ENTSO-E Annual Report

2019 Edition

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About ENTSO-E

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the pan-European association of 42 electricity transmission system operators (TSOs) in 35 countries. In 2009, ENTSO-E was registered in the EU legislation and has since then been given a series of legal mandates.

Introduction

ENTSO-E in 2019

This Annual Report covers the period from January to December 2019. It focuses on the legal mandates given to ENTSO-E. Activities covered in this report have been performed thanks to the 42 members of ENTSO-E who provide its financial resources and whose staff provides expertise to the Association.

The successful implementation of these activities also relies on the input provided by stakeholders via ENTSO-E's Independent Advisory Council, the Network Codes European Stakeholder Committees and other stakeholders groups, and via the public consultation processes.

This Annual Report will be submitted for stakeholders' views in a public consultation from mid-June to mid-July 2020. The comments received will be considered and the Annual Report will be submitted to ACER for opinion.

2019 was marked by the entry into force of the **Clean Energy Package (CEP)**. While ENTSO-E and TSOs are still implementing the Third Package, work has already begun in 2019 on new legal mandates stemming from the CEP.

Report structure

- **Chapter 1** describes the implementation of System Operation legally-mandated tasks. Many deliverables under the System Operation Guideline have been submitted, and activities stemming from the Emergency and Restoration Code were carried out in 2019. The chapter also outlines activities carried out in the field of regional development, Common Grid Model and European Awareness System.

- **Chapter 2** covers the Market legally-mandated tasks. In 2019, ENTSO-E and TSOs developed and submitted several methodologies for regional capacity calculation, bidding zones, capacity mechanisms and balancing.

- **Chapter 3** provides an overview of all future-planning system development activities. In 2019, ENTSO-E and ENTSOG published their second joint Scenario Report as well as a joint focus study on the interlinkage between gas and electricity scenarios and infrastructure, while the TYNDP 2020 projects portfolio features 148 transmission projects and 25 storage projects. Moreover, in 2019 ENTSO-E developed new methodologies related to the implementation of CEP provisions on system adequacy.

- **Chapter 4** explains the updates made to the Manual of Procedures of the Transparency Platform in line with the legal requirements stemming from Network Codes and Guidelines and to the list of data provided by TSOs, setting requirements for data quality and allowing users to re-use data with no restriction.

- **Chapter 5** outlines the ENTSO-E Research, Development and Innovation activities in 2019, such as the start of the development of its new R&I Roadmap 2020–2030, the publication of "The Cyber Physical System for the Energy Transition" Report and its participation in ETIP SNET.

- **Chapter 6** details cybersecurity and data exchange & the interoperability activities carried out in 2019. While cybersecurity activities have been carried out under the CEF project, ENTSO-E also performed risk assessments on its main legally-mandated IT platforms and participated in the EC Working group on Cybersecurity. The chapter also describes data exchange and interoperability activities to support network code implementation, the development of the Electronic Data Interchange library and the publication of the version of the Harmonised Electricity Market Role Model.

- **Chapter 7** describes the activities carried out in the framework of the TSO–DSO cooperation; a common report with DSOs on active system management was released in April 2019, while a TSO-DSO Steering Group was established in 2019.

Contents

1 System Operation

The System Operation Guideline

The Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SOGL) sets out harmonised rules on how to ensure security of supply through efficient grid operation in a variable renewables paradigm. The implementation of the SOGL and its stemming methodologies entails several challenging tasks for TSOs at 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 have been carried out in 2019:

	Further SOGL deliverables in 2019		Key documents and dates	
PAN-EUROPEAN ACTIVITIES	**Art. 75.1:**	Methodology for coordinating operational security analysis	**19 Jun 2019:**	decision by ACER requesting the submission of three amendments in 2020
	Art. 84.1:	Methodology for assessing the relevance of assets for outage coordination	**19 Jun 2019:**	proposal approved by ACER
SYNCHRONOUS AREA LEVEL	**Art. 154.2:**	All CE TSOs' proposal for additional properties of FCR	**27 Dec 2019:**	proposal submitted to relevant NRAs
	Art. 156.11:	Methodology for a cost–benefit analysis for assessing the required minimum activation time for FCR in Continental Europe and Nordic synchronous areas	**1 Mar 2019:**	1st amendment to proposal approved by relevant NRAs
CCR TASKS	**Art. 76.1:**	Core TSOs' Common provisions for regional operational security coordination	**19 Dec 2019:**	proposal submitted to relevant NRAs
			23 Sep – 24 Oct 2019:	public consultation
	Art. 76.1:	Hansa TSOs' Common provisions for regional operational security coordination	**20 Dec 2019:**	proposal submitted to relevant NRAs
			18 Oct – 15 Nov 2019:	public consultation
	Art. 76.1:	SEE TSOs' Common provisions for regional operational security coordination	**Dec 2019:**	proposal submitted to relevant NRAs
			12 Nov – 13 Dec 2019:	public consultation

Table 1 – SO GL implementation activities in 2019

Implementation monitoring

Between July and September 2019, ENTSO-E released three important yearly implementation monitoring reports: the Incident Classification Scale annual report (Art. 15 SOGL), the annual report on Load-Frequency Control (Art. 16 SOGL) and the all TSOs' scenario definition and scenario description for the year 2020 (Art. 65 SOGL).

KEY DATES & DOCUMENTS

11 JULY 2019

Publication of the "All TSOs' scenario definition and scenario description for the year 2020"

30 SEP 2019

Publication of the "Incident Classification Scale" annual report

30 SEP 2019

Publication of the "Load-Frequency Control" annual report

The Emergency and Restoration Code

The Emergency and Restoration Network Code (NC ER) sets out harmonised rules on how to deal with emergency situations and restore the system as efficiently and as quickly as possible. It entered into force on 18 December 2017 and is primarily subject to implementation at a national or TSO level. Implementation should be finished till December 2022 (Art. 55 NC ER).

ENTSO-E has monitored the national implementation of the network code (Art. 52.1 NC ER) and supported its member TSOs in the delivery of their proposals for National Defence and Restoration Plans (Art. 6.2 NC ER). Moreover, guidelines for the rules for the situations in which the market activities are suspended and restored, which in turn are the responsibility of each TSO to implement, have been established (Art. 36.1 NC ER). ENTSO-E has worked on the assessment of the level of harmonisation of the rules for the suspension and restoration of market activities established by TSOs, and will attempt to identify, as appropriate, the areas that require harmonisation. This report will be delivered by December 2020 (Art. 36.7 NC ER).

The implementation of the NC ER was discussed with stakeholders during meetings of the System Operation European Stakeholder Committee held on a quarterly basis in 2019.

The Common Grid Model

The Common Grid Model (CGM) finds its legal basis in three of the network codes: the SOGL (Art. 64), the Capacity Allocation and Congestion Management (CACM) Regulation (Art. 17) and the Forward Capacity Allocation (FCA) Regulation (Art. 18). The CGM, and its data exchange system the Operational Planning Data Environment (OPDE), are a prerequisite for several services harmonised in the network codes, including coordinated capacity calculation, operational security analysis, outage planning coordination and adequacy analysis.

The CGM compiles the Individual Grid Model (IGM) of each TSO, covering timeframes going from one year before real time to one hour before real time. TSOs' individual (in most cases, national) grid models, after following a quality assessment and pan-European alignment process, are picked up by Regional Security Coordinators (RSCs), who merge them into a pan-European CGM and feed the merged CGM back into the system.

Achievements and Challenges

The CGM Programme delivered Release 1.2 on schedule in June 2019, to TSOs and RSCs. In November 2019, TSOs, RSCs and the CGM Programme jointly demonstrated the Basic CGM Build Process, respecting the process times and achieving data quality levels. The Basic CGM Build Process test was carried out for three consecutive days and it was possible to merge IGMs from 17 TSOs into a CGM. In December 2019, the CGM Programme distributed Release 2.0 on schedule to TSOs and RSCs, including the associated security elements. The roll-out of the Physical Communication Network (PCN) is on schedule.

A joint User Group has been established to synchronise deliverables among RSCs, Capacity Calculation Region (CCRs) and the CGM Programme. The joint CGM–RSC User Group aligns requirements and timelines among RSCs and CCRs and coordinates subsequent activities with the CGM Programme.

Methodologies

As the implementation of the CGM needs to be consistent throughout the various processes set in the SOGL, CACM and FCA regulations, the consolidation of the three methodologies into a single document was initiated by TSOs, keeping stakeholders abreast of developments in this respect via the European stakeholder committees.

CGM Security Plan

In line with the CGM Security Plan approved during the previous year, all TSOs and RSCs performed a first compliance self-assessment in February followed by an update in June 2019. In July 2019, the ENTSO-E System Operations Committee (SOC) approved an update of the implementation timeline, defining a stepwise implementation approach, resulting in a full compliance by all participants in August 2021.

Operational Planning Data Environment

The OPDE, specified in the SOGL (Art. 114), is the information platform that will support the data exchange associated with the CGM merging process. It is also the foundation of the data exchange platform for fulfilling the five core tasks of RSCs. This platform is currently on schedule with the rollout of Release 1.2 and the distribution of the new release 2.0. With Release 1.2, a total set of 130 major changes were implemented, including a set of 68 new features and updates to the existing software packages. Release 2.0 mainly includes security updates as well as new business requirements.

European Awareness System

The European Awareness System (EAS) provides a real-time pan-European view of the state of transmission systems. All operators input a number of measurements including frequency and cross-border exchange. These measurements are then merged to provide an overall European view of each TSO on the platform. ENTSO-E has implemented the required updates to system status indications and predefined messages to ensure compliance of EAS with Art. 18 and 42 of SO GL. ENTSO-E is also working to ensure compliance of EAS with Art. 29 and 33 of the ER NC.

The Site Acceptance Test (SAT) has been successfully completed, and the upgraded EAS has been fully operational since September 2019. Moreover, to ensure safety on data exchange, ENTSO-E performed a cyber security risk assessment on EAS.

Regional development

Cooperation at the regional level is a building block for ensuring security of supply and implementing the Internal Energy Market. The development of variable generation and increased interconnections render regional coordination among TSOs more important than ever.

ENTSO-E supports regional tasks where it is beneficial for the TSOs of the region. In this respect ENTSO-E provides a platform for coordinating regional deliverables which affect neighbouring regions and where addressing the matter at the pan-European level is more efficient than bilaterally.

Regional Coordination

RSCs are entities owned and appointed by TSOs to fulfil five tasks: security analysis, capacity calculation, outage coordination, adequacy forecast, and the CGM. The System Operation Guideline formalised the role of the RSCs and made it legally binding for TSOs to procure at least the five core tasks from one of the RSCs. Through their recommendations to TSOs, RSCs contribute to increasing efficiency in system operation; minimising risks of wide area events such as brownouts or blackouts; and lowering costs through maximised availability of transmission capacity to market participants.

The four TSOs, ESO–EAD (Bulgaria), IPTO (Greece), Transelectrica (Romania) and Terna (Italy), of the South-East Europe (SEE) and Greece–Italy (GRIT) CCRs agreed in December 2019 to establish an RSC located in Thessaloniki.[1]

1 The South East electricity Network – Coordination Center (SEleNe CC) was officially established on 22 May 2020.

Regional Security Coordinators and the Clean Energy Package

The CEP establishes an enhanced framework for regional cooperation through the establishment of Regional Coordination Centres (RCCs). Art. 35 of Regulation (EU) 2019/943 (the "Electricity Regulation") requires that TSOs of System Operation Regions (SORs) develop a proposal for the establishment of RCCs of their region. These should be operational by 1 July 2022 and will replace existing RSCs, adding new tasks for the RCCs.[2]

In 2019, ENTSO-E developed a proposal defining SORs fully compliant with Art. 36 of the Electricity Regulation[3]. The SOR Proposal specifies that some of the new tasks shall be carried out through a SOR configuration, and others through CCR or other configurations.

KEY DATES & DOCUMENTS

24 OCT – 20 NOV 2019

Public consultation on the SOR proposal

Other regional developments

The operational rules of the TSOs of Continental Europe have been updated in April 2019 with the entry into force of the Synchronous Area Framework Agreement (SAFA), which ensures compliance with the EU network codes and guidelines.

The European Commission welcomed in October 2019 the Technical Solution for inclusion of the Swiss transmission system in CACM and SOGL methodologies of the Core and Northern Italian Borders regions.

Future synchronisation of Baltic countries to the Continental Europe synchronous area

The Agreement on the Conditions for a Future Synchronous Interconnection of the power system of the Baltic States and the power system of Continental Europe entered into force in May 2019. The Agreement contains the conditions and steps to be completed prior to the synchronisation of the Baltic TSOs (Elering, AST and Litgrid) to Continental Europe.

The Baltic synchronisation with Continental Europe is part of the EU Energy Union strategy and will provide for the Baltic TSOs to operate their systems under the EU rules.

KEY DATES & DOCUMENTS

27 MAY 2019

The Agreement on the Conditions for a Future Synchronous Interconnection of the power system of the Baltic States and the power system of Continental Europe enters into force

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

3 The proposal was submitted in January 2020 and ACER published its decision in April 2020. These developments are out of the scope of this Report and will be covered in the Annual Report 2020 to be drafted next year.

2 Market

The Capacity Allocation and Congestion Management Regulation

The rules set by the CACM Regulation provide the basis for the implementation of a single energy market across Europe. It sets out the methods for allocating capacity in day-ahead and intraday timescales and outlines how capacity will be calculated across the different zones. Putting in place harmonised cross-border markets in all timeframes will lead to a more efficient European market and will benefit customers.

Day-to-day management of the single day-ahead and intraday coupling

According to Art. 10 CACM, TSOs cooperate with Nominated Electricity Market Operators (NEMOs) to organise the day-to-day management of the single day-ahead and intraday coupling. ENTSO-E facilitates the discussion. Although the overall governance structure of the single intraday and day-ahead coupling has been previously agreed, the governance principles were jointly agreed by NEMOs and TSOs in the first quarter of 2019. This work helps jointly organise the further development of the market coupling by defining the responsible bodies and classifying of the decisions to be taken by each body, as well as helping to define the criteria for prioritising the functionalities to be developed.

KEY DATES & DOCUMENTS

24 JAN 2019

"ACER Decision on the Methodology for pricing intraday cross-zonal capacity" (Annex I)

31 JUL 2019

Submission to ACER of the amendments to Algorithm Methodology

After ACER's decision of January 2019 on the all TSOs proposal for a single methodology for pricing intraday cross-zonal capacity in accordance with Art. 55.3, requesting amendments to the "TSOs' common set of requirements for an efficient capacity allocation in the intraday timeframe", TSOs developed the requirements and submitted them to the NEMOs. The requirements were included in the annex of the algorithm methodology submitted by the NEMOs in July 2019 in accordance with Art. 37.

The second wave of the European Single Intraday Coupling (SIDC) went live in November 2019, expanding the continuous trading of electricity across Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania and Slovenia[4].

Other CACM evolutions

In accordance with the CACM Regulation, in 2019 CCRs delivered day-ahead and intraday capacity calculation methodologies (Art. 20.2[5]), methodologies for coordinated redispatching and countertrading (Art. 35.1) and redispatching and countertrading cost sharing methodology (Art. 74.1).

After an amendment request from all NRAs, in January 2019 all TSOs submitted the final version of the methodology for calculating scheduled exchanges resulting from single intra-day coupling" in accordance with Article 56.1.

4 They join the existing countries already operating the SIDC: Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Latvia, Lithuania, Norway, The Netherlands, Portugal, Spain and Sweden.

5 Article 21.1 provides with further details on the expected content of the proposal.

	DA and ID CapCalc (Art. 20.2)	RD and CT (Art. 35.1)	SchedExc single ID coupling (Art. 56.1)	RD and CT cost sharing (Art. 74.1)
All TSOs	n/a	n/a	Approved 8 Feb 2019	n/a
Italy North	DA and ID submitted 16 Aug 2019 Public consultation 15 Oct – 17 Nov 2019	Approved 18 May 2019	n/a	Already submitted
Core	Approved 21 Feb 2019	Submitted 22 Feb 2019	n/a	
SWE	Already approved	Approved 15 May 2019	n/a	Approved 15 May 2019
IU	Already approved	Submission 1st amendment 17 May 2019	n/a	Submission 1st amendment 17 May 2019
SEE	Approved Apr 2019	Approved 25 Jul 2019	n/a	Submission December 2019
Nordic	Already approved	Approved 14 Jan 2019	n/a	Approved 14 Jan 2019
Hansa	Already approved	Approved 28 Jan 2019	n/a	Approved 20 Feb 2019

Table 2 – Capacity Calculation methodologies in 2019

Implementation monitoring

The CACM Cost Report 2017 and the CACM Cost Report 2018 submitted to NRAs respectively in April 2019 and in September 2019 in accordance with Art. 80(1) of the CACM Regulation includes the costs of coordinated activities of all NEMOs and/or all TSOs, and costs incurred for activities performed by NEMOs or by TSOs and NEMOs in a certain region, in relation to single day-ahead and intraday market coupling.

In August 2019, ENTSO-E issued the 5th edition of the annual report on the progress and potential problems with the implementation of FCA, single day-ahead coupling and single intraday coupling (a *"Market Report"*) in pursuance of Art. 82(2)(a) CACM and Art. 63(1)(a) FCA. Furthermore, a biennial *"Report on Capacity Calculation and Allocation"* was submitted to ACER in August 2019 in accordance with Art. 82(2)(b) and 31(2) of CACM and Art. 63(1)(c) and 26(1) of FCA.

KEY DATES & DOCUMENTS

12 APR 2019
Submission to NRAs of the CACM Cost Report 2017

20 SEP 2019
Submission to NRAs of the CACM Cost Report 2018

14 AUG 2019
Submission to ACER of the ENTSO-E Market Report

14 AUG 2019
Submission to ACER of the ENTSO-E Report on Capacity Calculation and Allocation

The Forward Capacity Allocation Regulation

The FCA Regulation, which entered into force on 17 October 2016, sets out rules regarding the type of long-term transmission rights (LTTRs) that can be allocated via explicit auction, and the way holders of transmission rights are compensated in case their right is curtailed. The overarching goal is to promote the development of liquid and competitive forward markets in a coordinated manner across Europe and provide market participants with the ability to hedge their risk associated with cross-border electricity trading.

Methodologies

Regarding the implementation tasks at the regional level, some CCRs delivered common capacity calculation methodologies for long-term time frames (Art. 10.1 FCA) and methodologies for splitting long-term cross-zonal capacity (Art. 16.1 FCA).

	LT timeframes (Art. 10.1)	Splitting LT cross-zonal capacity (Art. 16.1)
Hansa	Submitted 18 Jun 2019 Public consultation 15 Apr – 15 May 2019	Submitted 18 Jun 2019 Public consultation 27 Mar – 25 Apr 2019
Core		Submitted 21 Aug 2019 Public consultation 10 Jun – 10 Jul 2019
SWE[6]	Public consultation 15 Mar – 15 Apr 2019 1st submission 15 May 2019[7]	Public consultation 1 – 30 Apr 2019[8]

Table 3 – Capacity Calculation methodologies for FCA

In accordance with Art. 31.1 of the FCA Regulation, ACER approved in October 2019 the second amendment to the Core TSOs' regional design of LTTRs that implemented financial transmission rights options at specific bidding zone borders. The third amendment to the Core TSOs' regional design of LTTRs, submitted in December 2019, introduces the switch from physical transmission rights with the use-it-or-sell-it principle to financial transmission rights on specific bidding zone borders. This third amendment does not change the impact of the previously approved amendment on the objectives of the FCA Regulation.

KEY DATES & DOCUMENTS

4 APR 2019

Submission of the 2nd amendment to the Core TSOs' regional design of LTTRs

12 DEC 2019

Submission of the 3rd amendment to the Core TSOs' regional design of LTTRs

7 FEB – 7 MAR 2019

Public consultation on the 2nd amendment to the Core TSOs' regional design of LTTRs

18 DEC 2019 – 26 JAN 2020

Public consultation on the 3rd amendment to the Core TSOs' regional design of LTTRs

6 Both methodologies have been approved in March 2020.

7 The 2nd submission took place in January 2020.

8 The methodology has been submitted in January 2020.

Following the all NRAs' request for amendment to the joint proposal for a methodology for sharing congestion income from FCA (Art. 57.1 FCA), all TSOs submitted the amended version in March 2019 and all NRAs approved it in May 2019.

All TSOs have elaborated a reviewed Harmonised Allocation Rules (HAR) proposal which was submitted in July 2019 and approved by ACER in October 2019, in accordance with Art. 68.5 of the HAR.

Finally, ENTSO-E has coordinated the preparation of the All TSOs' proposal for the methodology for sharing costs incurred to ensure firmness and remuneration of long- term transmission rights pursuant to Art. 61 (FCA).

KEY DATES & DOCUMENTS

22 MAY 2019

All NRAs approval of the amendment to the joint proposal for a methodology for sharing congestion income from FCA

KEY DATES & DOCUMENTS

29 OCT 2019

ACER approval of the reviewed HAR

The Electricity Balancing Regulation

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

1. Frequency containment reserves (FCR)[9], which stabilise the frequency after a disturbance at a steady-state value by a joint action of FCR within the whole synchronous area;

2. Frequency restoration reserves with automatic activation (aFRR) and frequency restoration reserves with manual activation (mFRR): these are activated to control the frequency toward its set point value and replace FCR;

3. Replacement reserves (RR), which replace and/or complement FRR by activation of RR;

4. Imbalance netting (IN), which reduces the amount of simultaneous and counteracting aFRR activations via imbalance netting power interchange.

9 The Guideline includes FCR in the balancing energy process but does not provide for an associated common platform.

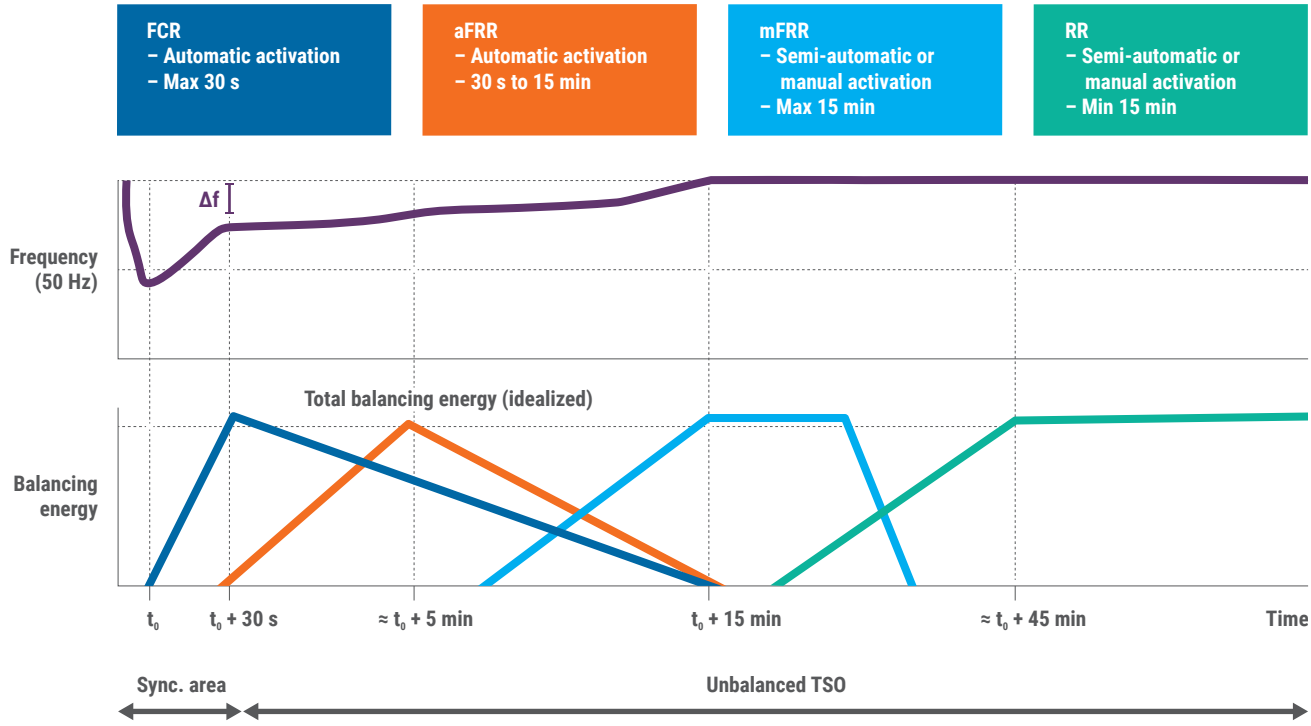

Figure 1 – Frequency restoration process

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

The European balancing platforms

- **European platform for replacement reserves – Trans-European Replacement Reserves Exchange (TERRE):** all TSOs performing the reserve replacement process have implemented the platform throughout 2019[10] (Art. 19.5 EB Reg.);
- **European platform for imbalance netting – International Grid Control Cooperation (IGCC):** in 2019, there were fourteen operational members that continued the implementation of the platform (Art. 22.5 EB Reg.); among these, two members TSO became operational in January 2019;
- **European platform for the exchange of mFRR and aFRR energy – Manually Activated Reserves Initiative (MARI) and Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO):** In accordance with the submission by all TSOs of the methodology proposals for implementation frameworks, pricing and activation purposes of balancing energy bids and TSO–TSO settlement of exchanges of balancing energy and the IN process, implementation of the platforms continued throughout 2019 (Art. 20.6 and 21.6 EB Reg.).

10 The platform was made operational in January 2020.

Further EB Reg. deliverables in 2019[11]

Further EB Reg. deliverables in 2019		Key documents and dates	
Art. 25.2:	Proposal for a list of standard products for balancing capacity for frequency restoration reserves and replacement reserves	**15 May – 31 Jul 2019:** **6 Jun 2019:** **17 Dec 2019:**	public consultation stakeholder workshop proposal submitted to all NRAs
Art. 29.3:	Proposal for a methodology for classifying the activation purposes of balancing energy bids	**11 Nov 2019:**	1st amendments submitted to all NRAs
Art. 30.1:	Proposal for pricing of balancing energy and cross-zonal capacity (CZC) used for the exchange of balancing energy (RR, FRR, IN)	**11 Feb 2019:**	proposal submitted to all NRAs
Art. 40.1:	Proposal for a methodology for a co-optimised allocation process of CZC for the exchange of balancing capacity or sharing of reserves	**15 May – 30 Jul 2019:** **6 Jun 2019:** **17 Dec 2019:**	public consultation stakeholder workshop proposal submitted to all NRAs
Art. 41.1:	Proposal for a methodology for a market-based allocation process of CZC for the exchange of balancing capacity or sharing of reserves (voluntary, each CCR to decide)	**20 Sep – 21 Oct 2019:** **18 Dec 2019:**	public consultations submission to relevant NRAs of Core and Hansa CCR TSOs' proposals
Art. 42.1:	Core CCR TSOs' proposal for a methodology for the allocation of cross-zonal capacity based on an economic efficiency analysis (voluntary, each CCR to decide)	**20 Sep – 21 Oct:** **18 Dec 2019:**	public consultation proposal submitted to relevant NRAs
Art. 50.1:	Proposal for TSO–TSO settlement of intended exchanges of energy as a result of the RR, mFRR, aFRR and/or RR processes	**11 Nov 2019:**	1st amendment to the proposal submitted to all NRAs
Art. 50.3.a:	Proposal for TSO–TSO settlement of intended exchanges of energy due to ramps and FCR within synchronous area continental Europe	**4 Jul 2019:**	proposal submitted to relevant NRAs
Art. 50.3.b:	Proposal for TSO–TSO settlement of intended exchanges of energy due to ramps and FCR within synchronous area Nordics	**18 Dec 2019:**	proposal submitted to relevant NRAs
Art. 50.4:	Proposal of TSO–TSO settlement of intended exchanges of energy due to ramp restrictions and FCR between synchronous areas	**18 Jun 2019:**	proposal submitted to relevant NRAs
Art. 51.1.a:	Proposal for TSO-TSO settlement of unintended exchanges within synchronous area continental Europe	**4 Jul 2019:**	proposal submitted to relevant NRAs
Art. 51.1.b:	Proposal for TSO–TSO settlement of unintended exchanges within synchronous area Nordics	**18 Jun 2019:**	proposal submitted to relevant NRAs
Art. 51.2:	Proposal for TSO–TSO settlement of unintended exchanges between synchronous areas	**18 Jun 2019:** NRAs	proposal submitted to relevant
Art. 52.2:	Proposal for imbalance settlement harmonisation	**11 Nov 2019:**	1st amendment to proposal submitted to all NRAs

Table 4 – Further EB Reg. deliverables in 2019

11 Deliverables in accordance with Art. 25.2, 29.3, 30.1, 40.1, 50.1 and 52.2 will be subject to an ACER decision to be taken by mid-2020. These developments are out of the scope of this Report and will be covered in the Annual Report 2020 to be drafted next year.

Transparency of capacity calculation by TSOs

The CEP, with the new Electricity Regulation, introduces a new regulatory framework for cross-border capacity calculation. Specifically, Article 16.8 demands that at least 70% of the interconnection capacity shall be made available to the market (respecting operational security limits of internal and cross-zonal critical network elements and considering contingencies). The total amount of 30% can be used for the reliability margins, loop flows and internal flows on each critical network element.

In 2019, ENTSO-E and TSOs worked to develop a consistent approach across the regions towards Art. 16.8 with regard to its understanding, implementation and monitoring of compliance. ENTSO-E and TSOs also engaged in constructive discussions with ACER and NRAs on this topic.

Bidding zone review

In accordance with Art. 14.5 of the EU Electricity Regulation (2019/943), all TSOs submitted in October 2019 a proposal for the methodology and assumptions to be used in the bidding zone review process and for the alternative bidding zone configurations to be considered, with the annexed alternative bidding zone configurations drafted by the TSOs of each bidding zone review region. All NRAs requested in December 2019 the re-submission of the proposal. Exchanges of view with stakeholders took place before and after submitting the above-mentioned proposal.

All TSOs proposal	All NRAs request for re-submission	Stakeholder consultation
4 Oct 2019: Submission to all NRAs of the proposal for the methodology and assumptions to be used in the bidding zone review process and for the alternative bidding zone configurations	**17 Dec 2019:** All NRAs request for re-submission of the proposal for the methodology and assumptions to be used in the bidding zone review process and for the alternative bidding zone configurations[12]	**8 Mar 2019:** Symposium on model-based approach for alternative bidding zone configurations **21 Oct 2019:** Stakeholder webinar: Bidding Zone review methodology, assumptions and configurations

Table 5 – Bidding Zone methodology and assumptions proposals

Capacity Mechanisms

In 2019, ENTSO-E developed six methodologies, common rules and tools for the participation of foreign providers in capacity mechanisms.

As required by Art. 26.11 of the Electricity Regulation, ENTSO-E shall submit such methodologies to ACER by 5 July 2020.

12 The proposal was re-submitted in February 2020.

Inter Transmission System Operator Compensation

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

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

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

According to Reg. (EU) 838/2010, ENTSO-E is mandated to determine the amount of losses incurred on national transmission systems by calculating the difference between: (1) the amount of losses actually incurred on the transmission system during the relevant period; and (2) the estimated amount of losses on the transmission system which would have been incurred on the system during the relevant period if no transit of electricity had occurred. In September 2019, ENTSO-E published the ITC Transit Losses Data Report 2018.

Key dates & documents

24 SEP 2019

Publication of the "ITC Transit Losses Data Report 2018"

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

3 System Development

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

The Ten-Year Network Development Plan (TYNDP) is the outcome of a two-year process, starting with the development of scenarios outlining how the European power system might look in 2030 and 2040. Over 200 experts Europe-wide carried out regional exploration studies and pan-European analyses, and assessed projects to reinforce the grid, submitted through a European-wide call for candidatures.

Imagine and model future electricity and gas systems scenarios

ENTSO-E and ENTSOG published their second joint Scenario Report for TYNDP 2020 in November 2019. Stakeholder feedback was collected through a public consultation on the joint scenarios held between November 2019 and January 2020, and through a public workshop on the draft TYNDP 2020 Scenarios held on 5 December 2019 in Brussels. The workshop presented the scenarios, explained how they were developed and detailed the next steps[13].

For the first time, the new set of scenarios are no longer formally attached to the TYNDP but have become a standalone product of both ENTSO-E and ENTSOG. Although the TYNDP is a major user of these scenarios, and the development processes of the TYNDP and scenarios are closely interlinked (see development cycle in the following section), ENTSO-E wants to highlight with this measure how the scenarios can and should be used for studies on all future aspects of the European energy system (internal and external to ENTSO-E and ENTSOG).

KEY DATES & DOCUMENTS

12 NOV 2019

Publication of the Joint Scenario Report for TYNDP

25 NOV 2019 – 22 JAN 2020

Public consultation on the joint TYNDP Scenarios

5 DEC 2019

Public workshop on the draft TYNDP 2020 Scenarios

Three Scenarios

- **National Trends** is the central scenario based on the draft NECPs, as well as on further national policies and climate targets already stated by the EU member states. It is compliant with the EU's 2030 Climate and Energy Framework (32 % renewables, 32.5 % energy efficiency) and EC 2050 Long-Term Strategy, with an agreed climate target of 80–95 % CO2 reduction compared to 1990 levels.
- **Global Ambition** is a scenario compliant with the 1.5° C target of the Paris Agreement, also considering the EU's climate targets for 2030. It considers a future that is led by the development in centralised generation. Economies of scale lead to significant cost reductions in emerging technologies such as offshore wind, but imports of energy from competitive sources are also considered as a viable option.

13 The final 2020 scenario report was published in June 2020.

› **Distributed Energy** is a scenario compliant with the 1.5° C target of the Paris Agreement, also considering the EU's climate targets for 2030. It takes a de-centralised approach to the energy transition. A key feature of the scenario is the role of the energy consumer (prosumer), who actively participates in the energy market and helps to drive the system's decarbonisation by investing in small-scale solutions and circular approaches.

Supply and demand data collected from both gas and electricity TSOs are used to build "National Trends", the central policy-based scenario, reflecting Member States' draft National Energy and Climate Plans (NECPs) and recognising EU climate targets. The "Global Ambition" and "Distributed Energy" Scenarios are developed as full energy scenarios (not limited to gas and electricity); they are built in line with the Paris Agreement target of limiting the increase in the global average temperature to 1.5 °C and considering the efforts of the EU-28 to reduce emissions to net-zero by 2050.

For the National Trends scenario, country-specific data were collected for 2030 and 2040 (when available for electricity) in compliance with the TYNDP timeframe. For gas, further assumptions have been made to compute the demand for 2050 on an EU28-level. Both the Distributed Energy and Global Ambition scenarios are developed on a country-level until 2040 and on an EU28-level until 2050.

The Ten-Year Network Development Plan

The TYNDP is a pan-European network development plan, providing a long-term vision of the power system. A legally mandated deliverable (Article 30(1), Regulation 943/2019), published by ENTSO-E every two years, it is the foundation of European grid planning and the basis for transmission projects that are eligible to be labelled as "Projects of Common Interest" (PCI).

The elaboration of each TYNDP is a two-year process:

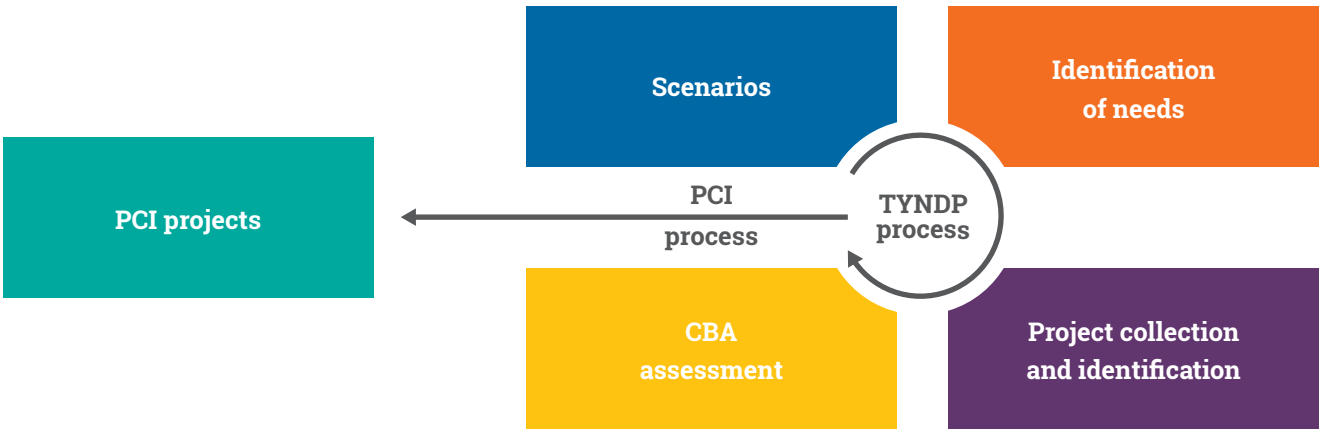

Figure 2 – TYNDP two-year process

Each scenario's impacts on energy markets and networks are analysed with the help of tailored modelling tools. Thanks to the models, ENTSO-E can explore various energy market needs and the corresponding power grid configurations. We can therefore understand, make transparent and better explain which parts of the network infrastructure are fit for purpose and which need to be reinforced or supported by alternative solutions or technologies. The main role of TYNDP is thus to identify where investment in the electricity system would help releasing the expected transmission constraints, and by doing so providing the adequate infrastructure. This is done in two stages: performing a system needs analysis that begins with a theoretical overview of the optimal set-up 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 an analysis of their performance under different scenarios.

In continuation of the work initiated two years ago, TYNDP 2020 highlighted the particular needs for strengthening the existing transmission grid as a prerequisite for a secure and stable power system and for achieving the European climate targets. The missing grid capacity for the rapidly increasing Renewable Energy Sources (RES) capacity translates into curtailment and congestion as well as expensive and CO2-intensive redispatch measures, as power would not be able to flow from lower-cost areas to more expensive ones. Therefore, the cost of no grid could largely exceed the cost of grid reinforcement. Alternatives to grid investments form part of the approach, such as storage and demand side measures.

A total of 174 projects were submitted to the TYNDP 2020 during the submission window that took place October–November 2019. As a result, 148 transmission projects and 25 storage projects compose the TYNDP2020 projects portfolio. Only one project was found not to comply with the criteria. ENTSO-E has verified the conformity of all submissions with the criteria for admission in the TYNDP2020 set in the Guidance for project promoters – Transmission and storage projects Criteria for applications and their treatment in the TYNDP2020.

KEY DATES & DOCUMENTS

17 JUN – 14 JULY 2019

Public consultation on the Guidance for project promoters

22 OCT – 22 NOV 2019

Submission of storage and infrastructure projects
→ 174 project submitted:

- **148 transmission**
- **25 storage**
- **1 not in line with criteria**

Electricity and gas: modelling the interlinkage

Highly volatile generation and possible low utilisation rates of RES require high system flexibility to optimally utilise the installed renewable capacity while avoiding potential overrated system development. The difference between local generation and consumption (surplus), in case it is not possible to develop an infrastructure which provides sufficient transmission capacity, leads to the need for different instruments, one of which could be the conversion to other energy forms or carriers. To this end, Power to Gas and other P2X (e.g. Power to Liquid, Power to Heat, etc.) may have the potential to efficiently provide a certain degree of flexibility and thus reduce the cost of the decarbonised energy system.

ENTSO-E has been working with ENTSOG since 2015 in developing a common set of scenarios. ENTSO-E and ENTSOG further investigated the interlinkage between gas and electricity scenarios and infrastructure project assessment with a joint focus study, examining all possible interactions between the gas and electricity sectors, and relevant gas and electricity infrastructure interactions. The key element of this model is the joint development of scenarios that constitute the basis for the cost–benefit analysis (CBA) of gas and electricity infrastructure projects. Once the scenarios have been commonly established, the submitted model proposes that ENTSO-E and ENTSOG perform the CBA of infrastructure projects based on their specific tools and methodologies.

KEY DATES & DOCUMENTS

SEP 2019

Publication of the joint ENTSO-E and ENTSOG Focus Study on Interlinkage between Gas and Electricity Systems

The study was supported by an ad hoc group of interested stakeholders representing European organisations and was also discussed with ACER and the European Commission in 2019. The “Focus study on gas and electricity interlinkage” report concludes that interactions between gas and electricity systems are captured by the TYNDP scenarios assumptions. The report also identified specific cases where additional interactions can be related to infrastructure projects. For TYNDP 2020, ENTSO-E and ENTSOG have already improved their scenario building process to account for gas and electricity interactions and will continue to build on stakeholders’ feedback to further improve the new editions.

The cost–benefit analysis methodology

The assessment of infrastructure and storage projects performed in the TYNDP uses a CBA methodology drafted by ENTSO-E, in consultation with stakeholders. The methodology when ready is proposed to the European Commission, who issues an opinion confirming or rejecting the proposal. The CBA results are also used as the basis of the PCI selection process. The main objective of the CBA methodology is to provide a common and uniform basis for the assessment of projects with regard to their value for European society.

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

KEY DATES & DOCUMENTS

25 OCT – 9 DEC 2019

Public consultation on the CBA methodology 3.0 → Comments received and ENTSO-E's assessment

8 NOV 2019

Public presentation of the 3rd CBA guideline

The CBA 3.0 was submitted to a formal public consultation process from 25 October until 9 December 2019. A workshop to present and discuss the CBA 3.0 took place in Brussels on 8 November 2019.

Ensuring system adequacy

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

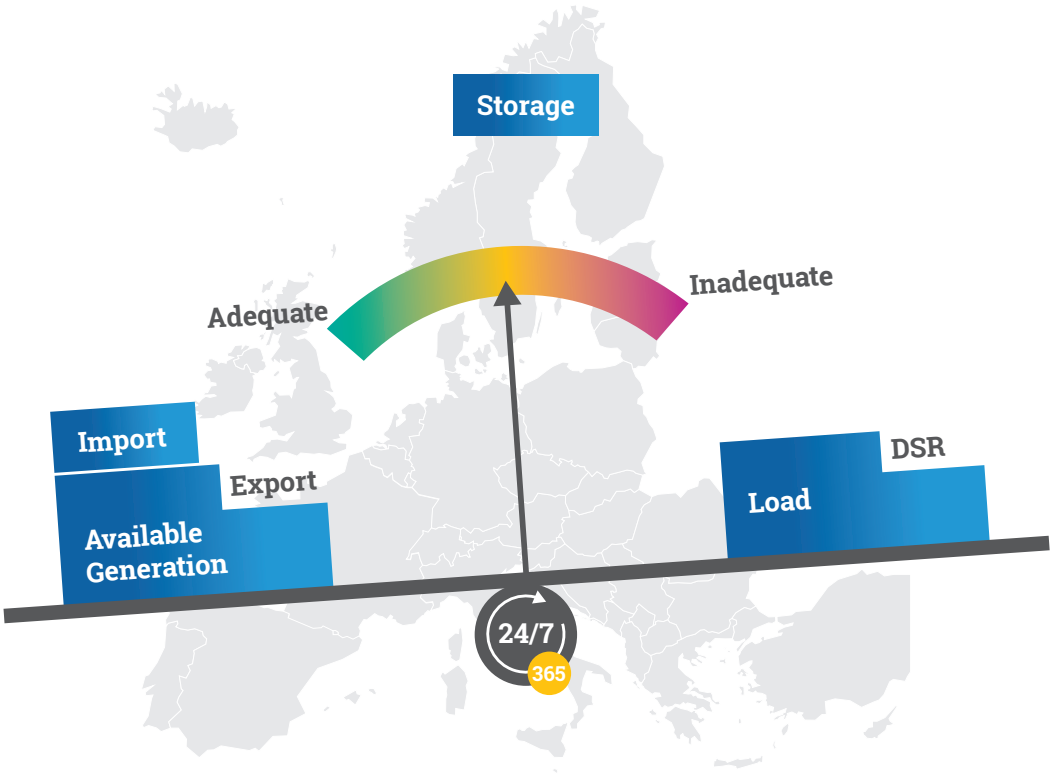

Figure 3 – Resource Adequacy

Due to the increasing level of variable RES in the European power system and the associated challenges for system development and operation, a pan-European analysis of resource adequacy has become ever more important. Cooperation across Europe is necessary to accelerate the development of common methodological standards, i.e. a common 'language' is required to perform these studies. Resource adequacy requires advanced methodologies to capture and analyse rare events with adverse consequences for the supply of electric power.

The Mid-term Adequacy Forecast

To account for a growing number of disruption risks related to the evolution of the energy mix – the growing development of RES, reduction of conventional power plants, availability of interconnection capacity – Europe needs a regular assessment of the adequacy situation, at time horizons of up to ten years ahead. The "Mid-term Adequacy Forecast" (MAF) aims to provide a pan-European adequacy assessment of the risks to security of supply and the need for flexibility for the coming decade. The MAF is based upon state-of-the-art probabilistic analysis, conducted using sophisticated market modelling tools. It contributes to the harmonisation of resource adequacy methodologies across Europe by being a reference study for European TSOs. The MAF aims to provide stakeholders with the data necessary to make informed, quality decisions and promote the development of the European power system in a reliable, sustainable and connected way.

KEY DATES & DOCUMENTS

21 NOV 2019

Publication of the MAF 2019

19 NOV 2019 – 13 JAN 2020

Public consultation on the MAF 2019

Data granularity and quality have improved significantly in MAF 2019. For example, for the first time, unit-by-unit information concerning thermal generation was collected and implemented in the models. In addition, the climate database was extended to include 35 years of hydrological data, and a new, improved methodology was introduced to construct hourly demand time series. Five different market modelling tools were used to assess the entire European perimeter based on comprehensive data for two target years: 2021 and 2025. The MAF 2019 updates, and provides a comparison to, the results of MAF 2018, which focused on the target year 2020. The second target year, i.e. 2025, was chosen as a pivotal year for evaluating adequacy due to significant reductions in coal and nuclear capacity expected between 2021 and 2025. Generally, the results of MAF 2019 indicate low risks of inadequacy in the system, if input assumptions of the assessment materialise, with the exception of islands and a few continental market zones.

The CEP places resource adequacy in a central position in the European energy policy context. It extends the scope of the ENTSO-E MAF and develops it further into a new Pan-European Resource Adequacy Assessment. As provided for by Article 23 of the Electricity Regulation, in 2019 ENTSO-E developed a methodology for a European resource adequacy assessment and a methodology for calculating the Value of Lost Load (VoLL), the Cost of New Entry (CONE) and the Reliability Standard. These methodologies were submitted to public consultation and presented to stakeholders at a workshop held in December 2019.

KEY DATES & DOCUMENTS

5 DEC 2019 – 30 JAN 2020

Public consultation on the methodology for a European resource adequacy assessment

5 DEC 2019 – 30 JAN 2020

Public consultation on the methodology for calculating the VoLL, the CONE and the Reliability Standard.

16 DEC 2019

Stakeholder workshop on European resource adequacy assessment methodologies

The Seasonal Outlooks

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

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

ENTSO-E is seeking to improve the methodology used in the seasonal outlooks, to further align with the one used for the MAF. This implies a switch from a mostly deterministic approach to a full probabilistic approach with hourly calculations at the Pan-European level. The change is being done following a step-by-step process, as it requires the implementation of new tools, methodologies and models.

KEY DATES & DOCUMENTS

8 JUL – 8 OCT 2019

Public consultation on the risk preparedness methodologies provided for by art. 5 and 8 of Reg. 2019/941

5 SEP 2019

Webinar on Risk Preparedness Methodologies

27 NOV 2019

Publication of the Winter Outlook 2019/2020

Moreover, to improve the coordination with the week-ahead adequacy assessment performed by RSCs, in 2019 ENTSO-E worked on a proposal for a methodology for assessing seasonal and short-term adequacy, namely monthly, week-ahead to at least day-ahead adequacy (Art. 8 of the Risk Preparedness Regulation 2019/941). ENTSO-E has also developed a proposal for Methodology for identifying regional electricity crisis scenarios (Art. 5 of the Risk Preparedness Regulation). For both risk preparedness methodologies, stakeholders were involved through a public consultation that took place from 8 July to 8 October 2019, and a webinar held on 5 September 2019.

Connection codes: Integrating renewables

The objectives of the three Connection Network Codes (CNCs) – Demand Connection Code (DCC), Requirements for Generators (RfG), and High Voltage Direct Current Connections (HVDC) – are threefold: first, to ensure the integration of decentralised RES and the increased demand response into the power system. Second, to facilitate the internal electricity market by levelling the playing field of grid users in different member states. Third, to increase competition among equipment providers by harmonising the requirements with what they need to comply in different markets.

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

Implementation monitoring

ENTSO-E monitors the implementation activities in each country via its Active library, looking in particular at divergences in national implementation. The "Monitoring report on Connection Network Codes Implementation" was published in December 2019.

KEY DATES & DOCUMENTS

16 DEC 2019

Publication of the "Monitoring report on connection network codes implementation"

4 Transparency Regulation

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

The Manual of Procedures (MoP) of the Transparency Platform has been updated to version 3.2, incorporating the amendments related to:

- Transparency Regulation art. 11.2 (Intraday offered cross-zonal capacity): The platform is ready to receive and publish such data submission. Once data providers finish their local IT implementation, offered capacity could be published accordingly;
- EB GL art. 12.3. h & i (Allocation and use of cross-zonal balancing capacity): aggregated reporting of market values, costs and benefits is introduced;
- EB GL art. 12.3.d (Information on bid conversion into standard products), 12.3.g (Terms and conditions) & 12.3.j (Approved methodologies): The area concepts for the reporting of the PDF documents are clarified;
- EB GL art. 12.3.b (information on all balancing energy bids from its scheduling area or scheduling areas, anonymised where necessary) and 12.3.f (information on offered volumes as well as offered prices of procured balancing capacity, anonymised where necessary): ENTSO-E has implemented these provisions by significantly enhancing the data processing part, enhancing data storage and implementing new functions like data archiving;
- Title 11 of the SO GL (Transparency information): information on operational agreements, frequency quality, load–frequency control structure, FCR, frequency restoration reserves, reserve replacements and sharing and exchange.

KEY DATES & DOCUMENTS

26 JUN 2019

Final upgrade of the MoP V3.2

18 DEC 2019

Entry into force of the MoP V3.2

ENTSO-E also conducted a dedicated two-day training programme for data providers in January 2019.

The Terms and Conditions of the Platform include the list of data provided by TSOs but also by Transmission Capacity Allocators, such as the Joint Allocation Office (JAO), which can be re-used by Transparency Platform users without any restriction. The list was updated in October 2019.

In parallel, ENTSO-E focuses on the evolution of the Platform from a legally mandated application to a market serving tool. In 2019, ENTSO-E completed phase 2 of the redesigning of the Graphical User Interface (GUI); the landing page and load domains along with data items from Proof of Concept are now accessible on the new Transparency Platform.

5 Research and Development

The European grid must be adapted to the arising energy transition power system, characterised by high and increasing variable RES shares, flexibility, and decentralised co-existing with centralised in one system. Innovative solutions on the physical side and the increasing use of digital technologies for the optimisation of the grid are to be applied. The power system will see new players emerge, such as aggregators, and also see the customers moving centre stage.

The section below describes ENTSO-E activities in the field of research and innovation (R&I) that occurred in 2019.

Research and Innovation Roadmap

ENTSO-E strongly supports the aim of the Mission Innovation initiative to double the involved governments' clean technology and research funding by 2021 and has reached out to policy makers, together with EDSO for smart grids, with Six Recommendations of Innovation to deliver the Energy Union.

ENTSO-E promotes and coordinates TSOs' innovation activities to transform the European energy system into an integrated one, with an emphasis on flexibility (including demand-side response, storage, etc.) and end-to-end digitisation to integrate different technologies and market services.

ENTSO-E advocates for the dissemination and sharing of best practices of R&I through its business coalition platform, named "Business Network for Innovation". In 2019, innovative business players, start-ups and thought leaders from academia and industry were invited to exchange their views in seven webinars on different topics related to European energy transition (e.g. storage, dynamic line rating, artificial intelligence and satellite technology, flexibility, etc.).

In addition, ENTSO-E organised on 13–14 May 2019, jointly with E.DSO, the InnoGrid2020+ conference centred around "Connecting Physics and Digits: Power Platforms on the Rise". The conference brought together more than 400 participants from the industry, associations, EU institutions, regulators, academic world and Member States, who discussed how to ensure that digitalisation delivers all its potential value to European citizens and how to ensure it leads to the best possible TSO–DSO interaction. Innovative TSO and DSO projects were showcased under four technical areas: 1) new technologies and grid planning, 2) active customer, active system management, 3) sector coupling and storage and 4) advanced grids resilience.

In 2019, ENTSO-E began to develop its new R&I Roadmap for the period of 2020–2030, outlining the methodology that contributes to achieving the European climate energy objectives and in line with the European Commission's Roadmap 2050. The development was led by the RDI Committee of ENTSO-E which initiated a major reprioritisation process to provide an updated basis for the Roadmap 2020–2030, to be aligned with European Green Deal, the new energy policy framework of the European Commission.

As a major step of the Roadmap preparation, RDI Committee began to work on a new RDI strategy of ENTSO-E. In light of the changing environment in which the TSOs operate, RDI Committee took a different approach, which is based on use cases and European flagship projects. The new RDI strategy identified three priority areas:

- **One System of Integrated Systems;**
- **Power Grid for Energy System;**
- **Cyber-Physical System.**

This document will serve as the main pillar of the work of RDI Committee and the RDI Roadmap 2020 – 2030.

ENTSO-E also worked on sharing innovation within the TSO community, via e.g. the mapping of TSOs' digitalisation-related innovative projects, resulting in "The Cyber Physical System for the Energy Transition" Report.

In addition, ENTSO-E strengthened its role in the European Technology Innovation Platform on Smart Networks Energy Transition (ETIP SNET), through active participation in its working groups and the Governing Board, of which ENTSO-E holds the chairmanship. ENTSO-E is also engaged in the integrated ETIP SNET 2050 vision of the energy system and will contribute to its 2020–2030 Roadmap and the further development of R&I building blocks.

The ETIP SNET Platform falls under the umbrella of the European Commission's Strategic Energy Technology (SET), as well as the Horizon2020 calls, in which ENTSO-E participates. In 2019, ENTSO-E continued to facilitate proposals for the Horizon2020 call and to foster TSO participation. ENTSO-E is involved in the following projects:

- **INTENSYS4EU**, jointly developed with the ETIP SNET, aims at supporting the further integration of innovative solutions and at extending the existing R&I Roadmaps, through permanent and direct interactions with the impacted stakeholders and EU member states.
- **TDX-Assist**, which aims to design and develop novel ICT tools and techniques that facilitate scalable and secure information systems and data exchange between TSOs and DSOs. Participating TSOs include Eles (Slovenia) and REN (Portugal).
- **INTERRFACE,** which groups TSOs, DSOs, aggregators and IT providers together to conceive a digital solution to support new flexibility markets and develop an interoperable architecture for data exchange between TSOs, DSOs and prosumers. In addition to ENTSO-E, its members Fingrid (Finland), Elering (Estonia), ELES (Slovenia), AST (Latvia), Transelectrica (Romania), and REN (Portugal) are participating in the project.

One additional project was formed within the **Horizon2020** framework, in which the "OneNet" consortium – including ENTSO-E and 14 TSOs – could develop further the TSO–DSO-prosumer cooperation and thus flexibility markets should the proposal be awarded funding by the European Commission.

6 Cybersecurity, Interoperability and Data

The current frame for digital activities in ENTSO-E is provided by its IT Strategy that was approved in 2017. This has led to the establishment of a Digital committee that is the advisory body to ENTSO-E on Digital matters. The ENTSO-E IT Strategy has clearly identified interoperability and cybersecurity as two of the founding capabilities for ENTSO-E's information systems. This has led to the development of an ENTSO-E Cyber Security Strategy that was approved in the first months of 2019.

In this context, relevant activities are steered as detailed in the following paragraphs.

Cybersecurity

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

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

- **Activity 1: Cybersecurity design**
  - ISO 27001 TSO Scope & Secure Software Development Lifecycle (SSDLC)
  - Risk Impact Matrix & Data Classification
  - Supply Chain security & procurement
  - Tech. & operation cybersecurity standards
- **Activity 2: Identify requirements for a cybersecurity testing facility**
- **Activity 3: Cybersecurity Operations Centre**

Moreover, ENTSO-E performed cyber risk assessments on the main ENTSO-E legally mandated IT platforms: CGM, EAS, Transparency Platform and Outage Planning Coordination/ Short Term Adequacy Assessment Process (OPC/STA). Regarding the latter, ENTSO-E performed external penetration testing and drafted the Security Plan.

Finally, ENTSO-E's participation in the European Commission Smart Grid Task Force, EG 2 – Working group on Cybersecurity culminated with the publication of the final report in June 2019. The working group focused on the cyber security aspects of cross-border electricity flows, and on common minimum requirements, planning, monitoring, reporting and crisis management for the electricity subsector.

Data exchange standards: Ensuring pan-European interoperability

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

ENTSO-E develops and maintains an Electronic Data Interchange library to enable interoperability between actors in the electrical industry in Europe. As part of this activity, 11 implementation guides, including profiles based on the Common Information Model (CIM), were developed or updated in support of several IT projects of ENTSO-E and TSOs, e.g. the Transparency Platform (including publication processes for capacity allocation configuration, outage, Transmission, data extraction, EB GL, Financial Settlement of KΔf, ACE and ramping period, SO GL and transparency reporting), European balancing platforms (aFRR, RR) and coordinated capacity calculation. In addition, a new release of the Common Grid Model Exchange Standard (CGMES 3.0) was developed to support the CGM building process required by the Network Codes and the TYNDP.

In 2019, ENTSO-E also published a new version of the Harmonised Electricity Market Role Model that includes the roles from the Network Codes.

Standardisation activities in 2019 also included continued collaboration with the standardisation organisation European Committee for Electrotechnical Standardisation (CENELEC) and the International Electrotechnical Commission (IEC), especially in relation to the implementation of network codes:

- **Committee Draft on balancing processes (IEC 62325-451-7);**
- **New Work Item on HVDC processes (IEC 62325-451-8);**
- **Committee Draft for CIM base (IEC 61970-301 Ed7);**
- **Committee Draft for Voting on CGMES (IEC 61970-600-1&2).**

7 TSO–DSO partnership and demand side flexibility

The energy transition corresponds to a change from a centralised system to a more complex integrated electricity system, with decentralised and centralised co-existing. The new system also sees new actors, such as aggregators, active customers, demand side response and distributed flexibility.

Integration of distributed flexibilities

A key area for cooperation is active system management and the coordinated use of distributed flexibility. Storage, distributed generation and customer participation through demand-side response have the potential to generate new services for the grid and the system. These are known as distributed flexibilities, and they will be key to efficiently managing the electrical system of the future and developing new market products. A common report with DSOs on active system management was released in April 2019, aiming to define the use of distributed flexibilities in active system management and analyse the interactions between TSOs, DSOs and market parties, in particular for balancing and congestion management.

In addition to the above, ENTSO-E contributed to the European Commission Expert Group on demand side response, which focused on the deployment of explicit demand-side response in Europe, contractual arrangements between different players and market solutions for accessing and using distributed flexibilities. This work culminated with the publication in April 2019 of a demand-side flexibility report.

KEY DATES & DOCUMENTS

15 APR 2019

Publication of the EU Smart Grids Task Force Report "Demand Side Flexibility: Perceived barriers and proposed recommendations"

16 APR 2019

Publication of the TSO-DSO Report "An integrated approach to Active System Management"

In March 2019, ENTSO-E decided to perform an analysis of regulatory gaps between the recommendations of these two reports and the set of existing network codes, as well as solutions for these gaps. ENTSO-E consulted on the identification of such gaps with TSOs' experts involved in network codes activities.

ENTSO-E also updated its catalogue of TSO – DSO innovation projects to identify best practices for the integration of distributed flexibilities.

Other activities

The TSO – DSO project group, set up on a temporary basis, was replaced by a permanent TSO–DSO Steering Group. In 2019, the Group provided its input to the ENTSO-E RDI roadmap 2020 – 2030 and decided to establish a roadmap for TSO – DSO cooperation on system planning (following the EC recommendation of the Energy Infrastructure Forum in 2019).

Moreover, ENTSO-E, T&D Europe and the four European associations representing DSOs (CEDEC, E.DSO, EURELECTRIC and GEODE) agreed in September 2019 to develop a new methodology that can help to monitor and better target the development of smart solutions in the transmission and distribution grid.

DELIVER A VISION FOR 2030

During its 10 Year Anniversary Conference, ENTSO-E delivered a joint "Vision on Market and System Operations Towards 2030". The Vision includes two focus papers – one on system operations and one on market design. The focus paper on system operations analyses the key drivers for the future of system operations, whereas the focus paper on market examines the different market design options.

The Vision introduces the concept of a system of systems where the different geographical and functional layers coordinate with each other and are connected to a digital layer on top of the physical infrastructure. This will allow for an alignment with the needs of all grid connected assets and for coupling with other sectors. TSOs will play a key facilitation role, together with Distribution System Operators, supported by Regional Coordination Centres and in dialogue with stakeholders.

ENTSO-E is planning to engage with stakeholders on the Vision in the course of 2020.

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

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

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

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

The implementation of European legislation is done on national, regional, and pan-European levels and often in combination. TSOs, as well as DSOs, market participants and regulators at the EU, regional and national levels, are involved in various ways. In some cases, Network Codes or primary legislation define clear and detailed roles for specific bodies/entities; in others, legal provisions are less detailed and require an additional layer of text to define roles and processes.

Implementation responsibility in Network Codes and Guidelines

Task attributed to	Responsibility	Approval[14]
ENTSO-E	ENTSO-E tasks	ACER
Pan-European 'All TSOs'	All TSOs	ACER
Regional 'All TSOs'	TSOs of the region	NRAs of the region. ACER to make the final decision if NRAs cannot agree[15]
National	Depending on national legislation (TSO, DSO…) (ENTSO-E may provide supporting documents and guidance)	National NRAs

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

Table 6 – Entities responsible for pan-European, regional and national tasks

Monitoring the implementation

ENTSO-E is responsible for the monitoring of the implementation of Network and Guidelines, as defined by the legal provisions of the latter. To fulfil this obligation, ENTSO-E elaborates monitoring plans and publishes reports. It also collects data, (termed 'lists of information'), and designs and implements interfaces for data collection. Based on new provisions under Regulation (EU) 2019/943, ENTSO-E will further cooperate with the future EU DSO entity on the monitoring of the implementation of possible new Network Codes and Guidelines. These will be adopted pursuant to this Regulation and are relevant to the operation and planning of distribution grids and the coordinated operation of the transmission and distribution networks.

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

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

15 In accordance with art. 5(3) of the ACER Regulation 2019/942.

Annex 2 – Governance

Assembly

Herve Laffaye
President of the Assembly, RTE

Zbyněk Boldiš
Vice-President of the Assembly, ČEPS

ENTSO-E is governed by an Assembly representing the 42 Transmission System Operators and by a Board consisting of 12 elected members.

Board

Joachim Vanzetta
Chair of the Board, Amprion

Pascale Fonck
Vice-Chair of the Board, Elia

Guido Guida
Member of the Board, Terna

Frank-Peter Hansen
Member of the Board, TenneT TSO BV

Michael Jesberger
Member of the Board, TransnetBW

Soren Dupont Kristensen
Member of the Board, Energinet

Manos Manousakis
Member of the Board, IPTO

Robert Paprocki
Member of the Board, PSE

Eduardo Prieto
Member of the Board, REE

Fintan Slye
Member of the Board, National Grid

Daivis Virbickas
Member of the Board, Litgrid

Yves Zumwald
Member of the Board, Swissgrid

Committees

Håkon Borgen
Research Development & Innovation Committee Chair, Statnett

Dimitrios Chaniotis
System Development Committee Chair, RTE

Inés de la Barreda
Legal and Regulatory Group Chair, REE

Tahir Kapetanovic
System Operations Committee Chair, APG

Konrad Purchala
Market Committee Chair, PSE

Annex 3 – Resources

Budget

ENTSO-E AISBL[16] is a non-for-profit organisation under Belgian law.

ENTSO-E's budget is covered by membership fees as well as other revenues and incomes. For 2019, the budget of ENTSO-E amounted to EUR 30.1 million funded by TSO member fees for EUR 28.7 million and by other revenues for EUR 1.5 million (H2020 grants and additional TSO funding).

Staff

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

At the end of 2019, ENTSO-E had 103 employees.

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

Acronyms

Acronym	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
CGM	Common Grid Model
CGMES	Common Grid Model Exchange Standard
CIM	Common Information Model
CNC	Connection Network Code
CoNE	Cost of New Entry
CZC	Cross-Zonal Capacity
DCC	Demand Connection Code
DSO	Distribution System Operator
EB Reg.	Electricity Balancing Regulation
ENTSOG	European Network of Transmission System Operators for Gas
ETIP SNET	European Technology and Innovation Platform Smart Networks for Energy Transition
FCA	Forward Capacity Allocation
FCR	Frequency Containment Reserve
FSKAR	Financial Settlement of KΔf, ACE and ramping
GL	Guideline
GRIT	Greece–Italy
GUI	Graphical User Interface
HAR	Harmonised Allocation Rules
HVDC	High-Voltage Direct-Current
iAC	Independent Advisory Council
IEC	International Electrotechnical Commission
IGDs	Implementation Guidance Documents
IGM	Individual Grid Model
IN	Imbalance Netting
ITC	Inter Transmission System Operator Compensation
JAO	Joint Allocation Office
LTTR	Long-Term Transmission Rights
MAF	Mid-term Adequacy Forecast
mFRR	Manual Frequency Restoration Reserves
MoP	Manual of Procedures
NC ER	Emergency and Restoration Network Code
NECP	National Energy and Climate Plan
NEMO	Nominated Electricity Market Operator
NRA	National Regulatory Authority

Acronym	Definition
OPC/STA	Outage Planning Coordination/Short Term Adequacy Assessment Process
OPDE	Operational Planning Data Environment
PCI	Project of Common Interest
PCN	Physical Communication Network
PECD	Pan-European Climate Database
Prosumers	Neologism that designates producers and consumers
RCC	Regional Coordination Centre
RES	Renewable Energy Source
RfG	Requirements for Generators
RGCE	Regional Group Continental Europe
R&I	Research and Innovation
RR	Replacement Reserves
RSC	Regional Security Coordinator
SAFA	Synchronous Area Framework Agreement
SAT	Site Acceptance Test
SET	Strategic Energy Technology
SEE	South-East Europe
SEleNe CC	South East electricity Network – Coordination Center
SIDC	Single Intraday Coupling
SO	System Operation
SOC	ENTSO-E System Operations Committee
SOGL	System Operation Guideline
SOR	System Operation Region
SSDLC	Secure Software Development Lifecycle
TSO	Transmission System Operator
TYNDP	Ten-Year Network Development Plan
VoLL	Value of Lost Load

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LOOKING FORWARD


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