

ACER Decision on the FNA methodology: Annex I

**Type and format of data and the methodology for
TSOs' and DSOs' flexibility needs analysis**

in accordance with Article 19e(4) of Regulation (EU) 2019/943

25 July 2025

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Whereas

1. Article 19e(1) of Regulation (EU) 2019/943 ('Electricity Regulation') mandates that the regulatory authority or another authority or entity designated by a Member State ('designated authority or entity') shall adopt a report on the estimated flexibility needs for a period of at least the next 5 to 10 years at national level ('FNA report'). The FNA reports will support the Member States in setting their indicative national objectives for non-fossil flexibility according to Article 19f of the Electricity Regulation, and must be based on the data and flexibility needs analyses provided by the transmission system operators ('TSOs') and distribution system operators ('DSOs').
2. This document is referred to as the flexibility needs assessment methodology ('FNA methodology'). It defines the data type and format, as well as the methodology for the analysis to be conducted by TSOs and DSOs for the preparation of the FNA reports. The aim is to create a standardised framework that ensures consistency and compatibility of inputs to the FNA reports across all Member States.
3. As stated in the Electricity Regulation, the FNA reports are necessary in view of the need to cost-effectively achieve security and reliability of supply and decarbonise the electricity system. These considerations encompass the integration of variable renewable energy sources ('RES') and the different sectors, as well as the interconnected nature of the electricity market, including interconnection targets and potential availability of cross-border flexibility. To ensure that the FNA reports effectively fulfil their intended purpose, the FNA methodology has been developed with these objectives in mind and should be applied accordingly.
4. Considering the above, the FNA methodology takes into account the reliability standard, where it is set by the Member State under Article 25 of the Electricity Regulation, which indicates the necessary level of security of supply. It also takes into account the binding overall Union renewable energy target set in Directive (EU) 2018/2001 and the national contributions to meet this target, set as part of their integrated National Energy and Climate Plans ('NECP'). The FNA methodology also aligns with the overarching principles and objectives outlined in the Electricity Regulation and Directive (EU) 2019/944 ('Electricity Directive').
5. The FNA methodology also ensures the FNA reports will be consistent with the European resource adequacy assessment ('ERAA') and the national resource adequacy assessments ('NRAAs') carried out under Articles 23 and 24 of the Electricity Regulation. Consequently, the FNA methodology addresses flexibility needs in a manner that is consistent with these assessments while ensuring that there is no overlap.
6. To ensure cost-effectiveness, the FNA methodology uses the economic viability assessment ('EVA') conducted as part of ERAA or NRAA based on the ERAA methodology.
7. This methodology distinguishes between two main types of flexibility needs: network flexibility needs and system flexibility needs. Network flexibility needs are assessed at DSO and TSO level. They reflect the flexibility needed to adjust for grid availability, by means of preventing or solving congestion or voltage issues. System flexibility needs are described by three indicators: RES integration, ramping and short-term. They reflect the flexibility needed to adjust to the variability of generation and consumption. Flexibility needs are categorised as upward needs when more injection into or less demand from the network is required, and as downward needs when less injection or more demand is required.
8. This methodology also distinguishes between covered and uncovered flexibility needs. The former refer to the portion of the flexibility needs that are expected to be met by the available sources of flexibility, in accordance with Article 19e(4)(b)(i) and (ii) of the Electricity Regulation. The latter refer to the flexibility needs that are not expected to be met by the existing flexible resources or resources expected to be deployed in the system, e.g. new resources identified by the EVA.

9. According to Article 32(3) of the Electricity Directive, the DSOs' distribution network development plans ('DNDPs') shall include the flexibility resources that the DSOs are to use as an alternative to system expansion. Therefore, this flexibility is, in principle, expected to be available to the DSOs. In the context of the nomenclature adopted by the FNA methodology, the flexibility identified in the DNDPs is considered covered, i.e. expected to be available to DSOs for the target years considered.
10. The indicator of the RES integration needs represents the amount of flexibility needed to reduce the curtailment of renewables in order to achieve the renewable targets set in the NECPs. RES generation curtailment typically happens during low demand and high renewable generation conditions when the RES surplus is not stored, shifted or exported by available energy storage, demand response, other non-fossil flexibility resources or transmission capacity.
11. The indicator of the ramping needs represents the amount of flexibility needed to cover the expected variation of the residual load (demand minus RES generation), taking into consideration the technical constraints of available flexible generation units. This analysis complements ERAA or NRAA studies which may not account for capabilities that are less relevant for adequacy studies, e.g. start-up or shut-down constraints.
12. The indicator of the short-term flexibility needs represents the amount of flexibility needed to cover unexpected variations in demand, RES generation (forecast errors) or unexpected outage of generation or transmission assets (forced outages). This analysis complements 'hourly resolution' and 'perfect forecasts' assumptions followed in the ERAA and NRAA, and covers market flexibility and TSO balancing from day-ahead to real-time.
13. As short-term flexibility needs aim to address all forecast errors and forced outages in the system, part of the short-term needs will be covered by the frequency restoration reserve ('FRR') capacity pursuant to Article 157 of Commission Regulation (EU) 2017/1485.
14. In case of processing of ERAA or NRAA economic dispatch results, downward ramping needs and short-term flexibility needs - leading to RES curtailment - are calculated first and then added to the RES curtailment time series used to calculate the RES integration needs, in order to avoid overlaps and double counting between these indicators.
15. Network flexibility needs are locally- and time-specific, because congestion occurs where and when the forecasted current exceeds operational limits on a given grid asset. Network flexibility needs depend on the local injection and demand patterns, on the local kinematics of connection applications or changes in injection consumption patterns, as well as on grid topology and configuration.
16. Congestion issues may address network situations beyond 'congestion' as defined in the Electricity Regulation or 'physical congestion' as defined in Commission Regulation (EU) 2015/1222 establishing a guideline on capacity allocation and congestion management. The FNA methodology defines 'congestion issue' as a situation in which the electric current flow exceeds operational limits that are not solely security limits on assets on the network. These operational limits may also be related to additional thresholds, such as contractual agreements between system operators on the use of the network capacity at the connection point between systems operators' networks, limited ranges for importing or exporting active or reactive power between system operators, or limited flows due to aging equipment.
17. TSOs' and DSOs' network flexibility needs include both upward and downward local needs associated with network constraints. These needs are not observable within the economic dispatch results of ERAA or NRAA, which rely on the simplified network model with limited number of critical network elements with contingency. Hence, to avoid any underestimation of total flexibility needs, a fine-tuning of system needs is necessary. This fine-tuning would take into account local network constraints and the potential unavailability of flexible resources whose activation is limited based on

grid prequalification and temporary limits set by TSOs or DSOs.

18. TSOs and DSOs outline the planned development of their networks in their respective network development plans ('NDPs'). According to Articles 32(3) and 51(3) of the Electricity Directive, they are required to consider alternative solutions to system expansion in these plans. Article 32 also establishes that regulatory frameworks shall ensure that DSOs are able to procure flexibility where such services cost-effectively alleviate the need to upgrade or replace electricity capacity and support the efficient and secure operation. Furthermore, DSOs shall be adequately remunerated for the procurement of such services.
19. The fine-tuning is carried out only when certain conditions of relevance are met. It involves the re-analysis of system needs, taking into account the data coming from the network and the unavailability of flexible resources due to prequalification and temporary limits. Additional needs resulting from the fine-tuning must be clearly identifiable.
20. Guiding criteria further characterise the needs quantified under this FNA methodology. These include considerations on how to account for interactions among different needs, recognising that flexibility technologies may have the technical capabilities to cover multiple needs. The criteria highlight the importance of understanding the interactions between FNA and other relevant studies, such as NDPs and the results from ERAA and NRAA, as well as the interdependencies among the needs and the consideration of other cost-effective solutions. The impact of instruments used to manage network needs, such as those provided in the bidding zone review in accordance with Article 14 of the Electricity Regulation and remedial actions in accordance with Article 2(13) of Regulation (EU) 2015/1222 should also be considered in the FNA reports for a comprehensive analysis. The goal is to ensure that the FNA reports provide the Member States with comprehensive and useful information for identifying indicative national objectives for non-fossil flexibility, including the specific contributions of both demand response and energy storage to that objective.
21. TSOs and DSOs should use common NECP targets in their scenarios to ensure consistency. ENTSO-E, the EU DSO Entity and ACER have a role in steering the implementation by providing guidance throughout the process.
22. In line with Article 32(3) of the Electricity Directive, DSOs are required to produce a distribution network development plan ('DNDP'). The DNDP is expected to be the main data source for the distribution level under the FNA methodology, as it provides transparency on the medium and long-term flexibility needs and outlines planned investments for the next 5 to 10 years. However, DNDPs might not always be available since Member States may not require them from the integrated electricity undertakings with fewer than 100,000 customers or serving small isolated systems. In those cases, the data required for the FNA methodology may be based on other relevant data sources indicated in the FNA methodology.
23. The DSO data and analysis referenced in the FNA methodology should be submitted using the template in Table 15 of Annex 2 to ensure that each specific group of DSOs maintains the necessary harmonisation, to facilitate the coordination with other groups of DSOs and/or TSO(s), and to streamline the preparation of the FNA report by the designated authority or entity.
24. DSOs operating within the Member States differ significantly in size, measured by the number of connected customers, the presence or absence of connections to the TSO grid, and in their obligations, such as the preparation of a DNDP. Recognising this, the FNA methodology allows DSOs to assess their network flexibility needs individually or collectively through a group of several DSOs, based on similar network configuration, electrical interconnection between themselves, similar planning methods, or other relevant criteria. A DSO may also delegate all or part of any tasks with

which it is entrusted under the FNA methodology to one or more DSOs or to an organisation representing DSOs, a TSO or another third party, provided that they can carry out the relevant task(s) at least as effectively as the delegating DSO. Finally, while the obligation to provide data and analysis under the FNA methodology applies to all TSOs and DSOs, Article 64 of the Electricity Regulation envisages that Member States may request derogations from certain provisions of the Regulation, including those outlined in Article 19e. However, such derogations may only be granted under specific circumstances listed in the Electricity Regulation, such as challenges in operating small, isolated systems, small connected systems or systems lacking physical interconnection with the EU energy market.

25. The FNA methodology does not specify the governance structures, roles, or responsibilities of the designated authority or entity responsible for developing the FNA report. These aspects are outside the scope of the FNA methodology and should be addressed by each Member State. However, approval of the FNA methodology triggers the processes outlined in the Electricity Regulation, which ultimately lead to Member States defining their indicative national targets for non-fossil flexibility and to ACER analysing flexibility needs of the EU as a whole. It is therefore essential that these national processes, particularly the regulatory approvals of the FNA reports where required, are completed in a timely manner to prevent delays in the effective implementation of the Electricity Regulation.
26. Dynamic stability, including system inertia, is primarily related to the frequency stability of the power system. As frequency is a common variable across interconnected systems, these stability factors are synchronous area-level issues and therefore extend beyond the scope of the FNA methodology.
27. Given that twelve months for the adoption of the FNA report is a relatively short timeframe, especially considering the complexity of establishing the data collection and analysis processes, the FNA methodology allows the system operators to implement certain specific elements gradually. Additionally, the process for amending the FNA methodology is outlined so as to acknowledge that amendments may be needed as more experience is gained.

Article 1. Subject matter and scope

1. In accordance with Article 19e(4) of the Electricity Regulation, the FNA methodology:
 - a. defines the type and format of data that the TSOs and DSOs are to provide at national level to the designated authority or entity; and
 - b. sets out a methodology for the analysis by the TSOs and DSOs of the flexibility needs in each Member state including guiding criteria on how to assess the capability of the different sources of flexibility to cover the flexibility needs.
2. TSOs and DSOs in accordance with the FNA methodology shall analyse the following flexibility needs:
 - a. system flexibility needs, including:
 - i. RES integration needs pursuant to Article 8;
 - ii. ramping needs pursuant to Article 9;
 - iii. short-term flexibility needs pursuant to Article 10;
 - b. distribution network needs pursuant to Article 11;
 - c. transmission network needs pursuant to Article 12.

3. The quantification of system flexibility needs is carried out at bidding zone(s) level and includes needs associated with both the transmission and distribution network without localising them.
4. The FNA methodology also provides the main data categories relevant for the evaluation of barriers for flexibility in the market and the contribution of digitalisation, pursuant to Article 15.
5. The FNA methodology also contains guiding criteria on how to assess the capability of the different sources of flexibility to cover the flexibility needs, pursuant to Article 16.
6. TSOs and DSOs either individually or jointly some or all of them, may provide additional data and analysis not explicitly described in the FNA methodology. Except for additional target years, additional scenarios within the set of reference scenarios of ERAA and/or NRAA, higher granularity data, and additional data and analysis provided by DSOs pursuant to Article 6(7), any such additional data and analysis shall not be used for the definition of needs pursuant to the FNA methodology and shall be accompanied by appropriate descriptions to ensure their proper interpretation and justifications, clarifying the rationale for their submission. In the case of data, a detailed description of the data type and format must also be provided.

Article 2. Definitions

1. For the purposes of the FNA methodology, the definitions in Article 2 of the Electricity Directive, Article 2 of the Electricity Regulation, and Article 2 of the ERAA methodology shall apply.
2. In addition, the following definitions shall apply:
 - a. **‘climate year’** means a climatic year or weather scenario simulated within ERAA or NRAA. For the purpose of the FNA methodology, the terms ‘climate year’ and ‘weather scenario’ are given the same meaning;
 - b. **‘confidential information’** means non-aggregated information and information restricted under national law, trade secrets and relevant confidentiality agreements, exchanged for the purpose of the FNA report ;
 - c. **‘congestion issue’** means a situation in which the electric current flow through a physical asset exceeds operational limits;
 - d. **‘D-1’** refers to the latest forecast reported at, in local time of the bidding zone, 12:00 the day before real-time observation in the same bidding zone.
 - e. **‘daily timeframe’** means a timeframe for the characterisation of flexibility needs which occur at the level of the single day of the year. Depending on the specific indicator, daily values can be further characterised (e.g. cumulated, averaged, etc.) to provide statistical insight on flexibility needs;
 - f. **‘demand’** means the total instantaneous electricity consumption observed in the transmission and distribution systems, including the network losses;
 - g. **‘designated authority or entity’** means the regulatory authority or another authority or entity designated by a Member State to receive the data and analysis submitted by TSOs and DSOs pursuant to Article 19e(3) and adopt the FNA report pursuant to Article 19e(1) of the Electricity Regulation;
 - h. **‘dispatchable assets’** refers to assets (as individual units or aggregated) which are controllable by market participants or system operators to manage system or network needs;
 - i. **‘downward flexibility needs’** means the needs whose solution requires either decreasing

injection into the network or increasing demand from the network;

- j. **‘economic dispatch (ED)’** means a mathematical optimisation model as described in Article 7 of the ERAA methodology;
- k. **‘economic viability assessment (EVA)’**: means a model assessing the profitability of capacity resources, informing decisions on retirement, mothballing and re-entry, renewal/prolongation and new-build of a capacity resource as described in Article 6 of the ERAA methodology;
- l. **‘energy not delivered (END)’** means the energy which is not supplied due to network constraints;
- m. **‘energy not served (ENS)’** means the energy which is not supplied due to insufficient capacity resources to meet the demand;
- n. **‘ERAA’** means the most recent European resource adequacy assessment conducted by ENTSO-E pursuant to Article 23 and approved by ACER pursuant to Article 27 of the Electricity Regulation;
- o. **‘ERAA methodology’** means the methodology for the European resource adequacy assessment developed by ENTSO-E pursuant to Article 23(3) of the Electricity Regulation;
- p. **‘fast flexibility’** means the capacity able to react to aggregated D-1 or shorter error variations (15 to 60 minutes before real-time);
- q. **‘FNA report’** means a report on the estimated flexibility needs for a period of at least the next 5 to 10 years adopted at national level pursuant to Article 19e(1) of the Electricity Regulation;
- r. **‘hourly timeframe’** means a timeframe for the characterisation of flexibility needs which occur at the level of the single hour of the year. Depending on the specific indicator, hourly values can be further characterised (e.g. cumulated, averaged, etc.) to provide statistical insight on flexibility needs;
- s. **‘local service’** means energy or capacity procured by a TSO or DSO to solve congestion or voltage issues they have identified in their systems;
- t. **‘local maximum value’** means the maximum flexibility (expressed in MW) needed to solve a congestion or voltage issue on a given asset during a given time block;
- u. **‘NECP’** means an integrated national energy and climate plan pursuant to Regulation (EU) 2018/1999;
- v. **‘network flexibility needs’** means the flexibility needed to adjust for grid availability, by means of preventing or solving congestion or voltage issues, across relevant timeframe;
- w. **‘non-dispatchable generation’** refers to assets which are constrained in controllability of injections following weather or other conditions such as wind, solar and run-of-river hydro generation;
- x. **‘NRAA’** means the most recent national resource adequacy assessment pursuant to Article 24 of the Electricity Regulation. If an NRAA is subject to ACER’s opinion pursuant to Article 24(3) of the Electricity Regulation, it shall only be considered for the purposes of the FNA methodology once it is amended in accordance with ACER’s opinion or accompanied by a report detailing the reasons for not fully incorporating ACER’s opinion.
- y. **‘ramping needs’** refer to needs associated with variations of the residual load assuming perfect forecast conditions;

- z. **'RES curtailment'** means limiting the generation or transmission of renewable power for system operational reasons or grid-capacity reasons;
 - aa. **'RES integration needs'** refers to the quantity of flexibility required for the Member State to achieve its annual RES integration target;
 - bb. **'RES integration target'** refers to the maximum RES curtailment amount or share compatible with the RES target for the Member State. It is expressed either as a maximum RES curtailment in absolute terms, or as a maximum RES curtailment in relative terms to the total RES generation or to the total electricity demand, or symmetrically as the minimum effectively integrated (i.e., non-curtailed) RES generation in absolute terms or in relative terms to the total RES generation or to the total electricity demand.
 - cc. **'RES target'** refers to the national target for RES in the electricity sector of the most recent NECP or from another relevant official national document consistent with the most recent NECP. It is either expressed as a RES volume in absolute terms or as a share of RES production in relative terms to the total electricity demand;
 - dd. **'residual load'** refers to the total demand minus non-dispatchable generation (as individual units or as aggregated units), such as from wind or solar as well as generation, subject to must run conditions per market time unit;
 - ee. **'seasonal timeframe'** means a timeframe for the characterisation of flexibility needs which occur at the level of the single month of the year. Depending on the specific indicator, monthly values can be further characterised (e.g. cumulated, averaged, etc.) to provide statistical insight on flexibility needs;
 - ff. **'short-term flexibility needs'** means needs associated with unexpected variations of the residual load such as forced outage of assets during the intra-day or balancing timeframe;
 - gg. **'slow flexibility'** means the capacity able to react to aggregated D-1 or shorter horizons forecast error (60 minutes to 24 hours before real-time);
 - hh. **'system flexibility needs'** means the flexibility needed by the electricity system to adjust to the variability of generation and consumption patterns, across relevant market timeframe;
 - ii. **'target year'** means a year for which data and analysis are provided within the framework of the FNA methodology;
 - jj. **'uncovered flexibility needs'** means the additional flexibility needs identified by the FNA methodology, not expected to be met by new or existing resources based on ERAA or NRAA inputs;
 - kk. **'upward flexibility needs'** means needs whose solution requires either increasing injection into the network or decreasing demand from the network;
 - ll. **'voltage issue'** means a situation when voltage levels are not within the operational limits;
 - mm. **'very fast flexibility'** means capacity able to react to aggregated D-1 or shorter horizons forecast error variations (5 to 15 minutes before real-time).
3. Unless the context clearly indicates otherwise, any reference in the FNA methodology to legislation, regulations, directives, orders, instruments, codes, guidance documents or any other enactments shall be deemed to include any amendments, extensions, or re-enactments thereof in force at the relevant time.

4. Unless explicitly stated otherwise, references to paragraphs within an article shall be interpreted as pertaining specifically to the corresponding paragraphs of that article, while references to articles shall refer to the articles of the FNA methodology.

Article 3. Roles and responsibilities

1. Each TSO and DSO is responsible for:
 - a. providing the data and analysis for the preparation of the FNA report pursuant to Article 19e(3) of the Electricity Regulation and in accordance with the FNA methodology;
 - b. ensuring the correctness and completeness of the data provided and their adherence to the data-set requirements, data type and format specified in the FNA methodology including those in Article 6 and in Annexes 1 and 2.
2. Each DSO is responsible for:
 - a. assessing network flexibility needs to prevent or solve congestion or voltage issues on their own network over the next 5 to 10 years. These needs consist of both upward and downward network flexibility which the DSO is forecasting to use in order to prevent or solve congestion or voltage issues through active power in the most efficient and effective manner, in addition to, or in combination with other available means including grid reinforcement as defined in the DNDP processes; and
 - b. analysing the reasons for such network flexibility needs. This analysis shall take into account the national regulatory framework, particularly the transposition of Article 32(1) of the Electricity Directive, and the incentives for connecting additional RES, load, storage and/or other flexibility resources at specific locations of the distribution system.
3. ENTSO-E and the EU DSO entity shall coordinate TSOs and DSOs as regards the data and analysis to be provided for the preparation of the FNA reports. To this end, ENTSO-E and the EU DSO Entity shall also cooperate closely with each other. This coordination shall include providing the following guidance to TSOs and DSOs within 18 months from approval of the FNA methodology:
 - a. The EU DSO Entity shall publish guidance to DSOs in order to promote harmonisation of the DSO flexibility needs assessment defined under the FNA methodology, as well as to progressively improve their cooperation and coordination under the FNA methodology and the methods used for the analysis of their flexibility needs in a cost-effective manner. In developing this guidance, the EU DSO Entity shall take into account regulatory authorities' guidance on distribution network planning¹ and experiences and lessons learnt from the implementation of the FNA methodology in the Member States, and in particular of Articles 4, 6, and 11.
 - b. ENTSO-E shall issue and subsequently regularly update a 'Questions and Answers' document regarding the main and/or recurring implementation challenges related to the system needs assessment raised by TSOs. ENTSO-E shall consult ACER on any question related to the interpretation of the FNA methodology.

¹Prepared in cooperation with ACER and CEER according to Action 3 from the EU Action Plan for Grids (COM/2023/757 final).

Article 4. National implementation

1. Within four months of ACER's approval of the FNA methodology, TSO(s) and DSO(s) within each Member State shall agree with each other and with the respective designated authority or entity and, where an entity is designated, also with the regulatory authority:
 - a. The exact scope of data and analysis the TSOs and DSOs intend to provide at national level;
 - b. Their respective roles and responsibilities in providing the data and analysis;
 - c. Estimated timeline for the exchange of data;
 - d. Common target years for the purpose of data and analysis pursuant to Article 6(1), and Article 6(2) if applicable;
 - e. In case of multiple TSOs within one Member State, their respective contributions to the provision of data and analysis, as agreed between them;
 - f. Temporal, spatial and voltage granularity of DSO data pursuant to Articles 6 and 11;
 - g. Data to be provided, where relevant, for the purpose of evaluating the barriers for flexibility in the market and the contribution of digitalisation pursuant to Article 15;
 - h. Any additional DSO inputs and justifications for those inputs pursuant to Article 6(7);
 - i. Any additional data and analysis according to Article 1(6). Any additional data or analysis required from the DSOs to perform additional changes proposed by TSOs shall be duly justified and agreed by DSOs and vice versa.
 - j. Where possible, additional inputs to the FNA report requested by the designated authority or entity pursuant to Article 19e(3) of the Electricity Regulation.
 - k. Where applicable, the expected timeline for the approval of the FNA report.
2. Within ten months of ACER's approval of the FNA methodology, the TSO(s) and DSO(s) shall submit the agreed-upon data and analysis to the designated authority or entity based on the scope defined in paragraph (1). To facilitate the work of the designated authority or entity on drafting its FNA report, the TSO(s) and DSO(s) shall use reasonable efforts to gradually conduct parts of the agreed-upon analysis and submit it to the designated authority or entity prior to this deadline.
3. The second FNA report adoption cycle starts two years after ACER's approval of the FNA methodology, to be followed by subsequent cycles every two years.
4. Starting from the second cycle, the TSOs and DSOs shall agree on the scope under paragraph (1) within two months of the start of each cycle and submit the relevant data and analysis within 8 months of the start of each cycle.
5. A DSO may delegate all or part of its responsibilities under the FNA methodology to one or more DSO(s), an organisation representing the DSOs, a TSO, or a third party. In this case, the delegating DSO shall:
 - a. retain responsibility for ensuring compliance with the obligations set forth in the FNA methodology;
 - b. notify the designated authority or entity, and where an entity is designated also the regulatory authority without delay;
 - c. where applicable, ensure that the suitable confidentiality agreements with the other party have

been put in place prior to the delegation pursuant to Article 5.

6. The TSO(s) and DSO(s) submitting data and/or analysis pursuant to paragraph (2) shall cooperate with the designated authority or entity during the preparation of the FNA report to ensure clarity and correct representation of the submitted data and analysis in the report.
7. In case the DSO(s) and/or TSO(s) of a Member State are unable to reach an agreement on any points listed in paragraph (1), the DSO(s) and/or TSO(s), as the case may be, shall inform the designated authority or entity and where an entity is designated also the regulatory authority, about their disagreement(s), providing the relevant drafts of their proposals, if any, along with appropriate explanations.
8. Subject to the agreement of the designated authority or entity, the TSOs and DSOs may deviate from the deadlines specified in paragraphs (1), (2) and (4) as long as such deviation does not affect the adoption of the FNA report within 12 months of each cycle's start.

Article 5. Confidentiality obligations

1. Any confidential information received, exchanged or transmitted pursuant to the FNA methodology shall be subject to the conditions of professional secrecy laid down in paragraphs (2) to (4).
2. The obligation of professional secrecy shall apply to any person or authority, including the designated authority or entity, who is subject to the provisions of the FNA methodology.
3. Confidential information received in the course of duty by the persons or authorities referred to in paragraph (2) including the designated authority or entity, shall not be divulged to any other person or authority, without prejudice to cases covered by national law, other provisions of the FNA methodology or other relevant Union legislation.
4. Without prejudice to cases covered by national law or Union legislation, the regulatory authorities, bodies or persons who receive confidential information pursuant to the FNA methodology shall use it only for the purpose of carrying out their duties under the FNA methodology, except where written consent has been provided by the respective primary owner of the data.

Article 6. Data and analysis

1. The TSOs and DSOs shall provide the data and analysis as required by the FNA methodology for the target years used in ERAA progressively increasing the number of target years with each submission. The first submission shall include at least two target years, one being an EU policy target year in line with targets and objectives specified in Article 19e(4)(b)(iii) of the Electricity Regulation. Subsequent submissions shall, in addition to at least one EU policy target year, progressively expand the number of target years until they encompass all the common target years from ERAA and DNDPs. ENTSO-E and EU DSO Entity shall coordinate with each other and with all TSOs and DSOs in order to select at least one EU policy target year in line with targets and objectives specified in Article 19e(4)(b)(iii) of the Electricity Regulation that is assessed by the system operators in all Member States.
2. If agreed with the designated authority or entity, and where an entity is designated also with the regulatory authority, the TSOs and DSOs may provide data and analysis for additional target years beyond those specified in ERAA.
3. Pursuant to Article 13, the TSOs and DSOs shall provide the data needed to assess the volumes of unavailable flexible resources due to grid prequalification and temporary limits. This data shall be

sourced from the annual reports on the application of temporary limits and annual reports on grid prequalification, if available.

4. The data required to perform the TSOs' analysis shall be sourced from either national or European studies, platforms and other sources pursuant to Article 7, provided that consistency with ERAA and/or NRAA is ensured.
5. The TSOs shall provide the data and analysis for at least the same climate years or weather scenarios as those considered in the Economic Dispatch (ED) of ERAA and/or NRAA for the chosen target years. In the first cycle of adopting the FNA report, the TSOs may provide data and analysis only for the same climate years or weather scenarios as the EVA pursuant to Article 7(1). This approach must be agreed with the designated authority or entity and, if an entity is designated, also with the regulatory authority.
6. To provide the data and analysis for the FNA Report, each DSO shall use assumptions, scenarios, methods and data developed in the final version of their latest DNDP and, if relevant, information published in the framework of procurement of local services. The DSO data and analysis referenced in the FNA methodology shall be submitted using the template in Table 15 of Annex 2.
7. Where information in paragraph (6) is unavailable or insufficient, the DSOs may use additional assumptions, scenarios, methods or data only if their use is necessary for the purpose of the FNA methodology, and if the DSOs justify the necessity, consistency and relevance of using such additional information. The use of these additional assumptions, scenarios, methods or data shall be agreed with the designated authority or entity and, where an entity is designated, also with the regulatory authority. These additional assumptions, scenarios, methods or data shall meet the following requirements:
 - a. assumptions, scenarios, methods and data shall be transparent and consistent with development plans of the TSO(s) and other DSO(s) at national level for the purpose of the FNA methodology;
 - b. scenario(s) used by the DSO(s) shall be consistent with their DNDP, in particular:
 - i. reflect the most plausible futures of the electricity distribution system for the next 5 to 10 years;
 - ii. be coordinated with the planning methodology and scenario building process for the national transmission system development plan and between the relevant DSO(s) and TSO(s), to ensure sufficient consistency;
 - iii. encompass, at least, current and forecasted electricity demand, generation and storage capacities and consider NECPs, local energy strategies and other relevant development factors;
 - c. cost-effectiveness of using flexibility services as alternative to grid expansion shall be assessed.
8. In case the DSO(s) use data from other DSO(s) to assess their own network flexibility needs, the DSO(s) using such data shall ensure the relevance of both the data and the method used to process it to ensure that it is meaningful and consistent for the relevant needs. A DSO which provides data to another DSO shall also ensure the relevance and reliability of that data.
9. When providing data, where relevant, the DSOs shall consider the regulatory authorities' guidance

on distribution network planning² and any relevant guidance provided by EU DSO Entity, including the guidance according to Article 3(3)(a).

Article 7. System needs

1. Scenarios to be used for the assessment of system flexibility needs shall include at least one scenario consistent with one of the reference scenarios of ERAA. For the purpose of the national assessments of system needs, an EVA shall be carried out as part of ERAA and/or NRAA pursuant to Article 6 of the ERAA methodology. The TSOs may run the assessment for additional scenarios, either included within the set of reference scenarios of ERAA and/or NRAA or additional ones, such as a scenario measuring the impact of measures to unleash flexibility potential, pursuant to Article 4(1)(i).
2. For the quantification of system flexibility needs, the minimum set of data needed to run the analysis shall include those sourced from ERAA and/or NRAA pursuant to Article 6. It shall also include the data collected by TSOs at national level. The detailed list, including the type and format of data needed to run the analysis is provided in Annex 1.
3. The assessment of each system need shall be based on:
 - a. processing of ERAA's or NRAA's economic dispatch results pursuant to paragraph (1) and Article 6(1); or
 - b. an economic dispatch simulation conducted by the TSOs independently of ERAA's or NRAA's economic dispatch results, provided that:
 - i. it is based on the scenarios used pursuant to paragraph (1) and the associated set of inputs, installed capacities, climate scenarios and outage patterns;
 - ii. it embeds ramping needs and/or short-term flexibility needs.
4. In case the assessment of system needs is based on paragraph (3)(b) and the economic dispatch results already take into account:
 - a. the technical constraints of generation, storage and demand assets that would be needed to assess ramping needs pursuant to Article 9; and/or
 - b. the flexibility needs associated with forecast errors pursuant to Article 10;

the TSOs may limit their assessment to one of the following:

- i. the RES integration needs pursuant to Article 8 and the analysis of ERAA's and/or the NRAA's economic dispatch results for ramping and short-term needs, provided that the economic dispatch results consider both the technical constraints of ramping needs and short-term flexibility needs, i.e. both conditions in points (a) and (b) of the first subparagraph are met;
- ii. the RES integration needs pursuant to Article 8, the short-term flexibility needs pursuant to Article 10 and the analysis of ERAA's and/or NRAA's economic dispatch results for ramping needs, provided that the economic dispatch results take into account technical constraints of generation, storage and demand assets related to ramping only, i.e. only condition (a) of the first subparagraph is met;
- iii. the RES integration needs pursuant to Article 8 and the ramping needs pursuant to Article 9

²Prepared in cooperation with ACER and CEER according to Action 3 from the EU Action Plan for Grids (COM/2023/757 final).

and the analysis of ERAA's and/or NRAA's economic dispatch results for short-term needs, provided that the economic dispatch results take into account the short-term flexibility only, i.e. only condition (b) of the first subparagraph is met.

Article 8. System needs – RES integration needs

1. To quantify RES integration system needs, the TSOs shall characterise the RES generation curtailment and residual load time series extracted from the economic dispatch pursuant to Article 7(3) covering at least the seasonal, daily and hourly timeframe according to a time decomposition methodology. This characterisation shall be conducted for each target year and weather scenario pursuant to Article 6. To this end, the following actions in paragraphs (2), (3), (4), and (5) of this Article shall be carried out.
2. The TSOs shall extract RES generation curtailment time series from the economic dispatch results. Each time series consists of values per market time unit (MTU) and per weather scenario for each target year representing RES generation which could not be accommodated due to system constraints, economic optimisation or interconnection capability.
3. When extracting RES generation curtailment time series, TSOs shall add to it the additional RES generation curtailment resulting from uncovered downward ramping needs and uncovered downward short-term flexibility needs pursuant to Articles 9(6) and 10(5), provided that these needs have not been accounted for in the economic dispatch pursuant to Article 7(4). When doing so, and to avoid double-counting, the TSOs shall add to the RES curtailment time series, for each MTU, the maximum of the RES curtailment resulting from ramping needs and the RES curtailment resulting from short-term needs. For the first FNA report only, the TSOs may either exclude the contribution of additional RES curtailment pursuant to this paragraph or may consider it when fine-tuning RES integration needs with network needs.
4. The TSOs shall characterise RES generation curtailment time series with indicators expressed in terms of energy, duration and interval with the aim of evaluating the ability of the system to cope with periods of excess generation resulting in RES generation curtailment, covering at least the seasonal, daily and hourly timeframe. This shall be done by means of at least:
 - a. average, maximum and minimum values;
 - b. a probability distribution and relevant percentiles;
 - c. a representation as a function of time and day;
 - d. the correlation between RES generation curtailment and system conditions such as at least the wind generation, solar generation and demand.
5. The TSOs shall then extract residual load time series from economic dispatch results. These time series shall be characterised in terms of their variability with respect to the timeframes indicated in paragraph (1), using established decomposition methodologies (time decomposition, Fourier decomposition, etc.). In particular, at least the following indicators shall be calculated:
 - a. An hourly indicator, to be calculated as the sum of absolute variations between the hourly residual load and its daily average;
 - b. A daily indicator, to be calculated as the sum of absolute variations between the daily residual load and the weekly average;
 - c. A seasonal indicator, to be calculated as the sum of absolute variations between the monthly

residual load and the annual average.

The TSOs may calculate additional indicators associated with other timeframes, such as weekly, to account for specific conditions.

6. The TSOs shall then use the results of the characterisation obtained to provide an overview of the total excess generation resulting in RES generation curtailment in the system and shall compare it with the RES integration targets for the Member State. The RES integration target for the Member State is defined pursuant to paragraphs (7) and (8).
7. The TSOs shall extract the national target for RES in the electricity sector from the most recent NECP or an official national document consistent with the most recent NECP. If the most recent NECP, or official national document consistent with it, does not contain a national target for RES in the electricity sector and/or for a specific target year, the TSOs shall, upon agreement with the designated authority or entity, and where an entity is designated, also the regulatory authority, use as reference one of the following:
 - a. Interpolated or extrapolated values with respect to target years included in the NECP or other relevant approved and public national source;
 - b. the EU-wide RES target, national targets included in official and published EU-wide scenarios, or national values included in EU legislation for the given Member State;
 - c. a proxy derived from other parameters included in their NECP (for example using as reference the planned installed capacity of RES included in NECPs);
 - d. if none of the above applies, a set of representative values reflecting a reasonable range of RES targets.
8. The TSOs shall derive from the RES target in the electricity sector a RES integration target, which corresponds to the maximum RES curtailment acceptable, or, symmetrically, the minimum effectively integrated RES generation, to comply with the RES target in the electricity sector pursuant to paragraph (7).
9. The uncovered RES integration needs are defined as the amount of RES curtailment exceeding the maximum level of RES curtailment compatible with the RES integration target defined in this Article.
10. In case of positive uncovered RES integration needs, the TSOs shall analyse the benefit of adding new flexibility resources to the system for the target years. To ensure technological neutrality, the additional flexibility resources shall be characterised at least in terms of power, energy capacity, energy-to-power ratio, availability and roundtrip efficiency. The TSOs shall consider at least flexibility resources with an energy-to-power ratio of 2, 4, 8, 20, 50, 100 and 200 hours and the most representative roundtrip efficiency for each of these ratios.
11. The TSOs shall quantify additional flexibility resources required to meet the RES integration target. To measure the contribution of a solution to RES curtailment reduction, the TSOs shall consider the flexibility indicators defined in paragraphs (4) and (5) and/or economic indicators resulting from economic dispatch results. The TSOs shall then provide further characterisation of the quantified needs through the guiding criteria pursuant to Article 16(6).
12. The TSOs shall assess the impact of additional flexibility resources on the RES integration pursuant to paragraphs (6) to(11), either by running an economic dispatch simulation pursuant to Article 7(3)(b), or by reflecting the new flexibility resources in the residual load time series resulting from economic dispatch results pursuant to Article 7(3)(a) and taking into account the contribution of flexible resources and interconnections. In particular:

- a. In case the TSOs opt for an economic dispatch simulation pursuant to Article 7(3)(b), the TSOs shall model and then optimise the additional flexibility resources directly through the economic dispatch model, ensuring the achievement of annual RES integration targets as an average across the considered weather scenarios pursuant to Article 6(5);
 - or
 - b. In case the TSOs opt for the use of residual load time series resulting from economic dispatch results pursuant to Article 7(3)(a), they shall model new flexibility resources to reflect the behaviour they would have in electricity markets and their contribution to reducing hourly, daily, and seasonal residual load variability while meeting the RES integration target pursuant to paragraph (8).
13. Whenever relevant in accordance with the criteria in Article 14(3) and depending on the availability of data, the TSOs and DSOs shall determine downward needs resulting in additional RES curtailment due to transmission and distribution network constraints and unavailability of flexible resources due to grid prequalification or temporary limits to be used to fine-tune RES integration needs, pursuant to Article 14.
14. To produce fine-tuned results pursuant to Article 14, the TSOs shall repeat the relevant steps described in paragraphs (10) to (12) reflecting the additional RES curtailment and unavailability of flexible resources within either the separate economic dispatch or the ERAA's / NRAA's economic dispatch results. To avoid double-counting of RES integration needs, the RES curtailment hourly time-series to be used as input shall consider for each hour the maximum among RES curtailment derived pursuant to paragraphs (2) and (3) and RES generation curtailment associated with downward needs at the transmission and distribution level to be provided pursuant to Article 14.
15. Unavailability of flexible resources is applied in the form of derating factor to the flexible resources considered in the economic dispatch pursuant to Article 7(3), based on the estimation resulting from the application of Article 13 and correlating information via time periods (hour and day of the year) or system operation conditions (renewable and load conditions). The derating factor shall be allocated to hours in which the network could face constraints.
16. The derating of flexible resources pursuant to paragraph (15) shall be reported to the designated authority or entity.
17. Whenever accounting for the contribution of flexible resources considered in the inputs of the economic dispatch pursuant to Article 7(3), and whenever additional RES curtailment has been added due to ramping or short-term needs pursuant to paragraph (3), TSOs shall account for flexible resources that were already used in the computation of the flexibility gap for ramping and/or short-term needs.

Article 9. System needs – Ramping needs

1. For each MTU and weather scenario for each target year, the TSOs shall extract the residual load from economic dispatch results pursuant to Article 7(3). The TSOs shall calculate the variations of this residual load, i.e., the changes in the level of the residual load between consecutive MTUs. The TSOs shall characterize the variations of this residual load by means of at least:
 - a. average, maximum and minimum values;

- b. a probability distribution and relevant percentiles;
 - c. a representation as a function of time and day;
 - d. the correlation between residual load variations and system conditions such as at least the wind generation, solar generation and demand.
- 2. For each MTU and weather scenario for each target year, pursuant to Article 6(1), the TSOs shall extract from the economic dispatch results pursuant to Article 7(3) the dispatch of flexible resources (generation, storage and demand units), as well as the schedules of exchanges. The dispatches and schedules are used to calculate the ramping residual margins on the generation, storage, demand assets and exchange capacities by means of all the following:
 - a. the difference between the dispatched power production and the minimum and maximum power of the generation assets (on unit or aggregated level), including renewables;
 - b. the difference between the dispatched off-take and the minimum and maximum power of the demand and storage assets (on unit or aggregated level);
 - c. the difference between the scheduled import and export and the available exchange capacity.
- 3. For each MTU and weather year for each target year, pursuant to Article 6(1), the TSOs shall characterise the ability of the ramping residual margins (excluding reserve capacity) to provide upward and downward ramping capacity considering the technical constraints of generation (including renewable), storage, demand assets or exchange capacities as follows:
 - a. actual upward – and downward ramping rate (MW/min) capability of dispatchable units (on a unit by unit or aggregated level); and
 - b. wherever relevant, additional constraints for specific technology types as specified in Article 4(4) of the ERAA methodology including start-up and shut-down times, minimum up, minimum down time and energy or activation duration constraints in case of energy-limited assets; and
 - c. where relevant, the residual margins of exchange capacities pursuant to paragraph (2) can be reduced taking into account the market liquidity constraints that appear in extreme price situations. When doing so, the TSOs shall limit these reductions to periods with either the 1% lowest (for downward flexibility constraints) and 99% highest prices (for upward flexibility constraints) of the economic dispatch results pursuant to Article 7(3). These reductions shall be based on the observed cross-border liquidity in intra-day and balancing markets during the 1% lowest and 99% highest spot market prices.
- 4. The TSOs shall determine the up- and downward uncovered ramping needs per weather scenario for a target year. The uncovered ramping flexibility needs are calculated as the difference between the variations of the residual load and the ability of ramping residual margins (excluding reserve capacity) to manage these variations.
- 5. For upward ramping needs, the TSOs shall account for the possibility to ramp up capacities prior to their dispatch or offtake to cover needs.
- 6. For downward ramping needs, time series of the uncovered downward ramping needs resulting in additional RES curtailment shall be used to assess RES integration needs pursuant to Article 8(3). When doing so, the TSOs shall also include the additional RES curtailment that would arise in case the downward ramping needs are met using RES downward ramping flexibility.
- 7. The TSOs shall analyse the uncovered ramping needs in terms of capacity per event, duration per event and interval (duration between two events) and shall include at least:
 - a. the average amount of uncovered ramping needs; and

- b. a probability distribution of the uncovered ramping needs and relevant percentiles; and
 - c. a representation of the uncovered ramping needs per hour and day, for a full year; and
 - d. the correlation between uncovered ramping needs and specific system conditions, including at least the wind generation, the solar generation, and the demand.
- 8. The TSOs and DSOs shall determine unavailability of flexible resources due to grid prequalification or temporary limits to be used to fine-tune ramping needs, whenever relevant and depending on the availability of data, pursuant to Articles 13 and 14.
- 9. To produce fine-tuned results pursuant to Article 14, the TSOs shall repeat the relevant steps described in paragraphs (2) to (7), reflecting unavailability of flexible resources within the residual margins pursuant to paragraph (2). Unavailability of flexible resources is applied in the form of derating factor to their residual margin pursuant to paragraph (2) and (3), based on the estimation resulting from the application of Article 13 and correlating information via time periods (hour and day of the year) or system operating conditions (renewable and load conditions), allocating the derating factor to hours in which the network could face constraints.
- 10. The derated residual margins pursuant to paragraph (9) shall be reported to the designated authority or entity.
- 11. In cases where the TSOs opt for an economic dispatch simulation, pursuant to Article 7(3)(b) and this economic dispatch already embeds ramping constraints, the task of the TSOs is limited to extracting and analysing the uncovered ramping needs directly from the results of the economic dispatch simulation. Whenever not directly provided by the simulation tool, this shall be done by either comparing ENS and RES curtailment indicators with and without the ramping constraints, or by assessing the different hours in which either ENS or RES curtailment are a direct consequence of ramping constraints.

Article 10. System needs – Short-term flexibility needs

- 1. The TSOs shall determine the short-term flexibility needs as the 0.1 and 99.9 percentile of the probability distribution of the residual load forecast errors for each target year according to the following:
 - a. At the MTU granularity, the residual load forecast errors are defined as the difference between the D-1 forecast of the residual load and its real-time observations, or a combination of the difference between the D-1 forecast of load, solar, wind, and other generation subject to forecast errors and real-time observations. These residual load forecast errors for a target year shall be calculated as a time series based on the extrapolation of at least two years of time series of historical residual load forecast errors, or a combination of historical forecast errors of load, solar, wind, and other generation subject to forecast errors, after accounting for at least:
 - i. the projected evolution of the load; and
 - ii. the projected evolution of the installed capacity of wind power, solar power and other generation subject to forecast errors, in line with the installed capacities of the scenario pursuant to Article 7(1); and
 - iii. the expected forecasting improvements.
 - b. The probability distribution of residual load forecast errors for the target years shall account for separate distributions to represent different time periods (e.g. hour of day, day of week, season) or different system conditions (e.g. high or low renewable or load conditions).

- c. In case the forecast errors related to forced outages of large generation units and interconnection assets are accounted for in ERAA or NRAA, the TSOs shall distinguish their probability distributions from those of the residual load forecast errors to avoid double-counting. The parameters of these probability distributions (forced outage probability and duration per technology) can be provided with the analysis.
 - d. Lower percentiles may be considered by the TSOs as sensitivities on the 0.1 and 99.9 percentile for informative purposes.
 - e. The TSOs may calculate forecast errors for shorter horizons (from D-1 to 5 minutes between the residual load forecast and real observation), if available, and determine their distributions to further distinguish the slow, fast, and very fast residual load variations for a target year, for example from 5 to 15 minutes (to calculate very fast residual load variations), 15 to 60 minutes (to calculate fast residual load variations) and 1 hour to D-1 (to calculate slow residual load variations).
2. For each MTU and weather scenario for each target year, pursuant to Article 6(1), the TSOs shall extract from the economic dispatch results pursuant to Article 7(3) the dispatch of flexible resources (generation, storage and demand units), as well as the schedules of exchanges. The dispatches of generation, storage, demand and schedules of exchanges are used to calculate the short-term residual margins on these assets by means of all the following:
 - a. the difference between the dispatched power production and, respectively, the minimum and maximum power of the generation assets (on unit or aggregated level), including renewables;
 - b. the difference between the dispatched off-take and the minimum and maximum power of the demand and storage assets (on unit or aggregated level);
 - c. the difference between the scheduled import and export and the available exchange capacity.
 - d. If available, the TSOs may use shorter horizons to further distinguish between very fast, fast, and slow short-term residual margins for a target year, for example from 5 to 15 minutes (to calculate very fast short-term residual margins), 15 to 60 minutes (to calculate fast short-term residual margins) and 1 hour to D-1 (to calculate slow short-term residual margins).
3. For each MTU and weather scenario for each target year, the TSOs shall characterise the ability of the residual margins to provide upward and downward flexibility considering the technical constraints of the assets as follows:
 - a. actual upward and downward ramping rate (MW/min) capability of dispatchable units (on a unit by unit or aggregated level);
 - b. wherever relevant, additional constraints for specific technology types as specified in Article 4(4) of the ERAA methodology including start-up, shut-down times, minimum up, minimum down time and energy or activation duration constraints in case of energy-limited assets;
 - c. where relevant, the residual margins of exchange capacities pursuant to paragraph (2) can be reduced taking into account the market liquidity constraints that appear in extreme prices situations. When doing so, the TSOs shall limit these reductions to periods with either the 1% lowest (for downward flexibility constraints) and 99% highest prices (for upward flexibility constraints) of the economic dispatch results pursuant to Article 7(3). These reductions shall be based on the observed cross-border liquidity in intra-day and balancing markets during 1% lowest and 99% highest spot market prices.
 - d. If available, the TSOs may use shorter horizons to further differentiate between very fast, fast, and slow flexibility assets for a target year, for example from 5 to 15 minutes (to characterise very fast residual margin), 15 to 60 minutes (to characterise fast residual margin) and 1 hour

to D-1 (to characterise slow residual margin).

4. The TSOs shall determine the up- and downward uncovered short-term flexibility needs per MTU and per weather scenario for a target year. The uncovered short-term flexibility needs are calculated as the difference between the short-term flexibility needs and the residual margins (excluding FCR reserve capacity) as specified in paragraphs (2) and (3). When doing so:
 - a. The TSOs shall use similar system conditions for the short-term flexibility needs and for the flexibility resources when calculating the uncovered short-term flexibility needs (e.g., low or high renewable generation periods); and
 - b. The TSOs may analyse the potential contribution of technologies in providing balancing services to meet the balancing needs, by attributing the ability to provide FRR reserve capacity with the residual margins determined in paragraph (2) and (3). In this case:
 - (1) the TSOs' balancing needs shall be evaluated pursuant to Article 157 of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation; and
 - (2) the TSOs shall evaluate the potential of technologies in providing balancing services based on technical capabilities of scheduled units identified in paragraph (2) to meet aFRR and mFRR product requirements (on a unit by unit or aggregated level). These capabilities are derived as the percentage able to participate in aFRR and mFRR, derived from observed prequalification procedures and market behaviour.
 - c. The TSOs shall report the probability of occurrence of uncovered short-term flexibility needs to reflect their probabilistic nature.
 - d. The TSOs may use shorter horizons, if available, to further distinguish between very fast, fast or slow uncovered needs for a target year, for example from 5 to 15 minutes (to calculate very fast uncovered flexibility needs), 15 to 60 minutes (to calculate fast uncovered flexibility needs) and 1 hour to D-1 (to calculate slow uncovered flexibility needs).
5. Time series of the downward uncovered short-term needs resulting in additional RES curtailment shall be used to assess RES integration needs pursuant to Article 8(3). When doing so, the TSOs shall also include the additional RES curtailment that would arise in cases where downward short-term needs are met using RES downward short-term flexibility. The time series shall consist of the expected additional RES production curtailed, calculated as the capacity of the uncovered needs times the associated probability of occurrence of the corresponding uncovered needs.
6. The TSOs shall analyse the uncovered short-term flexibility needs in terms of capacity per event (expressed in MW), of expected energy per event (expressed in MWh and calculated as the capacity per event times the associated probability of the event), and shall include per target year at least:
 - a. the average capacity per uncovered short-term flexibility needs event;
 - b. a probability distribution of the capacity of uncovered short-term flexibility needs events;
 - c. the total amount of expected energy resulting from uncovered short-term flexibility needs events;
 - d. the expected number of hours with uncovered short-term flexibility needs events;
 - e. a representation of the uncovered short-term flexibility needs per hour and day, for a full year;
 - f. a representation of the expected energy resulting from uncovered short-term flexibility needs per hour and day, for a full year;
 - g. the correlation between uncovered short-term flexibility needs and specific system conditions (including at least the wind generation, the solar generation and the demand).

7. The TSOs and DSOs shall determine unavailability of flexible resources due to grid prequalification or temporary limits to be used to fine-tune short-term needs, whenever relevant and depending on the availability of data, pursuant to Articles 13 and 14.
8. To produce fine-tuned results, the TSOs shall repeat the relevant steps described in paragraphs (2) to (6) to reflect unavailability of flexible resources within the residual margins pursuant to paragraphs (2) and (3). Unavailability of flexible resources is applied in the form of derating factor to the residual margin of flexible resources pursuant to paragraphs (2) and (3), based on the estimation resulting from the application of Article 13 and correlating information via time periods (hour and day of the year) or system operating conditions (renewable and load conditions), allocating the derating factor to hours in which the network could face constraints.
9. The derated residual margins pursuant to paragraph (8) shall be reported to the designated authority or entity.
10. In case the TSOs opt for an economic dispatch simulation pursuant to Article 7(3)(b), and this economic dispatch already embeds forecast errors, the task of the TSOs is limited to extracting and analysing such needs directly from the results of the economic dispatch simulation. Whenever not directly provided by the simulation tool, this can be done by either comparing ENS and RES curtailment indicators with and without the consideration of forecast errors, or by assessing the different hours in which either ENS or RES curtailment are a direct consequence of forecast errors.

Article 11.DSO network flexibility needs

1. The following principles shall apply when considering the nationally coordinated temporal, spatial and voltage granularity of DSO network flexibility needs:
 - a. temporal granularity shall pertain to the common target year(s), as defined in Article 6, and, if available and relevant, to the time blocks (such as a year, season, months, days within a week, range of hours, or others);
 - b. spatial granularity shall be smaller or equal to:
 - i. the bidding zone when a Member State has more than one bidding zone;
 - ii. the Member State area, otherwise.
 - c. voltage granularity shall consist of needs per network voltage level or aggregating between different network voltage levels.
2. The DSO(s), alone or jointly with other DSOs, considering the nationally coordinated spatial and voltage granularity, shall detail their network flexibility needs per direction (upward and downward), and, if applicable, per scenario, according to one of the following options:
 - a. if available, summation of local maximum values of power (MW) and total energy (MWh) during time blocks and/or during representative days for each target year defined in Article 6;
 - b. as the minimum data set, summation of local maximum values of power (MW) and total energy (MWh) for each target year defined in Article 6.
3. If the DSO(s) cannot provide the quantitative information pursuant to paragraph (2), qualitative information may be provided for the purpose of the FNA report, but shall not be considered for the fine-tuning under Article 14.
4. The selection of representative days pursuant to paragraph (2)(a) shall be based on either:
 - a. a repetitive situation within a time block;

- b. a particular situation, relevant for network development or operation, such as extreme situations.
5. Data defined in paragraphs (2) and (3) shall be provided to the TSO(s) and to the designated authority or entity in accordance with the format described in Table 15 in Annex 2. Examples of the expected submission of data are also provided in Annex 2.
6. The DSO(s) shall provide the designated authority or entity with reasoning for the DSO network flexibility needs provided in Table 15 in Annex 2. This reasoning shall include potential effects of existing or planned frameworks and incentives to connect additional assets, such as generation, load, storages and other flexible resources, on certain parts of their networks, if technically feasible in terms of location or voltage levels. If available, each DSO shall also provide information on the expected contractual means to access flexibility, such as local services or flexible connection agreement, adding this information to Table 15 in Annex 2.
7. In order for the DSO(s) data to be used for the fine-tuning of RES integration system needs in accordance with Article 14, the DSO(s) shall identify the share of their downward flexibility needs that pertains to RES generation curtailment compared to the total downward flexibility needs. If the DSO(s) cannot identify the share of downward flexibility needs pertaining to RES generation curtailment compared to the total downward flexibility needs, this data shall not be used for the fine-tuning.
8. In addition to the data that shall be provided according to the format of Table 15 in Annex 2, each DSO shall provide to the designated authority or entity all of the following complementary information:
 - a. the source of data and the studies used to determine/assess its network flexibility needs;
 - b. the scenario(s) used to define future generation, loads and energy storages in its network;
 - c. the methods used to assess their network flexibility needs and to select representative days and time blocks.

Article 12. TSO network flexibility needs

1. Only in cases where the TSOs do not already model transmission network constraints within their bidding zone(s) in the economic dispatch simulation performed according to Article 7, the TSOs may quantify downward network needs resulting in RES generation curtailment due to transmission network constraints in the form of hourly time-series or another relevant time block.
2. If the analysis in fulfilment of paragraph (1) is performed, a TSO shall use the quantified needs to fine-tune RES integration needs quantified pursuant to Article 8, provided that the conditions of Article 14(3) are satisfied.
3. To avoid overlaps with the quantification of RES integration needs, pursuant to Article 8, the quantification of RES generation curtailment due to transmission network constraints in fulfilment of paragraph (1) should consider network simulation results that reflect representative periods (related to relevant time or system condition) in which the system is not experiencing high RES generation curtailment as a result of economic dispatch, but may be experiencing local RES generation curtailment due to local constraints.
4. Whenever not already accounted for in the reference ERAA or NRAA study and upon agreement with the designated authority or entity, and, where an entity is designated, also with the regulatory authority, the TSOs may quantify upward flexibility needs due to transmission network constraints

resulting in energy not delivered. When doing so, the TSOs shall analyse the upward flexibility needs in terms of capacity per event, duration per event and interval (hours between two events) and shall include at least:

- a. the average amount of upward flexibility needs;
 - b. a probability distribution of the upward flexibility needs and relevant percentiles;
 - c. a representation of the upward flexibility needs per hour and day, for a full year; and
 - d. the correlation between upward flexibility needs and specific system conditions, including at least the wind generation, the solar generation, and the demand.
5. The TSOs shall carry out a cost-benefit analysis to justify the use of flexible solutions as an alternative to grid expansion. In doing so, they shall provide to the designated authority or entity, and where an entity is designated also to the NRA, a description of the method and the calculations they used to make this comparison.
6. The quantification of RES generation curtailment due to transmission network constraints and of upward network flexibility needs shall be based on the same scenarios pursuant to Article 7(1) and the associated set of inputs and the reference grid conditions, as those used for the most recent published TYNDP or national development plan, and shall be quantified for the same weather scenarios.

Article 13. Unavailability of flexible resources due to grid prequalification and temporary limits

1. The DSOs in all cases and the TSOs only when not already accounted for in the economic dispatch simulation that are input or are computed as part of this FNA methodology, shall assess for each target year of the flexibility needs assessment the volumes of flexible resources that could be limited under the national implementation of grid prequalification and temporary limits processes.
2. To do so, the TSOs and DSOs shall use data from the annual reports on grid prequalification and on temporary limits according to the following process:
 - a. When historical data is unavailable or null,
 - i. system operators may provide estimation of unavailable flexible resources expressed as maximum hourly volumes power over an entire year, or per relevant time block in case the TSOs and/or DSOs foresee an important increase of unavailability of flexible resources due to grid prequalification and/or temporary limits;
 - ii. otherwise, system operators can neglect the effect of grid prequalification or temporary limits on the availability of flexible resources.
 - b. In all other cases, system operators shall provide an estimation of unavailable flexible resources expressed as maximum power over an entire year or per relevant time block, based on the available and relevant historical data. They will explain the method used to extrapolate historical data.
3. The TSOs and/or DSOs shall provide to the designated authority or entity the reasoning for the estimates, as well as the data, methods, and scenarios used for their assessment.
4. The data pursuant to paragraph (1) shall be used to fine-tune the flexibility needs assessment pursuant to Article 14.

Article 14. Fine-tuning system needs with network needs and unavailability of flexible resources

1. When network flexibility needs or unavailability of flexible resources are provided pursuant to Articles 11 to 13, the TSOs shall fine-tune system needs quantified pursuant to Articles 8 to 10. In doing so, they will take appropriately into account the downward network needs resulting in RES generation curtailment for the analysed bidding zone(s) quantified under Articles 11 and 12, and unavailability of flexible resources due to prequalification and temporary limits quantified under Article 13 according to the steps described in this Article and illustrated in Annex 3.
2. The TSOs and DSOs shall provide downward flexibility network needs resulting in RES curtailment due to local constraints aggregated per analysed bidding zone (pursuant to Article 12 for the TSOs and to Article 11 for the DSOs).
3. The TSOs shall first verify the relevance of transmission network needs, distribution network needs and unavailability of flexible assets due to prequalification and temporary limits for the purposes of the fine-tuning, based on the following criteria:
 - a. For the fine-tuning of RES integration needs with downward transmission network needs: the annual RES curtailment in MWh due to network constraints at transmission level (average among the climate years considered) aggregated for the analysed bidding zone(s) shall be higher than 10% of the RES curtailment (average among the climate years considered) quantified pursuant to Article 8;
 - b. For the fine-tuning of RES integration needs with downward distribution network needs: the annual RES curtailment in MWh due to network constraints at distribution level provided by the DSOs aggregated for the analysed bidding zone(s) shall be higher than 10% of the average RES curtailment (average among the climate years considered) quantified pursuant to Article 8;
 - c. For the fine-tuning of all types of system needs: the maximum hourly unavailability of flexible resources due to prequalification and temporary limits, to be provided pursuant to Article 13 shall be higher than 10% of the installed capacity of flexible resources as provided by the TSOs based on Annex 1.
4. The results of the verification of relevance pursuant to paragraph (3) shall be reported to the designated authority or entity.
5. Only for the criteria of paragraph (3) that are met, the TSOs shall fine-tune RES integration needs pursuant to paragraphs (13) to (17) of Article 8, taking into account RES curtailment due to network constraints at the transmission and/or distribution level and/or unavailability of flexible resources due to prequalification and temporary limits.
6. Only if the criterion in point (c) of paragraph (3) is met, TSOs shall fine-tune ramping and short-term needs pursuant to paragraphs (8) to (10) of Article 9 and paragraphs (7) to (9) of Article 10, taking into account unavailability of flexible resources due to prequalification and temporary limits.
7. If the granularity of the data provided under paragraph (2) and referred in Article 11 is lower than the minimum granularity referred to in Annex 1, the TSO(s) shall appropriately distribute the provided RES curtailment data to match the requested granularity, correlating data over time periods (hour, day, season or other relevant time block) or system operating conditions (renewable and load

conditions). In case no data distribution approach is provided by the DSO(s), the following default approach shall be used:

- a. in case data on DSO's RES curtailment is provided with annual granularity, RES curtailment shall be distributed across the year based on system-level daily wind and solar generation data and then within the single day, based on system-level hourly wind and solar generation data;
 - b. in case data on DSO's RES curtailment is provided with seasonal granularity, RES curtailment shall be distributed across each season based on system-level daily wind and solar generation data referred to each season and then within the single day based on system-level hourly wind and solar generation data;
 - c. in case data is provided with daily or hourly granularity for some typical days, such distributions of typical days shall be used as reference for the rest of the required input data.
8. The computed data pursuant to paragraph (7) shall be reported to the designated authority or entity.

Article 15. Market barriers and contribution of digitalisation

For the purpose of evaluating the barriers for flexibility in the market and the contribution of digitalisation in the FNA report pursuant to Article 19e(2), points (c) and (d) of the Electricity Regulation, the TSO(s) and/or DSOs shall provide, where relevant, data for the following categories:

- a. Lack of proper legal framework for market access to new entrants and small actors
- b. Lack of enablers and incentives to provide flexibility
- c. Restrictive requirements to provide balancing services
- d. Restrictive requirements to provide congestion management
- e. Complex, lengthy, and discriminatory administrative requirements
- f. Lack of regulatory incentives to system operators to consider non-wire alternatives.

Article 16. Guiding criteria

1. The TSOs and DSOs shall assist in the assessment of the capability of the different sources of flexibility to cover flexibility needs defined in the FNA methodology pursuant to the guiding criteria outlined in this Article. For this purpose, the TSOs and DSOs shall provide the indicators and analyses specified in this Article, while keeping a technology neutral approach and taking into account technical parameters and cost-efficiency as applicable.
2. Unless an alternative arrangement is agreed upon with the designated authority or entity and, where an entity is designated, also with the regulatory authority, the TSOs and DSOs shall provide the indicators and analyses listed in this Article to the designated authority or entity.
3. The TSOs and DSOs shall agree with the designated authority or entity, and where an entity is designated, also with the regulatory authority, on whether to provide analysis for the application of the guiding criteria to the fine-tuned system needs pursuant to Articles 8(14), 9(9), and 10(8) or to the system needs quantified pursuant to Article 8(9), Article 9(4), and Article 10(4). In either case, assessment of the capability of the different sources of flexibility to cover the different types of flexibility needs pursuant to Article 1(2), i.e. system needs or network needs, should be considered.
4. The DSOs shall provide the following indicators for the distribution network flexibility needs for the

relevant target years:

- a. the location of the flexibility need in terms of geographical and voltage level;
- b. the direction of the flexibility need (upwards or downwards);
- c. the timeframe in which the resource shall be available to solve the flexibility need, including, if available, data such as the duration of a continuous need, the cumulated duration of discontinuous need per time block, a measure of the frequency of activation (level of recurrence or sporadicity), the cumulated energy per time block and the applicable economic criteria;
- d. the local maximum power required during the activation;
- e. other available relevant criteria agreed upon with the respective designated authority or entity and, in the latter case, also the regulatory authority.

The indicators listed in this paragraph shall be based on the information published for the procurement of local services and information from Table 15 in Annex 2, or other studies, if available.

In case any part of the identified needs is not expected to be covered by the flexibility resources foreseen to be available at the distribution level, the DSOs shall clearly indicate that part of the flexibility needs and provide reasoning why it is not expected to be covered.

5. The TSOs shall provide, for each of the addressed system flexibility needs and transmission network flexibility needs, sub-indicators which further interpret the results obtained through the application of Articles 8 to 10 and Articles 13 and 14. The sub-indicators represent technical requirements of the flexibility needs that can assist in the identification of the most suitable resources to cover them. The below minimum set of sub-indicators of the uncovered needs shall be computed at the hourly, daily, and seasonal timeframe for each target year:
 - a. number of MTUs showing an uncovered need;
 - b. interval between uncovered needs;
 - c. duration of uncovered needs;
 - d. volume of uncovered needs in terms of energy and power.
6. The TSOs shall assist with further analysis of the assessment of the technical capability of the different sources of flexibility to meet uncovered downward needs as included in the RES integration needs. In particular:
 - a. identify for each flexibility resource the marginal contribution to RES integration via the reduction of RES curtailment assessed per additional unit of capacity until the RES integration target is reached; and
 - b. derive for each flexibility resource the curve representing the contribution to RES integration via the avoided RES curtailment as a function of the increasing capacity (expressed in GWh) of the resource; and
 - c. compare the resulting curves to establish a hierarchy among the flexibility resources that can facilitate the attainment of the RES integration target. Such comparison shall be based on the capability of technologies to reduce RES curtailment, the technology yielding the greatest reduction in RES curtailment per additional GWh being prioritised until another technology yields greater reduction in RES curtailment (depending on the slope of the respective curve,

i.e. their differential coefficients) or until the RES integration target is met.

7. The TSOs shall assist with further analysis of the assessment of the capability of the different sources of flexibility to meet uncovered upward needs, quantified pursuant to Articles 9, 10 and 12. In particular, the TSOs shall provide:
 - a. Analysis of the technical capability of the different sources of flexibility (e.g., additional flexibility resources - including at local level where relevant, additional reserve capacity, or further participation to balancing) to reduce the uncovered needs. The TSOs shall account for the technical characteristics, sub-indicators identified in paragraph (5), and cost-efficiency.
 - b. Analysis to verify possible overlaps with the adequacy findings of ERAA or NRAA, starting with the results of the scenarios compliant with Article 3(5)(a) of the ERAA methodology. When analysing the uncovered upward needs quantified pursuant to Articles 9 and 10, the TSOs shall consider reliability standards for the bidding zones, where such standard is defined.
8. As short-term needs are covered by the FRR capacity in line with Article 157 of Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation, the TSOs shall provide an analysis on how uncovered short-term flexibility needs quantified in Article 10 will first be met using additional reserve capacity or with further participation to balancing.
9. For the identified transmission network needs quantified pursuant to Article 12, the TSOs shall provide an analysis of the capability of grid reinforcements already identified by the most recent published TYNDP or a national development plan to cover these needs.
10. The TSOs shall provide an analysis of the interdependencies among the needs quantified pursuant to Articles 8 to 12, especially upward needs arising from network and system needs.
11. The TSOs and DSOs shall agree with the designated authority or entity and, where an entity is designated, also with the regulatory authority, on what data and analysis are needed, if any, for the assessment of other cost-effective solutions as an alternative to new flexible resources. These solutions could include, for example, the introduction of additional RES capacity, network development or any other means deemed relevant.

Article 17. Amendments of the FNA methodology

1. ACER, through a request for amendment, or ENTSO-E and the EU DSO Entity jointly, through a joint proposal for amendments, may initiate an amendment process of the FNA methodology.
2. If ACER requests amendments, ACER shall consult with ENTSO-E and the EU DSO Entity to determine the deadline by which they shall submit their proposed amendments to ACER. Unless otherwise specified in ACER's amendment request, the default deadline for submitting proposed amendments shall be nine months from the date of ACER's request.
3. Before submitting a proposal for amendments, ENTSO-E and the EU DSO Entity shall carry out a public consultation. They shall duly take the results of that consultation into consideration in their proposal.
4. Within three months of receiving the proposal for amendments referred to in paragraph (1), ACER shall either approve or amend it. In the latter case, ACER shall consult the Electricity Coordination Group, ENTSO-E and DSO Entity before adopting the amended proposal. The adopted proposal shall be published on ACER's website.

Article 18. Language

The reference language for the FNA methodology shall be English. Where the TSOs and DSOs need to translate the FNA methodology into their national language(s), the TSOs and DSOs shall provide the translation to the relevant regulatory authority. In the event of inconsistencies between the FNA methodology and any version in another language, the TSOs and DSOs shall, in accordance with national legislation, provide the relevant regulatory authorities with an updated translation of the FNA methodology.

Annex 1 – TSO input data to the FNA process – Type and format

The following set of data shall be provided by TSO(s) to the designated authority or entity pursuant to the provisions of Art. 1, 3 and 4 of the FNA methodology, based on the format indicated in the tables below.

The harmonised set of reference templates to be used to collect the information in each Member State is made available by ENTSO-E in the form of xml. Tables.

The set of data is intended to be provided for each target year and for the bidding zones considered in the assessment (besides the ones of the Member States and the modelled neighbouring bidding zones).

Input to FNA

Table 1. Demand

Data label	Type	Granularity	Unit	Reference Template
Demand	Time series	At least hourly 1 per WS	MW	ERAA public dataset
Implicit demand side response (iDSR) profiles (electric vehicles, heat pumps, behind-the-meter batteries)	Time series	At least hourly 1 per WS	MW	ERAA public dataset
Implicit demand side response flexible shares	Fixed value	1 per iDSR type and TY	%	ERAA public dataset

Table 2. Reserve requirements

Data label	Type	Granularity	Unit	Reference Template
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Balancing reserves requirements (FCR, FRR)	Time series	At least hourly	MW	ERAA public dataset
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Table 3. Installed capacities (used as input in ERAA/NRAA market dispatch, before and after EVA)

Data label	Type	Granularity	Unit	Reference Template
Solar PV	Fixed value	-	MW	ERAA public dataset
Solar CSP	Fixed value	-	MW	ERAA public dataset
Wind onshore	Fixed value	-	MW	ERAA public dataset
Wind offshore	Fixed value	-	MW	ERAA public dataset
Hydro (RoR, Reservoir, Pumped Storage OL and CL)	Fixed value	-	MW	ERAA public dataset
Hydro reservoir size	Fixed value	-	MWh	ERAA public dataset
Other RES	Time series	At least hourly	MW/% (capacity factor)	ERAA public dataset
Explicit Demand Side Response	Fixed value	1 per DSR price band	MW	ERAA public dataset
Resources installed capacities (thermal, etc.)	Fixed value	1 per unit (or technology if per unit not available)	MW	ERAA public dataset
Energy Storage size	Fixed value	1 per storage capacity	MW, MWh	ERAA public dataset
Availability timeseries (after planned maintenance and forced outage)	Time series	1 per unit (or technology if per unit not available)	%	ERAA public dataset
Derating factor	Time series	1 per unit (or technology if per unit not available)	%	ERAA public dataset

Table 4. Hydraulic generation

Data label	Type	Granularity	Unit	Reference template
Hydroelectric inflows per hydro technology	Time series	At least hourly or weekly 1 per WS	MWh	ERAA public dataset
Hydro reservoir min/max levels per hydro technology	Time series	At least hourly or weekly	MWh	To be provided in .xml
Hydro Min/max generating power per hydro technology	Time series	At least daily or weekly 1	MW	To be provided in .xml
PSP max pumping/generating power	Time series	At least daily or weekly, 1	MW	To be provided in .xml
Hydro Min/max generated energy per day/week per	Time series	At least daily or weekly 1	MWh	To be provided in .xml
Initial and final reservoir levels	Time series	At least daily or weekly 1	MWh	To be provided in .xml

Table 5. Must run generation

Data label	Type	Granularity	Unit	Template available?
Must-run	Time series	1 per must-run unit (or technology if per unit not available)	MW/% (capacity factor)	ERAA public dataset
CHP generation profile (based on CHP revenue profile, if not already accounted in Must Run)	Time series	At least hourly	MW	To be provided in .xml

Table 6. Technical and economic characteristics of dispatchable generation

Data label	Type	Granularity	Unit	Reference template
Efficiency range / heat rate	Fixed value	1 per unit (or technology if per unit not available)	% or MWh/GJ	ERAA public dataset (standard values)
Standard efficiency / heat rate	Fixed value	1 per unit (or technology if per unit not available)	%	
CO2 emission factor	Fixed value	1 per unit (or technology if per unit not available)	kg/net GJ	
Minimum time on	Fixed value	1 per unit (or technology if per unit not available)	hours	
Minimum time off (hours)	Fixed value	1 per unit (or technology if per unit not available)	hours	
Ramping up limit	Fixed value	1 per unit (or technology if per unit not available)	% of max output power /min	
Ramping down limit	Fixed value	1 per unit (or technology if per unit not available)	% of max output power /min	
Start-up time	Fixed value	1 per unit (or technology if per unit not available)	hours	
Shut down time	Fixed value	1 per unit (or technology if per unit not available)	hours	
Minimum stable generation	Fixed value	1 per unit (or technology if per unit not available)	%	
Start-up fuel consumption - cold start	Fixed value	1 per unit (or technology if per unit not available)	Net GJ/MW started	
Start-up fuel consumption - warm start	Fixed value	1 per unit (or technology if per unit not available)	Net GJ/MW start	
Start-up fixed cost (fuel consumption independent) warm start	Fixed value	1 per unit (or technology if per unit not available)	EUR/MW started	

Start-up fix cost (fuel consumption independent) cold start	Fixed value	1 per unit (or technology if per unit not available)	EUR/MW started	
Start-up fuel consumption - hot start	Fixed value	1 per unit (or technology if per unit not available)	Net GJ/MW started	
Start-up fix cost (fuel consumption	Fixed value	1 per unit (or technology if per unit not available)	EUR/MW started	
Transitional time from hot to warm	Fixed value	1 per unit (or technology if per unit not available)	H	
Transitional time from hot to cold	Fixed value	1 per unit (or technology if per unit not available)	h	
Fixed O&M Costs	Fixed value	1 per unit (or technology if per unit not available)	€/MW	
Variable O&M Costs	Fixed value	1 per unit (or technology if per unit not available)	€/MWh	
(De)mothballing cost	Fixed value	1 per unit (or technology if per unit not available)	€/MW	
Decommissioning or demothballing capacity	Fixed value	1 per unit (or technology if per unit not available)	MW	

The technologies considered are:

Nuclear

Hard coal (old 1, old 2, New, CCS)

Lignite (old 1, old 2, New, CCS)

Gas (conventional old 1, conventional old 2, CCGT old 1, CCGT old 2, CCGT present 1, CCGT present 2, CCGT new, CCGT CCS, OCGT old, OCGT new)

Light oil

Heavy oil (old 1, old 2)

Oil shale (old, new)

Table 7. Investment data

Data label	Type	Granularity	Unit	Reference template
CAPEX	Fixed value	1 per technology	€/MW	ERAA public dataset
Lifetime	Fixed value	1 per technology	Years	ERAA public dataset
Hurdle rate	Fixed value	1 per technology	%	ERAA public dataset
WACC	Fixed value	-	%	ERAA public dataset
Expansion constraints	Fixed value	1 per technology	MW	ERAA public dataset

Table 8. Commodities

Data label	Type	Granularity	Unit	Reference template
Fuel prices	Fixed value	1 per fuel type	EUR/net GJ	Scenario building
CO2 prices	Fixed value	-	EUR/ton	Scenario building
Activation price (when used for price-sensitive technologies)	Fixed value	1 per technology	EUR/MWh	ERAA public dataset
Activation Price for demand reduction for Price Band “X” (for explicit DSR)	Fixed value	-	EUR/MWh	ERAA public dataset

Table 9. Interconnections

Data label	Type	Granularity	Unit	Reference template
Interconnections capacities (NTC)	Fixed value or timeseries	1 value or timeseries for each border	MW	ERAA public dataset
Interconnections outages profiles	Time series	At least hourly 1 time series per border	%	ERAA public dataset
Flow-based domains: RAM, PTDF, hourly assignment	FBD representation (fixed values + timeseries)	At least hourly, time series of FBD assignment per border and WS	MW	ERAA public dataset
Exchanges with implicit regions	Time series	At least hourly, 1 timeseries for each border	MW	ERAA public dataset

Table 10. ERAA/NRAA market dispatch per unit (or technology if per unit is not available -only for TSOs opting for processing of ERAA/NRAA results)

Data label	Type	Granularity	Unit	Reference template
Generation per technology	Time series	At least hourly 1 per unit (or technology if per unit not available) 1 per WS	MW	To be provided in .xml
RES generation curtailment	Time series	At least hourly 1 per WS	MW	To be provided in .xml
Explicit and implicit demand side response schedules	Time series	At least hourly 1 per DSR type 1 per WS	MW	To be provided in .xml

Imports	Time series	At least hourly 1 per WS	MWh	To be provided in .xml
Exports	Time series	At least hourly 1 per WS	MWh	To be provided in .xml

Table 11. Other ERAA/NRAA dispatch output (only for TSOs opting for processing of ERAA/NRAA results and only if used in the FNA)

Data label	Type	Granularity	Unit	Reference template
Energy Not Served (only if used)	Time series	At least hourly 1 per WS	MWh	To be provided in .xml
Market clearing Price	Time series	At least hourly 1 per WS	€/MWh	To be provided in .xml

Additional data

Table 12. Forecast errors

Data label	Type	Granularity	Unit	Reference template
Forecast errors Demand	Time series/fixed value	At least hourly Historical	MWh	To be provided in .xml
Forecast errors RES generation	Time series/fixed value	At least hourly Historical	MWh	To be provided in .xml

Table 13. FNA computations

Data label	Type	Granularity	Unit	Reference template
Derated flexible resources (Art 8(17))	Time series	At least hourly 1 per technology, if applicable	MW	To be provided in .xml

		1 per WS		
Derated residual margins (Art 9(10))	Time series	At least hourly 1 per technology, if applicable 1 per WS	MW	To be provided in .xml
Derated residual margins (Art 10(9))	Time series	At least hourly 1 per technology, if applicable 1 per WS	MW	To be provided in .xml
Allocated DSO RES curtailment (Art 14(8))	Time series	At least hourly	MW	To be provided in .xml
TSO network flexibility needs (upwards and downwards; Art 12(6))	Time series	At least hourly	MW	To be provided in .xml

Table 14. FNA results

Data label	Type	Granularity	Unit	Reference template
Additional flexibility resource (Art 8)	Fixed values 1 per WS	-	MW	To be provided in .xml
Uncovered ramps (Art 9)	Time series 1 per WS	At least hourly	MW	To be provided in .xml
Short-term needs (Art 10)	Time series 1 per WS	At least hourly	MW	To be provided in .xml

Additional flexibility resource (Art 8) fine-tuned, if carried out	Fixed values 1 per WS	-	MW	To be provided in .xml
Uncovered ramps (Art 9) fine-tuned, if carried out	Time series 1 per WS	At least hourly	MW	To be provided in .xml
Short-term needs (Art 10) fine-tuned, if carried out	Time series 1 per WS	At least hourly	MW	To be provided in .xml

Annex 2 - DSO input data to the FNA process – Type and format

Pursuant to the provisions of Articles 3, 4, 6 and 11 of the FNA methodology, the following set of data shall be provided by the DSO(s) to the designated authority or entity, using the format indicated in the following tables.

Table 15. Table to report DSO's network flexibility needs

Line number	Direction of need	Target year	Time block	Spatial granularity	Voltage level of congestion or voltage issue	Type of value	Network flexibility needs	Share of downward flexibility needs pertaining to RES generation curtailment	Expected contractual means to access flexibility
1	Upward or downward	Data pursuant to Article 11(1)(a)	Data pursuant to Article 11(1)(a)	Data pursuant to Article 11(1)(b)	Data pursuant to Article 11(1)(c)	Data pursuant to Article 11(2)	Data pursuant to Article 11(2)	Data pursuant to Article 11(7)	Data pursuant to Article 11(6)

Information to be provided in addition to the information in Table 15:

- the reasoning for the flexibility needs reported in accordance with Table 15, including potential effects of existing or planned frameworks, and incentives to connect additional assets such as generation, load, storages and other flexible resources on certain part of their networks, if technically feasible in terms of location or voltage levels;
- the source of data and studies used to provide the network flexibility needs;
- the scenario(s) used to define future generation, load and energy storages in its network; and
- the methods used to assess their network flexibility needs and to select representative days and time blocks.

Table 16. An example of data provided in accordance with Article 11(2) (yearly values)

Line number	Direction of need	Target year	Time block	Spatial granularity	Voltage level of congestion or voltage issue	Type of value	Network flexibility needs	Share of downward flexibility needs pertaining to RES generation curtailment	Expected contractual means to access flexibility
1	Downwards	2030	Entire year		high voltage 132kV network	total energy over the year	4 500 MWh	70 %	local service
2						summation of maximum power	110 MW	70 %	

3				<i>Bidding zone = Region 1 + Region 2</i>	medium voltage 20kV network	total energy over the year	2 000 MWh	100 %	flexible connection agreements
4						summation of maximum power	45 MW	100 %	
5	Upwards	2030	Entire year	<i>Bidding zone = Region 1 + Region 2</i>	high voltage 132kV network	no need	-	-	-
6			Oct-Mar for all hours		medium voltage 20kV network	total energy over the year	60 MWh	-	local service
7						summation of maximum power	5 MW	-	

Additional explanation: Whereas this table represents yearly needs, upwards needs occur only in winter.

Table 17. An example of data provided in accordance with Article 11(2) (data provided by region and time block)

Line number	Direction of need	Target year	Time block	Reasoning to define the time block	Spatial granularity	Voltage level of congestion or voltage issue	Type of value	Network flexibility needs	Share of downward flexibility needs pertaining to RES generation curtailment	Expected contractual means to access flexibility
1	Downwards	2030	Jan-Dec Mon-Sun: 00:00 - 23:59	RES generation in region 1 being 90% from wind and 10 % from photovoltaics.	<i>Region 1</i>	high voltage 132kV network	total energy over the entire time block	3 000 MWh	50 %	local service
2							summation of Maximum power	50 MW	70 %	
3						medium voltage 20kV network	total energy over the entire time block	1 500 MWh	100 %	flexible connection agreements
4							summation of maximum power	20 MW	100 %	
5	Downwards	2030	Apr-Oct Mon-Sun: 12:00- 16:59	RES generation in region 2 being 95 % from photovoltaics	<i>Region 2</i>	high voltage 132kV network	total energy over the entire time block	1 500 MWh	100 %	flexible connection agreements
6							summation of maximum power	60 MW	100 %	
7						medium voltage 20kV network	total energy over the entire time block	500 MWh	80 %	local service
8							summation of maximum power	25 MW	80 %	
9	Upwards	2030	Any time	-	<i>Region 2</i>	high voltage 132kV network	no need		-	-
10			Oct-Mar	off hours in winter	<i>Bidding zone</i>		total energy over the entire time block	10 MWh	-	local service

11			Mon-Fri: 19:00-07:59 and Sat-Sun: 00:00-23:59		=Region 1 + Region 2	medium voltage 20kV network	summation of maximum power	3 MW	-	
12			Oct-Mar Mon-Fri: 08:00-18:59	working hours in winter			total energy over the entire time block	50 MWh	-	local service
13							summation of Maximum power	5 MW	-	

Additional explanation:

- Time block for Region 1 is the entire year (mainly windfarm) as wind blows throughout the year with equal probability, whereas spring-summer at daylight is the relevant time block for region 2 (mainly PV).
- Not statistically relevant to split per region for upwards needs; relevant time block was to split needs by working hours and off hours.

Table 18. An example of data provided in accordance with Article 11(2) (data provided for representative days – daily values)

Line number	Direction of need	Target year	Time block	Reasoning to define the representative day	Spatial granularity	Voltage level of congestion or voltage issue	Type of value	Network flexibility needs	Share of downward flexibility needs pertaining to RES generation curtailment	Expected contractual means to access flexibility
1	Downward	2030	Jan-Dec Mon-Sun: all hours	Typical windy day 90% of generation from wind, 10 % of generation from photovoltaics	Region 1 = DSO 1 and delegating DSO's Areas	high voltage 132kV network	total energy during the representative day	70 MWh	50 %	local service
2							summation of maximum power	40 MW	70 %	
3						medium voltage 20kV network	total energy during the representative day	30 MWh	50 %	local service
4							summation of maximum power	15 MW	70 %	
5	Downward	2030	Apr-Oct Mon-Sun: 09:00-18:59	Typical sunny day in a region where 95 % of generation is from photovoltaics	Region 2 = DSO 2 and delegating DSO's Areas	high voltage 132kV network	total energy during the representative day	30 MWh	100%	flexible connection agreements
6							summation of maximum power	50 MW	100%	
7						medium voltage 20kV network	total energy during the representative day	10 MWh	70%	local service

8							summation of maximum power	20 MW	60%	
9	Upward	2030	Any time	-	<i>Region 2</i>	high voltage 132kV network	no need		-	-
10			Oct-March	2 hours local duration if/where needed	<i>Bidding zone</i> = <i>Region 1 + Region 2</i>	medium voltage 20kV network	total energy during the representative day	10 MWh	-	local service
11			Mon-Sun: all hours				summation of maximum power	5 MW	-	

Additional explanation: The representative days have been chosen as a likely day for downward needs. The representative days have been chosen as the extreme case for upward needs, as the use would mainly be to cover unplanned outages (rare events).

Annex 3 - Fine-tuning Process

Fine-tuning Process*

