY DATES & DOCUMENTS

14 Jan 2022	ENTSO-E's and EU DSO Entity's submission to ACER of the Network Code on Cybersecurity
06 Jul 2022	ACER's submission to EC of the revised Network Code on Cybersecurity

In cooperation with the EU DSO Entity, ENTSO-E led the formal drafting of the Network Code on Cybersecurity (henceforth NCCS) in 2022, which aims to set a European standard for the cybersecurity of cross-border electricity flows. It includes rules on cyber-risk assessment, common minimum requirements, cybersecurity certification of products and services, monitoring, reporting and crisis management. Since July 2022, ENTSO-E and the EU DSO Entity have in parallel and in collaboration with various stakeholders continued discussions on technical aspects of the key processes and deliverables for implementation of the phase of this Network Code. The implementation phase is expected to start after the entry into force of the NCCS.

On 23 November 2022, ENTSO-E, E.DSO and ENCS hosted the 5th edition of their joint Cybersecurity event "European energy grids' security in a radically changed landscape" and discussed the challenges of the increasing volume and sophistication of malicious acts towards the European energy grid.

6.2 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, and several of ENTSO-E's IT tools and data environments, such as the Operational Platform for Data Exchange (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.

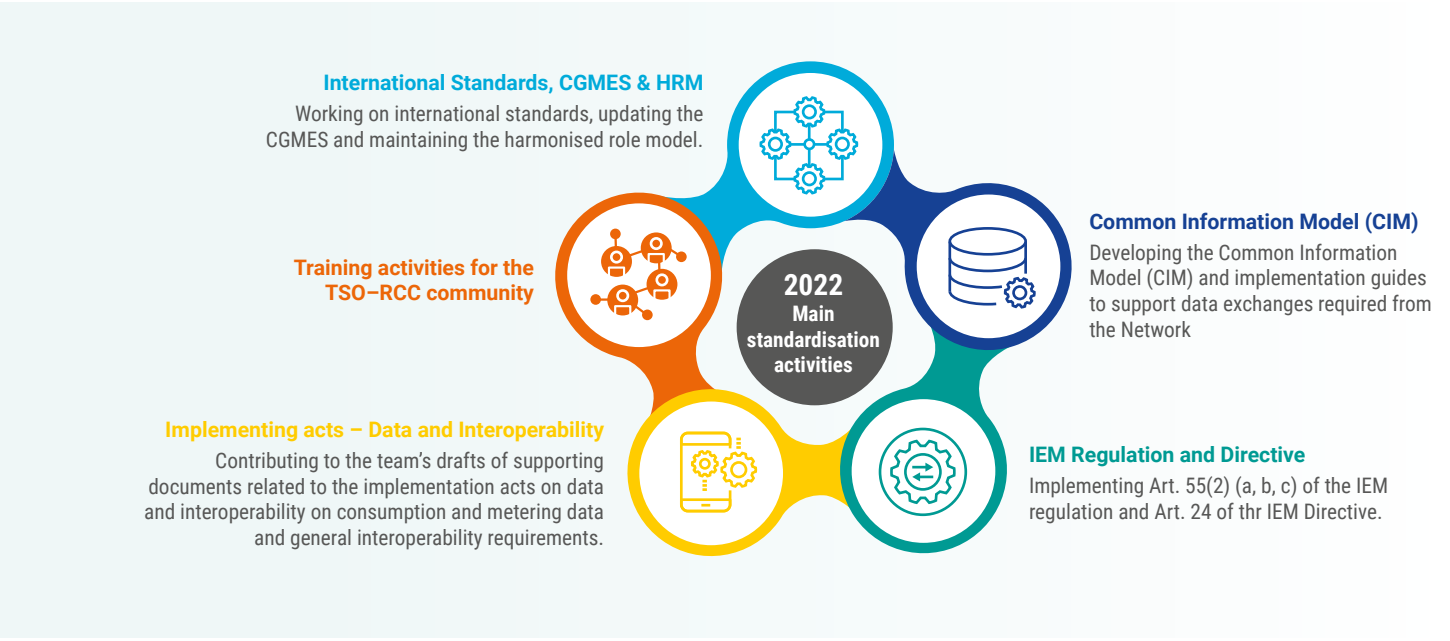


Figure 11 – 2022 main standardisation activities

In 2022, the main standardisation activities included developing the Common Information Model (CIM) and implementation guides to support data exchanges required from the Network Codes; working on international standards; updating the CGMES; maintaining the harmonised role model; contributing to the editorial team's drafts of supporting documents related to the implementation acts on data and interoperability on consumption and metering data and general interoperability requirements; implementing Art. 55(2)(a, b, c) of the IEM regulation and Art. 24 of the IEM Directive; and training activities for the TSO–RCC community.

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 encompasses 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.

7.1 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 the 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 into the operation and market process will be key to the efficient management of the electrical system of the future.

ENTSO-E pursued its cooperation with the EU DSO Entity on this topic with a joint statement on the ACER draft Framework Guideline on Demand Response. In their joint statement, both associations endorsed and supported the overall objective of the Framework Guidelines to integrate demand-side flexibility in transmission and distribution-related services on a level playing field with other resources. ENTSO-E and the EU DSO Entity noted that several recommendations of the joint TSO – DSO Roadmap on Distributed Flexibility published in 2021 have been acknowledged by ACER in its proposal. Both associations emphasised that they are ready to work together on the co-development of regulations, per the principles of the Memorandum of Understanding signed in January 2022 that focuses on ensuring consistency with existing Network Codes and guidelines, implementing acts on data interoperability and access and proposing, where relevant, possible developments.

SolarPower Europe has been collaborating closely with ENTSO-E, amongst others through the ENTSO-E Independent Advisory Council. Given the crucial role of power grids, the solar sector is committed to working alongside TSOs and DSOs to provide a future-proof grid to support Europe's decarbonisation.

Walburga Hemetsberger, CEO of SolarPower Europe

Cooperation between TSOs and DSOs is essential to enable the energy transition. The MoU not only sets the framework of our cooperation, but it also reaffirms our joint commitment to a decarbonised energy system.

Damian Cortinas, Co-Chair of the Transmission and Distribution Interface

7.2 Memorandum of Understanding

The Memorandum of Understanding (MoU) between ENTSO-E and the EU DSO Entity was signed and entered into force in January 2022. The Assemblies of ENTSO-E and the EU DSO Entity both approved the MoU in 2021, which provided a framework for the two Associations to fulfil their legal obligations per Article 30(1) and Article 55(2) of Regulation (EU) 2019/94319. It covers the following areas: development and amendments of Network Codes and Guidelines; cooperation on monitoring Network Codes and Guidelines; promotion of best practices related to the planning and operation of transmission and distribution systems; and provisions to facilitate institutional cooperation between the two Associations. In this regard, ENTSO-E and the DSO Entity developed a common T&D work plan for 2022/23 and on 20 December 2022 signed the official Declaration of Intent to develop jointly the Digital Twin of the EU electricity grid as suggested in the EU Action plan from October 2022, including the formation of a joint ENTSO-E and EU DSO Entity Task Force.

7.3 Other areas of cooperation

ENTSO-E started to cooperate with the newly established EU DSO Entity expert group on the TYNDP 2024. 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. The Network Code on Cybersecurity was co-drafted by ENTSO-E and the EU DSO Entity, and the proposal was submitted to ACER in January 2022.

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.

Appendices

Appendix 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 and Guidelines and the CEP represents a substantial effort, which ENTSO-E is prioritising.

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

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

The implementation of European legislation takes place on national, regional and pan-European levels, frequently in combination. TSOs, DSOs, and market participants and regulators at the EU, regional and national levels are also involved in various ways. In some cases, Network Codes or primary legislation define clear and detailed roles for specific bodies or 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*
ENTSO-E	ENTSO-E tasks	ACER
Pan-European "All TSOs"	All TSOs	ACER
Regional "All TSOs"	TSOs in the region	NRAs in the region. ACER to make the final decision if NRAs cannot agree**
National	Depending on national legislation (TSO, DSO…) (ENTSO-E may provide supporting documents and guidance)	National NRAs

Table 6 – Entities responsible for pan-European, regional and national tasks
* In accordance with the CEP provisions of the Electricity Regulation 2019/943. ** In accordance with Art. 5(3) of ACER Regulation 2019/942.

"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").

Monitoring the implementation

ENTSO-E is responsible for monitoring the implementation of Network Codes and Guidelines as defined by the legal provisions of the latter. To fulfil this obligation, ENTSO-E adds to 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 to monitor 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 on data collection and provision to ACER. This agreement is currently being used to monitor the CACM and should then be extended to other Network Codes and Guidelines.

Appendix 2 – Governance and Staff

In 2022, ENTSO-E was governed by an Assembly representing the 39 TSOs and by a Board consisting of 12 elected members.[6]

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

Dirk Biermann
50Hertz Transmission GmbH, Germany

Damian Cortinas
RTE,
France

Maurice Dierick
Swissgrid AG,
Switzerland

Guido Guida
Terna S.p.A.,
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

6 The new Observer Membership Agreements signed with Ukrenergo and with TEİAŞ (Turkish Electricity Transmission Corporation) were formalised on 26 April and 13 December 2022, respectively

Committee Chairs

Kjell A. Barmsnes
Market Committee Chair
Statnett SF, Norway

Håkon Borgen
Research, Development & 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

Radek Hartman
Information & Communication technologies Committee Chair
ČEPS, Czech Transmission System Operator

The ENTSO-E Secretariat Management Team

Sonya Twohig
Secretary-General

Norela Constantinescu
Head of Innovation Section

Bruno Gouverneur
Head of Operations Section

Zoltan Gyulay
Head of Market Section

Edwin Haesen
Head of System Development Section

Christelle Verstraeten
Head of Policy, Communications and Stakeholder Management Section

Florence Melchior
Head of Corporate Governance Section & General Counsel

Bertrand Macabeo
Head of Corporate Services Section

Nicolas Richet
Head of ICT Governance & Architectures Section

Ivan Taleski
Head of Legal Section

Ervis Bregu
Head of ICT Solutions Section

Evelyne Driane
Head of People, Talent & Culture Section

Appendix 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.

In 2022, ENTSO-E monitored the situation and continued to provide expert advise when requested.

Appendix 4 – Resources

Budget

ENTSO-E AISBL[7] is a not-for-profit organisation under Belgian law.

ENTSO-E's budget is covered by membership fees as well as other revenues and incomes. For 2022, the budget of ENTSO-E totalled EUR 58.5 million, funded by TSO member fees of EUR 31.8 million, self-financing of EUR 5.3 million via ENTSO-E reserves and other revenues of EUR 21.4 million (H2020 grants and additional TSO funding)[8].

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).

On 31 December 2022, ENTSO-E counted 127 employees.

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

8 UK (GB) TSO contribution currently included in "other revenues" as considered as a service fee

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
CIM	Common Information Model
CNC	Connection Network Code
CNEC	Critical Network Element
CSAM	Methodology for Coordinating Operational Security Analysis
CZCA	Cross-Zonal Capacity Allocations
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
ENTSOG	European Network of Transmission System Operators for Gas

Abbreviation	Definition
ERAA	European Resource Adequacy Assessment
EU	European Union
FCA	Forward Capacity Allocation
FCR	Frequency Containment Reserve
GHG	Greenhouse Gases
GL	Guideline
GUI	Graphical User Interface
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
LTTR	Long-Term Transmission Rights
MAF	Mid-term Adequacy Forecast
MARI	Manually Activated Reserves Initiative
MEC	Maximum Entry Capacity
mFRR	Manual Frequency Restoration Reserves
MoP	Manual of Procedures
MoU	Memorandum of Understanding
NC ER	Emergency and Restoration Network Code

Abbreviation	Definition
NEMO	Nominated Electricity Market Operator
NRA	National Regulatory Authority
OPC	Outage Planning Coordination
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
PMU	Phasor Measurement Unit
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
SCC	Security Coordination Centre
SDAC	Single Day-Ahead Coupling
SEE	South-East Europe
SEleNe CC	South East electricity Network – Coordination Centre
SET	Strategic Energy Technology
SIDC	Single Intraday Coupling

Abbreviation	Definition
SLA	Service-Level Agreement
SO	System Operation
SOC	System Operation Committee
SOGL	System Operation Guideline
SOR	System Operation Region
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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