ENTSO-E Annual Work Programme

2020 Edition

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About ENTSO-E

ENTSO-E, the European Network of Transmission System Operators for Electricity, represents 43 electricity transmission system operators (TSOs) from 36 countries across Europe. ENTSO-E, which was established and given legal mandates by the EU's Third Legislative Package for the Internal Energy Market in 2009, aims to further liberalise the gas and electricity markets in the EU.

Contents

Executive Summary

About the Annual Work Programme 2020

This Annual Work Programme covers the period from September 2019 through the end of 2020. It builds on the legal mandates and strategic objectives of ENTSO-E. The activities foreseen in this work programme will be delivered thanks to the expertise of the 43 members of ENTSO-E, who provide the Association with financial resources and whose staff provides expertise to the Association. The successful implementation of this work programme also hinges on the input provided by stakeholders, via the Advisory Council; the Network Codes European Stakeholder Committees; other stakeholder groups; and via the public consultation processes.

This work programme has been submitted for stakeholders' views in a public consultation from 17 October to 15 November 2019. The work programme has been equally submitted to the Agency for the Cooperation of Energy Regulators (ACER) for opinion in December 2019. This work programme was developed in coordination with the ENTSO-E's budget for 2020. The need of budgetary stability together with a sound management of the Association's resources may lead to updates to this programme necessary to create alignment with the budget. The accomplishment of this work programme will be assessed by the ENTSO-E Annual Report 2020, to be released in early 2021.

Report structure

Chapter 1 provides an overview of all implementation activities for ENTSO-E. First, implementation activities stemming from Network Codes and Guidelines are listed. Second, the Clean Energy for all Europeans Package (CEP) recognises an increased role of TSOs and ENTSO-E, and represents an important and significant update to Europe's electricity market design, TSO cooperation, and tasks of ENTSO-E's. Third, the creation of a European-wide IT architecture for electricity is one of the key enablers for the energy transition. The Common Grid Model (CGM) is a prerequisite for, among others, coordinated capacity calculation, operational security analysis, outage planning coordination, and adequacy analysis. As mentioned in the report, ENTSO-E and the TSO community attach great importance to these implementation activities and believe that – also considering the many legal requirements introduced by the CEP – focus and resources should now be devoted to the implementation of existing Network Codes and CEP provisions.

Infrastructure development, resource adequacy, regional development, data and transparency, and research and development activities are, according to ENTSO-E, the key drivers to develop the future power system. Chapter 2 describes the main activities planned in 2020 in all these fields, and explains how each of them contributes to the transition to a sustainable and more reliable power system.

1 Strong Focus on Implementation

ENTSO-E is fully committed to the transition toward clean energy and a carbon-neutral economy. Both the Network Codes (NCs) and Guidelines and the recently approved Clean Energy for All Europeans Package (known as the Clean Energy Package, or CEP) represent a substantial legislative framework that directs our joint efforts towards a more sustainable and reliable, electricity system.

Since 2009, ENTSO-E has developed eight Network Codes and Guidelines. Moreover, the Clean Energy Package provides for additional mandates on resource adequacy assessment, capacity mechanisms registry, risk preparedness, etc. Figure 1 sheds light on legal mandates that ENTSO-E has to implement as well as the current status of the implementation:

2011 – 2018	2019 – 2020 CEP entry into force 4 Jui 2019	2021 – 2023 CEP implementation
	CEP: New NCs drafting 2019: Cybersecurity (tbc); DSR (tbc); Joint ENTSO-E – EU DSO NCs work	New NCs drafting: interoperability & data (tbc); Joint ENTSO-E– EU DSO NCs work
	Digital tools & platforms (NC & CEP-related)	Digital tools & platforms
	CEP: RPP scenarios & methodologies, tools	CEP RPP: scenarios & methodologies updates, new tools
	CEP: Methodologies, registry and tools for capacity providers & CM specifications & methods Technical report on structural congestions	Methodologies, registry and tools for capacity providers & CM specifications & methods Technical report on structural congestions
8 NC & GI drafting finished by 2017	8 NC/GL implementation & monitoring (incl. all-TSO), 8 NC/GLs amendments	8 NC/GI implementation & monitoring (incl. all-TSO), 8 NC/GIs amendments
TYNDP, TEN-E guidelines 347/2013	TYNDP & interlinked models with ENTSOG, TEN-E guidelines	TYNDP & interlinked models with ENTSOG, TEN-E guidelines
Adequacy outlooks: MAF/Seasonal	CEP pan-European adequacy assessment & seasonal outlooks	CEP pan-European adequacy assessment & seasonal outlooks
RSC development	CEP: RCC regions, methodologies, tools development	RCC implementation
RDIC development, implementation and monitoring	RDIC development, implementation and monitoring plans	RDIC development, implementation and monitoring plans
Transparency Platform (Reg. 543/2013)	Enhanced Transparency Platform (Reg 543/2013) for all NCs	Enhanced Transparency Platform (Reg 543/2013)
Other Reg.: REMIT Regulation; ITC mechanism	Other Regulations: REMIT; ITC mechanism	Other Regulations: REMIT; ITC mechanism
Others mandated products: Annual Work programs; Annual reports;	Other mandated products: Annual Work programs; Annual reports; **Non-mandated products**	Others mandaled products: Annual Work programs; Annual reports; **Non-mandated products**

Existing ENTSO-E mandates | continuous implementation/enhanced mandates | new CEP mandates | most resource intensive

Figure 1: Current status of ENTSO-E implementation activities.

Figure 2 shows current status of all TSOs implementation activities with respect to some of which ENTSO-E has a potential facilitation and coordination role.

New task	Deadline after EIF
■ BZ review methodologies & scenarios ('relevant TSOs') coordinated by ENTSO-E	3 m
■ Bidding Zone Review	12 – 18 m (~ approval)
■ Capacity calculation threshold of min 70 % (unless derogations granted) & review of relevant methodologies	1 Jan 2020 by 2025 latest
■ National adequacy assessments with a regional scope & based on ENTSO-E-methodology	As of 1 Jan 2020
■ RCC framework: TSO proposal for establishing the RCCs (EU TSOs for each system operation region)	12 m
■ DA/ID products, ISP (in cooperation with NEMOs)	1 Jan 2020
■ New requirements for balancing products' procurement	5 Jul 2021
■ Use of congestion income methodology	
■ RPP framework: TSOs consulted in identification of crisis scenarios at national level and establishment of national risk preparedness plans	As of 14 m
■ Cooperation with DSOs on DSR, data exchange	1 Jan 2021
■ Provisions on ancillary services, storage	
■ RCC framework: relevant methodologies and digital tools for 10 new tasks	1 Jul 2022

Figure 2: Current status of all TSOs implementation activities

The implementation of the above-mentioned legal mandates implies a challenging work programme for transmission system operators (TSOs) and ENTSO-E. Therefore, ENTSO-E considers that implementation of these legal provisions must be the priority. Furthermore, consistency across the legislation (for example, between already adopted NCs and the new CEP) should be ensured.

What is ENTSO-E's role in implementation?

Implementation of European legislation is done on national, regional, and pan-European levels and often in combination of those. 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 some others, legal provisions are not detailed enough and require an additional layer of text to define roles and processes.

Implementation responsibility in Network Codes and Guidelines

Task attributed to…	Responsibility	Approval[1]
ENTSO-E	ENTSO-E tasks	ACER
Pan-European 'All TSOs'	All TSOs	ACER
Regional 'All TSOs'	TSOs of the region	National NRAs of the region. ACER to make the final decision if NRAs cannot agree[2]
National	Depending on national legislation (TSO, DSO…) (ENTSO-E may provide supporting documents and guidance)	National NRAs

Figure 3: Entities responsible for pan-European, regional, and national tasks.

'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').

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

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

Network Codes & Guidelines

A secure, competitive, and low-carbon European electricity sector and the internal energy market require a set of common rules. The European Network Codes are technical rules that complement primary legislation. They define a common basis for all parties with respect to practices and business processes across Europe and thus contribute to the harmonisation, integration, and efficiency of the European electricity market. ENTSO-E as a technical association is entrusted by the EC and through Reg. 943/2019 (the so-called "Electricity Regulation") with the drafting of such codes. The Clean Energy Package for all Europeans has addressed, in primary legislation, some of the elements covered in the Network Codes: e.g. Bidding Zones, Regional Security Coordinators. As a next step for ensuring consistency between the just adopted primary legislation and the existing Network Codes, policy-makers will update (where needed) the related NCs.

The Network Codes & Guidelines are grouped into three families:

- **Market Codes & guidelines** move market integration forward, furthering competition and resource optimisation. They set rules for capacity calculation and allocation, day-ahead and intraday markets, forward markets, and balancing markets.
- **Operational Codes & guidelines** reinforce the reliability of the system through state-of-the-art and harmonised rules for operating the grid. They cover system operation, regional cooperation, and emergency situations.
- **Connection Codes** set the EU-wide conditions for linking all actors safely to the grid, including renewables and smart consumption. They include the technical requirements for generation and demand facilities and high-voltage direct-current (HVDC) connections.

Network Codes & guidelines deliver benefits in terms of sustainability (e.g. connection of solar and wind generation capacity to the EU networks), security of supply (via Regional Security Coordinators, for example), competitiveness, and social welfare (e.g. market coupling).

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

Monitoring implementation

Per legal provisions included in each Network Code and Guideline, ENTSO-E is responsible for implementation monitoring. 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 EU DSO entity on the monitoring of implementation of 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 networks and distribution networks.

European Stakeholder Committees

ACER and ENTSO-E have set up **European Stakeholder Committees,** whose role is to monitor progress in implementation of the Network Codes, inform the decision-making process for the implementation deliverables, and serve as a platform for exchange with stakeholders. The Market Stakeholder Committee, the Grid Connection Stakeholder Committee, and the System Operations Stakeholder Committee will meet regularly throughout 2020. The Balancing Stakeholder Group also meets regularly to discuss the implementation of the Electricity Balancing Guideline.

ENTSO-E provides logistical and organisational support and prepares agendas jointly with ACER. ENTSO-E also maintains, with the support of ACER, the European Commission, and Committee members, the **Issue Logger Tool**, where questions raised by members of the stakeholder committees are gathered and answered in a transparent manner.

Training for the implementation community and beyond

To help improve the understanding of the Network Codes, the stakeholders involved, and the related challenges and solutions, ENTSO-E has inspired a new series of training courses on Network Codes with the Florence School of Regulation. ENTSO-E supports these courses content-wise and financially, with staff and members widely participating in the trainings on the three relevant areas of Network Codes.

The following sections provide the status of implementation and the planned implementation activities in 2020 for the three families of codes: markets, operations, and connection.

Market Codes & Guidelines

Capacity Allocation & Congestion Management Regulation

Establishing harmonised cross-border markets in all timeframes will lead to a more efficient European market and will benefit customers. To this end, capacity calculation for the day-ahead and intraday market timeframes need to be coordinated at the regional level to ensure that they are reliable and that optimal capacity is made available to the market. The rules set by the **Capacity Allocation & Congestion Management Regulation** (CACM) provide the basis for implementation of a single energy market across Europe. The CACM Regulation sets out the methods for allocating capacity in day-ahead and intraday timescales and outlines how capacity[3] will be calculated across the different zones. It introduces the concept of Capacity Calculation Region (CCR), with each region corresponding to a geographical area in which capacity calculation is coordinated among TSOs. It also stipulates the definition of Nominated Electricity Market Operator (NEMO): NEMOs are the entities designated by EU member states to perform tasks related to single day-ahead or single intraday coupling in cooperation with TSOs. According to Article 7 of the CACM Regulation, such tasks include receiving orders from market participants, having overall responsibility for matching and allocating orders in accordance with the single day-ahead and intraday coupling results, publishing prices, and settling and clearing the contracts resulting from trades according to relevant participant agreements and regulations.

Art.	CACM – KEY IMPLEMENTATON ACTIVITIES	Responsible body	2019 S	O	N	D	2020 J	F	M	A	M	J	J	A	S	O	N	D
	PAN-EUROPEAN TASKS																	
55 (1)	XBID implementation of the algorithm methodology by end 2023 following its approval by ACER	All TSOs and all NEMOs																
80	Costs report on Market coupling – yearly report	TSOs and NEMOs																
37 (6)	TSOs and NEMOs review of the effectiveness of the price coupling and continuous trading matching algorithms	All TSOs and all NEMOs																
82(2-3)	Monitoring plan of the implementation of single day-ahead and intraday coupling	ENTSO-E																
10	Day-to-day management of the single day-ahead and intraday coupling – new governance	TSOs and NEMOs																

ENTSO-E/TSOs activity Publication/Deadline Implementation activity

Figure 4: CACM key implementation activities.

After the ACER Decision on the All TSOs proposals for a single methodology for pricing intraday cross-zonal capacity as required by Article 55, TSOs and NEMOs will jointly work on the preparation and implementation of the mechanism. TSOs and NEMOs are also jointly setting up the governance structure for day-ahead and intraday coupling, which is expected to be implemented by Q3 2020. They will meet regularly to discuss and decide on day-to-day operational issues, and ACER and the EC shall be invited as observers.

As mentioned later (p. 15), the Clean Energy Package contains new legal provisions for CACM regarding bidding zone review and allocation of cross-zonal capacity across timeframes[4].

3 'Capacity' refers to the maximum power exchange flow between two zones.

4 Please see Articles 14, 16, 17, and 26 of the new Electricity Regulation.

Implementation monitoring

Per Article 80, all relevant NEMOs and TSOs are required to provide to National Regulatory Authorities (NRAs) a yearly report on the costs of establishing, amending, and operating single day-ahead and intraday coupling. Such a report will be delivered by June 2020. All TSOs and all NEMOs are expected to review the operation of the price coupling algorithm and continuous trading matching algorithm and submit the report to the Agency in August 2020 in compliance with Article 37 (6).

In compliance with Article 82(2) of the CACM Regulation, ENTSO-E has submitted to ACER in mid-August 2019 a monitoring plan of the implementation of single day-ahead and intraday coupling and will work on further improvements to be made based on details and insights of the report compared to previous years.

In addition, ENTSO-E is finalising the development of an IT tool for the purpose of collecting data from TSOs (please see Transparency Platform section). The collected data will be made available to ACER in line with Article 82(4) of the CACM GL. Data collection will start in 2020 and will be done gradually as the relevant methodologies will go live at different times in the regions. The data will be used by ACER to monitor the effects of the network codes.

Forward Capacity Allocation

The FCA Regulation, which entered into force on 17 October 2016, sets out rules regarding the type of long-term transmission rights 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 way across Europe and provide market participants with the ability to hedge their risk associated with cross-border electricity trading.

The FCA Regulation entered its fourth year of implementation in October 2019. In accordance with Article 61, within six months after the approval of the methodology for sharing congestion income, all TSOs shall jointly develop a methodology for sharing costs incurred to ensure firmness and remuneration of long-term transmission rights. Such a methodology will be submitted in January 2020.

Implementation monitoring

In 2019, ENTSO-E delivered to ACER three reports: first, the sixth market report on progress and potential problems with the implementation of single day-ahead coupling (SDAC), single intra-day coupling (SIDC), and long-term (LT) markets in August 2019; second, the second LT capacity calculation and allocation report; and third, the first report on the effectiveness of the operation of the forward capacity allocation and the single allocation platform.

In 2020, we expect the delivery of the seventh market report on progress and potential problems with the implementation of SDAC, SIDC, and LT markets, committing to improve details and insights of the report in comparison to previous years.

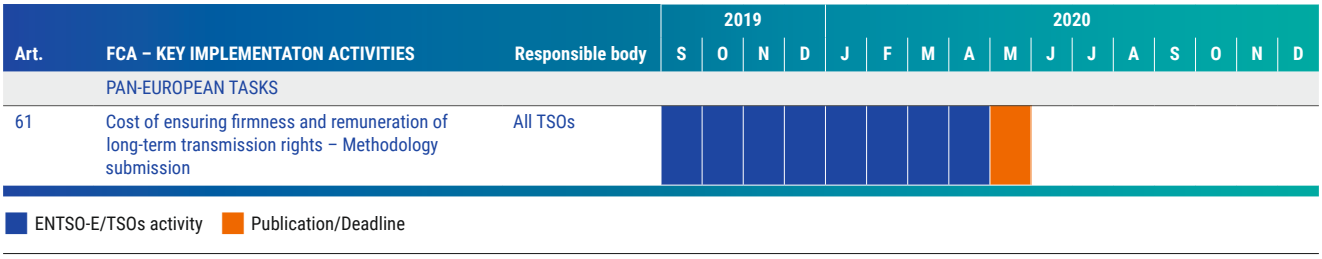

Figure 5: FCA key implementation activities.

Electricity Balancing Guideline

To maintain system security, the tendency – or even imperative – is that markets and operations move closer. Traders have to be fully responsible for their imbalances: this is the only way in which the needed reserves for balancing can be incentivised to bid into all markets, including the balancing one. 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 Guideline (EBGL) – which entered into force on 18 December 2017 – sets a framework for common European rules and European platforms for cross-border balancing markets. The frequency restoration process shown in Figure 6 is organised in the following steps:

1. Frequency containment reserves (FCR)[5], 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 activation via imbalance netting power exchange.

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

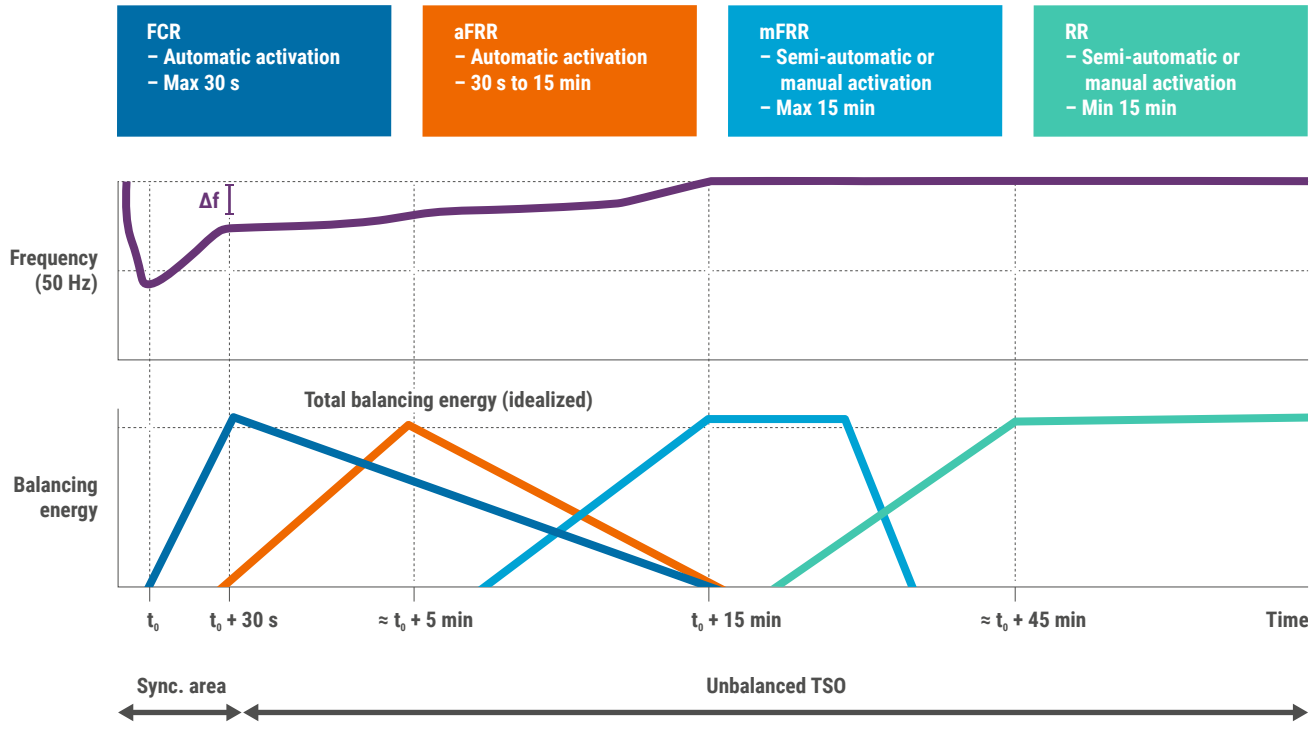

Figure 6: Frequency restoration process.

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

Implementation frameworks (IF)

European platforms for the exchange of balancing energy from frequency restoration reserves with manual activation (Article 20(1) EBGL) and European platforms for the exchange of balancing energy to frequency restoration reserves with automatic activation (Article 21(1) EBGL): All TSOs have submitted proposals for the implementation frameworks (IFs) for European platforms for the exchange of balancing energy from aFRR and mFRR. In the event of NRAs (National Regulatory Authorities) requesting amendments, all TSOs will need to submit a new version in early Q4 2019, to be approved or sent to ACER for decision. TSOs may decide to make a proposal for modification to be drafted during 2020. As provided by the EBGL, 18 months after approval of the aFRR IF and mFRR IF, all TSOs may develop proposals for their modification. The date for completion is dependent on the dates of approval of the implementation frameworks by NRAs.

European platform for the exchange of balancing energy from replacement reserves (Article 19 EBGL): all NRAs approved in mid-January 2019 the proposal for the implementation framework for a European platform for the exchange of balancing energy from replacement reserves. All TSOs performing the reserve replacement process and that have at least one interconnected neighbouring TSO performing the replacement reserves process will implement and make the platform operational by mid-January 2020.

European platform for the imbalance netting process (Article 22(1) EBGL): The proposal for the implementation framework for a European platform for the imbalance netting process ("INIF") was submitted to NRAs in Q1 2019, after NRAs' request for amendments. NRAs may approve the submitted INIF or send it to ACER for decision by end-2019. Activity for 2020 is not yet confirmed, as it depends on NRAs' approval of these proposals.

Activation purposes, pricing, settlement, and imbalance settlement harmonisation proposals

All TSOs have submitted proposals to their respective NRAs for classifying the activation purposes of balancing energy bids (Article 29(3) EBGL), pricing of balancing energy, and cross-zonal capacity used for exchange of balancing energy or for operating the imbalance netting process (Article 30(1) EBGL), TSO-TSO settlement of intended exchanges of energy (Article 50(1) EBGL), and imbalance settlement harmonisation (Article 52(2) EBGL). Moreover, FSkar proposals for intended and unintended exchanges of energy within synchronous areas (Article 50(3) and Article 51(1)) and for intended and unintended exchanges of energy between synchronous areas (Article 50(4) and Article 51(2)) have been submitted to NRAs, who in turn have to either approve or request amendments to the proposal by end-2020. Activity for 2020 is not yet confirmed; in case NRAs request amendments to the submitted proposals, TSOs would need to submit a new version to be approved by NRAs or sent to ACER for decision.

European Balancing Platforms: pilots for the real world

The EBGL foresees the implementation of common European platforms and thereby the harmonisation of the European market balancing processes. As to achieve this goal, European TSOs have established the following implementation projects:

1. International Grid Control Cooperation (IGCC) for the imbalance netting process;
2. Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO) for the aFRR process;
3. Manually Activated Reserves Initiative (MARI) for the mFRR process;
4. Trans-European Restoration Reserves Exchange (TERRE) for the RR process.

TERRE (Article 19(5) EBGL) is expected to finish by end-2019, while IGCC (Article 22(5) EBGL) aims to finalise its implementation during early 2020. PICASSO (Article 20(6) EBGL) and MARI (Article 21(6) EBGL) will continue their implementation activities, keeping end-2021 as a target, in accordance with EBGL request.

ENTSO-E intends to organise a public stakeholder workshop on implementation and operation of the platforms.

Balancing Cost Report

ENTSO-E will submit in 2020 a yearly report on costs of establishing, amending, and operating the European platforms to NRAs, in compliance with Article 23(1) of the EBGL.

Balancing energy and capacity standard products

All TSOs have submitted the definition of standard products for balancing energy as part of the proposals for the implementation frameworks for the European platforms (Article 19, 20 and 21 EBGL). National Regulatory Authorities (NRAs) are expected to approve the standard products for balancing energy in 2019 (approval of the implementation frameworks). In case NRAs cannot reach an agreement, ACER shall adopt a decision during 2020.

All TSOs shall submit the list of standard products for balancing capacity by end-2019 and review such a list every two years, in accordance with EBGL Article 25 (2-3). Should the NRAs request amendments of the list of standard products for balancing capacity, all TSOs shall develop an amended proposal in 2020, and an appropriate public consultation shall be organised.

Balancing capacity cooperation

ENTSO-E will deliver by December 2019 the all-TSO methodology for a co-optimised allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves, in compliance with Article 40(1) of the EBGL. The Balancing Guideline provides the possibility for Capacity Calculation Regions to deliver proposals for a methodology for a market-based allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves (Article 41(1) EBGL) and a proposal for a methodology for the allocation of cross-zonal capacity based on an economic efficiency analysis (Article 42(1) EBGL) by December 2019. NRAs may approve the submitted proposals or send them to ACER for decision by mid-2020. Should the NRAs request amendments, all TSOs shall develop an amended proposal in 2020, and an appropriate public consultation shall be organised.

Cross-zonal capacity calculation

Within five years of the Electricity Balancing Guideline entering into force, all TSOs of a Capacity Calculation Region shall develop a methodology for cross-zonal capacity calculation within the balancing timeframe for the exchange of balancing energy or for operating the imbalance netting process, in compliance with Article 37(3) of the EBGL. In 2020, all TSOs and CCRs will agree on the drafting process of such a methodology.

Implementation monitoring

In accordance with Article 59(1) of the EBGL, ENTSO-E and the four balancing platforms shall publish by June 2020 a European report focusing on monitoring, describing, and analysing the implementation of the regulation, as well as reporting on the progress made toward the integration of balancing markets in Europe. A set of performance indicators as well as the structure of the report should be proposed to ACER prior to the delivery of the report.

System Operations Codes

The System Operation Guideline

The System Operation Guideline (SOGL) sets out harmonised rules on how to ensure security of supply through efficient grid operation in a variable renewables paradigm. Its implementation entails several challenging tasks for TSOs at pan-European, synchronous area, and regional levels[6]. Work at the pan-European level is facilitated by ENTSO-E, while synchronous areas' activities are decided by TSOs in the respective regional groups within ENTSO-E.

Figure 7 shows the implementation activities that will be carried out in 2020:

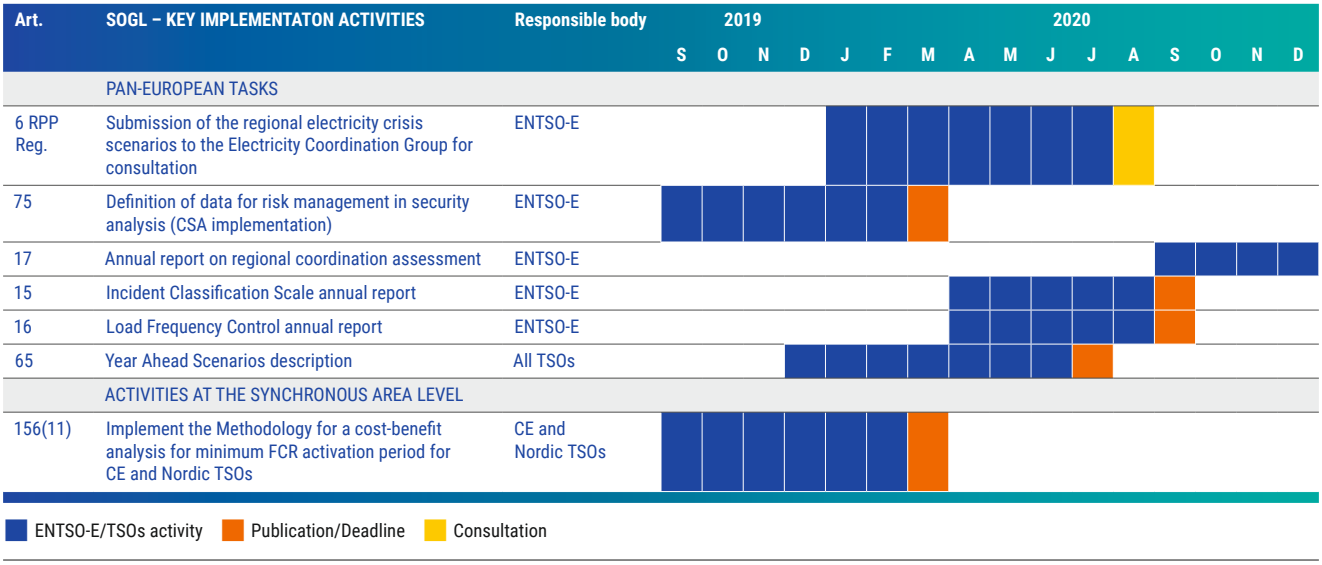

Figure 7: SOGL key implementation activities.

Regional Security Coordination

Neighbouring countries impact on each other's power system. TSO coordination has to increase the efficiency of system operations to minimise risks of wide-area events and to lower costs through maximised availability of transmission capacity to market participants. Regional Security Coordinators (RSCs) ensure the regional coordination services; for example, they provide either a regional model of the grid or advanced calculations to allow TSOs to evaluate which remedial actions[7] are the most cost-efficient. A deeper coordination in operational planning between operators also supports the integration of more renewables into the grid and the reduction of carbon emissions cost-effectively and safely. Coordination between TSOs also creates economies of scale; for instance, TSOs can share the same IT system to perform a certain task.

Regional Operational Security Coordination: all TSOs of each capacity calculation region are jointly developing a proposal for common provisions for regional operational security coordination for the day-ahead, to be applied by the regional security coordinators and the TSOs of the capacity calculation region, pursuant to Article 76 and 78 of the SOGL.

Short Term Adequacy Forecasts (STA, Article 81) and Outage Planning Coordination (OPC, Article 80): Article 81 of the SOGL states that each regional security coordinator shall perform adequacy assessments for at least the week-ahead timeframe on the basis of the information provided by the relevant TSOs with the aim of detecting situations that can experience a lack of adequacy in any of the control areas or at the regional level, considering possible cross-border exchanges and operational security limits. Article 80 provides for outage coordination, for which each TSO shall provide the regional security coordinator with the information necessary to detect and solve regional outage planning incompatibilities. We expect three deliverables to be carried out to implement those provisions in 2020: 1) the OPC year-ahead process (without CGMES) will go live; 2) OPC CGMES will be tested and run in parallel; 3) Cross-regional STA & OPC pan-European tools will go live and be operative.

6 The SOGL sets a number of implementation tasks at the regional – meaning Capacity Calculation Regions – level. These are not the same as the areas covered by Regional Security Coordinators. The tasks rollout by RSCs is a pan-European task, steered by ENTSO-E.

7 In the power sector, "remedial actions" are measures such as ordering a power plant to start or stop operating in order to maintain operational security.

Implementation monitoring

In 2020, ENTSO-E will establish a framework to fulfil such requirements by defining the scope of information and analyses required and the associated level of detail to report, and establishing a framework to answer specific requests coming from ESC SO and/or ACER.

Emergency and Restoration Code

All TSOs submitted to their respective NRAs proposals for rules concerning the suspension and restoration of market activities in December 2018. Depending on the NRAs' approval, ENTSO-E shall draft and submit to ACER by 18 December 2020 a report assessing the current level of harmonisation of the rules for suspension and restoration of market activities established by the TSOs and identifying, as appropriate, areas that require harmonisation.

Art.	FCA – KEY IMPLEMENTATON ACTIVITIES	Responsible body	2019 S	O	N	D	2020 J	F	M	A	M	J	J	A	S	O	N	D
	PAN-EUROPEAN TASKS																	
36 (7)	Reporting on the level of harmonisation of the rules for suspension and restoration of market activities	ENTSO-E																

ENTSO-E/TSOs activity Publication/Deadline

Figure 8: E&R key implementation activities.

Implementation monitoring

In 2020, we will establish the same implementation monitoring pattern as applied in the SOGL implementation monitoring process (see above).

Connection Codes

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 renewable energy resources 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 (MS). Third, to increase competition among equipment providers by harmonising the requirements with which they need to comply in different markets.

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; as well as 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. In 2020, ENTSO-E plans to evaluate existing IGDs with an update if the assessment comes to the conclusion that this update is needed. Stakeholder engagement (especially ACER and EC) is performed through the Grid Connection Code European Stakeholder Committee (GC ESC) and associated expert groups; to keep track of their strategic views, inputs and findings from the expert groups will feed into the reports that will be drafted in 2020.

ENTSO-E will strive to achieve both an alignment of standards and compliance procedures with, and a system perspective and added value through, the CNCs, thus demonstrating transparency, technical competence, and credibility. To improve consistency between CNCs and operational codes and guidelines, cross-committee structures and processes shall be established. Moreover, technical groups will also be established to provide clarification on technical matters.

Implementation monitoring

ENTSO-E monitors the implementation activities in each country via its Active Library, in accordance with the scope of the monitoring activity defined in Article 59 of the NC RfG, Article 57 of the NC DCC, and Article 76 of the NC HVDC. In 2020, ENTSO-E will provide further guidance on the application of CNCs, in particular on compliance test procedures and harmonisation of testing Guidelines. An implementation monitoring report on items requested by ACER will be issued during the year.

Implementing the Clean Energy Package (CEP)

The Clean Energy for all Europeans Package (CEP) entered into force on 4 July 2019[8]. The CEP represents an important and significant update to Europe's electricity market design, TSO cooperation, and ENTSO-E's tasks. It recognises an increased role of TSOs and ENTSO-E. As mentioned in the introduction to this chapter, ENTSO-E and the TSO community believe that, given the many requirements introduced by the CEP, focus and resources should now be devoted to the implementation of existing Network Codes and CEP provisions.

ENTSO-E conducted an impact assessment of the CEP on ENTSO-E resources and budget. The assessment focuses on the key CEP provisions with direct impact on ENTSO-E: these include provisions for regional cooperation (RCCs), for European resource adequacy assessment, for the role of ENTSO-E in the triennial report on structural congestions required in Article 14.2 and in the coordination of the All TSO proposal for the methodology to be used in Bidding Zone reviews, for the capacity mechanisms' registry and foreign capacity participation, and for risk preparedness methodologies and framework. The following other areas are expected to have a tangible impact on ENTSO-E in the future: requirements for TSO-DSO cooperation on new tasks through the future EU DSO entity; requirements for future Network Codes and new NC drafting process; and requirements for enhanced transparency, oversight, and data. Finally, some of the CEP tasks may require the development of new IT tools or the enhancement of existing tools to support new mandates and functions. ENTSO-E plans to set up an implementation monitoring plan.

Provisions for Regional Coordination Centres

Regional security coordination has gained increasing attention with the Clean Energy Package. Originally set up on a voluntary basis and then enshrined in the SOGL, the CEP will add ten more services to the RSCs. As the RSCs are owned by TSOs, the CEP will thus help them deliver their tasks both individually and collectively in a region.

The CEP foresees an enhanced framework for regional cooperation through the establishment of Regional Coordination Centres (RCCs). These should be operational by 1 July 2022 and will replace existing regional security coordinators, adding new tasks for the RCCs[9]. ENTSO-E is assessing options for the new RCC tasks and will recommend the most efficient approach. In 2020, ENTSO-E will adopt a framework for the cooperation and coordination between RCCs (Article 30 Electricity Reg.).

An early project has already been launched to prepare the all-TSO proposal on the definition of the geographical scope of System Operation Regions, to be submitted to ACER by 5 January 2020, in compliance with Article 36. Subsequently, by 5 July 2020, the TSOs of a System Operation Region will submit a proposal for the establishment of Regional Coordination Centres to the concerned regulatory authorities.

In addition, further assessment will look at potentially needed new IT tools, or updates to existing ones, able to support the new RCC tasks at the pan-European level and to fulfil ENTSO-E's obligations to promote cooperation between TSOs at the regional level and ensure interoperability, communication, and monitoring of regional performance.

European resource adequacy assessment

The Clean Energy Package extends the scope of the ENTSO-E Mid-term Adequacy Forecast and develops it further into a new Pan-European Resource Adequacy Assessment. The CEP requirements for the Pan-European Resource Adequacy Assessment include the development of five new methodologies within six to 12 months after entry into force. The future European adequacy assessment will see a major extension of its scope compared to the current Mid-term Adequacy Forecast; it will need to cover new requirements such as yearly granularity for a ten-year horizon, flow-based calculations, generation viability, sensitivities with/without CRM, and sector integration, among others. ENTSO-E has developed a roadmap for the development and step-by-step implementation of the methodologies and requirements for the assessment called the Resource Adequacy Roadmap 2019 – 2023. Resource adequacy studies by 2025 will be of particular importance, taking into account the National Energy and Climate Plans (NECP) objectives and the impact of different national generation "phase out" programs on adequacy and system stability in Continental Europe.

8 While the Electricity Regulation is broadly applicable as of 1 January 2020, some of the Regulation provisions are applicable as of its entry into force, while others will require the delivery of some mandates by specific deadlines. Moreover, the "Directive on common rules for the internal market for electricity" will require the transposition into national law at the member state level.

9 Article 37 of the Electricity Regulation mentions 10 new tasks in addition to the ones provided for by the System Operation Guideline and the Emergency and Restoration Network Code as adopted on the basis of Regulation 714/2009.

The revised Electricity Regulation of the CEP requires ENTSO-E to develop several methodologies related to resource adequacy (Electricity Regulation Chapter IV, Article 23 to 26):

1. Methodology for assessing European resource adequacy, including the definition of Expected Energy Not Served (EENS) and Loss Of Load Expectation (LOLE) (required 6 months after entry into force in CEP text);

2. Methodology for the definition of Cost of New Entry (CONE), Reliability Standards and Value of Lost Load (VoLL) (required 6 months after entry into force in CEP text);

3. Methodology for calculating the maximum entry capacity for cross-border participation in capacity mechanisms (required 12 months after entry into force in CEP text).

Each methodology and resource adequacy report will be subject to public consultation, in accordance with both ENTSO-E's stakeholder engagement vision and the requirements of CEP. To keep alignment and foster transparency in the process, quarterly tripartite web-conferences or meetings at project level will be organised with ACER and DG ENER.

Role of ENTSO-E in the Bidding Zone methodologies, review, and reporting on structural congestions

ENTSO-E's role in virtue of Article 14 (2) of the Electricity Regulation consists of preparing a technical report on structural congestions affecting neighbouring bidding zones (BZs) on a three-year basis. In case the result of the technical report is relevant and member states decide to run a BZ review, this will be conducted by the TSOs in the relevant control area in accordance with Article 14 (7). Additionally, ENTSO-E has coordinated the preparation of the all-TSO proposal for BZ review methodology, assumptions, and configurations.

According to Article 14 (5), relevant TSOs will deliver the BZ methodologies, assumptions, and configurations by 5 October 2019, and relevant NRAs have to take a unanimous decision within three months of the submission of the proposal. If the regulatory authorities are unable to reach a unanimous decision on the proposal within that deadline, ACER will, within an additional three months, decide on the methodology and assumptions and the alternative bidding zone configurations to be considered. The final proposal to maintain or amend the current bidding zone configuration will have to be carried out by relevant TSOs and submitted to the member states or their designated competent authorities no later than 12 months after approval of the methodology and assumptions.

Transparency in Capacity Calculation

Transparency and timely implementation of the above-mentioned Network Codes are seen as paramount for achieving the optimal integration of the European market. In 2018, ENTSO-E investigated the status of data available to market parties in different CCRs and possible new indicators. ENTSO-E also consulted stakeholders on their expectations, which stakeholders described as to understand, beforehand, how capacities are calculated and optimised and, afterwards, what limited the capacity, how the grid was used, and what measures were taken to mitigate contingencies. Several improvement opportunities were identified, and the regions will further work on the implementation of these transparency recommendations with the entry into force of the capacity calculation methodologies provided for by the CACM Regulation.

Moreover, the Clean Energy Package, 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 TSOs and ENTSO-E are jointly working with ACER, national regulators, and the Commission to find a common interpretation and applicability of this article.

Capacity mechanisms' registry and provisions for foreign capacity participation

The CEP grants ENTSO-E new mandates to develop six methodologies, common rules, and tools for the participation of foreign providers in capacity mechanisms. As required by Article 26 of the Electricity Regulation, ENTSO-E shall submit such methodologies by July 2020. A public consultation shall be arranged by March 2020. ENTSO-E is currently investigating the potential need for development of relevant IT tools to support the capacity provider registry.

Risk preparedness framework and methodologies

The CEP sets a new framework for an enhanced and better-coordinated approach to risk preparedness at the regional level, which will be delivered through key methodologies for short-term adequacy assessments and electricity risk crisis scenarios. ENTSO-E must develop the methodologies within six months after entry into force and are expected to present them to ACER by the end of 2019. Following ACER approval in 2020, ENTSO-E has six months to use the methodology to identify the regional electricity risk crisis scenarios so that the member states can develop their risk-preparedness plans. ENTSO-E is already preparing for early implementation of the new requirements. ENTSO-E is further investigating the potential needs and benefits of developing relevant IT tools to deliver related tasks more efficiently and to support both further beneficial RCC coordination and the TSOs in their future tasks related to risk-preparedness plans.

The networks interface: transmission and distribution (TSO-DSO)

ENTSO-E will pursue its activities with the DSOs' associations based on the Memorandum of Understanding signed in 2018 and with the support of a new Steering Group dedicated to the TSO-DSO Interface.

A key area for cooperation is to follow up on last year's report on Active System Management developed by ENTSO-E and the DSOs associations as well as the report on Demand Side Flexibility developed by the Expert Group 3 of the Task Force Smart Grids. These reports describe the high-level principles for the implementation of market mechanisms aimed at procuring flexibility services from distributed energy resources while taking due account of each nation's specific needs. The impact on the Harmonised Role Model and existing Network Codes/Guidelines will be assessed. Concepts will be tested 'on the field' in the frame of Horizon 2020 projects such as Interrface or Coordinet, and findings will be discussed and compared with similar sandboxes in dedicated workshops.

Other initiatives include further coordination on the planning of network infrastructures and development of smart grids. ENTSO-E will kick-off common work with DSOs associations (and with the EU DSO entity, once established) on the building of scenarios for the Ten-Year Network Development Plan (assumptions of generation, demand side response, and storage assets connected at DSOs level), beyond their participation to stakeholders' workshops. Furthermore, the associations might proactively develop and propose to the European Commission and National Regulatory Authorities a set of 'smart grid indicators', in accordance with Article 59(1) of the Electricity Directive.

Methodology for the use of congestion income

In accordance with art. 19(4) of the Electricty Regulation, all TSOs shall submit a methodology for the use of congestion income to ACER by 5 July 2020. ENTSO-E is currently supporting and coordinating the all TSO work and will continue to do so in the first half of 2020. ACER shall decide on the proposed methodology within six months of receiving the proposal.

The Common Grid Model

The **Common Grid Model** (CGM) is the IT architecture that allows for the coordination of power flows in Europe. It finds its legal basis in three of the Network Codes: the SOGL (Art. 64), the CACM Regulation (Art. 17), and the FCA Regulation (Art. 18). The CGM and its data exchange system, the Operational Planning Data Environment (OPDE), are indeed a prerequisite for, among others, coordinated capacity calculation, operational security analysis, outage planning coordination, and adequacy analysis.

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

The CGM is a major project for ENTSO-E. Following a review conducted in early 2019, the CGM Programme Plan was updated to include:

1. Finalisation of an acceleration plan including establishing a clear decision process for Business Requirement Specifications;
2. On-boarding of additional resources to develop detailed Business Requirement Specifications;
3. Strengthening of the CGM Programme management team: e.g. Programme Management Office (PMO).

CGM should go live no later than December 2021.

A key CGM Programme milestone is to commence a Basic CGM Building Process Q3 2019 which aims at achieving a first model merge considering AC flows on a scope expanding to the largest possible interconnected model inside Continental Europe. This model is based on Individual Grid Models delivered by early adopter TSOs and will test the usage of the merged model for at least one existing RSC service. The main objective of this phase to be completed in 2020 is to allow upload and download functionality of Individual Grid Models/ Common Grid Models using central system applications.

Merging of the Electronic Highway and ATOM – The Physical Communications Network (PCN)

Since 1999, 38 TSOs have been physically connected via the Electronic Highway, a meshed router network (separate from the internet) designed for real-time data exchange between TSOs. In parallel, ENTSO-E started developing a data exchange communication network to support the Common Grid Model, called ATOM. ATOM is a pan-European private network based on the TSO-owned backbone network. It allows for the exchange of non-real-time operational and market-operations related data.

In 2017, the decision was taken to merge the Electronic Highway with ATOM. This created one single physical infrastructure for the TSO communication network called Physical Communications Network (PCN) and will support multiple services, including, as a priority, the Operational Planning Data Environment/Common Grid Model.

The PCN roll-out and migration will be phased in five separate batches throughout 2019, 2020, and 2021 to smooth the associated budget impact for ENTSO-E.

The target date for the first effective exchange of real-time data is August 2021 to allow TSOs and RSCs to check their level of compliance with the OPDE and PCN security plan.

2 Develop the Future Power System and Ensure Transparency

Developing infrastructure and resource adequacy

In line with the new mandates set in the Clean Energy Package, ENTSO-E aims to contribute efficiently to the future power system and develop a secure, reliable, environmentally sustainable, and cost-effective transmission system which can facilitate the creation of a well-functioning European electricity market.

Imagine the grid of tomorrow

Scenarios

The starting point of investment decisions are scenarios: it is important to understand what new investments or measures would be the most effective in the future.

Storylines form the basis of the scenarios. They are co-constructed every two years with stakeholders, NRAs, and EU member states through a series of dedicated consultations and workshops, and are developed jointly with the European network of TSOs for gas, ENTSOG. The ENTSOs later use their own data and advanced modelling tools to build the scenarios' outputs by simulating the market and network behaviours of the system. Dedicated cooperation will also be developed with external organisations (including the European Commission, ACER, IRENA, industry associations, and NGOs) to strengthen the input used to build the scenarios.

Although these scenarios have been developed primarily for the TYNDP (see the development cycle in the following section), it is worth mentioning that scenarios can and should be used for studies on all future aspects of the European energy system (internal and external to the ENTSOs).

Before publishing a Scenario Building Report (by March 2020), ENTSO-E will identify pan-European decarbonisation targets. National energy mix and reserves will also be taken into account. Collaboration with ENTSOG on TYNDP 2020 will be ensured at all stages, and ENTSO-E will seek to strengthen the interlinkage as well as highlight the benefits of cooperation between the gas and electricity sectors. Furthermore, ENTSO-E has decided that the scenario building exercise for the next TYNDP and MAF should be based on the National Energy and Climate Plans (NECP). The NECPs are the new framework within which EU member states must plan, in an integrated manner, their climate and energy objectives, targets, policies, and measures and submit them to the European Commission[10]. In this framework, resource adequacy studies by 2025 will play an important role, as they will take into account the impact of the different national generation "phase out" programmes on adequacy and system stability in Continental Europe.

10 According to the governance of the energy union and climate action rules, which entered into force on 24 December 2018, EU countries are required to:
1. Develop integrated national energy and climate plans (NECPs) that cover **the five dimensions of the energy union** for the period 2021 to 2030 (and every subsequent ten-year period thereafter) based on a common template.
2. Submit a draft NECP by 31 December 2018 and be ready to submit the final plans by 31 December 2019 to the European Commission.
3. Report on the progress they make in implementing their NECPs, mostly on a biennial basis.

Data and models

ENTSO-E is supportive of improving transparency of information and decision making within the framework of confidentiality governed by data policy and resource allocation according to the rules of the association. By assessing various scenarios, models are the tools through which we identify development needs in the power grid. The aim is to stay at the forefront of grid planning and power system analysis in Europe by developing up-to-date and forward-looking planning and analysis methodologies and tools in close cooperation with TSOs.

As compared to the previous years, ENTSO-E will implement and apply approved new TYNDP 2018 methodologies in TYNDP 2020 processes and establish standards for market and network modelling processes in all relevant activities (planning, adequacy, investment, dispatch, capacity calculation). In particular, data quality will be improved by introducing multiple climatic year computations, while the Data and Models Working Group will make use of the Pan-European Market Modelling Database 3.0 (PEMMDB) to enhance modelling capability with respect to higher-granularity data.

ENTSO-E will establish a market modelling platform, improve analytical and visualisation techniques, and enhance investment modelling capabilities. New algorithms for scenario building, TYNDP, mid-term adequacy forecasts, and seasonal outlooks will be created. Granularity of models will be enhanced by mapping other network and market databases. Further improvements will be made regarding sector coupling: ENTSO-E aims at building joint power and gas modelling capabilities to screen, assess, and (just in relevant cases) stress the strategic importance of this interlinkage.

The integration of large amounts of renewable energy sources, completion of the internal electricity market, as well as new storage technologies, demand side response, digital revolutions, and evolving energy policies require continuous updates of the input data and assumptions.

Enhanced pan-European consistency is aimed at all datasets, but particularly the following ones:

- Demand modelling
- Generation modelling, including wind and PV
- Storage modelling, especially hydro storage
- Transmission capacity
- Network modelling

ENTSO-E will seek to improve data access for third parties to ensure high credibility and increase stakeholder trust in its work; the guidelines for transparency of data for third parties will provide an easier, clearer, and more transparent access to structure, information, and processes, promoting a better basis for common TSO work, TSOs' own work, and the access of third parties to specific information.

We will also strive to ensure a high quality of regional and pan-European studies through proper consistency of network and market model data by applying the guidelines on network modelling. We aim to increase the consistency of the interlinked gas and electricity TYNDP modelling and outcomes as well as market data input for all products (demand, RES, thermal generation, hydro, etc.). To this end, ENTSO-E will take the following actions in 2020:

1. Enhance Pan-European Market Modelling (PEMMDB) and implement its database framework
2. Conduct a climate change impact assessment of weather data
3. Evaluate the availability of market modelling input data for TYNDP, MAF, Summer Outlook, and Winter Outlook
4. Publish the Pan-European Climate Database (PECD)
5. Launch the web-based comprehensive calendar and dashboard for stakeholders
6. Handle transparency and confidentiality of data according to Data Policy agreed upon within the association.
7. Update the ENTSO-E PowerFacts Europe 2019 Report

Plan the grid of tomorrow

The Ten-Year Network Development Plan covering the 2025, 2030, and 2040 time frames

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).

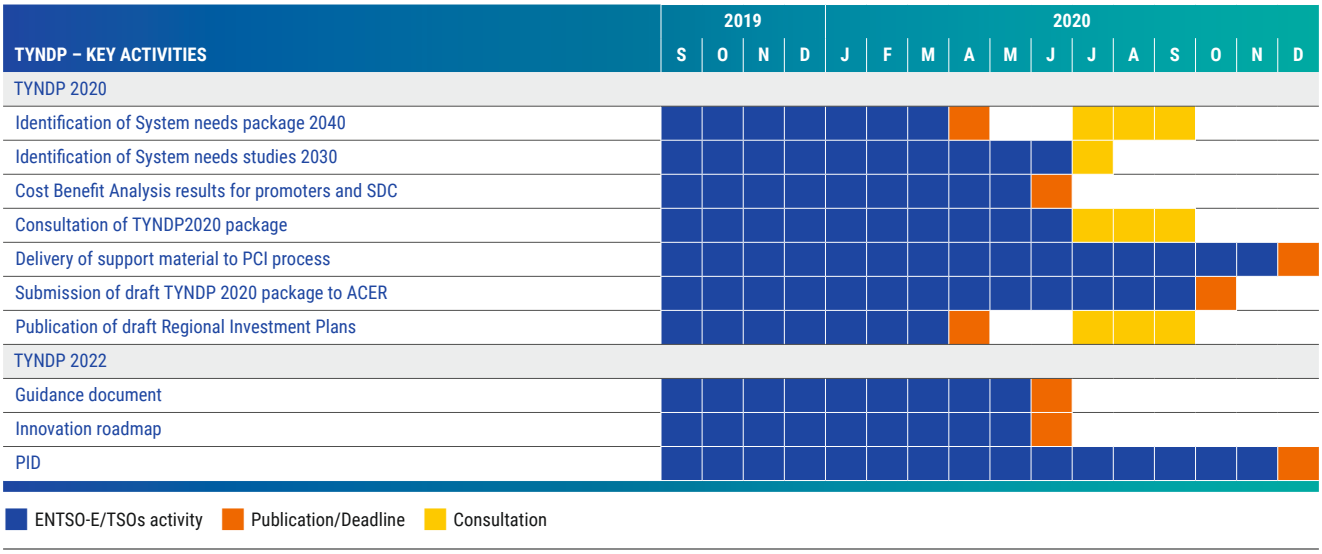

Figure 9: TYNDP key activities.

The TYNDP aims to provide a benchmark for transmission network development (scenarios, system needs, development solutions, and project assessments). Pan-European system development is coordinated and linked with national needs, finding synergies where possible between European, regional, and national studies, and making use of the expertise of the regional and local conditions of TSOs.

Each scenario's impacts on energy markets and networks are analysed with the help of tailored modelling tools (see above). 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 working well and which need to be stronger or supported by alternative solutions or technologies. The main role of TYNDP is thus to identify where investment in the electricity system would help deliver the Energy Union, and by doing so, bring benefit to all Europeans. This is done in two stages: performing a system needs analysis starting 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.

TYNDP 2018 highlights 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 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.

The elaboration of each TYNDP is a two-year process, as described in Figure 10:

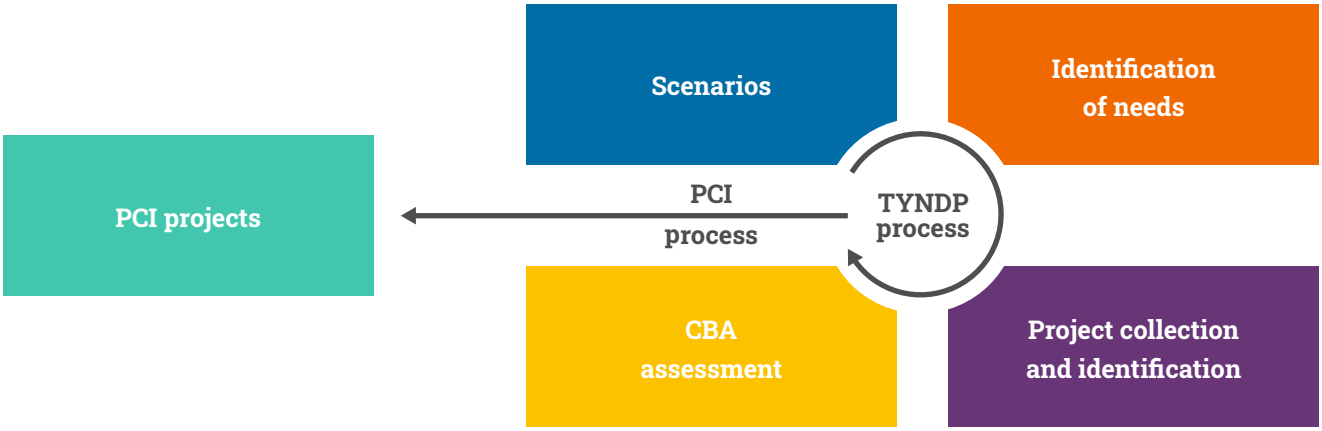

Figure 10: TYNDP process.

In 2020, ENTSO-E will conduct the TYNDP 2020 analysis by focusing on a 2030 needs analysis and also by adopting a cross-sector approach (e.g. gas infrastructure). Several areas of improvements for cost-benefit analysis (CBA) and TYNDP have been identified. There will be experiments on interlinked CBA for relevant projects and an analysis on the impact of a delayed or anticipated energy transition (a "current trends" scenario). All of this will take the national energy mix and available reserves into account.

Stakeholder interaction is of fundamental importance for success of the plan: the TYNDP team will pay special attention to ensuring open and inclusive consultations of stakeholders at key moments of the process, improving the transparency of the inputs and the impact of each report, and updating the stakeholder-oriented reporting concept of the project results with more focused reports (including argumentation on national/regional level). Further improvements will also be made on the TYNDP website, with new user-friendly features highlighting the TYNDP outcomes and the candidate projects.

The cost-benefit analysis methodology (CBA), version 3

The assessment of infrastructure and storage projects performed in the TYNDP uses a cost-benefit analysis (CBA) methodology drafted by ENTSO-E in consultation with stakeholders and in close cooperation with the European Commission. The methodology drafted by ENTSO-E is proposed to the European Commission, which approves the final version. The CBA results are also used as the basis of the PCI selection process as run jointly by the European Commission and the Joint Research Centre (JRC).

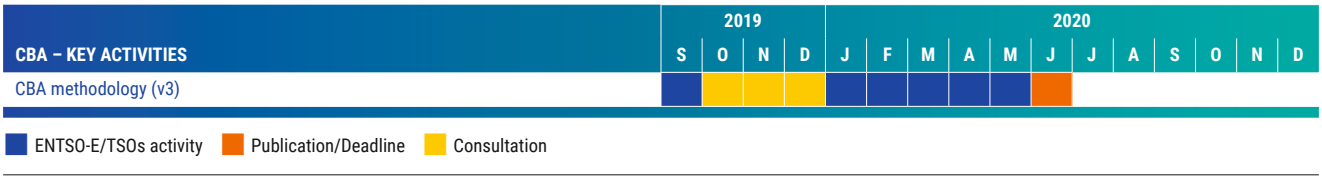

Figure 11: CBA activities.

Sector Coupling and 'Power to X'

To date, the electricity transmission grid and currently available technologies efficiently integrate renewable sources of electricity into the power system. However, highly volatile generation and possible low utilisation rates of renewable energy sources 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 providing enough 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 to develop a common set of scenarios, with the gas sector providing input to the electricity sector and vice-versa. In light of the upcoming Gas Package 2020, ENTSO-E will further highlight the value of sector coupling. We will contribute to the TYNDP 2020 joint CBA experimentation on relevant projects (methodology preparation, analysis, reporting strategy, communication) and develop by March 2020 an internal roadmap for building up expertise and conducting cross-sector analyses.

Assess system adequacy

Increasing levels of variable renewable energy sources in the European power system, as well as rare events with adverse consequences on European power lines, may pose challenges to the security of supply. '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.

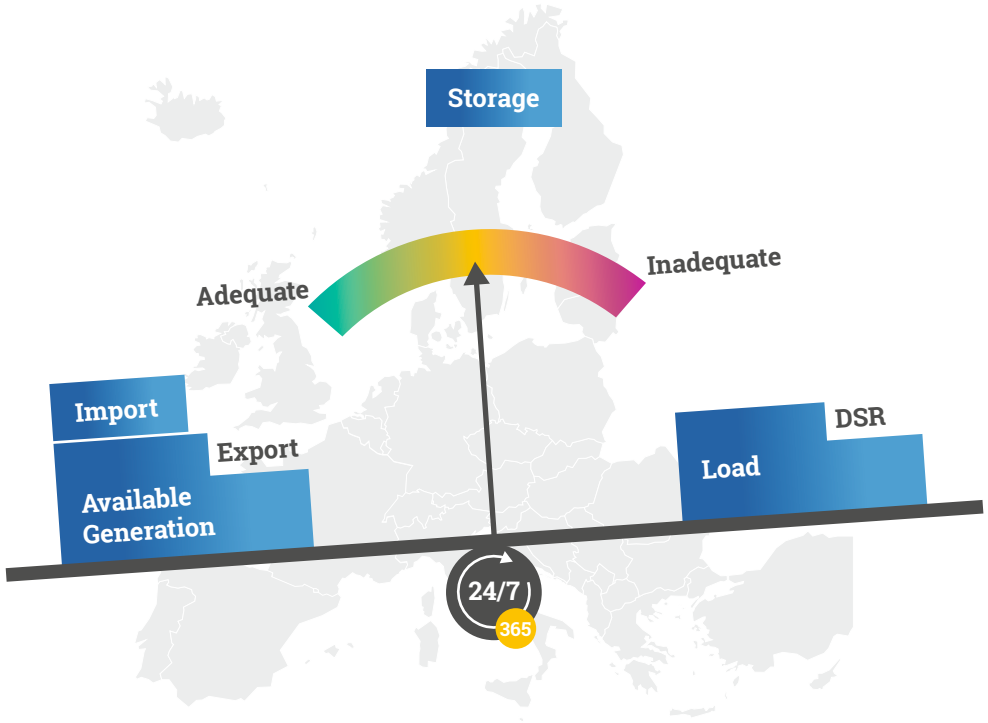

Figure 12: Assessing system adequacy.

Over the past years, ENTSO-E has developed advanced analyses and methodologies to assess resource adequacy; cooperation across Europe in developing such methodologies is necessary to ensure common standards – i.e., a common 'language'. ENTSO-E is now willing to improve such cooperation by establishing a working framework with TSO expert modellers that perform studies on behalf of ENTSO-E.

The Mid-Term Adequacy Forecast and Pan-European Resource Adequacy Assessment

ENTSO-E aims to provide stakeholders with comprehensive support to make qualified investment decisions. Article 8(3) b of Regulation 714/2009 requires ENTSO-E to develop a European generation adequacy outlook every two years. ENTSO-E complied with such a provision by creating the Mid-term Adequacy Forecast (MAF), a yearly[11] pan-European monitoring assessment of power system resource adequacy spanning the timeframe up to ten years in the future. The MAF is based upon a probabilistic analysis conducted using sophisticated market modelling tools, and its methodology has been considerably improved upon since 2016. ENTSO-E relies on the feedback received from stakeholders to identify the needs for improvements. Each edition of the MAF is released for public consultation in the last quarter of the year.

In 2020, given the new legal obligations derived from CEP (in particular Article 23 and Article 30(1) of Reg. 943/2019), ENTSO-E will finalise the implementation of the Resource Adequacy Methodologies and extend the scope of the MAF by establishing the new Pan-European Resource Adequacy Assessment (see p. 16).

The Seasonal Outlooks

ENTSO-E's Winter and Summer Outlooks (Article 30(1)f, Regulation 943/2019) are pan-European, system-wide analyses of risks to the security of the electricity supply. They present TSOs' views on the risks to security of supply and the countermeasures they plan for the coming season, either individually or in cooperation. Analyses are performed twice a year to ensure a comprehensive view regarding the summer and winter, the seasons in which weather conditions can be extreme and strain the system. They are based on a state-of-the-art probabilistic analysis conducted using sophisticated market-modelling tools.

ENTSO-E publishes a Summer Outlook before 1 June and a Winter Outlook before 1 December. Each outlook is accompanied by a review of events for the previous season. The review is based on qualitative information by TSOs that presents the most important events that occurred during the past period and compares them to the forecasts and risks reported in the previous Seasonal Outlook. Important or unusual events or conditions of the power system as well as the remedial actions taken by the TSOs are also mentioned. The Winter outlooks are thus released with Summer reviews and the Summer outlooks with Winter reviews. The outlooks are based on data collected from TSOs and on a common methodology. 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.

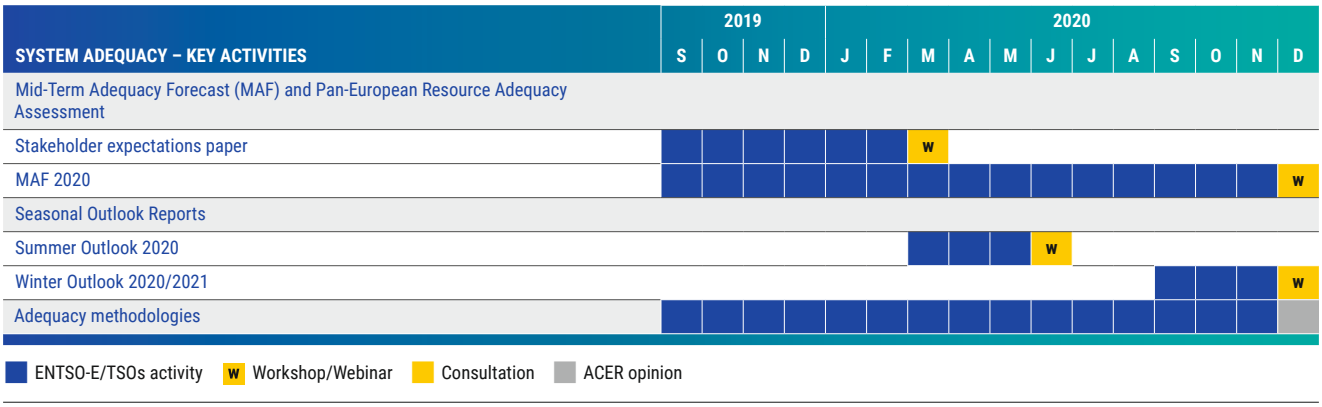

Figure 13: System adequacy key activities.

11 ENTSO-E goes beyond the legal requirements to provide operators with more up-to-date information.

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 is committed to implementing regional tasks. In that sense, strengthening and intensifying coordination of TSOs, CCRs and all RSCs to discuss strategic topics will be expedited. These strategic topics include the development of a common vision by CCRs and RSCs. ENTSO-E is also following the submission of the regional legal mandates, facilitating legal consultations and providing, through the Regional Implementation Project, a forum for CCRs and RSCs to discuss their methodologies, exchange best practices, and work on the next steps.

Key pillars for enhanced TSO regional coordination by 2030

- TSOs act locally, coordinate regionally – within and across regions – and collectively think European. TSOs coordinate for the benefit of society at large.
- The evolution of regional TSOs' coordination should be pragmatic and follow an evolutionary approach, taking stock of lessons learned to resolve new challenges.
- Strengthening the link between system and market operation is core for a secure, sustainable and cost-effective electricity supply in Europe.
- The Regional Coordination Centres (RCC) are to continue and build upon the positive structures and services of RSCs to TSOs. In accordance with the Clean Energy Package (CEP), RCCs should address the capacity calculation regions (CCRs) and appropriately accommodate the future concept of System Operation Regions (SORs)[12].
- Coordination services should grow in a flexible, modular and organic manner, addressing the needs in running CCRs and SORs and possibly going beyond legal requirements.
- TSOs' regional coordination needs a suitable legislative and regulatory framework as well as the adequate time to deliver the legally mandated tasks. Furthermore, Regional Energy Forums would support the evolution of TSOs' coordination by providing the necessary policy alignment and perspective.
- TSOs' coordination will support a „European pathway" to maximize social welfare in partnership with DSOs and relying on close cooperation of all Member States, NRAs, EC, ACER, and other relevant stakeholders.

It is important to note that implementation of the capacity calculation, countertrading, and redispatching methodologies, as well as shortened to 15 min market time units in day-ahead, intraday, balancing markets, and as imbalance settlement period will be major steps in the CCRs in the coming years, and further developments of the CCRs should be based on experiences gained with the implemented methodologies (Figure 14).

12 System operation regions of CEP of tomorrow will be defined by ENTSOE, ensuring consistency of requirements in Guidelines and effective implementation of CEP requirements.

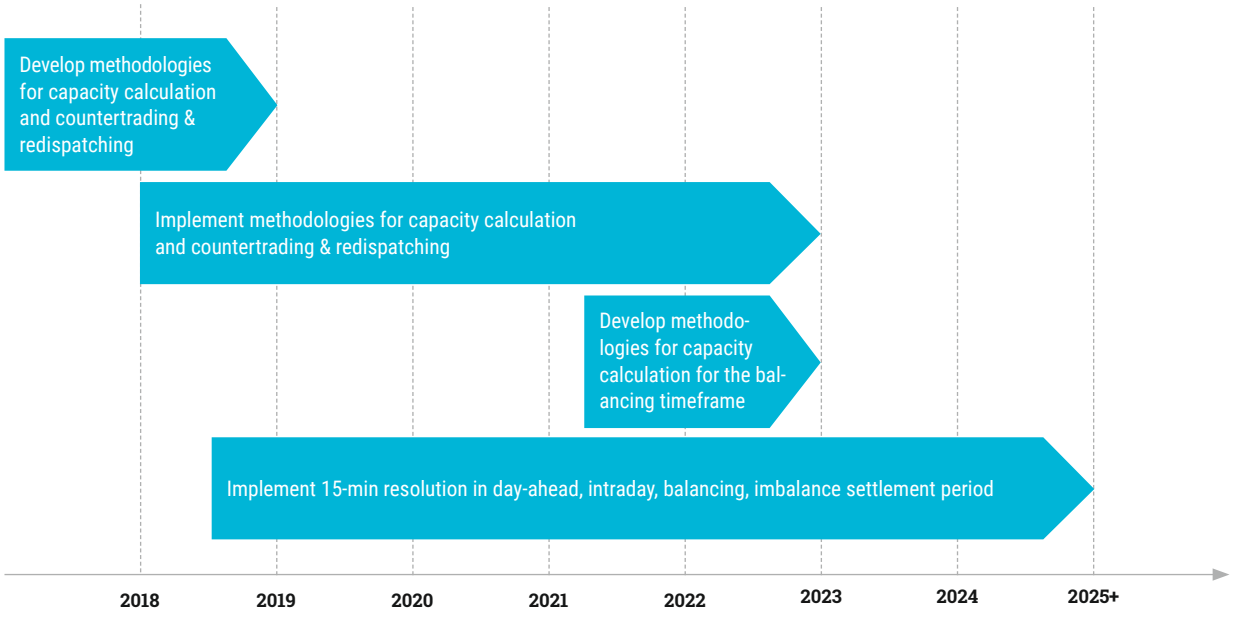

Figure 14: Indicative timeline for major change implementation in CCRs.

RCCs will evolve from RSCs as required by the CEP. The five standard operational services[13] and the service for organizational support[14] will be transferred from RSCs to RCCs in the next decade. The services that TSOs identify themselves as in need of regional coordination – for example for the management of critical grid situations – and the additional tasks identified in the CEP will become part of the RCCs portfolio, while some of the identified tasks in CEP will only become RCC task if delegated by TSOs. This portfolio should remain flexible, allowing TSOs to adapt to regional needs and to go beyond legal requirements if needed.

A view on evolution of regional coordination services from the current perspective is shown in Figure 15.

13 Common grid model, coordinated operational planning security analysis, outage planning coordination, short-medium term adequacy forecast (all pursuant to SO GL) and capacity calculation (pursuant to CACM)

14 Consistency check of TSOs system defence and restoration plans pursuant to NC ER

Roadmap for evolution from RSCs towards RCCs

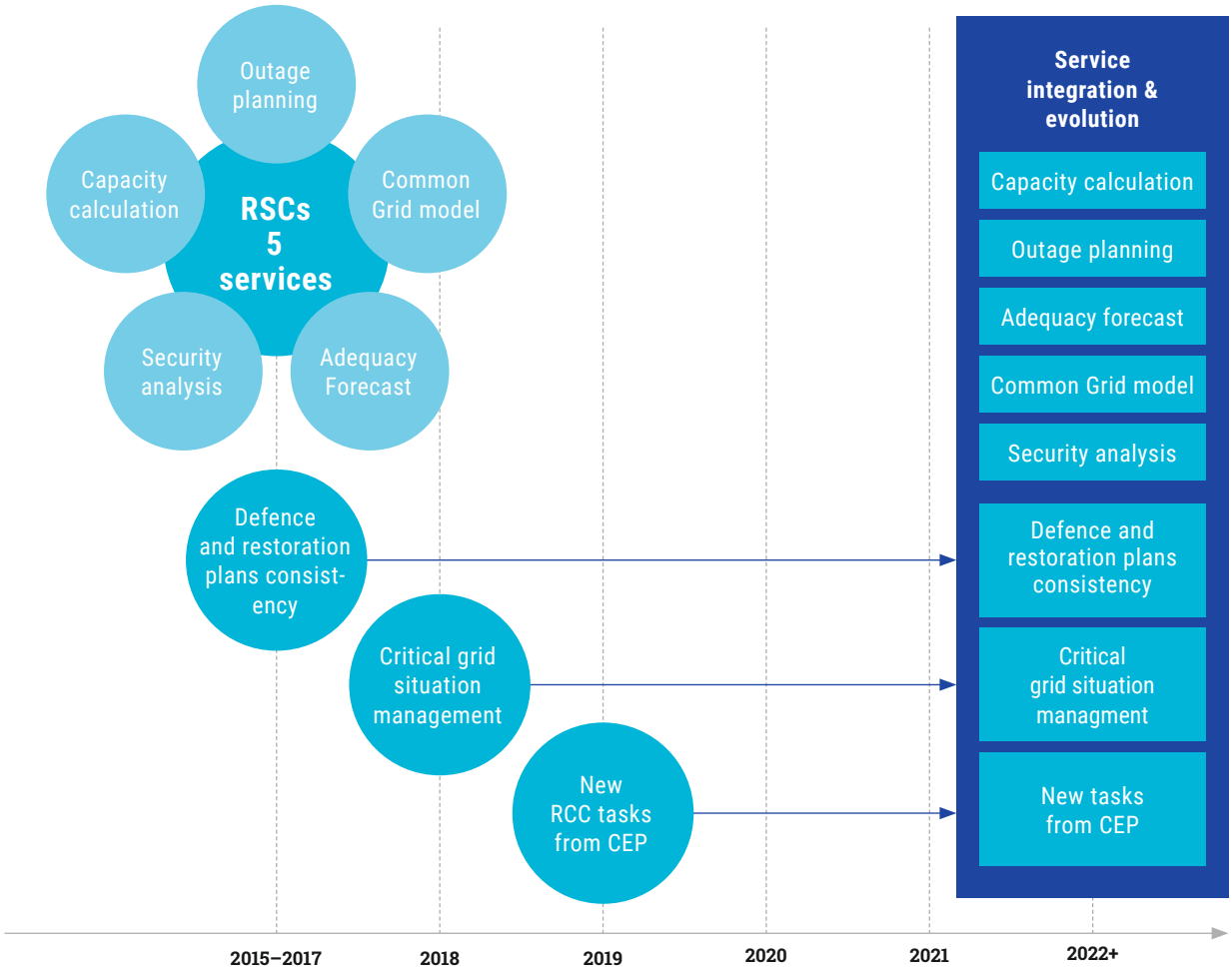

Figure 15: Evolution in regional coordinated services[15]

The future of regional TSO coordination and focus of the RCCs in the next years will be strongly driven by the integration of costly remedial actions in complex capacity calculation methodologies when needed – RCCs will integrate remedial actions (including countertrade and redispatch) into the capacity calculation process; this will result in an increased complexity in the calculation process, which will rely on the data provided by TSOs, as ultimately responsible for a secure, reliable, and efficient electricity system. In this process, TSOs and RCCs are committed and bound for the highest transparency.

Driven by the increased variability of the encountered situations in intraday, a key focus also will be to develop advanced regional coordinated security analyses to ensure security of the system while minimizing, at regional and cross-regional levels, the use of costly remedial actions, for the benefit of all system users.

In addition, a key governance concept for regional coordination will be Regional Energy Fora (REF), aiming to ensuring regulatory and institutional alignment and agreement on aspects very relevant for coordination.

Starting with 2020, prerequisites for the post-2030 period include fully fledged RCCs, a fully implemented CEP and profound preconsiderations for new markets models, and a corresponding deep-reaching view for a new way to operate the power system.

15 Timeline refers to entry into force and implementation of relevant network codes, all TSOs decisions and CEP regulation.

Data and transparency

TSOs, as regulated monopolies working for society at large, are bound to implement and be committed to high transparency standards. This means making the highest quality information available, and remaining in constant engagement with stakeholders, regulators, and the general public.

ENTSO-E collects TSOs' data via its Transparency Platform (in line with the legal requirements of Regulation 543/2013) and a number of yearly publications, including the Statistical Factsheet (Q2), the Overview of Transmission Tariffs in Europe (Q2), and PowerFacts Europe (Q1). Network datasets are also made available upon request (see **Online Application Portal for Network Datasets**).

Transparency Platform

Transparency of fundamental information is essential to foster the Internal Electricity Market (IEM). It is also crucial for creating a level playing field between market participants and avoiding the abuse of market power.

ENTSO-E's **Transparency Platform** (Article 3, Regulation 543/2013) centralises data relating to the generation, transportation, and consumption of electricity at the European level. Its functioning is regulated by the Manual of Procedures, developed by ENTSO-E following the discussions with stakeholders, a public consultation, and review by ACER. The data is collected from data providers, including TSOs and other qualified third parties. Depending on the users' needs, this data can serve various purposes, such as market analysis, research, or trading. The platform is also instrumental in 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.

ENTSO-E members entered into a Memorandum of Understanding (MoU) setting the requirements for the quality of data provided by TSOs and for the checks by ENTSO-E of these requirements.

In 2020, the Transparency Platform (TP) will help implement the deliverables included in Figure 16:

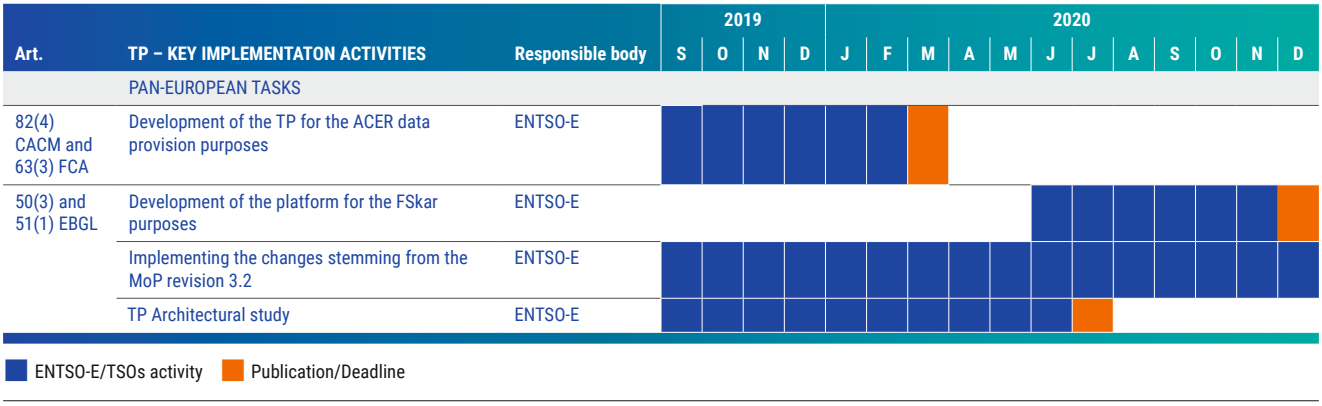

Figure 16: TP key implementation activities.

Title 11 of the SO GL and Article 12(3) of the EB GL mandate ENTSO-E to publish the information in relation to the balancing and system operational activities on the Transparency Platform (TP). To meet the new data requirements stemming from these Guidelines, ENTSO-E will ensure that data flows from local IT TSO systems to TP is smooth and uninterrupted.

Once the European balancing platforms (i.e., TERRE, MARI, and PICASSO) enter into operation, it is foreseen that a part of the balancing data will be populated to the TP directly by these platforms.

In the context of the amendments to the Manual of Procedures v3r2, a snapshot of the most recent values of the offered capacity for explicit and implicit allocations will be published every 15 minutes on the TP. The full evolution of the offered capacity will also be made available. Furthermore, the critical network elements (CNECs) will be de-anonymized, and additional parameters relevant to flow-based allocations will be published. In 2020, ENTSO-E is expected to follow up on outcomes of the public consultation conducted by ACER on inside information platform and inside information related thresholds. With the entry into force of the CEP, Article 26 of the Electricity Regulation mandates ENTSO-E to set up a registry in relation to cross-border participation in capacity mechanism.

Data exchange standards: ensuring Pan-European interoperability

Standards facilitate cross-border exchange and allow for efficient and reliable identification of different objects and parties relating to the internal energy market and its operations. Standards support the implementation of Network Codes in various ways, and several of ENTSO-E's IT tools and data environment, such as the Operational Planning Data Environment (OPDE), rely on standards.

ENTSO-E maintains the Electronic Data Interchange library and Common Grid Model Exchange Standard (CGMES) library, which gather documents and definitions for the harmonisation and implementation of standardised electronic data interchanges between actors in the electrical industry in Europe.

Main standardisation activities in 2020 will include the following:

1. Development of the Common Information Model (CIM) and implementation guides to support data exchanges required from the Network Codes. This will include support to the Common Grid Model (SOGL, CACM), coordinating operational security analysis (SOGL), balancing platforms (EBGL), and capacity calculation (SOGL, CACM).

2. Development of the CIM and implementation guides to support the data exchange required for the TYNDP and for the Pan-European Market Model process.

3. Continue the ongoing work on the international standards IEC (International Electrotechnical Commission) 62325 series (CIM for Market), including developing the Unified Modelling Language (UML) model for the European market profile, defining the core components needed, and generating the relevant documentation for IEC standards including the balancing data exchange standard, standard of the communication tool (proposed Technical Specification IEC 62325-505), HVDC scheduling, capacity calculation, and outage planning standards.

4. Update the Common Grid Model Exchange Standard (CGMES) and conformity assessment scheme to meet the latest requirements from CGM Programme and RSC services and propose evolution to the CIM to IEC to cover European needs in terms of grid model standardisation.

5. Maintain the harmonised role model for the European electricity market to ensure a common vocabulary and views on the different roles and extract a European electricity market role model based on the Network Codes and Guidelines.

6. Support future data exchange requirements between TSOs and DSOs and the new tasks from the Clean Energy Package including those related to the capacity mechanism registry. An assessment of the Clean Energy Package in terms of standardisation needed from ENTSO-E should also be done.

7. Continue training activity in data exchange standardisation to the TSO-RSC community.

Ramping up on Transparency and Communication

In 2020, ENTSO-E will continue to develop activities to increase transparency and communication to stakeholders, as set in the strategic priorities. This will translate into the following actions:

1. **Transparency activities:** Building on previous work in 2019, we will ensure a continuous effort to increase the volume and quality of the data released under an open data licence on the Transparency Platform.

2. **Powerfacts Europe:** This publication launched in 2019 will be issued twice a year (in June and December) and will include more data sets relating to the effect of the green transition on the power system looking back at the previous three years.

3. **Events:** ENTSO-E will continue working with E.DSO on Innogrid as the annual event in Brussels where power grid innovation projects supported by European funds are showcased. ENTSO-E will also co-organise another conference on regional coordination in cooperation with one of the five Regional Security Coordinators (to become Regional Coordination Centres).

4. **Independent Advisory Council:** Set up in 2016, it gives opinions on ENTSO-E's work programme and deliverables (its minutes and recommendations to ENTSO-E are available here), with a view toward serving society at large. It is composed of 15 representatives of important institutional and business stakeholders of ENTSO-E: BEUC, EFET, DSOs associations, RES associations as full members, as well as the European Commission, the European Parliament, and ACER as observer members. Members are appointed for a period of two years, and their mandate can be renewed once. In 2020, several stakeholder interactions will take place through the Advisory Council, and stakeholders will continue to provide opinions on ENTSO-E's Work Programme and strategic deliverables.

Research and Development activities

The TSO community, collaborating within ENTSO-E, is putting a strong emphasis on Research, Development and Innovation (RDI). The Transmission and Distribution Interface is also of prime importance. The following section presents the TSO-DSO work, as well, in line with Regulation (EC) 943/2019, the Research and Innovation activities workplan.

The European grid, built for the needs of a different paradigm, must be adapted to the arising power system, characterised by high and increasingly variable RES shares, related increasing need for flexibility, and the use of digital technologies. Innovative solutions on the physical side, such as dynamic line rating, and on the increasing use and availability of digital technologies for optimisation of the grid are to be applied. The power system will see new players emerge, such as aggregators, and the customers moving centre stage.

ENTSO-E's R&D activities, as legally mandated by Regulation (EC) No 943/2019 and Directive 2009/72/EC, involve promoting and coordinating research, development, and innovation activities of TSOs. ENTSO-E promotes and coordinates TSOs' innovation activities in various areas: assets and technologies, security and operations of tomorrow, flexibility and markets, future of energy systems, and digital and communication systems. Emphasis is currently put on flexibility (including demand-side response, storage, etc.) and end-to-end digitisation to integrate different technologies and enable new market places and services, with a focus on maximising social welfare through a customer-centric approach.

ENTSO-E RDI plans outline a methodology to achieve EU objectives and lay groundwork for the upcoming electricity highways, smart grids, and the change to a low-carbon electricity system.

ENTSO-E will produce in 2020 the RDI Roadmap 2020 – 2030, reflecting the TSOs research and innovation needs for the decade to come. The Roadmap will consider major trends stemming from political framework and technological developments as well as the needs of the business units of TSOs in terms of operations, market, and infrastructure deployment. It will illustrate how necessary these projects are in realising Europe's climate and energy policy targets and how they support other TSO tasks related to EU Network Codes and ten-year network development plans.

The Roadmap will make use of the gap analysis with the already covered activities made available in ENTSO-E R&I Monitoring Report 2018 edition. Most RDI projects have been developed in assets and system operation; alternatively, more projects need to focus on digital applications, accessing distributed flexibility, and developing the power system of tomorrow with more power electronics and AC/DC hybrid systems as well.

The TSOs' RDI activities in the period of 2020 – 2030 will continue to be focused on assets and technologies, security and operation of tomorrow, flexibility and markets, future of energy system, and digital and communication fields.

Other RDI activities will include an overview of hardware, software, and digital technologies and applications by TSOs presented in Technology Fact Sheets and support the compliance with European environmental regulations on greenhouse gas emissions. The use of satellite technologies for TSOs will be investigated also in collaboration with the European Space Agency, and the interoperability and reliability of the HVDC systems will be the focus of exchange with technology providers.

Increasing need for flexibility will be managed by developing a flexibility framework for TSOs and mapping existing pilots. New ways of engaging TSOs in innovations by using digital technologies will be tested. Furthermore, the major issues which are key priorities and key uncertainties for TSOs are developed in cooperation with the World Energy Council.

The timeline of these activities is presented in Figure 17:

No.	RDI - KEY ACTIVITIES	Responsible body	2019 S	O	N	D	2020 J	F	M	A	M	J	J	A	S	O	N	D
	PAN-EUROPEAN TASKS																	
1	ENTSO-E R&I Roadmap																	
2	Technology factsheets																	
3	Position paper on Sulfur hexafluoride gases																	
4	Interoperability and the reliability of the HVDC systems																	
5	Flexibility framework and mapping of the pilot projects																	
6	Digital Hackathon																	

ENTSO-E/TSOs activity Publication/Deadline

Figure 17: RDI key activities.

All the RDI activities described above will be based on ENTSO-E Cross Committee work.

ENTSO-E will develop its 2030/2050 Vision in line with the targets set in the Energy Roadmap 2050 of the European Commission and the Energy Union strategy to decarbonise the European economy. ENTSO-E remains committed to a low-carbon, secure, reliable, resilient, accessible, cost-efficient, and market-based pan-European integrated energy system supplying the whole economy and paving the way for a fully CO2-neutral and circular economy by the year 2050.

Research and innovation is an added value to ENTSO-E business: ENTSO-E Committees will contribute to the Vision 2030/2050 by identifying innovation needs related to their specific field.

ENTSO-E will advocate for the dissemination and sharing of best practices of RDI through its Business Network for Innovation, launched in Q4 2018, where innovative business players, start-ups, and thought leaders from academia and industry are invited to exchange their views on specific topics related to the European energy transition. In addition, ENTSO-E organises, jointly with E.DSO, the yearly InnoGrid2020+ conference where innovative TSO and DSO projects are showcased.

ENTSO-E strongly supports the **Mission Innovation** claim 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 **Ten Innovation Actions** and **Six Recommendations for a COP21-Compliant Grid**.

ENTSO-E will also strengthen cooperation with policy makers and stakeholders in research and innovation. 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 2020, ENTSO-E will continue to facilitate proposals for the Horizon2020 call and to foster TSO participation. ENTSO-E is involved in the following projects:

1. **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.

2. **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).

3. **INTERRFACE,** which gathers TSOs, DSOs, aggregators, and IT providers in the conception of a digital solution to support new flexibility markets. Participating TSOs are Elering, AST, Fingrid, ESO, Transelectrica, Eles, and REN.

Acronyms

Acronym	Definition
ACER	Agency for the Cooperation of Energy Regulators
aFRR	Automatic Frequency Restoration Reserves
aFRRIF	Automatic Frequency Restoration Reserves Implementation Framework
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
CGM	Common Grid Model
CGMES	Common Grid Model Exchange Standard
CIM	Common Information Model
CSA	Coordinated Security Analysis
DCC	Demand Connection Code
DSO	Distribution System Operator
EB	Electricity Balancing
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
HVDC	High-Voltage Direct-Current
ICS	Incident Classification Scale
IEC	International Electrotechnical Commission
IEM	Internal Electricity Market
MAF	Mid-term Adequacy Forecast
mFRR	Manual Frequency Restoration Reserves
mFRRIF	Manual Frequency Restoration Reserves Implementation Framework
MoU	Memorandum of Understanding
NECP	National Energy and Climate Plan
NEMO	Nominated Electricity Market Operator
NRA	National Regulatory Authority
OPDE	Operational Planning Data Environment
PCI	Project of Common Interest
PECD	Pan-European Climate Database
PEMMD	Pan-European Market Modelling Database
PSA	Programme Support Action
RDI	Research, Development, and Innovation
RES	Renewable Energy Sources
RfG	Requirements for Generators
RR	Replacement Reserves
RSC	Regional Security Coordinator
SOGL	System Operation Guideline
TSO	Transmission System Operator
TYNDP	Ten-Year Network Development Plan
UML	Unified Modelling Language
XBID	Cross-Border Intraday

External relations

ENTSO-E also has relations with TSOs that are not members of the Association. Ukrenergo and Moldelectrica are implementing a catalogue of measures (including a series of technical requirements) that will enable the future interconnection with Continental Europe TSOs. TEIAS is part of ENTSO-E as an observer member. Moreover, Georgian State Electrosystem, Ukrenergo, and Southern African Power Pool are part of the ENTSO-E global training programme “Cooperation Beyond Membership”, in which ENTSO-E shares best practices and underlines the role of TSOs in enabling the energy transition in Europe.

Resources

This work programme was developed in coordination with the ENTSO-E’s budget for 2020. The need of budgetary stability together with a sound management of the Association’s resources may lead to updates to this programme necessary to create alignment with the budget.

European Network of
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