Definition of the type and format of data and the methodology for the analysis by transmission system operators and distribution system operators of the flexibility needs at national level

in accordance with Article 19e of Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019, as amended by Regulation (EU) 2024/1747 of the European Parliament and of the Council of 13 June 2024

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Whereas

1. This document defines the type and format of data that transmission system operators (hereinafter referred to as "TSOs") and distribution system operators (hereinafter referred to as "DSOs") are to provide to the regulatory authority, or another authority or entity designated by each Member State (hereinafter referred to as "designated authority or entity") for the preparation of the report on estimated flexibility needs (hereinafter referred to as "FNA report"), in accordance with Article 19e(4)(a) of Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity (hereinafter referred to as "Electricity Regulation"), as amended by Regulation (EU) 2024/1747 of 13 June 2024 amending Regulations (EU) 2019/942 and (EU) 2019/943 as regards improving the Union's electricity market design. This document also sets out a methodology for the analysis by TSOs and DSOs of the flexibility needs in accordance with Article 19e(4)(b) of the Electricity Regulation. The authority or entity is designated by each Member State after the approval of this "Flexibility Needs Assessment methodology" (hereinafter referred to as "FNA methodology") by the European Union Agency for the Cooperation of Energy Regulators (hereinafter referred to as "ACER").

2. The FNA report adopted at the national level aims to support each Member State in the identification of indicative national objective for non-fossil flexibility, which also include the resources needed to cover flexibility needs quantified in the FNA report, pursuant to Article 19f of the Electricity Regulation. The FNA methodology considers the general principles and goals set out in the Electricity Regulation as well as in the broader EU legal framework, in particular:

    a. Directive (EU) 2019/944 of 5 June 2019 on common rules for the internal market for electricity (hereinafter referred to as "Electricity Directive");

    b. The methodology for the European resource adequacy assessment approved by ACER Decision No 24/2020 of 2 October 2020 (hereinafter referred to as "ERAA methodology").

3. In this FNA methodology, congestion issues may address network situations beyond the definition of 'physical congestion' contained within the Electricity Regulation or the definition of 'congestion' included in Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management. The draft Network Code on Demand Response, which is under development at the time of this FNA methodology's adoption, intends to define congestion issues as situations where the electric current 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.

4. In accordance with Article 32 of the Electricity Directive, DSOs develop a distribution network development plan (hereinafter referred to as "DNDP") to ensure transparency on medium and long-term flexibility needs and outline planned investments for the next 5 to 10 years. The DNDP is expected to be the main source for the FNA methodology, reflecting indications at the distribution level. As Member States may exempt integrated electricity undertakings with fewer than 100,000 customers or operating in small isolated systems from certain DNDP obligations pursuant to Article 32(5) of the Electricity Directive, the data required for the FNA methodology may be based on other relevant processes indicated in this document. DSO may develop additional studies to DNDP, which provide additional and relevant information for this FNA methodology provided these studies follow consistent requirements ruling the DNDP in terms of assumptions, scenarios and methods.

5. This FNA methodology is established to provide a robust and standardised framework for the data

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and analyses that DSOs and TSOs are required to submit to the regulatory authority or another authority or entity designated at national level for the purposes of adopting the FNA report (hereinafter referred to as "designated authority or entity"). This FNA methodology aims to harmonise and guide the technical and analytical elements of such submissions, ensuring consistency and comparability across Member States when TSOs and DSOs present their data and analyses. However, in accordance with Article 19e of the Electricity Regulation, the scope of the FNA methodology does not extend to defining or regulating the governance structures, roles, or responsibilities of the designated authority or entity in the process of developing the FNA report. These matters are explicitly excluded from the scope of the FNA methodology and are intended to be addressed at the Member State level.

6. When carrying out their roles and responsibilities described in the FNA methodology, TSOs and DSOs should cooperate 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.

7. The quantification of system needs is carried out at bidding zone(s) level and includes needs associated with both the transmission and distribution network without localising them.

8. Recognising that the relevance of flexibility needs may vary by Member State, and with the aim of complementing the analyses of the needs included in the FNA methodology to take into account more specific national conditions, TSOs and DSOs within each Member State have the discretion to consider additional aspects of such needs, for example investigating as part of the renewable energy sources (hereinafter referred to as "RES") integration needs the prolonged periods of RES shortage. Moreover, consistency between scenarios considered by TSOs and DSOs is ensured since both use common National Energy Climate Plan (hereinafter referred to as "NECP") targets in their scenarios and national grid planning processes.

9. NECP are introduced by the Regulation (EU)2018/1999. They are integrated planning tools that Member States are required to prepare in view of the implementation of the Energy Union objectives covering ten-year periods starting from 2021 to 2030. NECPs describe how each Member State plans to contribute to the achievement of the common Energy Union objectives.

10. As required by Article 19e(1)(a) of the Electricity Regulation, consistency between the FNA report adopted at the national level, the ERAA and the national resource adequacy assessments (hereinafter referred to as "NRAA") must be ensured. To facilitate this, the FNA methodology mandates that the data and analyses provided to the designated authority or entity rely on the same definitions of terms as understood for the purposes of the ERAA and NRAA and rely on data belonging to one of the reference scenarios of the ERAA or to consistent ones used in the NRAA. To consider more specific national conditions, TSOs can run the analyses for additional scenarios, either included within the set of reference scenarios of the ERAA or additional ones. While starting with the same set of consistent input, as listed in Article 8 of this FNA methodology, TSOs have the possibility to assess system needs at the national level through processing of ERAA or NRAA economic dispatch results or by running separate economic dispatch simulations.

11. Whenever applicable, TSOs may conduct the analyses of system needs on a separate economic dispatch simulation based on the same scenario data of the ERAA/NRAA but taking into consideration technical constraints concerning ramping and start-up and shut-down times of generation, storage and demand response units and/or reserve capacity to manage forecast errors. When doing this ramping and/or short-term needs would be captured into the analysis of RES integration needs and

could be extracted and analysed directly from economic dispatch simulations.

12. For each target year considered in the assessment ERAA/NRAA scenarios already take into account:
    a. existing sources of flexibility such as existing dispatchable assets (thermal, storage, DSR, etc.), downward flexibility from RES plants; and
    b. sources that have been contracted through capacity or other support mechanisms;
    c. sources that are expected to be available as a result of national policies and not already accounted for in point a) and b);
    d. sources available in other countries and made available through interconnection capacity.
13. The indicator of the RES integration needs is calculated to cover RES generation curtailment, typically during low demand and high renewable generation conditions and alleviate system stress during low RES generation and high demand periods (including periods of prolonged shortage, so-called "Dunkelflaute"). It follows system constraints and cannot be stored, shifted or exported by available energy storage, demand response, other non-fossil flexibility resources or transmission capacity. It is characterised in terms of relevant timeframes (hourly, daily and seasonal) and further expressed in the form of additional technology-neutral flexible capacity needed to achieve national RES integration targets.
14. The indicator of the ramping needs represents the additional system needs to cover expected hourly residual load variations taking into consideration the technical constraints of flexible generation units. This analysis complements the simplification of some technical constraints not accounted for in the ERAA/NRAA studies used as reference for the FNA methodology which have lower relevance for adequacy on the day-ahead market (e.g. simplification of minimum power or start-up/shut-down constraints to manage computation power). The ramping needs are expressed by flexibility shortages (GW) per hour and per simulation for a certain target year. Member States that take into account such technical constraints already in their NRAA, in case this is used as a reference for the FNA methodology, directly extract and analyse upward and downward flexibility shortages from market simulation results, assessing the behaviour of RES generation curtailment during RES excess periods and the behaviour of relevant shortage indicators (e.g. Energy Not Served - ENS) during scarcity periods. RES generation curtailment data may then be used to fine-tune the results of the RES integration need indicator, while accounting for the same RES integration target.
15. The indicator of the short-term flexibility needs represents the additional system needs to cover unexpected variations of the demand, RES generation or unexpected outage of generation or transmission assets. Initially, the gross needs are determined based on historic prediction errors and outage rates to cover all flexibility required by the market, to balance their portfolios, as well as to balance TSOs' residual imbalances. Then, the net needs are determined based on the remaining upward and downward margins of generation, demand and storage units following economic dispatch simulations conducted for the ERAA and NRAA assessments while taking into account remaining network capacity for import and export, as well as technical operational constraints of units in terms of ramping and start-up or shut-down. 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. The net short-term flexibility needs are expressed by flexibility shortages (GW) per hour or relevant timeframe and per simulation for a certain target year.
16. While short-term flexibility needs aim to at addressing all forecast errors and forced outages in the system, part of these needs will be covered by FRR reserve capacity in line with Article 157 of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity

transmission system operation to cover 99% of system imbalances and the dimensioning incident. While FRR and also FCR reserve capacity can be already accounted in economic dispatch simulations to account for prediction errors and forced outages during scarcity, these already contribute to the residual margins. However, these margins do not account for the full short-term flexibility needs of the system, nor for the reserve capacity needs during non-scarcity periods. Uncovered short-term flexibility needs calculated in Article 11 should therefore be covered with additional reserve capacity or other measures. If short-term flexibility needs results in additional RES curtailment, this may be used to fine-tune the RES integration needs. In relation to this fine-tuning, it is highlighted that energy-based targets (like the RES integration target used to quantify RES integration needs) are not significantly impacted by rare but large forecast errors events.

17. In view of the need to achieve cost effective security and reliability of supply and to decarbonise the electricity system, taking into account the integration of variable RES, the different sectors, and the planned reinforcements, DSOs should estimate, in accordance with the DNDP, for a period of at least the next 5 to 10 years their flexibility needs, including the curtailment of generation that would appear in case of lack of flexibility resources.

18. 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.

19. The indicators of distribution network flexibility needs provide as a minimum data set:

    a. a summation of each locally needed maximum power to solve congestion or voltage issues, expressed in MW, that is the sum of the maximum power needed at all the locations where a congestion or voltage issue is forecasted; and

    b. a cumulated value in terms of energy per time block to capture the total effect on the system.

20. Guiding criteria are intended to assess the capability of resources to cover the flexibility needs. The most granular data to describe a network flexibility need is generated at the time of procuring local services and is updated whenever the actual need at any given location changes. Therefore, market information, pursuant to the procurement of local services, is the main source of information to assess the capability of flexible resources to cover network flexibility needs.

21. TSOs and DSOs network flexibility needs include both upward and downward local needs associated to network constraints, which are not observable within economic dispatch results that assume copper plate conditions. To avoid double-counting in the quantification of downward network needs and system flexibility needs associated to RES integration, the approach considered in this FNA methodology involves the quantification of downward network needs corresponding solely to RES generation curtailment to be used to possibly fine-tune RES integration system needs. All types of system needs may be also fine-tuned taking into account unavailability of flexible resources due to prequalification and temporary limits to be accounted in the economic dispatch simulations or the residual margins/residual load used for the calculations in Article 9, 10 and 11.

    On the contrary, upward network needs due to network constraints both at transmission and distribution level do not result in any fine-tuning of system needs and are assessed individually, since they reflect a different requirement (energy not delivered due to local constraints) with respect to system needs (energy not served due to technical limits of generation units and short-term needs).

    Finally downward network needs due to network constraints both at transmission and distribution level neither result in any fine-tuning of downward uncovered ramping needs and downward

uncovered short-term flexibility needs. These are not expected to be highly impacted by demand shedding due to network constraints as these network needs are assumed to show limited volatility and high predictability.

22. Fine-tuning represents an additional analysis with respect to the assessment of system needs based solely on ERAA/NRAA or separate economic dispatch results, aimed at correctly quantifying overall needs (system and network) taking into account local network constraints and reflecting them on system needs. This is carried out only when certain conditions of relevance apply 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, when available. Additional needs resulting from the fine-tuning must be clearly identifiable.

23. The fine-tuning also involves the potential unavailability of flexible resources whose activation is limited based on grid prequalification and temporary limits set by TSOs or DSOs. Such 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.

24. The diversity of DSOs operating at each Member State level reflects significant differences in size, as measured by the number of connected customers, the presence or absence of connections to the TSO grid, and differing obligations, such as the preparation of a DNDP. In this context, allowing each DSO to delegate all or part of any tasks with which it is entrusted under the FNA methodology to one or more DSOs or to an organization representing DSOs, a TSO or another third party, in case they can carry out the respective function at least as effectively as the delegating DSO, would aim at enhancing efficiency while maintaining the distinct roles and responsibilities of the involved parties. Moreover, DSOs might 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.

25. The DSO data and analyses referenced in the FNA methodology should be submitted in using the national template provided in Article 13 of this methodology to ensure that each specific group of DSOs maintains the necessary harmonisation, facilitates the coordination with other groups of DSOs and/or TSOs, and streamlines the preparation of the FNA report by the designated authority or entity. Annex I of this FNA methodology includes several examples.

26. As required by the second subparagraph of Article 19e(4) of the Electricity Regulation, the FNA methodology includes guiding criteria on how to assess the capability of different flexibility resources to cover the flexibility needs. Guiding criteria aim at providing additional information to the Member States to support the identification of indicative national objectives for non-fossil flexibility, targets for demand side response, storage and flexible resources, pursuant to Article 19f of the Electricity Regulation. To this aim, guiding criteria provide additional characterization of the needs quantified as part of this FNA methodology and also include criteria on how to take into consideration interactions among the various needs, the fact that flexibility technologies may have the technical capabilities to cover multiple needs, and the interactions between FNA and other national studies, including the results of the latest published ERAA/NRAA.

When defining targets national policymakers should therefore take into account information derived from the application of guiding criteria together with other information such as those resulting from assessment of market barriers and contribution of digitalisation, other relevant national studies and documents consistent with the latest approved NECP, other relevant national data and relevant cost-

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effective measures to meet national objectives.

27. To provide data and analysis pursuant to this FNA methodology, TSOs and DSOs should consider the relevant published guidance from ENTSO-E, EU DSO Entity and ACER and make best use from lessons learnt while implementing this FNA methodology at national level, on topics such as methods, organization, or data handling.

Article 1. Subject matter and scope

1. In accordance with Article 19e(4) of the Electricity Regulation, this document shall:
    a. define the type and format of data that TSOs and DSOs shall provide at national level to the designated authority or entity; and
    b. develop a methodology for the analysis by TSOs and DSOs of the flexibility needs at national level, including guiding criteria on how to assess the capability of the different sources of flexibility to cover the flexibility needs.

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, for this FNA methodology the following definitions shall apply:
    a. '**climate year**' means a climatic year or weather scenario simulated within the ERAA/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 as part of the FNA report adopted at national level;
    c. '**congestion issue**' means a situation when the electric current flow through a physical asset exceeds operational limits;
    d. '**daily timeframe**': one of the timeframes for the characterization of flexibility needs; it refers to needs occurring 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;
    e. **'demand'** means the total instantaneous electricity consumption observed in the transmission and distribution systems, including the network losses;
    f. **'demand shedding'** means limiting demand for system operational reasons or grid-capacity reasons;
    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 decreasing injection on 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 Methodology for the European resource adequacy assessment (ERAA Methodology);

l. **'Energy Not Delivered (END)':** the energy which is not supplied due to network constraints;

m. **'Energy Not Served (ENS)':** the energy which is not supplied due to insufficient capacity resources to meet the demand;

n. **'ERAA'** means the European resource adequacy assessment conducted by ENTSO-E pursuant to Article 23 of the Electricity Regulation**;**

o. **'ERAA methodology'** means the methodology for the European resource adequacy assessment approved by ACER Decision 24/2020**;**

p. **'fast flexibility'** means the capacity able to react to aggregated intra-day error variations (15 to 60 minutes before real-time);

q. '**hourly timeframe**': one of the timeframes for the characterization of flexibility needs; it refers to needs occurring 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;

r. '**local service**' means energy or capacity procured by a TSO or DSO to solve congestion or voltage issues they have identified in their systems;

s. '**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;

t. '**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;

u. '**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;

v. '**ramping needs**' refer to needs associated with variations of the residual load assuming perfect forecast conditions;

w. '**RES curtailment**' means limiting the generation or transmission of renewable power for system operational reasons or grid-capacity reasons;

x. **'RES integration needs'** refers to the quantity of flexibility required to achieve annual RES integration targets or maximum acceptable level RES curtailment for the Member State.

y. **'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;

z. '**seasonal timeframe**'**:** one of the timeframes for the characterization of flexibility needs; it refers to needs occurring 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;

aa. **'short-term flexibility needs'** refers to needs associated with unexpected variations of the residual load or forced outage of assets during the intra-day or balancing timeframe;

bb. **'slow flexibility'** means the capacity able to react to aggregated day-ahead forecast error (1 to 5 hours before real-time);

cc. **'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;

dd. '**target year**' means a year for which data and analyses are provided within the framework of the FNA methodology;

ee. **'upward flexibility needs'** means needs whose solution requires increasing injection on the network or decreasing demand from the network;

ff. '**voltage issue**' means a situation when voltage levels are not within operational limits;

gg. **'very fast flexibility**': means capacity able to react to aggregated day-ahead or intra-day forecast error variations (5 to 15 minutes before real-time).

Article 3. Roles and responsibilities

1. Each TSO and DSO of each Member State is responsible for:
   a. providing the required data and analyses pursuant to Article 19e(3) of the Electricity Regulation and in accordance with the definitions and procedures established in this FNA methodology, as well as taking into account the type and format of data set out in Annex I and Annex II of this FNA methodology;
   b. ensuring the correctness and completeness of the data provided, and making sure that the submitted data adheres to the minimum standards and complies with the data types and formats specified in the FNA methodology; and
   c. providing any additional information that might be needed or requested by the designated authority or entity pursuant to Article 19e(3) of the Electricity Regulation within the required timeframe and in accordance with Article 4 of this FNA methodology. The request of the designated authority or entity shall be duly justified and proportionate, any change in the input data or further extensions of the analysis must receive agreement from all national TSOs and DSOs to the extent they are concerned.
2. ENTSO-E and EU DSO Entity shall closely cooperate and coordinate the TSOs and DSOs in the provision of data and analyses. This coordination shall include the required guidance on how TSOs and DSOs implement the FNA methodology. In particular, EU DSO Entity shall within two years from the approval of this methodology assess lessons learnt while implementing this FNA methodology at national level, in particular, considering provisions from Articles 4, 12, and 13, and if relevant draft and publish guidance to DSOs.

3. A DSO is entitled to delegate all or part of any tasks with which it is entrusted under the FNA methodology to one or more DSOs, to an organisation representing DSOs, to a TSO or to a third party. The delegating DSO shall remain responsible for ensuring compliance with the obligations under this FNA methodology.
4. If all or part of any tasks specified in the FNA methodology are delegated to another party, the delegating DSO shall ensure that the suitable confidentiality agreements with the other party have been put in place prior to the delegation pursuant to Article 5 of the FNA methodology.

Article 4. National implementation

1. The implementation of this methodology involves the following steps and timeframes at the national level, as defined in this Article.
2. By three months after the approval of the FNA methodology by ACER, and every two years thereafter:
    a. TSOs and DSOs shall agree on the roles, responsibilities, and timeline related to the exchange of data to fulfil their requirements pursuant to the FNA methodology and inform the designated authority or entity and the NRA;
    b. If DSOs intend to use assumptions, scenarios, methods, or data in addition to DNDP to fulfil their requirements pursuant to the FNA methodology, DSOs shall inform the designated authority or entity and the NRA and, pursuant to Article 14(2)c, justify the necessity, consistency and relevance of using such additional assumptions, scenarios, methods or data for the purpose of this FNA methodology;
    c. When there are multiple TSOs in the same Member State, they shall collaboratively agree on the contribution to the FNA analyses and on the data that each of them shall provide in accordance with the requirements and procedures established in this FNA methodology and inform the designated authority or entity;
    d. All TSOs and DSOs shall agree on the common target years to provide data and analyses pursuant to Article 6(3) of this FNA methodology and inform the designated authority or entity;
    e. All DSOs shall coordinate with TSOs and seek input from the designated authority or entity on the temporal, spatial and voltage granularity of DSOs data, pursuant to Articles 12 and 13 of this FNA methodology;
    f. TSOs and DSOs shall communicate to the designated authority or entity the type of data and analyses they will provide, if any, in addition to the minimum requirements of the FNA methodology. Any additional data or analyses required from DSOs to perform additional changes proposed by TSOs shall be agreed by DSOs and vice versa. The proposal by TSOs and DSOs shall be duly justified;
    g. TSOs and DSOs shall seek input from the designated authority or entity and the NRA on the timeframe for the approval of the FNA report.
3. By four months after the approval of this FNA methodology by ACER, and every two years thereafter, the full scope of data and analyses that TSOs and DSOs shall provide at the national level shall be defined pursuant to the provisions set out in Articles 3 and 6 of this FNA methodology.

4. By ten months after the approval of the FNA methodology by ACER, and every two years thereafter, TSOs and DSOs shall send data and analyses to the designated authority or entity.
5. All DSOs and TSOs who have provided data or analysis pursuant to the previous paragraph shall coordinate with the designated authority or entity during the finalization and adoption phase of the FNA report to ensure clarity and correct representation of the provided data and analyses in the FNA report, which shall also address market barriers and contribution of digitalisation.
6. In instances where the DSOs and/or TSOs are unable to reach an agreement at the national level regarding any provisions outlined in paragraph 1(c) of this Article within the deadlines specified in this methodology, the DSOs and/or TSOs, as the case may be, shall inform the designated authority or entity about the lack of agreement. DSOs and TSOs shall provide the relevant drafts of their proposals along with appropriate explanations. In case the Member State has designated a TSO or another entity for the purpose of adopting the report, the disagreeing DSOs and/or TSOs shall also inform the regulatory authority.

Article 5. Confidentiality obligations

1. Any confidential information received, exchanged or transmitted pursuant to this FNA methodology shall be subject to the conditions of professional secrecy laid down in paragraphs 2, 3 and 4 of this Article.
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 of this Article 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 this 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. The complete list of data and analyses, including details on type and format, to be provided by DSOs and TSOs to the national regulatory authority or the designated authority or entity pursuant to Article 1(1) of this methodology is reported in Annex I and II, respectively.
2. The data needed to perform the analyses by the TSOs shall be sourced by either national or European studies, platforms and other sources, pursuant to Article 8 of this methodology, provided, where relevant, that consistency with the ERAA and NRAA is ensured.
3. TSOs and DSOs shall provide data and analyses for at least one of the target years considered in the latest published ERAA or NRAA, complying with the 5 to 10 years requirement in Articles 23 and 24 of the Electricity Regulation with respect to the same latest published ERAA or NRAA and aligned with the policy year considered in the latest approved NECP. In addition, TSOs or DSOs are entitled

to consider other common target years to provide data and analyses.

4. Pursuant to the provisions included in Article 12 of this FNA methodology, the data needed to perform the analysis relative to the network flexibility needs at distribution system level shall be sourced by either the DNDP if available, annual reports on grid prequalification, annual reports on the application of temporary limits, published information in the framework of procurement of local services, or other relevant studies performed by DSOs.
5. For TSOs, data and analyses shall be provided for at least the same climate years/weather scenarios as those considered in the Economic Viability Assessment (EVA) of the latest published ERAA/NRAA for the chosen target years, if an EVA is carried out.

Article 7. Needs covered

1. 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.
2. 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 8. 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 the ERAA and the associated availability of economic dispatch results. TSOs may run the assessment for additional scenarios, either included within the set of reference scenarios of the ERAA/NRAA, or additional ones, pursuant to the provisions of Article 4(2)(f) of this methodology.
2. For the quantification of electricity system needs, the minimum set of data needed to run the analysis shall include those related to either the latest published NRAA pursuant to Article 24 of the Electricity Regulation, or to the latest published ERAA. It shall also include the data to be collected by TSOs at national level. The list of data needed to run the analyses, including information on source and required minimum quality is provided in Annex II.
3. As detailed in Articles 9, 10 and 11 of this FNA methodology, the assessment of each system need involves the processing of either ERAA or NRAA economic dispatch results. In case the TSOs of a Member State opt for the use of ERAA/NRAA economic dispatch results and in case these already take into account:

a. the ramping constraints of generation, storage and demand assets (also during non-scarcity related periods) that would be needed to assess ramping needs pursuant to Article 10 of this FNA methodology; and

b. the flexibility needs associated to forecast errors pursuant to Article 11 of this FNA methodology (short-term flexibility needs) through reserve capacity requirements as specified in Article 4(6)(g) of the ERAA methodology.

The TSO can limit its assessment to:

a. the RES integration needs pursuant to Article 9 of this FNA methodology and the analysis of NRAA economic dispatch results for ramping and short-term needs, provided that the economic dispatch results take into account both the technical constraints of ramping needs and short-term flexibility needs (conditions a) and b) above); or

b. the RES integration needs, pursuant to Article 9 of this FNA methodology, and the short-term flexibility needs pursuant to Article 11 of this methodology and the analysis of NRAA economic dispatch results for ramping needs, provided that the NRAA economic dispatch results only take into account technical constraints of generation, storage and demand assets (condition a) above); or

c. the RES integration needs pursuant to Article 9 of this methodology and the ramping needs pursuant to Article 10 of this methodology and the analysis of NRAA economic dispatch results for short-term needs, provided that the NRAA economic dispatch results only take into the short-term flexibility (condition b) above).

4. As an alternative to what is prescribed in paragraph 3 of this Article, TSOs may conduct the assessment of system needs based on an economic dispatch simulation separate from that of the ERAA/NRAA, provided this is based on the same scenario, pursuant to paragraph 1 of this Article and associated set of input, climate scenarios and outage patterns rate and that the TSOs are capable of embedding ramping needs and/or short-term flexibility needs. In this case the minimum set of data to run the analysis does not include economic dispatch results, as reported in Annex II.

5. TSOs may provide additional data and data with higher granularity than the one referred in Annex II.

Article 9. System needs – RES integration

1. To quantify RES integration system needs the TSOs shall first characterize the RES generation curtailment and residual load time series extracted from the ERAA, NRAA or separate economic dispatch 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 climate years, pursuant to Article 8 of this FNA methodology. To this aim, the following actions in paragraph 2, 3 and 4 of this Article shall be carried out:

2. Pursuant to Article 8 of this FNA methodology, TSOs shall extract RES generation curtailment time series from economic dispatch results. Each time series consists of values per hour and per climate year for each target year representing RES generation which could not be accommodated due to system constraints or interconnection capability.

3. The TSOs shall characterise RES generation curtailment time series to derive 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.

4. Pursuant to Article 8 of this FNA methodology, TSOs shall then extract residual load time series from economic dispatch results. These 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 such as periods of prolonged high residual load.

5. The TSOs shall then use the results of the characterisation obtained to provide an overview of the total excess generation resulting in RES generation curtailment in the system which shall be used to verify the achievement of national targets for RES integration.

   To do so, the TSOs shall identify a national target for RES integration for each target year, either derived from the latest approved NECP or from other relevant official national documents consistent with the latest approved NECP. The national target for RES integration shall either be expressed as integrated RES volume in absolute terms, or as a maximum acceptable RES curtailment in absolute terms, or as a maximum acceptable RES curtailment in relative terms to the total RES generation or to the total electricity demand. In the case that the Member State does not have a national target for RES integration 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 integration 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. in case all of the above do not apply, a set of representative values reflecting a reasonable range of RES integration targets.

6. In case the identified RES curtailment exceeds the level of acceptable RES curtailment defined in paragraph 5 of this Article, the TSOs shall analyse the benefit of adding new flexibility resources to the system for the target years in which the above condition is not respected. 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.

7. 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 Article 9(3) and 9(4) or economic indicators resulting from economic dispatch results or a combination of these. TSO shall then provide further characterization of the quantified needs through guiding criteria, pursuant to the provisions of Article 17 (5, 6 and 7) of this FNA methodology.

8. TSOs shall assess the impact of additional flexibility resources on the RES integration pursuant to paragraphs 6 and 7 of this Article, either by running a separate economic dispatch pursuant to Article 8 (4) of this FNA methodology, or by reflecting the new flexibility resources in the residual load time series resulting from ERAA or NRAA economic dispatch results and taking into account the contribution of existing flexible resources and interconnections. In particular:

    a. In case the TSOs opt for a separate economic dispatch, pursuant to paragraph 4 of Article 8 of this FNA methodology, 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 climate years; or

    b. In case the TSOs opt for the use of residual load time series resulting from ERAA/NRAA economic dispatch results, they shall model new flexibility resources to reflect the behaviour they would have in day-ahead electricity markets and their contribution to reducing hourly, daily, and annual residual load variability while meeting the national RES integration target.

9. 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 16 of this FNA methodology. To produce fine-tuned results TSOs shall repeat the relevant steps described in paragraph 6 to 8 of this Article reflecting the additional RES curtailment and unavailability of flexible resources within either the separate economic dispatch or the ERAA/NRAA 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 paragraph 2 of this article and RES generation curtailment associated with downward needs at the transmission and distribution level to be provided pursuant to Article 16 of this methodology.

    Unavailability of flexible resources is applied in the form of derating factor to flexible resources, based on the estimation resulting from the application of Article 15 and correlating information via time periods (hour and day of the year) or system operating conditions (renewable and load conditions).

    In case the TSOs opt for separate economic dispatch, and these are conducted including ramping

constraints or flexibility needs associated to forecast errors, pursuant to paragraph 4 of Article 8 of this FNA methodology, which result in additional RES curtailment, this RES curtailment is embedded in the quantification and fine-tuning of RES integration needs. In case the TSO identifies the uncovered ramping needs and short-term needs via processing of the economic dispatch results, pursuant, to paragraph 4 of Article 8 of this FNA methodology, which result in additional RES curtailment the associated time-series may be used to fine-tune RES integration system needs by adding for each hour the maximum between the RES curtailment resulting from ramping needs and short-term needs to the RES curtailment derived pursuant to paragraph 2 of this article.

Article 10. System needs – Ramping Needs

1. For each hour and climate year for each target year, TSOs shall extract the hourly residual load from ERAA or NRAA input data. Residual load indicator represents a value per hour and per climate year representing the demand to be covered by dispatchable units.
2. For each hour and climate year for each target year, TSOs shall extract from the economic dispatch results of the ERAA or NRAA the schedules of flexible resources on generation, storage and demand units, as well as the flow schedules of interconnectors modelled in the economic dispatch simulations. These schedules of generation, storage, demand and interconnection assets are used to calculate the residual margins on these assets by means of:
    a. the difference between the scheduled power production and the minimum and maximum power of the generation or storage assets (on unit or aggregated level);
    b. the difference between the scheduled 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 transmission capacity of an interconnector.
3. For each hour and climate year for each target year, TSOs shall verify if the residual margins (excluding reserve capacity) in paragraph 2 of this Article can provide upward and downward ramping capacity to manage the residual load variation expected for the following hour considering the technical constraints of generation (including renewable), storage, demand or transmission assets:
    a. actual upward – and downward hourly 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 flexibility on interconnectors, based on the calculation of the remaining transmission capacity available for intra-day and balancing in Article 10(2)c, is reduced taking into account market liquidity constraints during high spot prices (upward flexibility constraints) or very low prices (downward flexibility constraints). This reduction shall be based on the observed cross-border liquidity in intra-day and balancing markets during 0,1% lowest and 99,9% highest spot market prices.
4. TSOs shall determine the up- and downward uncovered ramping needs as the difference between the hourly residual load variation specified in paragraph 1 and the residual margins specified in paragraphs 2 and 3 of this Article.

5. TSOs shall analyse the uncovered ramping 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 uncovered ramping needs;
    b. a probability distribution of the uncovered ramping needs and relevant percentiles;
    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.

    TSOs may extend the analysis of the ramping needs to intra-hourly variations providing that adequate intra-hourly resolution data is available.
6. Whenever relevant and depending on the availability of data, pursuant to Article 16 of this FNA methodology TSOs and DSOs shall determine unavailability of flexible resources due to grid prequalification or temporary limits to be used to fine-tune ramping needs. To produce fine-tuned results TSOs shall repeat the relevant steps described in paragraph 2 to 5 of this Article reflecting unavailability of flexible resources within the residual margins. Unavailability of flexible resources is applied in the form of derating factor to flexible resources, based on the estimation resulting from the application of Article 15 and correlating information via time periods (hour and day of the year) or system operating conditions (renewable and load conditions).
7. In the case that TSOs opt for separate economic dispatch, pursuant to Article 8(4) of this FNA methodology and this economic dispatch already embeds ramping constraints, the task of the TSO is limited to extracting and analysing the uncovered ramping needs directly from the results of the separate economic dispatch. Whenever not directly provided by the simulation tool, this can be done by either comparing ENS and RES curtailment indicators with and without the ramping constrains or by assessing the different hours in which either ENS or RES curtailment are a direct consequence of ramping constraints.

Article 11. System needs – Short-term flexibility needs

1. TSOs shall determine the short-term flexibility needs as the 0.1 and 99.9 percentile of the probability distribution of the residual load forecast errors for each target year:
    a. The residual load forecast error for a target year shall be calculated as a time series based on:
        i. the hourly or quarter-hourly granularity forecast errors between the day-ahead forecast and real-time observations, as well as the forecast error between the intra-day forecast and real-time observation when available, for a period of at least two years;
        ii. the historical time series of the residual load forecast errors calculated as the sum of historic forecast errors of wind power, solar power and other generation subject to forecast errors, minus the forecast error of the load, for each hour or quarter hour; and
        iii. the extrapolation of the historical time series of the residual load forecast errors for each hour or quarter-hour in the target year after taking into account the projected evolution of the load and 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 of ERAA or NRAA while taking into account expected forecast improvements.

b. The probability distribution of the residual load forecast errors shall take into account:

   i. distributions to represent forecast errors in at least one time frame as specified in Article 11(1)(a)(i) of this FNA methodology. The distributions representing the day-ahead, intra-day forecast errors can be used to distinct respectively the slow and fast flexibility needs. The distribution representing the hourly or quarter-hourly variation of forecast errors can be used to define very fast flexibility needs;

   ii. TSOs may use 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); and

   iii. TSOs may aggregate the probability distributions of the residual load forecast errors with probability distributions of the forced outage of large generation and transmission units. The parameters of this probability distribution (forced outage probability and duration per technology) will be provided with the analysis.

c. Lower percentiles may be considered by TSOs as sensitivities on the 0.1 and 99.9 percentile for informative purposes.

2. For each hour and climate year for each target year, TSOs shall extract from the economic dispatch results of ERAA or NRAA the schedules of flexible resources on generation, storage and demand units, as well as the flow schedules of interconnectors modelled in the economic dispatch simulations. These schedules of generation, storage, demand and interconnection assets are used to calculate the residual margins on these assets by means of:

   a. the difference between the scheduled power production and the minimum and maximum power of the generation or storage assets (on unit or aggregated level);

   b. the difference between the scheduled 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 transmission capacity of an interconnector.

3. For each hour and climate year for each target year, TSOs shall assess the upward and downward residual margins in at least the time frame consistent with the time frame studies in Article 11(1)(b)(i) of this FNA methodology, being 5-15 minutes (to compare with very fast flexibility needs), 15-60 minutes (to compare with fast flexibility needs) and 1 to 5 hours (to compare with slow flexibility needs) taking into account the technical constraints of these assets:

   a. actual upward and downward hourly 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 (such as start-up, shut-down times, minimum up and minimum down time); and

   c. wherever relevant, the flexibility on interconnectors, based on the remaining transmission capacity for intra-day and balancing, is capped considering market liquidity constraints during high spot market prices (upward flexibility constraints) or very low prices (downward flexibility constraints). This reduction shall be based on the observed cross-border liquidity in intra-day and balancing markets during 0,1% lowest and 99,9% highest spot market prices.

4. TSOs shall determine the uncovered short-term flexibility needs per hour and per climate year for a target year. The uncovered short-term flexibility needs are calculated as the difference between the short-term flexibility needs specified in Article 11(1)(a) of this FNA methodology and the sum of

residual margins of all flexibility assets as specified in Article 11(2) and (3) of this FNA methodology:

a. TSOs shall relate the conditions of short-term flexibility needs to similar system conditions assessed for the flexibility resources (such as comparing the flexibility needs and resources during low and high renewable generation conditions); and

b. TSOs shall relate the short-term flexibility needs to the relevant time scale of the flexibility resources (at least comparing the needs and resources for very fast, fast or slow time frames specified in Article 11(1) and Article 11(2) of this FNA methodology).

5. TSOs may further analyse the contribution of the TSOs' balancing market. In this case:

   a. the TSOs' balancing needs shall be evaluated pursuant to Article 157 of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation; and

   b. 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.

6. TSOs shall analyse the uncovered short-term flexibility needs in terms of capacity per event (expressed in MW), duration per event (expressed in hours) and interval (expressed in hours between two events) and shall include per target year (over all climate year) at least:

   a. the average amount of uncovered short-term flexibility needs;

   b. a probability distribution of the uncovered short-term flexibility needs;

   c. a representation of the uncovered short-term flexibility needs per hour and day, for a full year; and

   d. the correlation between uncovered ramps and specific system conditions (including at least the wind generation, the solar generation and the demand).

7. Whenever deemed relevant and depending on the availability of data, pursuant to Article 16 of this FNA methodology 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. To produce fine-tuned results TSOs shall repeat the relevant steps described in paragraph 2 to 6 of this Article reflecting unavailability of flexible resources within the residual margins. Unavailability of flexible resources is applied in the form of derating factor to flexible resources, based on the estimation resulting from the application of Article 15 and correlating information via time periods (hour and day of the year) or system operating conditions (renewable and load conditions).

8. In the case that TSOs opt for a separate economic dispatch, pursuant to Article 8(4) of this FNA methodology and this economic dispatch already embeds short-term flexibility needs, the task of the TSOs is limited to extracting and analysing such needs directly from the results of the separate economic dispatch. Whenever not directly provided by the simulation tool, this can be done by either comparing ENS and RES curtailment indicators with and without the reserve constraints or by assessing the different hours in which either ENS or RES curtailment are a direct consequence of reserve constraints.

Article 12. Principles to assess DSO network flexibility needs

1. Each DSO is responsible for:

a. assessing the 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 the upwards and downwards network flexibility needs for preventing or solving 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 reasoning for such network flexibility needs taking into account the regulation, the frameworks, and the incentives to connect additional RES, load, storages or other flexibility resources on certain parts of their distribution systems.

2. Each DSO shall use assumptions, scenarios, methods and data developed in their latest final version of DNDP.

3. 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 they are necessary for the purpose of this FNA methodology and only if they follow consistent requirements ruling the development of DNDP. In particular:

   a. assumptions, scenarios, methods and data shall be transparent and consistent at national level for the purpose of this FNA methodology;

   b. 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.

   c. DSOs shall justify the necessity, consistency and relevance of using such additional assumptions, scenarios, methods or data for the purpose of this FNA methodology.

4. In case DSOs use data from another 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 13. DSO network flexibility needs

1. Pursuant to Article 4(2)(e) of this FNA methodology, the following principles shall be applied in consideration of the nationally coordinated temporal, spatial and voltage granularity of DSO network flexibility needs:

   a. temporal granularity shall pertain to the agreed common target year(s), as defined in Article 4(2)(d), 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 country 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. DSOs, 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. As the minimum data set, summation of local maximum values of power (MW) and the total energy (MWh) over each target year and, if available, values per time block within each target year;

   b. Information pursuant to paragraph 2(a) of this Article and, if available and in addition, summation of local maximum values of power (MW) and the total energy (MWh) during representative days for each target year; or

   c. As qualitative description of data from paragraphs a) or b) of this Article if DSO(s) cannot provide quantitative information in paragraph a) of this Article.

3. The selection of representative days pursuant to paragraph 2.b of this Article 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.

4. Data defined in paragraph 2 of this Article shall be provided to the designated entity or authority and to TSOs, and published, in accordance with the following Table 1 with samples of example of each a), b), and c) included in Annex I:

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
Upwards or downwards	Data pursuant to Art 13(1)(a)	Data pursuant to Art 13(1)(a)	Data pursuant to Art 13(1)(b)	Data pursuant to Art 13(1)(c)	Data pursuant to Art 13.2	Data pursuant to Art 13.2

5. DSOs shall provide to the designated authority or entity the reasoning for the DSO Network flexibility needs provided in Table 1, including the 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 may also provide information on the expected contractual means to access flexibility, such as local services or flexible connection agreement.
6. In addition to the data included within Table 1, each DSO shall provide to the designated authority or entity all the following complementary information:

a. the source of data and the studies used to provide network flexibility needs;
b. the scenario(s) used to define future generation, loads and energy storages on DSO network;
c. the methods used to assess the network flexibility needs and to select representative days.

Article 14. 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 at national level 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. When doing so, TSO shall use the quantified needs to fine-tune RES integration needs quantified pursuant to Article 9 of this FNA methodology, provided the condition set in the following Article 15(2) are satisfied.
2. To avoid overlaps with the quantification of RES integration needs, pursuant to Article 9 of this FNA methodology, quantification of RES generation curtailment due to transmission network constraints pursuant to paragraph 1 of this Article 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 observing local RES generation curtailment due to local constraints.
3. Whenever not already accounted for in the reference ERAA or NRAA study, 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. 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) of this FNA methodology and the associated set of inputs and reference grid conditions and shall be quantified for the same climate years.

Article 15. Unavailability of flexible resources due to grid prequalification and temporary limits

1. Where TSOs and DSOs do not model flexible resources in economic dispatch simulations which are input to the FNA methodology, TSOs and DSOs shall assess for each target year of the flexibility needs assessment as defined in Article 4(2)(d), the maximum 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 historical data from the annual reports on grid prequalification and on temporary limits according to the following process:

a. when historical volumes are unavailable, null or almost zero, 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.

3. The data pursuant to paragraph 1 of this Article shall be used to fine-tune the flexibility needs assessment pursuant to Article 16 of this FNA methodology.

Article 16. Fine-tuning system needs with network needs

1. Whenever needs are provided, pursuant to Articles 13, 14(1) and 15 of this methodology, TSOs shall fine tune system needs quantified pursuant to Articles 9 (9), 10(6) and 11(7) of this FNA methodology, taking appropriately into account the downward network needs resulting in RES generation curtailment for the analysed bidding zone(s) quantified under Articles 13 and 14(1) of this methodology and unavailability of flexible resources due to prequalification and temporary limits quantified under Article 15 of this methodology according to the steps described in this Article.

2. 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 due to network constraints at transmission level (average among the weather years considered) aggregated for the analysed bidding zone(s) is higher than 10% of the RES curtailment (average among the weather years considered) quantified pursuant to Article 9 of this FNA methodology;

   b. For the fine-tuning of RES integration needs with downward distribution network needs the average annual RES curtailment due to network constraints at distribution level provided by DSOs aggregated for the analysed bidding zone(s) pursuant to the timeframe set in Article 4 of this FNA methodology is higher than 10% of the average RES curtailment quantified pursuant to Article 9 of this FNA methodology;

   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 15 of this methodology and in line with the timeframe set in Article 4 of this FNA methodology, is higher than 10% of the installed capacity of flexible resources as provided by TSOs based on Annex II.

3. Only for the verified conditions reported in paragraph 2(a), 2(b) and 2(c) of this Article, TSOs shall fine-tune RES integration needs pursuant to Article 9(9) of this methodology taking into account RES curtailment due to network constraints at distribution level and transmission level and unavailability of flexible resources due to prequalification and temporary limits.

4. Only for the verified conditions pursuant to paragraph 2(c) of this Article, TSOs shall fine-tune ramping and short-term needs pursuant to Articles 10(6) and 11(7) of this methodology, taking into account unavailability of flexible resources due to prequalification and temporary limits.

5. Downward flexibility network needs resulting in RES curtailment due to local constraints aggregated per the analysed bidding zone(s), which are needed to verify relevance pursuant to paragraph 2 of this article and carry out the analysis referred to in paragraph 3 of this Article, shall be provided by TSOs pursuant to Article 14 and by DSOs pursuant to Articles 12 and 13 of this FNA methodology, for hour, day, season, year or other relevant time blocks.

6. If the DSOs do not dispose of downward flexibility network needs split by generation source, it is assumed that the totality of the downward flexibility network need provided pursuant to paragraph 5 of this article results in RES generation curtailment.

7. If the granularity of the data provided as per paragraph 5 and referred in paragraph 3 of Article 13 is lower than the minimum granularity referred to in Annex II of this methodology, TSOs 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 TSOs, the following default approach shall be used:

    a. in case data 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 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 shall be used as reference.

Article 17. Guiding criteria

1. TSOs and DSOs shall enable policymakers to assess the capability of flexible resources to cover flexibility needs identified pursuant to Articles 9 to 11 and in Articles 13 and 14 of this FNA methodology based on the guiding criteria defined in this Article while keeping a technology neutral approach and taking into account technical parameters and cost-efficiency as applicable.

2. The guiding criteria for distribution network flexibility needs being solved by local services include the following technical indicators:

    a. the location of the flexibility need;

    b. the direction of activation (upwards or downwards);

    c. the timeframe in which the resource shall be available to solve the flexibility need;

    d. the local maximum power required during the activation;

    e. if available, data related to the forecasted use, such as:

        i. the duration of a continuous need;

        ii. the cumulated duration of discontinuous need per time block;

iii. a measure of the frequency of activation (level of recurrence or sporadicity);

iv. a cumulated energy per time block;

f. the applicable economic criteria;

g. other available relevant criteria.

3. The data for paragraph 2 of this Article shall be based on market information published for the procurement of local services and information from Table 1, or other studies, if available.

4. For each of the system flexibility needs and transmission network flexibility needs addressed, TSOs shall derive sub-indicators capable of further interpreting the results obtained through the application of Articles 9, 10, 11, and 14 of this methodology. Sub-indicators represent technical requirements of the flexibility needs that would assist policymakers in the identification of the most suitable resources to cover them. The minimum set of sub-indicators to be computed includes the those related to frequency (number of hours or intervals per year showing a need, number of hours between two needs, volume energy, power) and duration of events per hour, day, week, season and year.

5. For the RES integration needs further analysis shall be carried out to address the contribution of the various types of new flexibility resources to reduce RES curtailment, as defined in Article 9 of this FNA methodology. In particular, TSOs shall:

   a. take into account for each flexibility resource the RES curtailment assessed for increasing capacities until the RES integration target is reached;

   b. derive for each flexibility resource the curve representing 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. The technology that yields the greatest reduction in RES curtailment per additional GWh shall be prioritised until another technology yields greater reduction in RES curtailment (depending on the slope of the curve) or until the RES curtailment target is met.

   Guiding criteria may be applied to either RES integration needs quantified pursuant to Article 9(6,7) of this methodology or to the fine-tuned needs pursuant to Article 9(9) of this methodology.

6. For upward uncovered ramping needs quantified pursuant to Article 10 and upward uncovered short-term needs quantified pursuant to Article 11 of this methodology, TSOs shall provide guiding criteria on how to cover needs including the use of additional reserve capacity or introduction of additional flexible resources capable of providing the required ramping capability, keeping a technology neutral approach and taking into account the sub-indicators identified in the previous paragraph. The guidance includes an assessment of the degree of coverage of the quantified needs by taking into account in a cost-efficient way the results of the latest published ERAA/NRAA report used as reference to the FNA pursuant to Article 6 of this methodology.

   For upward transmission network needs quantified pursuant to Article 14 of this methodology, TSOs shall provide guiding criteria on how to cover needs, including the introduction of additional flexible resources at local level capable of providing the required ramping capability, keeping a technology neutral approach and taking into account the sub-indicators identified in the previous paragraph. The guidance includes an assessment of the degree of coverage of the quantified needs by taking

into in a cost-efficient way account the results of the latest published ERAA/NRAA report used as reference to the FNA pursuant to Article 6 of this methodology and other relevant national studies.

7. To provide further guidance to the policymakers, TSOs may complement the analysis referred to in paragraph 5 of this Article by deriving curves reflecting other technical aspects such as the contribution of the various flexibility resources to reduce the indicators set in Article 9(3) of this FNA methodology or other economic indicators (e.g. reduction of average spot prices and others) resulting from market dispatch results and with other analysis to be proposed pursuant to Article 4(2)(e).
8. The same approach described in paragraph 7 of this Article may be applied beyond the scope of the FNA report to address the contribution of the various types of flexibility resources to generate economic value, considering also the costs (capital expenditures and operating expenses) associated to the introduction of new capacity of the various flexibility resources.
9. Whenever applicable, TSOs shall include within guiding criteria an assessment on the interdependencies among the needs quantified pursuant to Art 9-to-11, and 14 of this methodology.

Article 18. Derogations

1. Upon a duly justified request of a TSO or DSO, the regulatory authorities are entitled to temporarily exempt TSO or DSO from the responsibilities of this FNA methodology, in agreement with the designated authority or entity.

2. This methodology shall not apply to the transmission system and distribution systems, or to parts of the transmission system or distribution systems, of islands of Member States of which the systems are not operated synchronously with either the Continental Europe, Great Britain, Nordics or Ireland.

Article 19. Amendments of the methodology

1. Where ENTSO-E and EU DSO Entity deem necessary, they may suggest potential updates and amendments to the FNA methodology to ACER. When preparing their proposals, ENTSO-E and EU DSO Entity should consider the views of relevant stakeholders, including ACER.
2. Within three months of the date of receipt of the proposal referred to in paragraph 1, ACER shall either approve or amend it. In the latter case, ACER shall consult ENTSO-E and the DSO Entity before adopting the amended proposal. ACER shall publish the approved proposal on its website within three months of the date of receipt of the proposed documents.

Article 20. Language

1. 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.

Article 21. Market Barriers and contribution of digitalisation

1. Pursuant to the provisions of Article 19e of the Electricity Regulation, the designated authority or entity is entrusted with analysing market barriers and contribution of digitalisation to be included in the FNA report. For the analysis of market barriers, the designated authority or entity may rely on the information included in Annex III of this FNA methodology, which is to be provided by relevant entities at national level.
2. In case an authority or entity other than the NRA is designated to prepare the FNA report, this authority or entity may request and coordinate contributions to be provided by other relevant entities, including the NRA, to carry out the assessment of market barriers and contribution of digitalisation.

Annex I - Examples of Table 1 to report DSO flexibility network needs

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
Upwards or downwards	Data pursuant to Art 13(1)(a)	Data pursuant to Art 13(1)(a)	Data pursuant to Art 13(1)(b)	Data pursuant to Art 13(1)(c)	Data pursuant to Art 13.2	Data pursuant to Art 13.2

Illustrative example (not real data) Table 1 – yearly value

Line n°	Direction	Year	Time block	Spatial granularity	Voltage level of congestion or voltage issue	Type of value	Flexibility network needs
1	Downwards needs flexibility	2030	Entire year	***Bidding zone*** *= Region 1 + Region 2*	High Voltage 132kV network	Total energy over the year	4 500 MWh
2						Summation of Maximum power	110 MW
3					Medium Voltage 20kV network	Total energy over the year	2 000 MWh
4						Summation of Maximum power	45 MW
5	Upwards needs flexibility		Entire year	**Bidding zone** *Region 1 + Region 2*	High Voltage 132kV network	No need	
6			Oct-March Mon-Sun 00:00-23:59		Medium Voltage 20kV network	Total energy over the year	60 MWh
7						Summation of Maximum power	5 MW

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

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Illustrative example (not real data) Table 1 – By region and time block

Line n°	Direction	Year	Time block	Spatial granularity	Voltage level of congestion or voltage issue	Type of value	Flexibility network needs	Reasoning to define the time block
1	Downwards needs flexibility	2030	Jan-Dec Mon-Sun 00:00 - 23:59	*Region 1*	High Voltage 132kV network	Total energy over the entire time block	3 000 MWh	RES generation in region 1 is 90% wind, 10 % PV
2						Summation of Maximum power	50 MW	
3					Medium Voltage 20kV network	Total energy over the entire time block	1 500 MWh	
4						Summation of Maximum power	20 MW	
5	Downwards needs flexibility		Apr-Oct Mon-Sun 12:00-16:59	*Region 2*	High Voltage 132kV network	Total energy over the entire time block	1 500 MWh	RES generation in region 2 is 95 % PV
6						Summation of Maximum power	60 MW	
7					Medium Voltage 20kV network	Total energy over the entire time block	500 MWh	
8						Summation of Maximum power	25 MW	
9	Upwards needs flexibility		Any time		High Voltage 132kV network	No Need		
10			Oct-March Mon-Fri 19:00-07:59 and Sat-Sun 00:00-23:59	***Bidding zone*** *Region 1 + Region 2*	Medium Voltage 20kV network	Total energy over the entire time block	10 MWh	Off hours in winter
11						Summation of Maximum power	3 MW	
12			Oct-March Mon-Fri 08:00-18:59			Total energy over the entire time block	50 MWh	Working hours in winter
13						Summation of Maximum power	5 MW	

Explanation:

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

Illustrative example (not real data) Table 1 - Representative day – daily value

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Line n°	Direction	Year	Time block	Spatial granularity	Voltage level of congestion or voltage issue	Type of value	Flexibility network needs	Reasoning to define the representative day
1	Downwards needs flexibility	2030	Jan-Dec Mon-Sun 00:00 - 23:59	*Region 1* = *DSO* 1 and delegating DSO Area	High Voltage 132kV network	Total energy during the representative day	70 MWh	Typical windy day 90% wind, 10 % PV
2						Summation of Maximum power	40 MW	
3					Medium Voltage 20kV network	Total energy during the representative day	30 MWh	
4						Summation of Maximum power	15 MW	
5	Downwards needs flexibility	2030	Apr-Oct Mon-Sun 09:00-18:59	*Region 2* = *DSO* 2 and delegating DSO Area	High Voltage 132kV network	Total energy during the representative day	30 MWh	Typical sunny day in a region 95 % PV
6						Summation of Maximum power	50 MW	
7					Medium Voltage 20kV network	Total energy during the representative day	10 MWh	
8						Summation of Maximum power	20 MW	
9	Upwards needs flexibility	2030	Any time		High Voltage 132kV network	No need		
10			Oct-March Mon-Sun 0:00-23:59	Bidding zone Region 1 + Region 2	Medium Voltage 20kV network	Total energy during the representative day	10 MWh	2 hr local duration if/where needed
11						Summation of Maximum power	5 MW	

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 II - Input data to FNA process – Type and format

The following set of data shall be provided by TSO 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 harmonized 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 neighboring bidding zones)

Input to FNA

Demand

Data label	Type	Granularity	Unit	Reference Template
Demand	Time series	Hourly 1 per WS	MW	ERAA public dataset

Reserve requirements

Data label	Type	Granularity	Unit	Reference Template
Balancing reserves requirements (FCR, FRR)	Time series	Hourly	MW	ERAA public dataset

Installed capacities (used as input in ERAA/NRAA market dispatch, after EVA when carried out)

Data label	Type	Granularity	Unit	Reference Template
Solar PV	Fixed value	-	MW	ERAA public dataset
Solar CSP	Fixed value	-	MW	ERAA public dataset

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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
Other RES	Time series	Hourly	MW/% (capacity factor)	ERAA public dataset
Resources installed capacities	Fixed value	-	MW	ERAA public dataset
Energy Storage size	Fixed value	1 per storage capacity	MW, MWh	ERAA public dataset
Availability timeseries (after planned maintenance)	Time series	1 per thermal technology	%	ERAA public dataset
Derating factor	Time series	1 per technology	%	ERAA public dataset

Hydraulic generation

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

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Must run generation

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

Technical and economic characteristics of dispatchable generation

Data label	Type	Granularity	Unit	Reference template
Efficiency range / heat rate	Fixed value	1 per unit/technology	% or MWh/GJ	ERAA public dataset (standard values)
Standard efficiency / heat rate	Fixed value	1 per unit/technology	%	
CO2 emission factor	Fixed value	1 per unit/technology	kg/net GJ	
Variable O&M Costs	Fixed value	1 per unit/technology	€/MWh	
Minimum time on	Fixed value	1 per unit/technology	hours	
Minimum time off (hours)	Fixed value	1 per unit/technology	hours	
Ramping up limit	Fixed value	1 per unit/technology	% of max output power /min	
Ramping down limit	Fixed value	1 per unit/technology	% of max output power /min	

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Start-up time	Fixed value	1 per unit/technology	hours	
Shut down time	Fixed value	1 per unit/technology	hours	
Minimum stable generation	Fixed value	1 per unit/technology	%	
Start-up fuel consumption - cold start	Fixed value	1 per unit/technology	Net GJ/MW started	
Start-up fuel consumption - warm start	Fixed value	1 per unit/technology	Net GJ/MW start	
Start-up fixed cost (fuel consumption independent) warm start	Fixed value	1 per unit/technology	EUR/MW started	
Start-up fix cost (fuel consumption independent) cold start	Fixed value	1 per unit/technology	EUR/MW started	
Start-up fuel consumption - hot start	Fixed value	1 per unit/technology	Net GJ/MW started	
Start-up fix cost (fuel consumption	Fixed value	1 per unit/technology	EUR/MW started	
Transitional time from hot to warm	Fixed value	1 per unit/technology	H	
Transitional time from hot to cold	Fixed value	1 per unit/technology	h	

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

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Heavy oil (old 1, old 2)

Oil shale (old, new)

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

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	Hourly 1 time series per border	%	ERAA public dataset

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Flow-based domains: RAM, PTDF, hourly assignment	FBD representation (fixed values + timeseries)	Hourly, time series of FBD assignment per border and WS	MW	ERAA public dataset
Exchanges with implicit regions	Time series	Hourly, 1 timeseries for each border	MW	ERAA public dataset

ERAA/NRAA market dispatch per technology (only for TSOs opting for processing of ERAA/NRAA results)

Data label	**Type**	**Granularity**	**Unit**	**Reference template**
Generation per technology	Time series	Hourly 1 per technology 1 per WS	MW	To be provided in .xml
RES generation curtailment	Time series	Hourly 1 per WS	MW	To be provided in .xml
Imports	Time series	Hourly 1 per WS	MWh	To be provided in .xml
Exports	Time series	Hourly 1 per WS	MWh	To be provided in .xml

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	Hourly 1 per WS	MWh	To be provided in .xml
Market clearing Price	Time series	Hourly	€/MWh	To be provided in .xml

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		1 per WS		

Additional data

Forecast error

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

FNA results

Data label	Type	Granularity	Unit	Reference template
Additional flexibility resource (Art 09)	Fixed values 1 per WS	-	MW	To be provided in .xml
Uncovered ramps (Art 10)	Time series 1 per WS	Hourly	MW	To be provided in .xml
Short-term needs (Art 11)	Time series 1 per WS	Hourly	MW	To be provided in .xml
Additional flexibility resource (Art 09) fine-tuned, if carried out	Fixed values 1 per WS	-	MW	To be provided in .xml

Uncovered ramps (Art 10) fine-tuned, if carried out	Time series 1 per WS	Hourly	MW	To be provided in .xml
Short-term needs (Art 11) fine-tuned, if carried out	Time series 1 per WS	Hourly	MW	To be provided in .xml

Annex III - Possible topics for market barriers assessment

Market access to new entrants and small actors

- Participation in different timeframes and product markets, possibly split by technology, or by aggregation model
- Network charges for active customers

Incentives to provide flexibility

- Smart meters and submeters roll-out
- Availability of Time-of-Use network tariffs
- Availability of time-differentiated retail electricity contracts and dynamic electricity price contracts
- consumer awareness and engagement

Requirements to provide balancing services

- Pre-qualification of reserve providing groups
- Design of balancing products and market architecture

Requirements to provide congestion management

Administrative and infrastructure barriers

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