EASE Reply to ENTSO-E Public Consultation on “All Continental European and Nordic TSOs’ proposal for a Cost Benefit Analysis methodology”

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EASE Key Messages

Energy storage technologies can provide an important contribution to system security while enabling the transition to a decarbonised energy system. The fast dynamic response of energy storage devices is expected to help cope with the system inertia decrease and the RES intermittency, thereby contributing to grid stability. However, energy storage can only provide such services if there are no undue barriers in the network code provisions.

EASE therefore welcomes the opportunity to review and comment on the draft methodology to ensure that the ENTSO-E proposal constitutes a transparent and balanced approach that will allow TSOs to minimise FCR costs while safeguarding operational security.

EASE has carefully evaluated the proposal for a CBA methodology. EASE welcomes the efforts by ENTSO-E to propose a methodology suitable for assessing the time period required for FCR providing units or groups with limited energy reservoirs (LER) to remain available during alert state in Continental Europe (CE) and Nordic synchronous areas.

However, we wish to propose several amendments and clarifications, since some aspects of the proposed methodology might lead to strong distortions of the results or to an incomplete CBA:

- Normal state, pre alert state, alert state and emergency state parameters should be clearly defined to correctly run the CBA: these parameters should be based on the definitions of the System Operation Guideline and if not possible, more clearly defined in the draft CBA methodology.
  If we support the ENTSO-E proposal to analyse the sizing of LER-FCR reservoirs during the pre-alert and alert states, we also believe that all other states should be analysed in order to correctly size these reservoirs. Should the assessment be limited to pre-alert and alert state, we are afraid the whole approach proposed might be jeopardised, as each TSO would eventually keep large level of margins to adapt the sizing (resulting in different prequalification criteria for each TSO, and therefore market distortion)
- The FRR behaviour should also be clearly defined in terms of the amount of energy provided by this service and the way this energy is provided in time, since this can have an important effect on FCR provision.
- There should be more transparency regarding the relevant frequency profiles and historical data used to determine the different scenarios and Monte Carlo sampling assumptions. Incidents older than 10 years should not be taken into consideration because they do not reflect the current electricity system

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behaviour. The correlation between long lasting frequency deviations and power outages should be taken into account to produce a more precise evaluation.

- Regarding the economic approach needed to evaluate the cost-benefit impact of the FCR provision, more information should be given on how the costs will be determined. We need among others to better understand the hypotheses made regarding the characteristics of the units (% of the reserve allocated to FCR and FRR for each technology in each country, for coal, gas, co-generation, hydro, nuclear, etc.). As these data are very uncertain and hard to obtain, large sensitivities should be performed on the results, and EASE stresses the need to exchange on the sensitivities to be conducted in order to reach a consensual result.
- Following the previous remark and given the complexity to assess the reserve cost, we would also suggest to split the proposed methodology into two parts:
  - ✓ First, an evaluation of the technical requirements for FCR, taking into account system needs in terms of security and reliability.
  - ✓ Then the CBA.

1. Introduction

On 10 January 2018, ENTSO-E published its "All Continental European and Nordic TSOs' proposal for a Cost-Benefit Analysis methodology in accordance with Article 156 (11) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity on transmission system operation".

EASE welcomes the efforts by ENTSO-E to propose a methodology suitable for assessing the time period required for FCR providing units or groups with limited energy reservoirs (LER) to remain available during alert state in Continental Europe (CE) and Nordic synchronous areas. However, we wish to propose several amendments and clarifications: some aspects of the proposed methodology might, in our view, lead to strong distortions of the results or to an incomplete CBA.

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2. Definition of the FCR states and FRR conditions introduced in the methodology

The System Operation Guideline (SO GL) article 156 specifies that:

- An FCR providing unit shall guarantee the continuous availability of its FCR during the period of time in which it is obliged to provide FCR (with the exception of a forced outage);
- An FCR providing unit with an energy reservoir that does not limit its capability to provide FCR shall activate its FCR for as long as the frequency deviation persists;
- A FCR providing unit with an energy reservoir that limits its capability to provide FCR shall activate its FCR for as long as the frequency deviation persists, unless its energy reservoir is exhausted in either the positive or negative direction with the following clarifications:
    - during normal state, the FCR from FCR providing units with limited energy reservoirs shall be continuously available;
    - as of triggering the alert state and during the alert state, the FCR from FCR providing units with limited energy reservoirs shall be fully activated continuously for a time period to be defined according to a CBA. Where no period has been determined, each FCR provider shall ensure that its FCR providing units with limited energy reservoirs are able to fully activate FCR continuously for at least 15 minutes or, in case of frequency deviations that are smaller than a frequency deviation requiring full FCR activation, for an equivalent length of time, or for a period defined by each TSO, which shall not be greater than 30 or smaller than 15 minutes.

Chapter *5.4.3 Simulation of energy depletion of LER* (limited energy reservoir) of the explanatory document of the proposal for assumptions and methodology for a CBA published by ENTSO-E includes the following information:

- The LER are considered without energy limitations while frequency remains inside the standard frequency range. Once the simulated frequency exceeds this range, the model starts to calculate the activated energy and the residual energy in the reservoir.
- The residual energy is taken into account even if the alert state is not yet triggered (i.e. before the alert state trigger time).
- Considering a generic situation in which the alert state is triggered, the actual trigger of the alert state occurs after a period with a frequency deviation beyond

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the standard frequency deviation.

Additionally :

- The scope of the CBA analysis covers both the pre alert and the alert state, while the System Operations Guidelines requires a CBA for the alert state.
- The proposed simulations neglect both system inertia and FCR dynamic response.
- The calculations do not model the saturation of FRR. The resource is considered without limitations since the FRR-exhaustion-related phenomena are taken implicitly into account considering the Long Lasting Frequency Deviation events.
- The FRR dynamic response is referred to the time scale in which both automatic and manual FRR are deployed (1÷15 minutes).

a. CBA scope and FCR states definition

The ENTSO-E assessment defines neither the scope of the different FCR states nor their time period. In fact, one of the states that ENTSO-E mentioned is not included in the system operation guidelines: the pre alert state. Therefore, the ideal solution would be to stick to the SO GL definitions and, if not possible, to clearly define the scope of the different states, their technical management criteria, and their time periods. This is crucial or LER FCR providers to correctly size their equipment and participate in FCR services.

More importantly, we strongly believe that this CBA should cover all the possible states, and not only the "alert state". Indeed, should the perimeter stay as currently defined, each TSO will keep, by the end of the process, a strong level of margin to complement the requirements, as they would decide each on their own the sizing needed in normal state. This would then make most of the current process useless, as it would still result in TSOs requiring different sizing within the same synchronous zone.

b. More transparency with regards to the assumption on aFRR deployment

Additionally, the complementarity and interaction among the different system reserves and their management criteria should be clearly established. The participation of aFRR in order to restore the frequency value has an enormous impact on the way the frequency will behave, and therefore, on the FCR requirements: the technical criteria to size and manage aFRR, including its timely intervention to release FCR contribution, should be included in the approach.

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3. Greater amount of information regarding the selection of frequency behaviour

Article 153 of the SO GL establishes:

All TSOs of each synchronous area shall specify dimensioning rules in the synchronous area operational agreement in accordance with the following criteria:

(a) the reserve capacity for FCR required for the synchronous area shall cover at least the reference incident and, for the CE and Nordic synchronous areas, the results of the probabilistic dimensioning approach for FCR carried out pursuant to point (c);

(b) the size of the reference incident shall be determined in accordance with the following conditions:

(i) **for the CE synchronous area, the reference incident shall be 3,000 MW in positive direction and 3000 MW in negative direction**;

(ii) for the GB, IE/NI, and Nordic synchronous areas, the reference incident shall be the largest imbalance that may result from an instantaneous change of active power such as that of a single power generating module, single demand facility, or single HVDC interconnector or from a tripping of an AC line, or it shall be the maximum instantaneous loss of active power consumption due to the tripping of one or two connection points. The reference incident shall be determined separately for positive and negative direction.

(c) for the CE and Nordic synchronous areas, all TSOs of the synchronous area shall have the right to define a probabilistic dimensioning approach for FCR taking into account the pattern of load, generation and inertia, including synthetic inertia as well as the available means to deploy minimum inertia in real-time in accordance with the methodology referred to in Article 39, **with the aim of reducing the probability of insufficient FCR to below or equal to once in 20 years.**

In the methodology proposed by ENTSO-E, a simulation process of LER depletion based on an iterative Monte Carlo model will be developed, in order to size FCR services. This model will be carried out using the following inputs (historical data):

- Calculation of power imbalances due to outages.
- Long lasting frequency events.

These two variables are considered independent.

These historical frequency deviations will be recorded from the last 15 years, including 2017.

The simulation process evaluates the viability of different FCR sizes according to different:

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- Delivery schemes for LER;
- Horizon year;
- LER share on total FCR;
- Minimum LER-FCR time period.

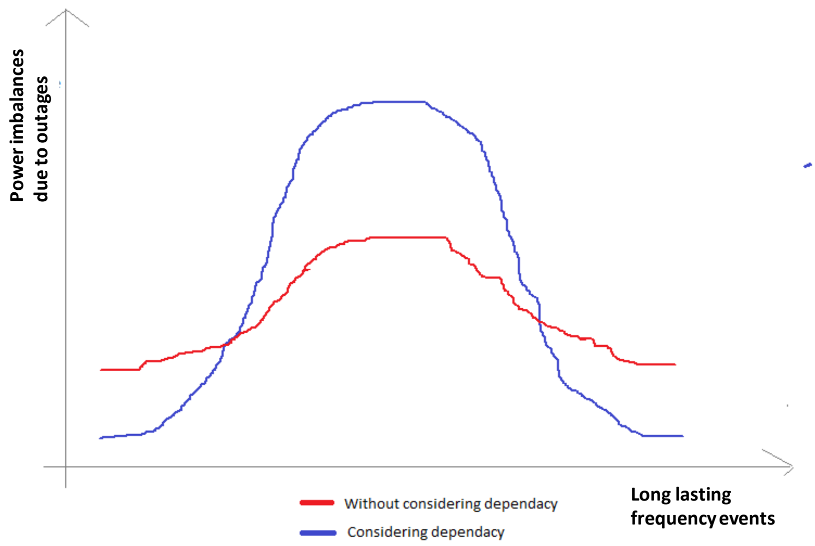
Regarding Article 153 of the System Operation Guideline, the reserve capacity for FCR required for the CE and Nordic synchronous area shall cover at least the reference incident and the results of the probabilistic dimensioning approach for FCR carried out, the reference incident being defined as 3,000 MW in positive and negative direction.

Overall, we believe that ENTSO-E should give more information on their probabilistic approach (Monte Carlo simulation) and we propose some lines of improvement.

a. Absence of correlation between long lasting frequency deviation events and power imbalance due to outages

The methodology proposed by ENTSO-E does not take into account the correlation between the long lasting frequency deviation events and the power imbalance due to outages. If this correlation is not taken into consideration, the volatility of Monte Carlo simulation outputs will be higher, producing some weird results during the simulation process (non-relevant incident could cause important outages and vice versa):

Figure 1. Example of Monte Carlo Simulation results without considering dependency and taking into consideration dependency



The results of not taking into account the dependency could lead to a higher probability of large impact due to the incidents. This higher impact is relevant to establish the FCR

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size and its activation period, increasing the period which is obtained in order to fulfil the security criteria.

There are some non-complex analytic approaches to include the correlation among the several in this simulation process to take into consideration the dependence. Finally, the assessment approach assumes that the requirements of reservoir up and down are equivalent.

$$E_{max} = 2 * \frac{T_{min\,LER}}{60} * FCR_{LER}\ [MWh]$$

Figure 2. Equivalent reservoir energy capacity (Emax)

The hypothesis that the needs for reserves are symmetrical should be verified with the historical information: in case this hypothesis is not proven, the result of the historical analysis should be taken into consideration.

b. Most relevant real frequency events

> Chapter 5.8 of the explanatory document published by ENTSO-E exposes that regarding the definition of scenarios to simulate, there are certainly important possible sequences of events that cannot be tested with the proposed Monte Carlo simulation because the historical period of observation does not guarantee an adequate probabilistic representativeness of those rare occurrences.
>
> In order to test the LER effects at least in some of these possible sequences of events, it is necessary to simulate the most important actual grid disturbances that each synchronous area experienced in the past 15 years.
>
> For example, in Continental Europe, the system disturbance on 4 November 2006 and 28 September 2003 blackout in Italy (for the effects on the rest of the system) will be tested.

The simulation of both 2003 and 2006 incidents in order to take into consideration some possible sequence events would not be suitable because:

- Article 153 establishes that the reference incident is 3,000 MW. The two incidents considered have a bigger impact due to extraordinary events that could not be repeated again, considering a.o. that new mechanisms to restore frequency have been put in place.

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> **System Operation Guideline, article 153 establishes:**
>
> (d) the shares of the reserve capacity on FCR required for each TSO as initial FCR obligation shall be based on the sum of the net generation and consumption of its control area divided by the sum of net generation and consumption of the synchronous area over a period of one year.

Besides, this type of incident is out of scope of the criteria (d) included in the article 153 for dimensioning FCR.

- The simulation of those two events would imply the consideration of too many assumptions and hypotheses regarding the system evolution after the power imbalance.
- The technological evolution should be taken into consideration. In last years, the technology and the electricity system operation procedures have changed dramatically, with a big impact on the generation and demand behaviours (greater amount of renewable energy connected to the grid, self-consumption, energy efficiency measurements, penetration of energy storage devices, more effective coordination among the European TSOs, etc.). Due to the fact that this evolution has a great effect on the number of incidents that could occur in the electricity grid and their relevance, it should be taken into consideration in the simulation.

  We therefore ask ENTSO-E to further clarify the criteria used to define the number of years to be taken into account in their Monte Carlo simulation and advise them to consider incidents no older than 10 years.

The Monte Carlo simulation, which should in our opinion exclude the simulation of the 2003 and 2006 events, would therefore not guarantee that the worse-case situation is observed in this analysis.

4. CBA methodology approach

a. Cost calculation method proposed by ENTSO-E

> The proposed ENTSO-E approach identifies two different technologies to provide the FCR according to the following economic criteria:
>
> - For non-limited energy reservoir (non-LER) solutions: the difference between the energy price and the marginal cost to provide the reserve.
> - For limited energy reservoir (LER) solutions: proportional to their investment costs.
>
> One single pan-European societal discount rate shall be used to calculate the NPV of total costs of FCR related to different years for each combination of LER Share and

Time Period. This shall be a real discount rate of 4% applied from the Starting Year to the last simulated snapshot year. The last simulated snapshot year is considered as the ending year of the assessment.

Some information provided by ENTSO-E to determine the cost of the system according to delivery schemes for LER, horizon years, LER share and minimum LER-FCR time period must be clarified:

- The definition of the price range used for FCR cost of LER resources and the type of evolution of FCR cost (linear, piecewise linear, quadratic, etc.).
- The characteristics of the units (% of the reserve allocated to FCR and FRR for each technology in each country, for coal, gas, co-generation, hydro, nuclear, etc.).
- The hypotheses on remuneration schemes for the FCR services: capacity only in €/MW, capacity in €/MW and energy in €/MWh?
- How ENTSO-E deals with the impact of a lack of harmonisation between Member States' remuneration schemes on the costs for providing FCR in the different Member States.
- The hypotheses on bidding strategies by different FCR providers:
    - For LER, we would ask for a better description of the bidding strategies. A bidding strategy proportional to investment costs seems less suitable for LER since investments costs sunk once the LER has been built.
    - For non-LER, a few questions need to be answered: if there is only capacity payment, are we sure that non-LER will bid only the opportunity cost (of not participating in the DA market)? When will non-LER recover their marginal cost (e.g. fuel costs) if there is no energy payment (either implicit or explicit)?

We would also like to underline that:

- The LER-FCR investment costs should consider the possibility for LER to stack revenues.
- ENTSO-E should specify if they will consider energy costs considering that the proposed methodology seems to take into consideration only capacity costs (€/MW), i.e. balancing capacity.

Additionally, the ENTSO-E economic approach defines a discount rate according to "societal" criteria: real discount rate of 4% (societal discount rate). Major details should be given on the choice of the value of this parameter, and eventually a sensitivity analysis performed.

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b. NPV comparative in CBA methodology

ENTSO-E CBA methodology proposal presents the following table in order to determine the most cost-effective scenario:

		LER share on total FCR providers									
		10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T_{min} LER	15 min										
	20 min										
	25 min										
	30 min										

The different scenarios are compared based on the Net Present Value (NPV) of the project, according to LER share, activation time period and a societal discount rate of 4%.

EASE strongly welcomes the ENTSO-E analysis covering various levels of LER penetration. However, we would like to get more information on how the decision to choose a minimum activation period will be taken if results differ strongly according to the LER penetration rate.

c. Proposal for a new CBA approach

Article 3 of the ENTSO-E proposal explains the main concepts of methodology for conducting a cost benefit analysis in order to assess the time period required for "FCR providers" with limited energy reservoirs to remain available during alert state:

"The CBA methodology consists of the identification of the combination of time period and LER share which entails the lowest total cost of FCR […], over the time period described […], without jeopardising the system stability during the most relevant real frequency events […]. The time period resulting from the aforementioned criteria for selection is directly associated to a specific LER Share and a specific FCR dimensioning."

ENTSO-E proposes an economic approach to run the CBA. This approach is complex considering the difficulty to determine the appropriate cost of each possible technical

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result obtained from the Monte Carlo simulation. Therefore, EASE would propose to split the methodology into two separate approaches:

- A technical approach to size the frequency containment reserve and establish the criteria to determine the time period required of this reserve.
    - First of all, the evaluation according to technical requirements, in terms of the amount of energy that should be provided by LER-FCR units and the system needs regarding security and reliability.

      According to a rational criterion, FCR should dimension regarding the reference incident (3,000 MW) and the worst incident in the last 10 years.

      However, if a simulation process is developed, the threshold reliability value (as a probability) that must be taken into account should be clearly identified in advance.
    - Once all the points and aforementioned data have been determined, and therefore the LER share and activation time period have been calculated regarding different horizon years and the fulfilment with the security and reliability criteria, the cost analysis can be conducted.
- An economic approach to evaluate the impact of frequency containment reserve's time period in terms of cost-benefit.

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About EASE

The European Association for Storage of Energy (EASE) is the voice of the energy storage community, actively promoting the use of energy storage in Europe and worldwide. It supports the deployment of energy storage as an indispensable instrument within the framework of the European energy and climate policy to deliver services to, and improve the flexibility of, the European energy system. EASE seeks to build a European platform for sharing and disseminating energy storage-related information and supports the transition towards a sustainable, flexible and stable energy system in Europe.

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Disclaimer

This response was elaborated by EASE and reflects a consolidated view of its members from an energy storage point of view. Individual EASE members may adopt different positions on certain topics from their corporate standpoint.

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