ACER's preliminary position in procedure ACER-ESN-2025-002
Draft of the FNA methodology of 14.05.2025

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

in accordance with Article 19e(6) of Regulation (EU) 2019/943

Month Day, Year

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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') must produce 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 inform 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 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 required data types and formats, as well as the methodology for the analyses 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 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. This consideration encompasses 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 interpreted accordingly.
4. Considering the above, the FNA methodology takes into account the reliability standard set by the Member States 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'), along with the wider regulatory framework established by the EU.
5. The FNA methodology also considers the requirement for FNA reports to 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. Additionally, it aims to align with the methodology for these assessments developed by ENTSO-E in accordance with Article 23(3) of the Electricity Regulation ('ERAA methodology').
6. To ensure cost-effectiveness, the FNA methodology requires an economic viability assessment (EVA), which is conducted as part of ERAA or NRAA. For assessing flexibility needs, it would be beneficial for EVA to consider revenues across all market timeframes, and to account for unit-constraints of generation, demand and storage assets. However, it should be noted that the scope of EVA is defined by the ERAA methodology.
7. This methodology distinguishes two main types of flexibility needs: pertaining to the network and pertaining to the system. Network flexibility needs are assessed at DSO and TSO level and 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, short-term, and reflect the flexibility needed to adjust to the variability of generation and

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consumption. Flexibility needs are categorised as upward needs when more injection into or less demand from the network is needed, and as downward needs when less injection or more demand is required.

8. The indicator of the RES integration needs represents the amount of flexibility that would be needed to reduce the curtailment of renewables to achieve the renewable targets set in the NECPs. RES generation curtailment happens typically 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.
9. The indicator of the ramping needs represents the amount of flexibility that would be 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 which are less relevant for adequacy studies (e.g. start-up/shut-down constraints).
10. The indicator of the short-term flexibility needs represents the amount of flexibility that would be needed to cover unexpected variations of the 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 assessments and covers market flexibility and TSO balancing from the day ahead to real-time.
11. 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 to cover 99% of system imbalances.
12. To avoid overlaps and double counting between these indicators, 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.
13. Network flexibility needs are local and locally time-specific, because congestion occurs where and when 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, on grid topology and configuration.
14. 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 issues' as situations in which the electric current flow exceeds operational limits, which are not solely security limits on assets on the network of a DSO. At the distribution level, 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' network, limited ranges for importing or exporting active or reactive power between system operators, or limited flows based on the aging of equipment.
15. TSOs' and DSOs' network flexibility needs include both upward and downward local needs associated with network constraints. These needs are not observable within economic dispatch results of ERAA or NRAA, which rely on the copperplate assumption. Hence, a fine-tuning of system needs is necessary to 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.

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16. Network constraints are quantified based on the network development plans. In their plans, TSOs and DSOs are required to consider resources as alternatives to system expansion according to Articles 32(3) and Article 51(3) of the Electricity Directive. On the other hand, the potential unavailability of flexible resources is quantified based on historical data included in the annual report on grid prequalification and on temporary limits prescribed by the Network Code on Demand Response.

17. The fine-tuning is carried out only when certain conditions of relevance are met and 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.

18. 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. They also emphasise the need to consider market barriers, contributions of digitalisation and cost-effective measures in the overall assessment of flexibility needs. The goal is to ensure that the FNA reports provide comprehensive and useful information to the Member States for identifying indicative national objectives for non-fossil flexibility, including the respective specific contributions of both demand response and energy storage to that objective.

19. When carrying out their roles and responsibilities described in the FNA methodology, TSOs and DSOs must cooperate with each other to provide complete and accurate data and analyses required for reporting in a way that is timely, effective and useful. This entails coordination and participation of all involved system operators before submitting their respective data and analyses to the designated authority or entity. To enhance consistency between their scenarios, TSOs and DSOs should use common NECP targets in their scenarios and national grid planning processes. ENTSO-E, EU DSO Entity and ACER have a role in steering the implementation by providing guidance throughout the process.

20. 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 integrated electricity undertakings with fewer than 100,000 customers or operating in small isolated systems. If this is the case, the data required for the FNA methodology may be based on other relevant data sources indicated in the FNA methodology.

21. 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 respective

task(s) at least as effectively as the delegating DSO. Finally, while the obligation to provide data and analyses 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.

22. 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.

23. Considering that dynamic stability and inertia are synchronous area-level issues that refer to pan-EU conditions, they go beyond the scope of the FNA methodology for national assessments.

24. Given that twelve months for the adoption of the FNA report fs relatively short, especially considering the complexity of establishing 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, acknowledging 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 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 TSOs and DSOs of the flexibility needs in all Member states 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. electricity system needs, including:
      i. RES integration needs pursuant to Article 9;
      ii. ramping needs pursuant to Article 10;
      iii. short-term flexibility needs pursuant to Article 11;
   b. distribution network needs pursuant to Article 13;
   c. transmission network needs pursuant to Article 14.

3. The quantification of electricity system 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 specifies data and analysis for the assessment of market barriers and contributions to 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 may provide additional analyses and data not explicitly described in the FNA methodology. Except for additional target years, higher granularity and additional data and analysis provided by DSOs pursuant to Article 11, any such additional analyses and data shall not be used for the definition of needs pursuant to the FNA methodology and must 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 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 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 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.

cc. **'RES target'** refers to the national target for RES in the electricity sector of the most recent NECP or from other 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 or 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 analyses 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 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).

2. 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

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be deemed to include any amendments, extensions, or re-enactments thereof in force at the relevant time.

3. 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 analyses 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 types and formats specified in the FNA methodology including those in Article 6 and in Annexes I and II.
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 EU DSO entity shall coordinate TSOs and DSOs as regards the data and analyses to be provided for the preparation of the FNA reports. To this aim, ENTSO-E and 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. EU DSO Entity shall publish guidance to DSOs in order to progressively improve their cooperation and coordination under the FNA methodology, the methods used for the analysis of their flexibility needs in a cost-effective manner, and to promote harmonisation of the DSO flexibility needs assessment defined under the FNA methodology. In developing this guidance, EU DSO Entity shall take into account regulatory authorities' guidance on distribution network planning[1] 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

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

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assessment raised by TSOs. ENTSO-E shall consult ACER on any question related to the interpretation of the FNA methodology.

Article 4.National implementation

1. By two months after the approval of the FNA methodology by ACER, TSO(s) and DSO(s) within each Member State shall agree with each other and with the respective designated authority or entity and, in the latter case, also the regulatory authority:
   a. The exact scope of data and analyses they intent to provide at national level;
   b. Their respective roles and responsibilities in providing the data and analyses;
   c. Estimated timeline for the exchange of data;
   d. Common target years for the purpose of data and analyses pursuant to Article 6(2), if applicable;
   e. In case of multiple TSOs within one Member State, their respective contributions to the provision of data and analyses, as agreed between them;
   f. Temporal, spatial and voltage granularity of DSO data pursuant to Articles 6 and 11;
   g. Data on market barriers' indicators and the contribution of digitalisation which are available to TSO(s) and DSO(s), pursuant to Article 15;
   h. If applicable, any additional DSO inputs and justifications for those inputs pursuant to Article 6(7);
   i. If applicable, any additional data and analyses, subject to Article 1(5). Any additional data or analyses required from DSOs to perform additional changes proposed by TSOs shall be duly justified and agreed by DSOs and vice versa.

2. By eight months after the approval of the FNA methodology by ACER, TSO(s) and DSO(s) shall submit data and analyses to the designated authority or entity and, in the latter case, also the regulatory authority, within the scope agreed with them pursuant to paragraph (1).
3. In all subsequent two-year cycles for adopting FNA reports, and unless an alternative timeline has been agreed upon with the designated authority or entity, and in the latter case, also with the regulatory authority, the TSOs and DSOs shall:
   a. complete the process set out in paragraph (1) no later than twelve months before the planned adoption of the FNA report.
   b. submit the agreed-upon data and analyses to the designated authority or entity, and in the latter case, also the regulatory authority, no later than six months before the planned adoption of the FNA report.
4. A DSO may delegate all or part of its responsibilities under the FNA methodology to one or more DSO(s), an organisation representing 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 in the latter case, 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.

5. TSO(s) and DSO(s) submitting data and/or analyses 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 analyses in the report.

6. In case DSO(s) and/or TSO(s) of a Member State are unable to reach an agreement regarding 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, in the latter case, also the regulatory authority, about their disagreement(s), providing the relevant drafts of their proposals, if any, along with appropriate explanations.

7. Subject to the agreement of the designated authority or entity, and in the latter case the regulatory authority, the TSOs and DSOs may deviate from the timelines set out in this article as long as they allow the designated authority or entity to adopt the FNA report within the 12 month timeframe allotted for the first cycle and in subsequent two-year cycles for adopting the FNA report specified in the Electricity Regulation.

8. This Article is without prejudice to the right of the designated authority or entity to request, where duly justified, additional input to the FNA report from TSOs and DSOs, pursuant to Article 19e(3) of the Electricity Regulation.

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 by the persons or authorities, including the designated authority or entity, referred to in paragraph (2) in the course of their duties 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, 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 analyses

1. TSOs and DSOs shall provide the data and analyses as required by the FNA methodology for the target years used in ERAA and, if applicable, NRAA. If agreed with the designated authority or entity and, in

the latter case, also with the regulatory authority, TSOs and DSOs may meet this requirement by progressively increasing the number of target years with each submission. In this case, the first submission shall include at least one relevant EU policy target year, such as 2030, 2040 or 2050, which is included in the most recent approved NECP. Subsequent submissions shall, in addition to at least one relevant EU policy target year, progressively expand the number of target years until they encompass all target years from ERAA and, if applicable, NRAA. ENTSO-E and the EU DSO Entity shall coordinate with each other and with all TSOs and DSOs in order to identify at least one common target year that is assessed by TSOs and DSOs in all Member States. Target years not complying with the 5 to 10 years requirement at the beginning of the drafting process pursuant to Article 4 shall not be included.

2. If agreed with the designated authority or entity, and in the latter case, also with the regulatory authority, the TSOs and DSOs may provide data and analyses for additional target years beyond those specified in ERAA and, if applicable, NRAA.

3. Pursuant to Article 13, TSOs and DSOs shall provide the data needed to assess the volumes of unavailable flexible resources due to grid prequalification and temporary limits which shall be sourced by 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' analyses shall be sourced from either national or European studies, platforms and other sources pursuant to Article 7, provided that consistency with ERAA and, if applicable, NRAA is ensured.

5. For TSOs, data and analyses shall be provided for at least the same climate years or weather scenarios as those considered in the Economic Dispatch (ED) of ERAA and, if applicable, NRAA for the chosen target years. For the first cycle of adopting the FNA report, and if agreed with the designated entity or authority and, the latter case, the regulatory authority, TSOs may provide data and analyses only for the same climate years or weather scenarios of the EVA pursuant to Article 8(1).

6. To provide the data and analysis for the FNA Report, each DSO shall use assumptions, scenarios, methods and data developed in their most recent DNDP and, if relevant, published information in the framework of procurement of local services. The DSO data and analyses referenced in the FNA methodology should be submitted using the template in Table 15 of Annex II to ensure that each specific group of DSOs maintains the necessary harmonisation, facilitates the coordination with other groups of DSOs and/or TSO(s), and streamlines the preparation of the FNA report by the designated authority or entity.

7. Where information in paragraph 6 is unavailable or insufficient, DSOs may use additional assumptions, scenarios, methods or data only if their use is necessary for the purpose of the FNA methodology, and if DSOs justify the necessity, consistency and relevance of using such additional information. These additional assumptions, scenarios, methods or data shall be consistent with the legal framework for DNDPs, and their use shall be agreed with the designated authority or entity and in the latter case 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 TSO(s) and other DSO(s) at national level for the purpose of the FNA methodology;

b. scenario(s) used by DSO(s) shall be consistent with 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 proven.

8. In case DSO(s) uses data from other DSO to assess their own network flexibility needs, the DSO using such data derived from another DSO shall ensure relevance of the data and the method used to process the data in a way that it is meaningful and consistent for the relevant needs. A DSO which provides data to another DSO shall ensure the relevance and reliability of that data.

9. When providing the data, where relevant, DSOs shall consider the regulatory authorities' guidance on distribution network planning[2] and any relevant guidance provided by the EU DSO Entity, including the guidance according to Article 3(3)(a).

~~**Deleted - Article 7. Needs covered**~~

~~3. This FNA methodology covers the following flexibility needs:~~

~~a. Electricity system needs, including:~~

~~i. RES integration needs pursuant to Article 9 of this FNA methodology;~~

~~ii. ramping needs pursuant to Article 10 of this FNA methodology;~~

~~iii. short-term flexibility needs pursuant to Article 11 of this FNA methodology;~~

~~b. network needs at the distribution level pursuant to Articles 12 and 13 of this FNA methodology;~~

~~c. network needs at the transmission level pursuant to Article 14 of this FNA methodology.~~

~~7. TSOs and DSOs may carry out additional analyses for the listed needs, in line with the timeframe set out in Article 4(2)(f) of this FNA methodology. When doing so, TSOs and DSOs shall provide to the designated authority or entity descriptions of the associated analyses, and the type and format of additional data.~~

Article 7.System needs

1. Scenarios to be used for the assessment of electricity system needs shall include at least one scenario consistent with one of the reference scenarios of ERAA and the associated availability of economic dispatch results. For the purpose of the national assessments of system needs, an EVA shall be carried

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

out as part of ERAA and, if applicable, NRAA pursuant to Article 6 of the ERAA methodology. TSOs may run the assessment for additional scenarios, either included within the set of reference scenarios of ERAA and, if applicable, NRAA, or additional ones, such as a scenario measuring the impact of measures to unleash flexibility potential, pursuant to Article 4.

2. For the quantification of electricity system needs, the minimum set of data needed to run the analysis shall include those sourced from either ERAA and, if applicable, NRAA pursuant to Article 6. It shall also include the data collected by TSOs at national level. The detailed list, including type and format of data needed to run the analyses is provided in Annex I.

3. The assessment of each system need shall be based on:

   a. processing of ERAA's or, if applicable, NRAA's economic dispatch results pursuant to Article 6(1); or

   b. upon agreement with the designated entity or authority and, in the latter case, the regulatory authority, an economic dispatch simulation conducted by 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 10; and/or

   b. the flexibility needs associated with forecast errors pursuant to Article 11;

   TSOs may limit their assessment to:

   i. the RES integration needs pursuant to Article 9 and the analysis of ERAA's and, if applicable, 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; or

   ii. the RES integration needs pursuant to Article 9, the short-term flexibility needs pursuant to Article 11 and the analysis of ERAA's and, if applicable, NRAA's economic dispatch results for ramping needs, provided that the economic dispatch results only take into account technical constraints of generation, storage and demand assets, i.e. only condition (a) of the first subparagraph is met; or

   iii. the RES integration needs pursuant to Article 9 and the ramping needs pursuant to Article 10 and the analysis of ERAA's and, if applicable, NRAA's economic dispatch results for short-term needs, provided that the economic dispatch results only take into the short-term flexibility, i.e. only condition (b) of the first subparagraph is met.

Article 8.System needs – RES integration

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 8(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 scenarios pursuant to Article 6. To this aim, the following actions in paragraph (2), (3), (4), and (5) of this Article shall be carried out.

2. TSOs shall extract RES generation curtailment time series from economic dispatch results. Each time series consists of values per 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), and provided that these needs have not been accounted for in the economic dispatch pursuant to Article 8(4). When doing so and to avoid double-counting, the TSOs shall add to the RES curtailment time series, for each MTU, the maximum between the RES curtailment resulting from ramping needs and short-term needs.

4. 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; and

    d. the correlation between RES generation curtailment and system conditions such as at least the wind generation, solar generation and demand.

5. 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; and

    c. A seasonal indicator, to be calculated as the sum of absolute variations between the monthly residual load and the annual average.

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

6. 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 compare it with the RES integration targets for the Member State. The RES integration target for the Member State is defined pursuant to paragraph (7) to (9).

7. TSOs shall extract the national target for RES in the electricity sector from the most recent NECP or official national document consistent with the most recent NECP. In the case, 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 use as reference either:
    a. Interpolated or extrapolated values with respect to target years included in NECP or other relevant approved and public national source; or
    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; or
    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); or
    d. if none of the above applies, a set of representative values reflecting a reasonable range of RES targets.
8. TSOs shall derive from the RES target in the electricity sector a RES integration target, which corresponds to the maximum RES curtailment acceptable to comply with the RES target in the electricity sector pursuant to paragraph (7).
9. The RES target and the RES integration target as defined in this paragraph shall be agreed upon with the designated authority or entity, and in the latter case also the regulatory authority. When identifying the target based on the NECP, directly or indirectly, the TSO shall also check if the potential for cost-effective renewable energy deployment was considered as relevant circumstance affecting renewable energy deployment pursuant to Article 5(1) of Regulation 2018/1999 and inform the designated authority or entity, and in the latter case also the regulatory authority.
10. 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.
11. 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.
12. 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. TSO shall then provide further characterisation of the quantified needs through guiding criteria pursuant to Article 16(5).
13. TSOs shall assess the impact of additional flexibility resources on the RES integration pursuant to paragraphs (6) and (7), 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 considered in the economic dispatch pursuant to Article 8(3). In particular:
    a. In case 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 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 national RES integration target pursuant to paragraph (6).

14. Whenever relevant and depending on the availability of data, 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.

15. To produce fine-tuned results due to downward network, TSOs shall repeat the relevant steps described in paragraphs (8) to (10) reflecting the additional RES curtailment and unavailability of flexible resources within either the separate economic dispatch or 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.

16. 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), allocating the derating factor to hours in which the network could face constraints.

17. The derating of flexible resources pursuant to paragraph 15 shall be reported to the designated authority or entity, and in the latter case, also to the regulatory authority.

18. 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 should 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, TSOs shall extract the residual load from economic dispatch results pursuant to Article 7(3). 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; and

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), 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:

   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; and

   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); and

   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), 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:

   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, 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 3 can be reduced taking into account the market liquidity constraints appearing in extreme prices situations. When doing so, 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.

4. 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, 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, TSOs shall also include the additional RES curtailment that would arise in case downward ramping needs are met using RES downward ramping flexibility.

7. 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. Whenever relevant and depending on the availability of data, pursuant to Article 14, TSOs and DSOs shall determine unavailability of flexible resources due to grid prequalification or temporary limits to be used to fine-tune ramping needs.

9. To produce fine-tuned results TSOs shall repeat the relevant steps described in paragraphs (2) to (5) 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), 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, and in the latter case, also to the regulatory authority.

11. In the case that TSOs opt for an economic dispatch simulation, pursuant to Article 7(3)(b) and this economic dispatch already embeds ramping constraints, the task of 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. TSOs shall determine the short-term flexibility needs as the 1 and 99 percentile of the probability distribution of the residual load forecast errors for each target year:

   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. 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 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 reference 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 forecast errors related to forced outages of large generation units and interconnection

assets are accounted for in ERAA or NRAA, TSOs shall distinguish their probability distributions with 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 TSOs as sensitivities on the 1 and 99 percentile for informative purposes.

e. If available, TSOs may calculate forecast errors for shorter horizons (from D-1 to 15 minutes between the residual load forecast and real observation) 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), TSOs shall extract from the economic dispatch pursuant to Article 7(3) 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:

   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; and

   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); and

   c. the difference between the scheduled import and export and the available exchange capacity.

   d. If available, 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, TSOs shall characterise the ability of the residual margins to provide upward and downward flexibility considering the technical constraints of the assets:

   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; and

   c. where relevant, the residual margins of exchange capacities pursuant to paragraph 3 can be reduced taking into account the market liquidity constraints appearing in extreme prices situations. When doing so, 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, 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. 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. 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. TSOs shall analyse the potential contribution of technologies in providing balancing means to meet the uncovered short-term flexibility needs, by attributing the ability to provide FRR reserve capacity with the residual margins determined in Article 11(3). In this case:
      (1) the TSOs' balancing means 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' balancing means shall be evaluated based on technical capabilities of scheduled units identified in paragraph (2) to meet up with aFRR and mFRR product requirements (on a unit by unit or aggregated level). These capabilities are derived as percentage able to participate in aFRR and mFRR derived from observed prequalification procedures and market behaviour.
   c. TSOs shall report the probability of occurrence of uncovered short-term flexibility needs to reflect their probabilistic nature.
   d. If available, TSOs may use shorter horizons to further distinct 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 uncovered slow 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, TSOs shall also include the additional RES curtailment that would arise in case 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. 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 event;
   c. the total amount of expected energy resulting from uncovered short-term flexibility events;
   d. the expected number of hours with uncovered short-term flexibility 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; and

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. Whenever relevant and depending on the availability of data, pursuant to Article 16, 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.

8. To produce fine-tuned results TSOs shall repeat the relevant steps described in paragraphs (2) to (6) reflecting 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, and in the latter case, also to the regulatory authority.

10. In the case that 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.

Deleted – Article 12. Principles to assess DSO network flexibility needs

~~1. Each DSO is responsible for:~~

~~4. assessing the network's 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 the upwards and downwards network flexibility which the DSO is planning 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~~

~~5. analysing the reasoning for such network flexibility needs taking into account their national regulatory framework following the implementation of Article 32(1), and the incentives to connect additional RES, load, storages or other flexibility resources on certain parts of their distribution systems.~~

~~2. When providing data under this article, where relevant, DSOs shall consider the guidance provided by ACER for DNDPs and any relevant guidance provided by the EU DSO Entity, including the guidance according to Article 3(2)a.~~

~~3. To provide the data and analysis for the FNA Report, each DSO shall use assumptions, scenarios, methods and data developed in their latest DNDP.~~

~~4. Where information in paragraph 2 of this Article is unavailable or insufficient for the purpose of this FNA methodology, DSOs may use additional assumptions, scenarios, methods or data only if their use is necessary for the purpose of this FNA methodology and if DSOs justify the necessity, consistency and relevance of using such additional information for the purpose of the FNA~~

~~methodology. These additional assumptions, scenarios, methods or data shall follow consistent requirements ruling the development of DNDP and their use shall be subject to agreement with the designated authority or entity and in the latter case also with the regulatory authority. These additional assumptions, scenarios, methods or data shall meet the following requirements:~~

~~d. assumptions, scenarios, methods and data shall be transparent and consistent with development plans of transmission and other distribution system operators at national level for the purpose of this FNA methodology;~~

~~e. scenario(s) used by DSOs shall be consistent with 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 distribution and transmission system operators, to ensure sufficient consistency;~~

~~iii. encompass, at least, current and forecasted electricity demand, generation and storage capacities and consider national energy and climate plans, local energy strategies and other relevant development factors.~~

~~5. In case DSO(s) uses data from other DSO to assess their own network flexibility needs, the DSO using such data derived from another DSO shall ensure relevance of the data and the method used to process the data in a way that it is meaningful and consistent for the relevant needs. A DSO which provides data to another DSO shall ensure the relevance and reliability of that data.~~

Article 11. DSO network flexibility needs

1. The following principles shall apply in consideration of 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. 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 per scenario if applicable, according to the following options:
   a. if available, summation of local maximum values of power (MW) and the total energy (MWh) during time blocks and/or during representative days for each target year defined in Article 6; or
   b. as the minimum data set, summation of local maximum values of power (MW) and the total

energy (MWh) for each target year defined in Article 6.

3. If DSO(s) cannot provide the quantitative information of 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:
   a. a repetitive situation within a time block; or
   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 and, in the latter case, also to the regulatory authority in accordance with the format described in Table 15 in Annex II. Examples of the expected submission of data are also provided in Annex II.

~~Table 1. Network flexibility needs~~

~~Direction of need~~	~~Target years~~	~~Time block~~	~~Spatial granularity~~	~~Voltage level of congestion or voltage issue~~	~~Type of value~~	~~Network flexibility needs~~	~~Expected contractual means to access flexibility~~
~~Upwards or downwards~~	~~Data pursuant to Article 13(1)(a)~~	~~Data pursuant to Article 13(1)(a)~~	~~Data pursuant to Article 13(1)(b)~~	~~Data pursuant to Article 13(1)(c)~~	~~Data pursuant to Article 13.2~~	~~Data pursuant to Article 13.2~~	~~Information pursuant to Article 13.5~~

6. DSO(s) shall provide to the designated authority or entity and, in the latter case, also to the regulatory authority the reasoning for the DSO network flexibility needs provided in Table 15 in Annex II. 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 part 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 II.
7. In order for DSO(s) data to be used for the fine-tuning of RES integration system needs in accordance to Article 14, 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) do not dispose the share of downward flexibility needs leading to RES generation curtailment compared to the total downward flexibility needs, an estimate should be provided by the DSO(s).
8. In addition to the data that shall be provided according to the format of Table 15 in Annex II, each DSO shall provide to the designated authority or entity and, in the latter case, also to the regulatory authority all the following complementary information:
   a. the source of data and the studies used to provide its network flexibility needs;

b. the scenario(s) used to define future generation, loads and energy storages in its network; and
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 case TSOs do not already model transmission network constraints within their bidding zone(s) into economic dispatch simulation, TSOs may quantify downward network needs resulting in RES generation curtailment due to transmission network constraints in the form of hourly time-series or other relevant time block.
2. TSO shall use the quantified needs to fine-tune RES integration needs quantified pursuant to Article 9, provided that the conditions of Article 16(3) are satisfied.
3. To avoid overlaps with the quantification of RES integration needs, pursuant to Article 9, quantification of RES generation curtailment due to transmission network constraints pursuant to paragraph (1) should focus on network simulations results reflecting 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, in the latter case also to the regulatory authority, 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.

4. TSOs shall provide analysis identifying and justifying with a cost benefit analysis comparing the use of flexible solutions as alternative to grid expansion. For doing so, they shall provide to the designated authority or entity, and in the latter case also the NRA, a description of the method and the calculations they used to make this comparison.
5. 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 9(1) and the associated set of inputs and the reference grid conditions used for the most recent published TYNDP or national development plan and shall be quantified for the same weather scenarios.
6. The quantification of RES generation curtailment due to transmission network constraints and of upward network flexibility needs pursuant to this Article shall be reported to the designated authority or entity, and in the latter case, also to the regulatory authority.

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

1. TSOs and DSOs shall assess for each target year of the flexibility needs assessment as defined in Article 6 the volumes of flexible resources that could be limited under the national implementation of grid prequalification and temporary limits processes.
2. To do so, 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 volumes are unavailable or null, 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 estimated maximum hourly volumes of unavailable flexible resources based on available and relevant historical data and explain the method to extrapolate historical data;
    c. In case TSOs and/or DSOs foresee an important increase of unavailability of flexible resources due to grid prequalification and/or temporary limits, TSOs and/or DSOs may still provide estimated hourly volumes of unavailable flexible resources, even if historical volumes are unavailable or null.
3. TSOs and/or DSOs shall provide to the designated authority or entity, and in the latter case, also to the regulatory authority 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. Whenever needs or unavailability of flexible resources are provided pursuant to Articles 11 to 13, TSOs shall fine-tune system needs quantified pursuant to Articles 8 to 10, taking 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 III
2. Downward flexibility network needs resulting in RES curtailment due to local constraints aggregated per the analysed bidding zone shall be provided by TSOs pursuant to Article 12 and by DSOs pursuant to Article 11.
3. TSOs shall first verify relevance of transmission network needs, distribution network needs and unavailability of flexible assets due to prequalification and temporary limits, 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) is 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 DSOs aggregated for the analysed bidding zone(s) is 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, maximum hourly unavailability of flexible resources due to prequalification and temporary limits, to be provided pursuant to Article 13 is higher than 10% of the installed capacity of flexible resources as provided by TSOs based on Annex I.

4. The results from the verification of relevance pursuant to paragraph (3) shall be reported to the designated authority or entity, and in the latter case, also to the regulatory authority.

5. Only if all the criteria of paragraph (3) are met, TSOs shall fine-tune RES integration needs pursuant to paragraphs (14) to (17) of Article 8, taking into account RES curtailment due to network constraints at transmission and distribution level and 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 I, TSO(s) shall appropriately distribute the provided RES curtailment data to match the requested granularity, correlating data via 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 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; and

    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, and in the latter case, also to the regulatory authority.

Article 15. Market barriers and contribution of digitalisation

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

a. Market access to new entrants and small actors
b. Incentives to provide flexibility
c. Requirements to provide balancing services
d. Requirements to provide congestion management
e. Administrative and infrastructure barriers
f. Incentives to consider non-wire alternatives

Article 16. Guiding criteria

1. The assessment of the capability of the different sources of flexibility to cover the flexibility needs defined in the FNA methodology shall be based on the guiding criteria outlined in this Article. TSOs and DSOs shall provide to the designated authority or entity, and in the latter case, also to the regulatory authority, the indicators and analyses specified in this Article to enable such assessment.
2. TSOs and DSOs shall agree with the designated authority or entity, and in the latter case also with the regulatory authority on whether to apply the guiding criteria to the fine-tuned needs pursuant to Article 8(9) or to the RES integration needs quantified pursuant to Article 8, paragraphs (6) and (7).
3. The DSOs shall provide the following indicators for the expected uncovered 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 activation (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, 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 II, or other studies, if available.
4. The TSOs shall provide, for each of the system flexibility needs and transmission network flexibility needs addressed, sub-indicators which further interpret the results obtained through the application

of Articles 8 to 10 and Article 12 and 14. Sub-indicators represent technical requirements of the flexibility needs that can assist policymakers in the identification of the most suitable resources to cover them. The 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.

5. TSOs shall carry out further analysis to address the capability of the different sources of flexibility to meet uncovered downward needs, i.e. RES integration needs, as defined in Article 8. 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;

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; and

d. reflect the cost-efficiency of additional flexible resources. The related costs shall be agreed with the designated authority or entity, and in the latter case, the regulatory authority or derived from the inputs of ERAA or, if applicable, NRAA.

6. As short term needs are covered by FRR reserve capacity in line with Article 157 of Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation to cover 99% of system imbalances, TSOs shall provide analysis to the designated authority or entity, and in the latter case also the regulatory authority, on how uncovered short-term flexibility needs calculated in Article 10 shall first be met with additional reserve capacity or other measures.

7. For upward uncovered ramping and short-term needs quantified pursuant to Articles 10 and 11, TSOs shall provide analysis to the designated authority or entity, and in the latter case also the regulatory authority, on the capability of the different sources of flexibility (e.g., additional flexibility resources, additional reserve capacity, or further participation to balancing when applicable) to reduce the uncovered needs. TSOs shall account for the technical characteristics, sub-indicators identified in paragraph (4), and cost-efficiency.

8. For upward transmission network needs quantified pursuant to Article 12, TSOs shall provide analysis to the designated authority or entity, and in the latter case also the regulatory authority, on the capability of the different sources of flexibility (e.g., additional flexibility resources, including at local level) to reduce the uncovered needs. TSOs shall account for the technical characteristics, sub-

indicators identified in paragraph (4), and cost-efficiency.

9. The different instruments to manage network congestion, such as those provided in the Network Development Plans, bidding zone review in accordance to Article 14 of the Electricity Regulation and remedial actions in accordance to Article 2(13) of Regulation (EU) 2015/1222 shall be accounted for. In case the identified transmission network needs could be solved by grid reinforcements already identified by the most recent published TYNDP or national development plan, it should be considered whether the need for additional flexibility resources can be covered by such reinforcement when realised.
10. When determining the flexibility resources to cover any uncovered upward need, it will be ensured that the reliability standard of the considered bidding zone is not surpassed, while also considering the overlaps with the adequacy findings of ERAA or NRAA and other upwards uncovered needs.
11. TSOs shall provide an assessment on the interdependencies among the needs quantified pursuant to Articles 8 to 10 and Article 12, in particular upward needs arising from network and system needs.
12. Upon request of the designated authority, the TSOs shall support with data and analysis the assessment of the impact of removal of market barriers to flexibility and the impact on digitalisation, the assessment of any other cost-effective solution, for example the introduction of additional RES capacity, network development or any other mean deemed relevant by the designated authority, as an alternative to the introduction of new flexible resources.

Article 17. Amendments of the FNA methodology

1. ACER, or jointly ENTSO-E and EU DSO Entity, may initiate an amendment process of the FNA methodology, with ACER doing so through a request for amendment, and ENTSO-E and EU DSO Entity through jointly notifying ACER of their intention. Within six months of the request or notification, ENTSO-E and EU DSO Entity shall jointly submit a proposal for amendments to ACER.
2. Before submitting a proposal for amendments, ENTSO-E and EU DSO Entity shall carry out a public consultation. They shall duly take the results of that consultation into consideration in their proposal.
3. 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 TSOs and DSOs need to translate the FNA methodology into their national language(s), 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, TSOs and DSOs shall provide, in accordance with national legislation, the relevant regulatory authorities with an updated translation of the FNA methodology.

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

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

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 at least the modelled 1st set of 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 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

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	Time series	At least hourly	MW	To be provided in .xml

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already accounted in Must Run)				

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	

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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	1 value 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

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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

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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 1 per WS	MW	To be provided in .xml
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

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

Pursuant to the provisions of Articles 3, 4, 6 and 13 of the FNA methodology, the following set of data shall be provided by DSO(s) to the designated authority or entity and, in the latter case, also to the regulatory authority, 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 t 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)

Data 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 paragraph 2 of Article 13 (yearly values)

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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	*Bidding zone = Region 1 + Region 2*	high voltage 132kV network	total energy over the year	4 500 MWh	70 %	local service
2						summation of maximum power	110 MW	70 %	
3					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	Bidding zone *= Region 1 + Region 2*	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 paragraph 2 of Article 13 (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		RES generation in region 1 being 90%	*Region 1*		total energy over the entire time block	3 000 MWh	50 %	local service

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2			Jan-Dec Mon-Sun: 00:00 - 23:59	from wind and 10 % from photovoltaics.		high voltage 132kV network	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	*Region 2*	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	-	*Region 2*	high voltage 132kV network	no need		-	-
10			Oct-Mar Mon-Fri: 19:00-07:59 and Sat-Sun: 00:00-23:59	off hours in winter	*Bidding zone =Region 1 + Region 2*	medium voltage 20kV network	total energy over the entire time block	10 MWh	-	local service
11							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 explanations:

- 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.

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Table 18. An example of data provided in accordance with paragraph 2 of Article 13 (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

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

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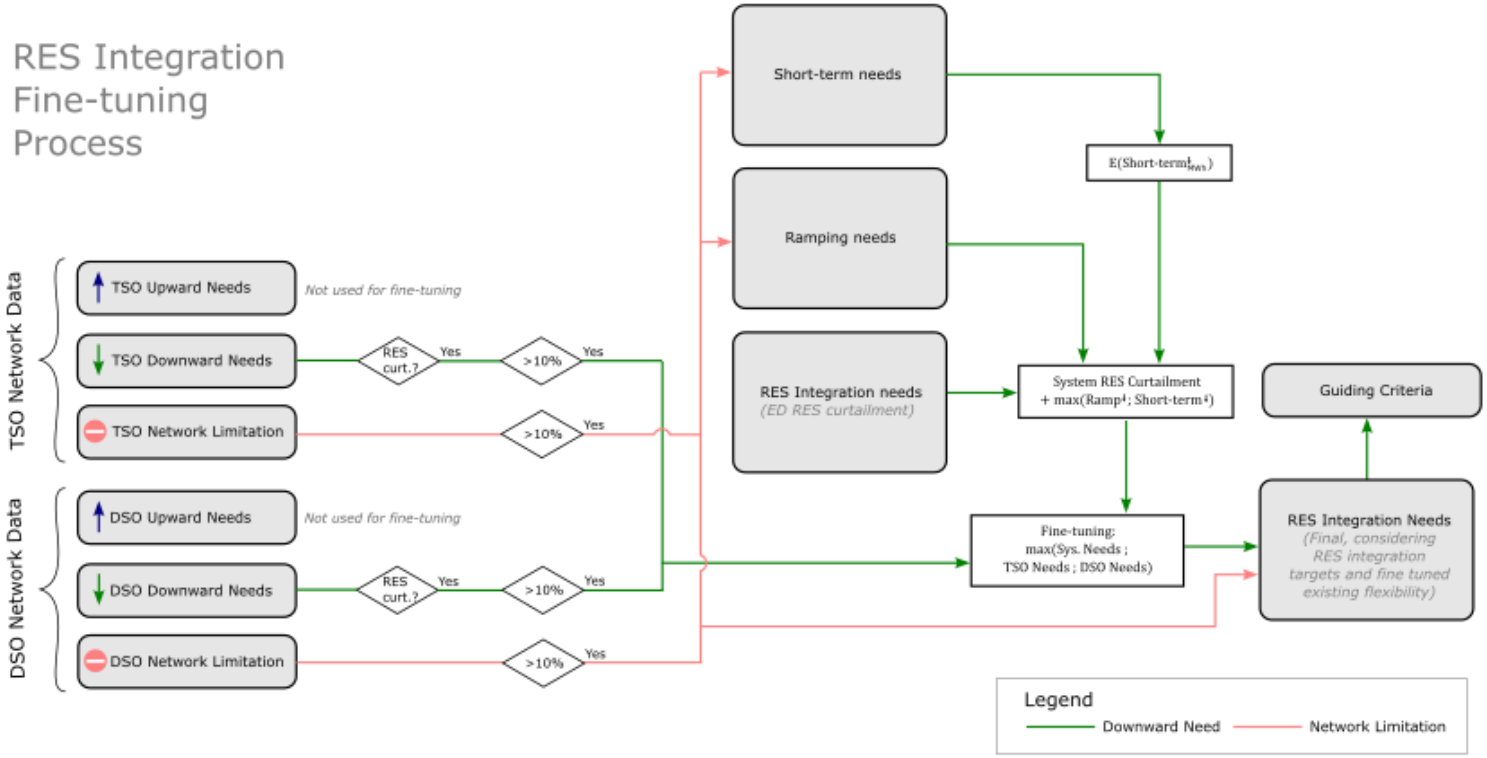
Annex III - Fine-tuning Process



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