Answers and clarifications to the comments received during the public consultation of the proposal for assumptions and methodology for a Cost Benefit Analysis (CBA) compliant with the requirements contained in Article 156(11) of Commission Regulation (EU) 2017/1485 of 2 August 2017

28 February 2018

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Summary

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1. Introduction

The public consultation on "All Continental European and Nordic TSOs' proposal for a Cost Benefit Analysis methodology" was carried out from 10th January 2018 to 18th February 2018, through announcement on ENTSO-E website. This consultation concerns the proposal on the assumptions and methodology for a cost-benefit analysis to be conducted, in order to assess the time period required for FCR providing units or groups with limited energy reservoirs to remain available during alert state, developed in accordance with article 156(11) of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SO GL). The public consultation on this proposal is requested according to SO GL procedures and represents an important step to improve the quality of the outcome and to consider the perspectives of the interested parties. For this reason, the TSOs thank all the stakeholders who have reviewed and answered the consultation document with their constructive feedbacks. The TSOs carefully considered all comments which were provided and updated the methodology in light of the proposed changes and comments. This document includes all the answers to stakeholder comments raised in the public consultation, providing a sound justification for including or not the views of the stakeholders within the methodology.

LEGENDA:

Comment by stakeholders

Answer or clarification by All TSOs

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2. Comment by: SwissGrid

Draft of Swissgrid feedback for the public consultation regarding the Cost Benefit Analysis methodology for Limited Energy Storage units delivering FCR

As per the methodology proposed, statistical analysis of long lasting frequency events is an input.(slide 12 public workshop).

Article 157, Paragraph C of SOGL states:

"all TSOs of a LFC block shall determine the ratio of automatic FRR, manual FRR, the automatic FRR full activation time and manual FRR full activation time in order to comply with the requirement of paragraph (b). For that purpose, the automatic FRR full activation time of a LFC block and the manual FRR full activation time of the LFC block shall not be more than the time to restore frequency"
As per Table 1 „Frequency quality defining parameters of the synchronous areas" of SOGL the time to restore frequency is 15 Minutes.
The question arises as to why long lasting frequency events should occur when the full activation time for FRR is 15 minutes.
Improper FRR delivery is one of the major reasons for the long lasting frequency deviations. If long lasting frequency deviations are being used as a input for dimensioning FCR availability time, this means that FCR product is indirectly bearing the cost of improper FRR product activation.

Suggestion: In the methodology when the input long lasting frequency deviation is considered it should first be determined why this deviation occurred and if it is due to incorrect FRR activation, then this input should be modified accordingly.

SO GL art 156 (11) requests considering prolonged or repeated frequency events. The frequency statistics of the last years doesn't shows a clear trend of better frequency quality in terms of long lasting events, hence it is proposed, in order to properly reflect the present scenario, not to mitigate the statistics of the frequency.

FCR acts independently by FRR and it is the most important, the first and the last line of defense of the power system available to TSOs. We acknowledge that there may be solutions to improve long lasting frequency deviations and deterministic frequency deviations, but until we see a significant improvement, we cannot exclude these events. It's not our intention to let FCR play the role of FRR or other balancing reserves, since it shall able to face this kind of events.

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3. Comment by: Axpo Trading AG

We thank ENTSO-E for the opportunity to comment on the proposal for a Cost Benefit Analysis methodology in accordance with Article 156(11) of the System Operation Guideline Regulation. We do not have specific comments on the methodology itself, however, we would like to emphasize the risk associated with production units with limited energy reservoirs (LER) in the FCR market. Given the importance of FCR, the main target should be operational security, also in case of system stress. The analysis should not only focus on disturbances occurred in the past, but also on potential future stress scenarios, such as several large outages within a short time period. Today, existing sources can supply enough FCR with high reliability at low costs. The inclusion of LER should therefore be treated with caution, we specifically see an activation period smaller than 30 minutes as critical. While the inclusion of LER may reduce procurement costs, it should not come at the expense of system security.

We get the rationale of the comment; the proposed methodology has indeed a twofold approach:

The probabilistic approach aims to simulate a wide set of possible system conditions as calculated by the Monte Carlo method (considering also the possibility of several events in a short time period, if this condition is highlighted from a probabilistic perspective);

Risk assessment check during the most relevant real frequency events, since there are complex sequences of events which can lead to significant power imbalances that cannot be investigated by means of probabilistic simulations

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4. Comment by: Swisscom Energy Solutions (tiko)

We have three different comments on the consultation document and the proposed cost-benefit-analysis in accordance with Art 156 (11) of the Commission Regulation 2017/1485 of 2 August:

First, it is not clear what «FCR providing units or groups with limited energy reservoirs» means. The Commission Regulation 2017/1485 of 2 August 2017 does not contain a definition concerning «units or groups with limited energy reservoirs». The consultation document does not contain a definition either. It seems to us, that this is an essential gap to be filled.
Swisscom Energy Solutions thinks that not only batteries have a limited energy reservoir, but also hydro-power plants, biogas plants, and others. Without a proper definition, 95% of the FCR providing units in Switzerland could be seen as “units or groups with limited energy reservoirs», as almost all of the FCR production comes from hydro-power plants. Both (pumped) storage power plants and run of river power plants do not have unlimited energy reservoirs. If the hydro power plants are seen as “FCR providing units or groups with limited energy reservoirs», they would also have to fall under the cost benefit analysis.

We acknowledge the comment; TSOs of CE and Nordic are working in order to clearly define LER FCR provider.

According to Commission Regulation 2017/1485 Art. 156 (11) the cost-benefit analysis shall take into account at least “(e) the impact of technological developments on costs of availability periods for FCR from its FCR providing units or groups with limited energy reservoirs». The cost-benefit analysis would have to take into account the technological advances for storage technologies like batteries but also those linked to the hydro power plants.

CBA is technology neutral as it considers all kind of technologies representing LER, not only batteries. Methodology will analyze a short-term scenario: in our opinion the proposed approach for non-LER costs calculation is then adequate to reflect the FCR costs for those technologies. A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

Second, the cost-benefit-analysis would have to address the implications of any modifications concerning the FCR market for the aFRR market.
Article 6 «Simulation scenarios» of the common proposal foresees that simulation scenarios shall include all the combinations of the following assumptions:

Time Period
LER Share
Time horizon

Swisscom Energy Solutions thinks that a fourth dimension (d.)) has to be considered: the one of aFRR. There is no doubt that the FCR activation time will have an influence on aFRR activation and related cost. Therefore Swisscom Energy Solutions thinks that all the analyses shall be performed considering also the influence of the FCR activation time on aFRR activation and related cost.

As described in the proposal the aFRR will be considered in the dynamic model without saturation. The FAT of FRR will be a weighted average of the FATs among LFCBs of each SA. A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

Third, the model of the influence of the activation time on the bids (section 5.6.1 in the explanatory document) has to take into account also the bid size, not only the bid price. If the activation time is increased, it affects not only the bid price but also the bid size. Depending on the technology, the influence of the activation time on the possible bid size can be much stronger than on the bid price. The following figure should outline this dependency (compare with Fig. 9 and 10 in the explanatory document).

The dependency FCRLER = f (1/TminLER) becomes obvious when analyzing the equation on page 16 of the explanatory document:
From E_"max" =2 T_("min" LER)/60 〖FCR〗_LER we get 〖FCR〗_LER= 〖60E〗_"max" /(2 T_("min" LER)).
We can confirm for our technology and market experience that the LER capacity (and therefore the bid size) decreases with increased activation time.

For existing LER FCR providers, methodology will also take into account the possibility to reduce the FCR amount offered

We thank you very much to take into account the three points when considering the cost-benefit-analysis in accordance with Art 156 (11) of the Commission Regulation 2017/1485.

Best regards
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And

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Head of Energy Services

PS: if there is a problem to see the graph and the formulas we used, we would be grateful to be able to send our contribution as a pdf to an email adress that you indicated to us.

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5. Comment by: Compagnie Nationale du Rhône

1) Presentation of our company LER Renewable Energy Hydraulic Power, supplier of FCR:
Compagnie Nationale du Rhône, CNR is a renewable energy company of the Rhone River. We operate with our type of hydraulic power that is a stream hydraulics power/ run of river hydros. So the FCR is providing by groups with limited energy reservoir (LER). The maximum and minimum water levels of each of the tanks must be respected in the regulatory framework for operation and for hydraulic safety. The primary source of energy that is water is available depending on weather conditions, tributaries and hydraulic inputs coming from Switzerland. Regulatory operating constraints must be respected.
CNR is the second-largest French supplier of primary reserve (45-50MW on average [0 to 110MW] following the flow because of our units run of river hydros. Each plant has 4 to 6 units and each unit is ~ 30 to 70MW).

2) FEEDBACK
a) Introduction:
FCR of CNR is therefore a LER renewable energy.
CNR wishes to play a leading role as renewable energy company in Europe and in line with the European objective to facilitate the integration of Renewable Energies.
The subject around "assessing the time period required for FCR providing units or groups with limited energy reservoirs (LER) to remain available during alert state" is a very impacting and critical subject for CNR and may appear as discriminant.

b) Summary:
Strong and real concerns exist by the assumptions made that led to the configuration of this study and the structure, the "theoretical" definition of the alert state, the feeling of not taking into account the Renewable Energy LER Hydraulics with their regulatory constraint of exploitation / safety and primary source "not loadable according to certain constraints" (unlike a battery), the question on the concrete use of the result which will emerge from the model of which the assumptions of starting-looping and the definition of "state alert" structure by essence the result.
Below our detailed remarks.

c) Assumptions made that led to the configuration of this study and which structure and remarks on the input assumptions for the model:
As we have explained above, the observation of an average frequency during the time of the day or in the day other than 50 Hz can not in any case lead to the conclusion that the FCR adjustment must be increased with, for example, a duration of 30 minutes. On the contrary, this finding should lead to the conclusion that secondary and / or tertiary adjustments, in particular, have failed.
As a reminder: with the current frequency of evolution (except “200mHz”), the limited energy of the LERs is used and reconstituted and beyond a duration of 30 min (because limit not reached) and so far the frequency drifts identified really exist, which supports the thesis of a problematic on secondary / tertiary reserves. Increasing the technical specification of the primary control behavior is not a solution to the problem and discriminated against the FCR in relation to the real role that the secondary reserve aFRR

(which acts in 200s (3.5 min) in full regime) should bring and tertiary mFRR / RR (which acts from 12 min) to restore the frequency to 50Hz.

Thus the historical frequency that will be used to determine input frequencies of the model integrates the issues that are not only the mainspring of the primary reserve. On the contrary, the failure of the secondary and tertiary adjustment leads to requesting the primary adjustment beyond its actual technical specifications. The conclusion that could therefore appear is the need to use the primary reserve (and therefore the increase in the duration Tmin LER) to compensate for the lack of secondary and tertiary reserve.
On the other hand, this dysfunction of the secondary reserve (with the coordination-coherence between TSO which improves recently) / tertiary (or also FCR volume too low with 3000 MW for Europe if the secondary and tertiary reserve do not make their role) leads our LER plants (like the non-LER ones) to already participate in more time than they should (current case within the overall volume of LERs for a current frequency <200mHz, see previous paragraph).
This observation is even more visible with the frequency taken in real and not in global statistics as the model suggests.

There is therefore an important bias to look only at the resolution of frequency deviations through the FCR by making it play the role of secondary and tertiary reserve! without paying for it and while strongly constraining some FCR sectors beyond their possibility (which may cause them to disappear like the LER run of river hydros with regulatory technical constraints and subject to external conditions). Basically this breaks down the very basis of the scheduling and the various balancing reserves (FCR-aFRR-mFRR-RR) and brings a non-coherence in the simulation that will denature the FCR and thus incite to increase the Tmin LER.

FCR acts independently by FRR and it is the most important, the first and the last line of defense of the power system available to TSOs. We acknowledge that there may be solutions to improve long lasting frequency deviations and deterministic frequency deviations, but until we see a significant improvement, we cannot exclude these events. This does not imply that FCR shall play the role of FRR or other balancing reserves, since it shall able to face this kind of events.

d) Hypotheses taken for the state alert, the looping of the algorithm on this subject and the output of digit result for "the time period required for FCR providing units or groups with limited energy reservoirs (LER)" "

We note a misunderstanding and a non-coherent / unacceptable result with the type of calculation "alert state".
For example, following the definition of the state alert if the start of the state alert is declared only during a continuous frequency at 99mHz after 15 min (alert state definition => 50mHz -15min or 5min if> 100mHz) then compared to currently for the same energy 200mHz-15min, we will have started (with 99mHz after 15 min) already half of the energy of the LER and without counting for the alert state !! inconceivable !!
Continuing this example if after the 15 min at 99mHz, we have 200mHz then with the same energy / requirement / volume than today (200mHz-15min) we would hold 7.5min (because volume 15min to

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99mHz already done). But in the context of this definition "alert state" we would have done only 7.5 min of alert state and if we must hold for the alert state 15 min we should double volume compared to today or if it was necessary hold 30 min, quadruple the volume !!
On the one hand it is not conceivable for LERs constrained by default by the external and regulatory context and on the other hand one is authorized to create discriminating and unacceptable rules for the FCR because modifies the coherence of the balancing products (FCR-aFRR which intervenes in full power from 3.5 min and tertiary from 12-15 min as described previously).
There is therefore a fundamental problem of definition adapted to the duration itself for the state alert and thus directly impacting the result to be applied which could leave the model.

It should be noted that the implicit observation of this problem was made in the ENTSOE document of the consultation by integrating into the calculations a phase of pre-alert! before the beginning of the declaration of the alert state and where the energy of the LERs was demonstrated already used (cf page 16) but without counting it in the duration of use for the state alert !!
We find the same observation with the default 5 minutes that are not counted for the state alert even if the energy / volume will be used for 200mHz. If the result of the model leads to be at 30 min, it will actually be at least 35 min even if it was 200mHz all the time instead of the current 15min, 2.33 times more!
In the context of this example, we can note that this evolution from 15min to maybe 35 min ("implied" 30 min in the texts but in reality 35 min) for the LERs and with the statements previously stated brings a lot of questions and concerns about the actual implementation of the texts and the forthcoming interpretation of the results of the study.

In addition to the result that will come out of the study and for the approach:
As mentioned above our concern is important, given the assumptions made. We can not agree without having had reassuring elements in relation to our remarks (which could be erroneous if our interpretation turns out to be incorrect). We ask for a detailed point of step on this consultation and following the return of all the actors.
Moreover, it obviously seems necessary that the actors can have different points of steps clearly explained to avoid, as much do this little, the non-transparency and the presentation of result "self-satisfactory" by the assumptions or the closure of the algorithm.

The pre-alert is normal state; the methodology will take into account only events (long lasting frequency deviations, deterministic frequency deviations, outages, or combination of those) that trigger alert state: in this case the assumption is that energy use starts above frequency deviations higher than standard frequency range. Recharging strategy when alert state is not triggered is out of scope of this methodology. The energy amount calculated this way will then be used to calculate an energy equivalent Time Period of full activation.

To note in addition to our previous remarks considering the possible impact of the result on our installations and the incoherence compared to the model of today, we have questions of type: what impact for the existing installations (important evolution of the constraint, operational implementation of an adjustable warning threshold as a function of the value of the frequency and in relation to different durations and a triggering delay of the alert!, real validation of the non-counting of the duration during the use of LER?, ...)? link with ROI-renovation-maintenance-solicitation?, desired disappearance of the participation LER RES type run-river hydros (with regulatory constraints / non-adaptable hydraulic safety and thus limited volume / energy without reloading possible according to cases of constraints and beyond non-coherent threshold/state) ? link with desired standard product from the market?

The aim of the methodology is to evaluate the energy content of frequency transients, with a consequent estimation of costs for a short term scenario which takes into account the impact of the various Time Periods. If a significant evolution regarding the CBA assumptions occurs, the methodology will be applied again in order to propose a Time Period in accordance with this evolution. Other aspects not related with this approach are considered out of scope of the methodology.

e) Other important points:
- Figure 8 (page 18) and his argument:
o all LERs and non-LERs can not all be in the same operating state at the same time, they must have an offset in the curves and not a simultaneity for all LERs and not LERs

o Wrong graph because the reserves aFRR, mFRR, RR are restored (on the adjustment mechanism, etc ...) and therefore the frequency does not decrease. Each balancing product does its part. We recall that the aFRR intervenes n steady state in 3.5 min and mFRR / RR in 12 and 15 min (cf 1st remarks)

Figure 8 is just an illustrative example and it already takes into account FRR activation. The dashed line has the aim to describe the impact of an insufficient FCR, compared to the power imbalance. The frequency is not contained anymore; balancing reserves other than FCR can balance the system but only on a longer time-scale (i.e. minutes).

- All things being equal, the LER price will increase if Tmin LER increases relative to the recurring intrinsic cost and the imposition of decreasing capacity in relation to energy. This may also lead to the final elimination of competitive RES sectors and, also to these new non-coherent technical constraints (effective implementation of these "theoretical" results that are not adapted to the actual functioning of the installations and to the safety of the system in question in link with the different balancing products) the LER run of rivers hydros.

- Article 156 (9) identifying that "limited energy reservoirs are permanently available when in a normal state (ie +/- 50mHz)" is not conceivable if the average frequency is is not at 50Hz. It's "theory". If the frequency remains on average permanently at 50.049mHz, the LER will obviously empty. Hence also another difficulty on the result of the study and its interpretation in relation with this article.

Requirements for frequency deviations within standard frequency range are out of the scope of this methodology; assumption is that thanks to appropriate State of Charge management there is no energy depletion of LER FCR providers during this frequency regime. This methodology does not take into account these strategies or other FCR properties.

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On the other hand, we find here the inconsistency where the LER will be empty and therefore the beginning of the " alert state" will not trigger and it will be asked again after (and without real possibility because LER emptied) to hold "the duration of the alert state that will come out of the model". We recall that for LER run of river, unlike batteries if the hydraulic or regulatory safety requirement (in relation to the defined volume) has been "touched" it will not be able to "recharge".

SO GL asked for several requirements that LER shall be fulfilled: the Time Period is one of these requirement; the aim of this methodology is to support the identification in terms of cost and benefits the best solutions. The FCR provider shall satisfy this requirement together with other technical constraints that will be identified for prequalification process (which is out of scope for this methodology).

Thanking you in advance for your reading and for the analysis of our remarks.
We remain at your disposal.

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6. Comment by: EnBW AG

Simulation design

We do not have specific comments on the choice of frequency data or combination with empirical events. We are convinced that the TSOs will properly assess the required FCR capabilities.

Alert State

For the current CBA, the alert state definition is used in simulations to represent the limitations of LER units. The "pre-alert state" is also allowed to be taken into account when considering the Tmin LER energy equivalent. This contradicts SOGL Art. 156(9) which requires an energy reservoir for full FCR activation "as of triggering and during the alert state". In practice, occurrence of a "pre-alert state" cannot be determined beforehand, anyway. Only after triggering an alert state (frequency deviations above +/- 100 mHz for 5 minutes in CE) the time before can be identified as "pre-alert".

While a common definition of an alert state is given, the interpretation on the consequences for Tmin LER is arbitrary, even though SOGL Art. 156(9) is pretty clear about this. For investment decisions prequalification standards, operational procedures and subsequent monitoring a common understanding and harmonized application are vital.

The pre-alert is normal state; the methodology will take into account only events (long lasting frequency deviations, deterministic frequency deviations, outages, or combination of those) that trigger alert state: in this case the assumption is that energy use starts above frequency deviations higher than standard frequency range. Recharging strategy when alert state is not triggered is out of scope of this methodology. The energy amount calculated this way will then be used to calculate an energy equivalent Time Period of full activation.

The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is the aim of this process.

LER depletion

Two situations of LER depletion are presented:

In the first example with predominantly non-LER bids, the non-LER bids are supposed to cover up for the depleted LER units in alert-state. The frequency deviation inflated this way (+50% in the example) can now easily exceed the +/- 200 mHz limit for full FCR provision. Furthermore, the immediate provision of backup services for LER units in the alert-state does pose an additional effort for non-LER units.

With a large share of LER bids, additional non-LER bids can become necessary in order to permanently ensure sufficient FCR capacity.

Both additional services of non-LER units (immediate backup and additional capacity) should be clearly identified and remunerated properly. Basically, a system-wide backup for LER depletion in alert-state is created.

The methodology does not allow a steady-state frequency deviation exceeding +/- 200 mHz. If non-LER bids cannot cover depleted LER, a new simulation run will be triggered considering a higher FCR procurement. Two situations are considered as acceptable:

- LER are not be depleted
- If depletion of LER occurs, non-LER have to cover missing capacity

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Cost calculation

The reduction of system costs as a consequence of reducing the Tmin LER is not valid, for two reasons:

- In a combined auction with non-LER bids, the LER bidder does not have any motivation to include a cost advantage compared to a longer Tmin LER (as illustrated in Figure 10) into his bids. This does become even more obvious when imposing a marginal-pricing scheme, but also holds for pay-as-bid settlement.
- Bidding into the FCR auction will not be based on investment costs for LER units. At the time of bidding, the investment is sunk cost and any revenue generated by bid prices above short-run marginal costs will be accepted, regardless of the investment being profitable eventually.

Therefore, system costs can at best stay the same and will otherwise increase. Any cost advantage that is generated for LER investments by reducing the Tmin LER will remain with the LER BSP.

For the cost increase by adding non-LER capacity, it is unclear how the available volumes of non-LER units are determined. It is not guaranteed that sufficient non-LER capacity is technically or economically available and is sufficiently incentivized to bid into the market.

Within the FCR context, the CBA has to determine if and how system costs change, taking into account a competitive setting, where no forms of distortion are present. For instance, this analytical setting implies that bids are the mere presentation of marginal opportunity costs.

In addition, the CBA has a long-run perspective, then the cost curve definition will be based on the long-run marginal cost concept, where all factors of production are endogenous, including investment costs for new installed FCR providing units.

Further assumptions about these topics will be released at the implementation stage

Share of LER bids

For different shares of LER bids the additional capacity of non-LER bids is calculated to determine additional system costs. This additional non-LER capacity is required for secure system operation. Once an acceptable situation has been identified, the targeted LER share has to be restricted during procurement. Otherwise the extra non-LER capacity will be insufficient.

The implementation of the market design is out of scope of the CBA.

The methodology provides a matrix of possible solutions based on which all TSOs will make a proposal for a time period to NRAs for approval considering these main key factors:

- FCR amount
- Total FCR costs estimated
- LER share

Most relevant frequency events

Generally, we support the approach of adding additional historical scenarios for stressing the simulations with extreme observations. Of course care has to be taken, if the conditions under which the situation occurred are still valid. Nevertheless, the situation can serve as an example for future incidents.

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Yes, extreme events will not be taken into account for the definition of the frequency statistics, but they will only be taken for the risk assessment.

Incidents are not foreseeable and can happen again. Instead of assessing deterministic worst cases the historical data are used and considered appropriate for the mitigation of simplified model assumptions: e.g. the network topology and the consequences of line tripping in different grid scenarios are not represented in the methodology.

General remarks
While the CBA aims to describe scenarios for technical simulations, the implied market consequences will decide about actual feasibility and costs. It is of utmost importance that a consistent market design is described. With respect to the different types of FCR provision, three qualities can be identified: LER units that are allowed to become unavailable in alert state, non-LER units covering up in case of LER depletion and additional non-LER capacity for FCR adequacy.

The additional relevance that is placed on non-LER units needs to be properly remunerated to keep participation attractive. For example, a separate clearing price for LER and non-LER bids could be applied in case of marginal pricing, linked to the maximum LER share. Also, the extra non-LER capacity that is only required for counteracting LER depletion in alert state could be procured and activated separately.

The cost curve will already consider the viability of FCR provided by non-LER, without the need of additional remuneration.

LER units that are part of a pool with non-LER units not increasing the BSP offered volume should still be considered as non-LER (as is done in Germany currently). In such a case the portfolio bids count as non-LER bids.

Methodology deals with costs estimation and not with bidding strategies for FCR provision. Furthermore, methodology will take into account a modelling of market curve for FCR. All assumptions and input data about these topics will be released at the implementation stage.

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7. Comment by: Enercon GmbH

General: We think that the introduction of asymmetric bids in the FCR is very important. In today's system with symmetric bids only, the market access for the participation of technologies is limited and a level playing field between all (new and existing) market participants isn't given.
Separate auctions for upward and downward FCR are preferred, because the allocation of upward and downward capacity may come with different prices and will be delivered by different market participants (wind, biomass, virtual power plants) in the future.
Of the two auctions for upward and downward FCR, the one with the larger number of offers in terms of total capacity, is to be executed first so additional quantities could be opened for the second auction.

The methodology will consider the current best practices in term of FCR procurement (e.g. FCR cooperation). A new market design and its implication on the results is out of scope for this CBA.

The methodology will apply with a symmetrical procurement of time period: in case of further developments in terms of asymmetrical FCR provision, the possibility to apply again the CBA will be considered

Article 6 a) We think that a shorter minimum activation period (15min) will enable more technologies to participate in the market and therefore lead to higher competition and lower overall costs for the provision of FCR. Longer minimum activation periods would create market barriers, hence inefficiencies.

SO GL Article 156(9)-(11) explicitly asks for a minimum activation period comprised between 15 and 30 min. The CBA methodology proposal aims to assess also the impact of a shorter minimum activation period on FCR costs.

Article 6 c) Today, LER resources can be easily backed up by non-LER resources for instance in FCR pools. Due to the fact that the CBA simulation takes different time horizons into consideration, we think that it makes sense to increase the requirement for the Time Period during which LER shall be able to fully activate FCR continuously in alert state - if at all gradually i.e. proportional to the shutdown of non-LER resources.
Existing LER providing FCR could be easily retrofitted in the future when related investment costs have further decreased which leads to lower overall costs for the provision of FCR.

The methodology approach is an estimation of costs for a short term scenario. If a significant evolution regarding the CBA assumptions occurs, the methodology will be applied again in order to propose a Time Period in accordance with this evolution.

Article 9 From our point of view the Time Period during which LER shall be able to fully activate FCR continuously in alert state, should be not more than 15 minutes. High security margins in the energy rating of a LER lead to significantly higher upfront costs.

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The CBA aims to minimize the social cost over the time horizon without jeopardising the system stability.

Based on our operational experience we state that recharging the LER via scheduled energy market transactions allows to sufficiently balance the SoC of a LER and is therefore a suitable alternative to high security margins. This approach leads to a variabilisation of a share of the upfront investment and therefore to lower costs for the provision of FCR.

Please remark that only an adequate energy/power ratio can avoid the depletion in case of prolonged and repeated unidirectional frequency deviations, whereas the SOC management of a LER in such conditions could not be sufficient.

8. Comment by: VGB

The methodology will use historical frequency disturbances as examples to define the duration of FCR (15 minutes or 30 minutes) in the future.
It is not allowed to use the historical examples as such because evolutions of the electrical system have to be taken into account.

If conditions will change, CBA will be applied again

Deterministic frequency deviations are initiated by commercial flows between synchronous areas. In the future the impact of such commercial flows will be limited by Art. 137 of the GL SO. The article 137 allows a limitation of the ramping rate of HVDC installations and PGMs by a TSO. TSOs have to define their position : OR apply article 137 OR accept that deterministic frequency deviations will continue to exist because art. 137 is not applied in the future.

The frequency statistics of the last years doesn't shows a clear trend of better frequency quality. The TSOs of SA CE and Nordic proposes, in order to properly reflect the present scenario, not to mitigate the statistics of the frequency, being the FCR the most important, the first and the last line of defense of the power system. We acknowledge that there may be solutions to improve long lasting frequency deviations, but until we see a significant improvement, we cannot exclude these events. If conditions will change, CBA will be applied again.

The incident of 4/11/2006 is an example of a long lasting frequency event. This is NOT correct because wind farms in Spain tripped by islanding protection and made this incident too big. The islanding protection of wind farms is modified since that incident and the consequences of an identical cause would stay smaller in the future.
Also the manual FRR was not activated as it should have been ; also this issue is solved now.
So the incident of 4/11/2006 can be used only PARTIALLY as a historical example.
This comment is also applicable for other incidents used as example.

Incidents are not foreseeable and can happen again. Instead of assessing deterministic worst cases the historical data are used and considered appropriate for the mitigation of simplified model assumptions: e.g. the network topology and the consequences of line tripping in different scenarios are not represented in the methodology.

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9. Comment by: TIWAG - Tiroler Wasserkraft AG

1) TIWAG-Tiroler Wasserkraft AG generally agrees with the ENTSO-E proposal. We would like to stress once more that the security of the energy system is the backbone of Europe's economy. In cases of doubt the system security has to be the guideline for our common rules.
2) We support the inclusion of the extreme events in the past decades, e.g. the system disturbances of 2003 and 2006 as mentioned in the explanatory document (5.8).
Justification: the proposed probabilistic methods of data analysis – e.g. for the frequency behaviour – have the disadvantage that they do not represent very rare events properly. We would also welcome the inclusion of a narrow sequence of strong synthetic events. Finally the system has to hold for all cases albeit some occur rarely.
3) The method should include the case in which no new LERs are entering the market. We think it would be already possible to run the system safely with existing LERs at no additional investment/welfare costs and at the 30 min – best – security level. At least a distinction between newly to be built LER and existing LER has to be made.

A scenario representative of the current share will be simulated. Also the distinction between existing and new LER are considered in the CBA methodology proposal.

4) The economic assumptions are not comprehensible. We do not see which sources are used for prices, marginal and investment costs and non-LER capacities. The calculation of the NVP needs the criteria for cash-flow/return distribution to be uniquely defined in common terms. For this we ask for more information and transparency.

The detailed adopted assumptions will be defined during the implementation phase.

NPV is no more used since there is only one short term scenario. A specific disclaimer has been added to clarify that as soon as the scenario is not representative anymore the CBA has to be run again.

5) The proposed 4 % discount rate is lower than the common long term expectation for energy investments on volatile markets. Nevertheless we argue for a low "4 %" rate because most technologies in this sector will not specifically be calculated on FCR cash only. Many business models will have flexible sources of cash and the FCR market can only yield additional revenue due to its market size. Thus the zero entry "risk" into an optional market is represented adequately with a lower discount rate in the ENTSO-E proposal.

NPV is no more used since there is only one short term scenario. A specific disclaimer has been added to clarify that as soon as the scenario is not representative anymore the CBA has to be run again.

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10. Comment by: Vorarlberger Illwerke AG

Thank you for the opportunity to comment your proposal and highlight a few aspects of importance to us.

First, we like to state that we seriously question the approach to combine different technical requirements for different FCR-providers in one market. The often-discussed level playing field is obviously not respected here. LER providers profit from non-LER providers who ensure system stability and receive the same renumeration. Instead, if necessary, we would suggest the introduction of an additional FCR product for LER providers with specific technical requirements. Thereby no market participant would be discriminated or favored.

On the basis of the SO GL there are no the necessary conditions to assume different markets for LER and non-LER providers. These considerations are anyway out of scope of the CBA since the Art.156 (11) only requests for a CBA methodology for the definition of a minimum time period of FCR full activation in alert state and not for a market design of FCR procurement

Furthermore we would like to add the following remarks:

Article 4:
Instead of running a huge amount of different (Monte Carlo generated) scenarios, the focus should be on the edges of the distribution. Especially those frequency deviations with a huge amplitude and/or a long period are critical. Thereby it is not that important to understand the source but the consequences. Perhaps it is useful not only to use the past to model those deviation but also synthetically deviations (extreme values) to represent future uncertainties.

The use of Monte Carlo method has precisely the aim to explore a large part of all the possible combinations of the uncertainties sources in the future.

A probabilistic approach is more consistent than a deterministic approach that determines - with a "a priori" criterion - the edges of the distribution.

Article 5:
Building of FCR market curve
System cost prediction in this methodology strongly depends on marginal cost estimation, which is in practice rather complex. Marginal costs of non LERs have to include assumption on plant efficiencies and further technical restriction associated to FCR provision. Marginal costs of LER providers have a reciprocal dependency to energy prices, here hourly or quarter hourly prices, which determine possible income from energy only selling/buying and thereby the FCR bidding price. A methodology how to determine those prices is missing and in the comparison (LER<> non LER) together with the consideration of further investment costs the most important factor.

In our opinion instead of concentrating on cost assumptions, that are changing constantly, and complicated analyses the whole procedure should concentrate on the technical necessities to define the FCR needs and separate between non LER and LER Providers right form the beginning. Meaning different FCR products if needed and the same requirements for all providers.

The Article 156 requires to define a cost-benefit analysis in order to assess the time period required for FCR providing units.

Article 156 11 (b) explicitly requires to take into account "the impact of a defined time period on the total cost of FCR reserves in the synchronous area".

Article 156 11 (d) explicitly requires to take into account the impact on total cost of FCR in case of increasing total volume of FCR.

Article 156 11 (e) explicitly requires to take into account the impact of technological developments on costs.

There is then the need to define a proper methodology to assess the effects of time period requirements on FCR costs.

In the proposed methodology, marginal cost estimation relies on ENTSO-E TYNDP scenarios. Any needed further assumption shall be made during the implementation phase.

Assuming and defining different products for FCR provision is not the aim of the CBA methodology.

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11. Comment by: Eurelectric

Assumptions and methodology for a Cost Benefit Analysis for FCR providing groups with limited energy reservoir

Eurelectric welcomes this public consultation and appreciates the opportunity to express its views on this proposal for assumptions and methodology for a Cost Benefit Analysis, for FCR providing groups with limited energy reservoir (LER).

1) The methodology described in the document does not seem to be in line with the article 156 of the SO GL, regarding the consideration of the pre-alert state period. Indeed, the guideline requires that:

"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."

This definition means that it is the responsibility of FCR providing units with LER to make sure that, at any point during normal state, the LER resources have always an energy content that will allow them to remain available as of triggering the alert state and during alert state for the minimum time which will be defined by the CBA, between 15 and 30 minutes (called Tmin LER).

The period which is called "pre-alert state" from which (overcome of +- 100 mHz), the energy consumption of LER is taken into account in the CBA, is not what the article 156 of the SO GL strictly requires (the notion of "pre-alert state" does not exist in this article).
In summary, while a common definition of an alert state is given, the interpretation on the consequences for Tmin LER seems arbitrary, even though SOGL Art. 156(9) is pretty clear about this. For investment decisions, prequalification standards, operational procedures and subsequent monitoring a common understanding and harmonized application is vital.

The pre-alert is normal state; according to article 156(4) of System Operation GuidelineSO GL, FCR should be constantly available in normal state. Because of this assumption, the CBA methodology ignores

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the events that do not trigger alert state, assuming a theoretical no impact on the energy consumption. The methodology will then take into account only events that trigger alert state: in this case the assumption is that If a continuous exceeding of the standard frequency range includes the triggering of an alert state, the activated energy and the residual energy in the reservoir is calculated from the first exceeding of the standard frequency range limits. Recharging strategy when alert state is not triggered is out of scope of this methodology. The energy amount calculated this way will then be used to calculate an energy equivalent Time Period of full activation

The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is part of this process.

2) Normal state being out of the scope of this methodology, there is the risk that requirements for this state differ significantly from one area to the other.

We regret that the methodology doesn't look at the requirements needed to ensure full availability in normal state, as this will probably mean that each TSO will then stay free of asking what they consider needed, which still leads to possible market distortions from one country to another.

We understand the rationale of the comment. The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is part of this harmonization process. Also FCR cooperation project has been started on a volunteer basis by nine TSOs, although it is not requested by GL EB.

3) Eurelectric has some doubts about the need for this methodology

Eurelectric considers that a Tmin LER higher than 15 min represents an over-specification of FCR product. Indeed, "FCR providing units shall be able to fully activate FCR continuously until the activation of FRR". Considering full FRR activation within the time to restore Frequency, (15 minutes for CE: SO GL, Article 157), this requirement would result in extra costs for FCR supply.

FCR acts independently by FRR and it is the most important, the first and the last line of defense of the power system available to TSOs. We acknowledge that there may be solutions to improve long lasting frequency deviations and deterministic frequency deviations, but until we see a significant improvement, we cannot exclude these events. This does not imply that FCR shall play the role of FRR or other balancing reserves, since it shall able to face this kind of events.

4) LER and non LER services

Eurelectric considers that non LER will probably have to play an extra role in case of LER depletion situations. The additional relevance that is placed on non-LER units needs to be properly remunerated to keep participation attractive.

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Regarding the share of non-LER, their additional capacity is calculated to determine additional system costs. This additional non-LER capacity is required for secure system operation. Once an acceptable situation has been identified, the targeted LER share has to be restricted during procurement. Otherwise the extra non-LER capacity will be insufficient.

The implementation of the market design is out of scope of the CBA.

The methodology provides a matrix of possible solutions based on which all TSOs will make a proposal for a time period to NRAs for approval considering these main key factors:

- FCR amount
- Total FCR costs estimated
- LER share

5) Hypothesis considered for the calculation are questionable, and need more transparency

For instance, eurelectric considers that more transparency on FRR dimensioning rules, among which the Full Activation Time of aFRR which will be taken for the study is needed.

As described in the proposal the aFRR will be considered in the dynamic model without saturation. The FAT of FRR will be a weighted average of the FATs among LFCBs of each SA. A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

The approach of adding additional historical scenarios for stressing the simulations with extreme observations may be relevant if used with care. About the frequency historical trends of 15 years, eurelectric thinks that this period which include the incidents occurred in September 2003 and in November 2006, is too large and not representative of the current European Electricity Network.

Extreme events will not be taken into account for the definition of the frequency statistics.

To properly represent the present scenario and consider the effects that the mitigation measures will have on frequency the CBA methodology has been amended: the future scenarios has been moved out and a specific disclaimer clarify that as soon as the scenario is not representative anymore the CBA has to be run again.

15 years of data have been chosen for to represent an adequate amount of data for the statistics of frequency and also mitigate model assumptions: incidents are not foreseeable and can happen again. Instead of assessing deterministic worst cases the historical data are used and considered appropriate for the mitigation of simplified model assumptions: e.g. the network topology and the consequences of line tripping in different scenarios are not represented in the CBA methodology.

Eurelectric asks for transparency with the assumptions and sources of data needed for the Monte Carlo simulation as the choice of the TYNDP scenario, the relevant real frequency events as frequency profiles.

We acknowledge your comment. The detailed adopted assumptions will be defined and published during the implementation phase, including frequency statistics. The CBA analysis will be performed considering a short term development instead of multiple time horizons.

A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs of CE and Nordic SAs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

Eurelectric would like to know which assumptions will be taken to consider the evolutions of electricity mix in each country and market design (ISP, Balancing…). Eurelectric considers that a duplication of the past into the future is foreseen, whereas many market design parameters have been changing or will change meantime.For example, with a 15 min imbalance settlement, the deterministic frequency deviation phenomena should decrease, as it has been assessed recently by ENTSO-E.

The CBA analysis will be performed considering a short term development instead of multiple time horizons.

A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

For more clarity and transparency with the sources of the data, it is important that the assumptions and the methodology needed to build FCR market curves would be released.

The detailed adopted assumptions will be defined and published during the implementation phase, including market curves modelling

a. Which energy market prices will be used for the study?

The detailed adopted assumptions will be defined and published during the implementation phase.

b. As the settlement of BSP which participate at the FCR Procurement market, is actually a Pay as Bid settlement (ie the costs per unit are actually not public), which assumptions will be taken to evaluate the costs of LER and non LER FCR providers?

The methodology does not deal with remuneration schemes and bid approach but with cost estimation of FCR

c. It is also necessary to calculate the FCR market curves with sensibilities.

The CBA analysis will be performed considering a short term scenario instead of multiple time horizons.

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A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs of CE and Nordic SAs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

As written in page 6 but not in pages 23/24, EURELECTRIC considers that run of river units with LER should be considered for the study.

We acknowledge your comment. CBA is technology neutral as it considers all kind of technologies representing LER, not only batteries.

The implication of the stakeholders and the transparency of ENTSO-E are key for the results of CBA, to minimize FCR costs without jeopardizing operational security. The collect of data and the definition of assumptions needed for the study should be done in consultation with stakeholders. Thus, it is also important that the detailed results of the study become public.

We acknowledge your comment. The detailed adopted assumptions will be defined and published during the implementation phase.

Finally, eurelectric considers that the CBA methodology should be discussed during a "Stakeholders Committee" before its submission to regulatory authorities.

The tight schedule does not allow a further step with the Stakeholder Committee before the submission of the CBA methodology to the NRAs. Anyhow the involvement by ENTSO-E of ESC will keep continuing during the whole process.

A clear planning with the next steps should also be released.

We acknowledge the request; a planning of the next steps will be available during the implementation phase.

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12. Comment by: European Association for Storage of Energy (EASE)

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".

The European Association for Storage of Energy (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.

Please note that the full version of the EASE reply to this public consultation has been sent via email to Mr Alexander Mondovic (Alexander.Mondovic@entsoe.eu).

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

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.

Pre-alert state is a part of the normal state. Art. 156(9) of SO GL requires that the FCR from FCR providing units or groups with limited energy reservoirs are continuously available during normal state.

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.

We understand the ratio of the comment. The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is part of this process.

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.

We understand the ratio of the comment. The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is part of this process.

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.

As described in the proposal the aFRR will be considered in the dynamic model without saturation. The FAT of FRR will be a weighted average of the FATs among LFCBs of each SA.

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

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.

Please note that the probabilistic approach for FCR dimensioning described in SO GL art. 153 is not mandatory and the Monte Carlo simulation proposed for the CBA methodology aims to assess the stability risk in presence of LER with a probabilistic approach.

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):

When considering the long lasting events the outage will be tracked in order to avoid double counting: long lasting events caused by multiple outages will not be used as input for the statistics. More in general all the available information related to the dependence amongst the three sources of frequency disturbance (Long lasting, deterministic frequency deviations and outages) will be taken into account in order to avoid the double counting of phenomena.

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

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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.
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.

The methodology will consider the current best practices in term of FCR procurement (e.g. FCR cooperation). A new market design and its implication on the results is out of scope for this CBA.

b. Most relevant real frequency events

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.

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

Instead of assessing deterministic worst cases the historical data are used and considered appropriate for the mitigation of simplified model assumptions: e.g. the network topology and the consequences of line tripping in different scenarios are not represented in the CBA methodology; also please consider that 15 years have been chosen because we can consider since 2003 a process starts in the path of more close cooperation between the TSOs.

- 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 assessment of the system security considering the presence of LER during those events will be made considering the frequency trend and the consequent FCR activation requested to the LER. This simplifies the assumptions regarding the system evolution after the power imbalance to avoid an excessive modelling complexity to deal with.

- 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.

15 years of data have been chosen for to represent an adequate amount of data for the statistics of frequency and also mitigate model assumptions: incidents are not foreseeable and can happen again.

Considering what above mentioned and that the frequency statistics of the last years doesn't show a clear trend of better frequency quality the TSOs of SA CE and Nordic proposes, in order to properly reflect the present scenario, not to mitigate the statistics of the frequency, being the FCR the most important, the first and the last line of defense of the power system.

Furthermore the CBA analysis will be performed considering a short term developments instead of multiple long-term time horizons.

A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

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.

The worst case events of the past years will not be taken into account in the frequency statistics and as an input of the probabilistic simulations.

3. CBA methodology approach

a. Cost calculation method proposed by ENTSO-E

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.).

Methodology will analyze a short-term scenario: in our opinion assumptions on costs in a short term reduces the exposure to costs forecast uncertainties. All assumptions about these topics will be released at the implementation stage. If the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

- 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.).

Methodology will take into account a modelling of market curve for FCR provision (note: the methodology does not implement a complete market model of FCR and FRR): the detailed adopted assumptions will be defined during the implementation phase

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- The hypotheses on remuneration schemes for the FCR services: capacity only in €/MW, capacity in €/MW and energy in €/MWh?

The methodology will consider the current best practices in term of FCR procurement (e.g. FCR cooperation). A new market design and its implication on the results is out of scope for this CBA.

- 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 methodology does not deal with remuneration schemes and bid approach but with cost estimation of FCR.

- 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.

Within the FCR context, the CBA has to determine if and how system costs change, taking into account a competitive setting, where no forms of distortion are present. For instance, this analytical setting implies that bids are the mere presentation of marginal opportunity costs.

In addition, the CBA has a long-run perspective, then the cost curve definition will be based on the long-run marginal cost concept, where all factors of production are endogenous, including investment costs for new installed FCR providing units.

o 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)?

Methodology will analyze a short-term scenario: in our opinion the proposed approach for non-LER costs calculation is adequate to reflect the FCR costs for those technologies. If the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs will submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

We would also like to underline that:

- The LER-FCR investment costs should consider the possibility for LER to stack revenues.

The investment costs for LER shall be considered only if they are sustained in order to qualify for FCR provision. As described in the methodology, in case of storage revenue stacking the investment cost should be associated only to the share sustained for FCR provision.

- 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.

The methodology will consider the current best practices in term of FCR procurement (e.g. FCR cooperation), then capacity costs (€/MW) will be taken into account.

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.

Discount rate is no more used for the calculation of NPV of costs starting from the results of different forecast scenarios since there is only one short term scenario. A specific disclaimer has been added to clarify that as soon as the scenario is not representative anymore the CBA has to be run again.

b. NPV comparative in CBA methodology

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.

The methodology provides a matrix of possible solutions based on which all TSOs will make a proposal for a time period to NRAs for approval considering these main key factors:

- FCR amount
- Total FCR costs estimated
- LER share

c. Proposal for a new CBA approach

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 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.

o 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.

o 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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It seems that CBA methodology already comprises all of these steps: evaluation of energy amount for FCR, cost estimation and a risk assessment analysis

4. Summary of key EASE 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).

Pre-alert state is a part of the normal state. Art. 156(9) of SO GL requires that the FCR from FCR providing units or groups with limited energy reservoirs are continuously available during normal state.

We understand the ratio of the comment. The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is part of this process.

- 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.

As described in the proposal the aFRR will be considered in the dynamic model without saturation. The FAT of FRR will be a weighted average of the FATs among LFCBs of each SA

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

Input data and frequency statistics will be released at the implementation stage

15 years of data have been chosen for to represent an adequate amount of data for the statistics of frequency and also mitigate model assumptions: incidents are not foreseeable and can happen again. Instead of assessing deterministic worst cases the historical data are used and considered appropriate for the mitigation of simplified model assumptions: e.g. the network topology and the consequences of line tripping in different scenarios are not represented in the CBA methodology; also please consider that 15 years have been chosen because we can consider since 2003 a process starts in the path of more close cooperation between the TSOs.

Considering what above mentioned and that the frequency statistics of the last years doesn't shows a clear trend of better frequency quality the TSOs of SA CE and Nordic proposes, in order to properly reflect the present scenario, not to mitigate the statistics of the frequency, being the FCR the most important, the first and the last line of defense of the power system.

When considering the long lasting events the outage will be tracked in order to avoid double counting: long lasting events caused by multiple outages will not be used as input for the statistics. More in general all the available information related to the dependence amongst the three sources of frequency disturbance (Long lasting, deterministic frequency deviations and outages) will be taken into account in order to avoid the double counting of phenomena.

- 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.

Methodology will take into account a modelling of market curve for FCR provision (note: the methodology does not implement a complete market model of FCR and FRR): the detailed adopted assumptions will be defined during the implementation phase.

- 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.

It seems that CBA methodology already comprises all of these steps: evaluation of energy amount for FCR, cost estimation and a risk assessment analysis

13. Comment by: Energy Pool

Energy Pool, aggregator participating in the FCR common market, welcomes the decision from the ENTSOE to clarify energy requirement for BSPs using resources with limited energy reservoirs for FCR provision.

Our comments regarding this proposal mainly deal with our expectations of clear, sustainable and fair rules to provide FCR through a market from different types of units (generation plants, consumers, storage) potentially subjected to different local TSOs' regulations:

- Energy Pool favours the clarification of rules allowing storage operators to size the optimal system to provide FCR. The inclusion of a new specific class of assets (LER) is however a source of concerns in the frame of markets allowing single standard products. Outputs of the presented methodology include the acceptable share of LER in the FCR. Energy Pool would like to make sure definition of LER, eventual specific market conditions (such as a specific cap), situation in aggregated units will be clearly tackled and stated at a market level.

We acknowledge the comment; TSOs of CE and Nordic are working in order to clearly define LER FCR provider.

- Requirements for Normal state operations are considered out of scope for this methodology and assigned to TSOs responsibilities. While the present methodology will hopefully homogenise the Alert State requirements, it will not provide answers to the requirements for standard frequency range. Still, normal state operations seem to impact system stability since they contribute to defining the regulation quality and the possible states in which LER would reach the beginning of relevant frequency events considered in this methodology. Another concern to Energy Pool is the difference in acceptable sizing and therefore competitivity of LER located in balancing areas under distinct TSO rules. Differences already appear in requirements stated by European TSOs on this matter so far. A solution would be to include in this methodology the requirements for normal State operations.

We understand the rationale of the comment. The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is part of this process. Also FCR cooperation project has been started on a volunteer basis by nine TSOs, although it is not requested by GL EB.

- Costs of LER technologies and the relationship between costs and sizing are structuring assumptions in this methodology. Could the ENTSOE detail how these costs will be evaluated?

The CBA proposal will be amended clarifying that FCR cost for LER shall be calculated as follows:

- For new LER providers considering:
  - investment,
  - OPEX
  - opportunity costs (if any)

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if they are sustained in order to qualify for FCR provision;

• For existing LER providers considering instead:
  - OPEX
  - opportunity costs (if any)

if they are sustained in order to qualify for FCR provision.

14. Comment by: EDF

EDF welcomes this ENTSO-E public consultation and appreciates the opportunity to express its views on this proposal for assumptions and methodology for a Cost Benefit Analysis, to determine the minimum time (Tmin) for FCR providing groups with limited energy reservoir (LER) to provide FCR.

First, EDF would like to recall its doubts about the relevance of the requirement described in article 156 (11) of the System Operation Guideline (SO GL) as already expressed during the comitology phase. Considering a Tmin for FCR providers with LER higher than 15 min represents, in our view, an over-specification of FCR products, as the general rule is that "FCR providing units shall be able to fully activate FCR continuously until the activation of FRR". Considering full FRR activation within the time to restore Frequency (which is 15 minutes for CE, cf. SO GL, Article 157), this requirement would result in extra-costs for FCR providers. EDF recalls that preserving the right balance between minimizing system operation costs (here FCR provision costs) on the one hand and ensuring operational security of the system on the other should not be forgotten.

Beyond that statement, EDF would like to deliver some general comments in terms of process and CBA methodology, and some more specific points on the present draft methodology submitted to consultation.

In terms of general comments and principles, EDF first considers that:

- In order to foster acceptability, the data, the scenarios and the methodology used to perform cost-benefit analyses must be undisputed or at least consensual : this requires transparency on the reference scenarios used, on the sensitivity analyses in order to ensure relevance, on the costs and benefits taken into account ; it also requires that some processes are guaranteed, notably the transparent access to (or controllability for confidential data) of the data used to perform the CBA, as well as the possibility to be informed and to discuss while the CBA is being carried out.

Future scenarios have been moved out in order to minimize the uncertainties. A specific disclaimer clarify that as soon as the scenario used for the methodology is not representative anymore the CBA has to be run again

Data will be published, also in terms of market curves modelling during the implementation phase.

More in general the detailed adopted assumptions will be defined and published during the implementation phase.

- A clear categorization of categories of costs and benefits for the system must be carried out in order not to forget some of them (i.e. stranded costs, value destruction, ancillary services, CAPEX, etc.) as well as to avoid double counting.

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The methodology provides a matrix of possible solutions based on which all TSOs will make a proposal for a time period to NRAs for approval considering these main key factors:

- FCR amount
- Total FCR costs estimated
- LER share

The solutions are identified analyzing the solutions which entails the lowest social cost without jeopardizing the system stability.

- The CBA is a tool to objectively assess an evolution from an economical point of view on the basis of all the potential costs and benefits that can be monetized. If other relevant non-monetary indicators are used, it has to happen in a second step in the frame of a multi-criteria assessment.

In terms of process, EDF considers that the CBA methodology should also be discussed in the System Operation European Stakeholders Committee (SO-ESC) prior to its submission to the regulatory authorities in order for ENTSO-E to explain the changes brought or not further to the present consultation and for stakeholders to react. Stakeholders shall not be left waiting for a potential written report on the comments received to be published weeks or months afterwards. Moreover, a clear planning with the next steps should be released.

The tight schedule does not allow a further step with the Stakeholder Committee before the submission of the CBA methodology to the NRAs. Anyhow the involvement by ENTSO-E of ESC will keep continuing during the whole process.

EDF's more specific comments to the proposed methodology are the following:

EDF approves and appreciates the Monte Carlo approach used to reproduce realistic scenarios, as opposed to basing the CBA on hypothetical worst-case scenarios for example. It is also appreciated that intermediate values of Tmin (15, 20, 25, 30 min) will be examined, rather than comparing only the 15 minutes and 30 minutes scenarios.

However,

1) The definition of Time Period included in the TSOs proposal is compliant with article 156 of the SO GL but the methodology described in the explanatory document does not seem to be in line with this article, regarding the consideration of the pre-alert state period. Indeed, the guideline requires that:

"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.

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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."

This definition means that FCR providing units with LER have to make sure that, (i) at any point during normal state, the LER resources still have an energy content that will allow them to remain available as of triggering the alert state and (ii) during alert state must be capable of delivering full FCR continuously for a minimum time to be defined by the CBA, between 15 and 30 minutes (Tmin LER).

In the TSOs' proposal (consultation document), Time Period means "the time for which each FCR provider shall ensure that its FCR providing units with limited energy reservoirs are able to fully activate FCR continuously, as of triggering the alert state and during the alert state". This definition is consistent with article 156 of SO GL. However, in the explanatory document, the actual energy consumption between the overcoming of the limits of the Standard Frequency Range and the trigger of alert state is taken into account, even though, by definition (cf. article 18(2)), the system is not in Alert State during this period. This integration is not only uncompliant with SOGL but also is inconsistent with the definition of Time Period in TSOs' proposal. Consequently, EDF would like the methodology to be clarified to ensure consistency between the guidelines and the TSOs' proposal.

The pre-alert is normal state; the methodology will take into account only events (long lasting frequency deviations, deterministic frequency deviations, outages, or combination of those) that trigger alert state: in this case the assumption is that energy use starts above frequency deviations higher than standard frequency range. Recharging strategy when alert state is not triggered is out of scope of this methodology. The energy amount calculated this way will then be used to calculate an energy equivalent Time Period of full activation.

2) Normal state being out of the scope of this methodology, there is the risk that requirements for this state of the system differ significantly from one area to the other.

We regret that the methodology does not look at the requirements needed to ensure full availability of FCR providing units in normal state, as this will probably mean that each TSO will then remain free to ask what they consider to be needed. This could lead to potential market distortions from one country to another.

We understand the rationale of the comment. The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period is part of this harmonization process.

3) Hypotheses considered for the calculation are questionable, and require more transparency

EDF considers that more transparency is needed on Frequency Restoration Reserve (FRR) dimensioning rules, among which the Full Activation Time of aFRR which will be taken into account for the study.

ENTSO-E bases its assumptions purely on historical trends and EDF regrets that they are not more forward-looking. Regarding the frequency historical trends of the last 15 years, EDF believes that this period is too large and not representative of the current European Electricity Network in terms of deterministic frequency deviations as it includes the incidents of September 2003 and November 2006. These cases are no longer representative of the situation in the current European power system, due to improvements brought to the system since then.

The FAT of FRR will be a weighted average of the FATs among LFCBs of each SA.

SO GL art 156 (11) requests to consider prolonged or repeated frequency events. The frequency statistics of long lasting events of the last years doesn't shows a clear trend of better frequency quality, hence it is proposed, in order to properly reflect the present scenario, not to mitigate the statistics of the frequency. Moreover a specific disclaimer has been added and clarifies that as soon as the scenario is not representative anymore the CBA will be run again.

Extreme events will not be taken into account for the definition of the frequency statistics.

15 years of data have been chosen for to represent an adequate amount of data for the statistics of frequency and also mitigate model assumptions: incidents are not foreseeable and can happen again. Instead of assessing deterministic worst cases the historical data are used and considered appropriate for the mitigation of simplified model assumptions: e.g. the network topology and the consequences of line tripping in different scenarios are not represented in the CBA methodology.

EDF calls for transparency in the assumptions and sources of data needed for the Monte Carlo simulation as well as for the choice of the TYNDP scenario, the relevant real frequency events as frequency profiles.

We acknowledge your comment. The detailed adopted assumptions will be defined and published during the implementation phase, including frequency statistics. The CBA analysis will be performed considering a short term developments instead of multiple time horizons in order to reduce possible uncertainties.

A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

EDF would like to know which assumptions will be considered to take into account the evolutions of the electricity mix in each country and as well as the market design evolutions (ISP, Balancing…). EDF considers that a duplication of the past into the future is not satisfactory, whereas many market design parameters have been changing or will change meantime. For example, with a 15 min imbalance settlement, the deterministic frequency deviation phenomena should decrease, as it has been assessed by ENTSO-E himself in the joint ENTSO-E/EURELECTRIC report of 2011 and works on the impact analyses carried out in 2012.

We acknowledge your comment. The CBA analysis will be performed considering a short term scenario instead of multiple time horizons in order to reduce possible uncertainties.

A disclaimer will clarify that if the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs shall submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

For more clarity and transparency on the sources of the data, it is important that the assumptions and the methodology required to build the FCR market curves be released. Here are some examples of questions that are raised:

a. Which energy market prices will be used for the study?

The detailed adopted assumptions will be defined and published during the implementation phase.

b. As the settlement of Balancing Service Providers participating at the FCR Procurement market, is actually a "Pay as Bid" settlement (ie the costs per unit are actually not public), which assumptions will be taken to evaluate the costs of LER and non LER FCR providers? EDF recalls that the FCR market curves have to be calculated with sensitivity analyses.

The methodology does not deal with remuneration schemes and bid approach but with cost estimation of FCR

Among the types of FCR providing units to be considered in the study, EDF is surprised to see no mention of run of rivers (written in page 6 but not in pages 23/24 where the question of the costs of the different technologies is developed). EDF considers that run of river units with LER are to be considered for the study, as they represent 15 % of the FCR need in France.

CBA is technology neutral as it considers all kind of technologies representing LER, not only batteries.

The implication of the stakeholders and the transparency of ENTSOE in this process are key for the results of CBA. The collection of data and the definition of the assumptions needed for the study should be done in consultation with stakeholders. Thus, it is also important that the detailed results of the study are made public.

The detailed adopted assumptions will be defined and published during the implementation phase.

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15. Comment by: Enel

Enel strongly believes that storage will have an increasingly important role in electricity systems, contributing with its flexibility and allowing further penetration and integration of renewable energy sources.

Enel, therefore, welcomes the opportunity to review and comment the proposed methodology and assumptions for a cost-benefit analysis, developed in accordance with article 156(11) System Operation Guidelines (SO GL).

The proposal under consultation takes into due consideration the complexity of the analysis to be performed in order to identify minimum activation time requirements for LER FCR providers that, while minimizing the costs of the FCR process for the system, will guarantee a secure network operation.

However, the assumptions described in the document under consultation as well as in presentation used during the workshop of 15th of January 2018 need to be further clarified by ENTSO-E with respect to SO GL provisions: in fact, the results of the CBA could be highly affected by eventual incorrect hypothesis.

1. Object of the CBA and system states

The System Operation Guideline (SO GL), in 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.

The provisions for LER FCR providers are, then, given for normal state (in terms of continuous availability) and alert state (in terms of minimum activation period, to be determined through a CBA).

The methodology under consultation, instead, when describing the simulation model and the energy depletion of LER FCR providers, makes the following assumptions:

- 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

The model which ENTSO-E intends to use in the future CBA considers that LER FCR providers start to deplete their energy reservoir when entering the “pre-alert state”, a state which is not defined in the SO

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GL. As far as it can be understood, the model starts consuming the LER energy and depleting the reservoir before entering the alert state, this last being the object of the CBA and of the SO GL requirements in terms of minimum activation period.
ENTSO-E should better explain the assumptions taken in the proposed methodology and reconcile them with what required by SOGL in article 156 for normal states and alert states. A definition of pre-alert state should also be given.
Finally, the document under consultation and SO GL should clearly define the requirements for FCR LER providers in terms of an equivalent energy content [MWh] for a given FCR provided by them [MW], in all system states, i.e. normal, pre-alert (if needed) and alert states. This parameter is the most important one, both for potential market participants to size their equipments and offer services in the electricity markets, than for TSOs to evaluate the real contribution of LER.
Otherwise, should this not be clarified, there is the risk that each TSO will have margins to complement these 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. Besides, the results and assumptions of the CBA would be questionable, as the model would start to deplete LER resources of the energy required for alert state before entering the alert state, without considering the additional possible energy requirements of TSOs for normal state.

The pre-alert is normal state; the methodology will take into account only long lasting frequency deviations that trigger alert state: in this case the assumption is that energy use starts above frequency deviations higher than standard frequency range. Recharging strategy when alert state is not triggered is out of scope of this methodology. The energy amount calculated this way will then be used to calculate an energy equivalent Time Period of full activation

2. Intervention of FCR and FRR reserves

The LER depletion acceptance criterion FCR used in the iterative model presented by ENTSOE requires additional FCR to be added until a quasi-steady state frequency is not reached with a deviation < 200mHz.
We think that major details should be given on the hypothesis taken on FRR intervention, in terms of volumes, timing of intervention and FAT. In fact, the contribution of FRR to restore system frequency has a great impact on the control of frequency and, therefore, on the requirements for FCR. The complementarity and interaction among the different reserves should be clearly established, taking also into account the requirements currently under definition in the aFRR and mFRR platforms.
Stakeholders should be ensured that FCR is not oversized due to poor sizing and wrong assumptions taken on FRR contribution.

The FAT of FRR will be a weighted average of the FATs among the LFCBs of each SA.

Finally, the methodology proposed by ENTSO-E is based on the SOGL requirement of a full FCR activation for a frequency deviation of 200mHz. In some countries, the practice of the FCP can be different, conventional units have to reserve a certain band with respect to the nominal power and FCR is activated as per the droop value imposed by TSOs. How these differences are taken into account in the methodology proposed by ENTSO-E?

The methodology considers the FCR response at SA level, acting by droop. This also corresponds to a full activation of the FCR amount at 200 mHz. The dynamic of the FCR response is not taken into consideration since the methodology deals with energy evaluations. About conventional units, it is assumed that they will provide FCR as long as the frequency deviation persists, acting as non-LER.

3. FCR costs evaluation

The evaluation of total FCR costs is done globally on multi-years scenarios, considering the NPV of costs sustained in different years. The following aspects have to be clarified by ENTSO-E.

- The actualization of costs sustained in different years is done considering a discount factor “r” of 4%, which is not clearly defined and substantiated. The choice of this factor has to be better explained and at least a sensitivity analysis should be performed.
- LER penetration in the market and their minimum time of activation are considered in a static way in the model: we think that there is a recursive aspect not considered in the simulation, due to the fact that the choice of Tmin, LER strongly influences LER development and their share in the FCR provision. Smaller Tmin, LER should, in principle, translate into lower entry barriers for new entrants, major competition, less market power and offers of a lower value. Besides, it is not clear if the NPV in a given scenario is calculated considering a fixed couple of parameters “LER shares and Tmin, LER” or if their evolution is considered.

Future scenarios have been moved out in order to minimize the uncertainties. A specific disclaimer clarifies that as soon as the scenario used for the methodology is not representative anymore the CBA has to be run again

Data will be published, also in terms of FCR cost curves modelling during the implementation phase.

More in general the detailed adopted assumptions will be defined and published during the implementation phase.

- FCR markets are not harmonized in EU countries. 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? Which are the hypotheses on remuneration schemes for the FCR services (capacity only in €/MW, capacity in €/MW and energy in €/MWh, settlement of imbalances)? ENTSO-E should clarify if the model uses a unified rule or the existing market rules in each Member State.

The methodology does not deal with remuneration schemes and bid approach but with cost estimation of FCR.

- Bidding strategies of FCR providers seem to be unified in the model, without considering possible different market arrangements and remuneration schemes in the different countries. The following questions should be answered and explained in the methodology.

The methodology does not deal with remuneration schemes and market design but with cost estimation of FCR. The key concept is to reflect the social opportunity cost of FCR instead of prices observed in the market. The proposed approach to be adopted for cost estimation is detailed in the CBA methodology proposal and is different for LER and non-LER providers but uniform within the SA since the costs can be considered not affected by the market arrangements and remuneration schemes.

- For LER providers, the bidding strategy proposed is a bid proportional to investment costs, but investments costs could be considered sunk costs once the LER has been built and no marginal cost is taken into account.

The cost curve definition will be based on the long-run marginal cost concept, where all factors of production are endogenous, including investment costs. To this respect, it is important to highlight that only prospective investments will be taken into account as they have an impact on welfare. On the other hand, investments both in LER and non-LER that have already taken place will be considered as sunk costs.

- For non–LER providers, in case there would be only an FCR capacity payment, we are not sure that they 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)?

Methodology will analyze a short-term scenario: in our opinion the proposed approach for non-LER costs calculation is adequate to reflect the FCR costs for those technologies. If the assumptions adopted will change significantly after entering into force of the Time Period, all TSOs will submit the results of an updated CBA to the concerned regulatory authorities, suggesting an updated Time Period.

4. Frequency deviation assumptions.

Real events of the past will be used both in the Monte Carlo simulation and in the final “test”. This last test, in particular, is performed once the NPV is calculated and, being a pass/no-pass test, strongly influences the possible adoption of a certain value of Tmin, LER.

Particular attention should be kept on the hypothesis that will be taken and the real events that will be chosen for the simulation and for the final test: some severe events of the past should not be tested if currently not foreseeable, for example due to the increased cooperation between TSOs at system operation level.

In the 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, penetration of energy storage devices, more effective coordination among the European TSOs). 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. Therefore, considering incidents older than 10 years would not be appropriate.

Extreme events will not be taken into account for the definition of the frequency statistics.

To properly represent the present scenario and consider the effects that the mitigation measures will have on frequency in the future the CBA methodology has been amended: the future scenarios has been moved out to reduce uncertainties and a specific disclaimer clarify that as soon as the scenario is not representative anymore the CBA has to be run again.

Incidents are not foreseeable and can happen again. Instead of assessing deterministic worst cases the historical data are used and considered appropriate for the mitigation of simplified model assumptions: e.g. the network topology and the consequences of line tripping in different scenarios are not represented in the CBA methodology.

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16. Comment by: ETH Zurich / THEMA Consulting Group

I hereby reply to the "proposal on the assumptions and methodology for a cost-benefit analysis to be conducted, in order to assess the time period required for FCR providing units or groups with limited energy reservoirs to remain available during alert state, developed in accordance with article 156(11) of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SO GL)"

I am currently a consultant with THEMA Consulting Group in Norway. We consult companies, authorities and other stakeholders in the power sector and adjacent sectors on strategic, regulatory and market issues. However, I want to make it clear that this reply to the proposal is my personal opinion as a researcher in power systems and not the opinion of my company. In fact, this reply is written without prior knowledge or consent of my employer and should be treated as a personal submission. Prior to my current position, I worked at ETH Zurich as a research assistant where I received my doctoral degree, in part due to the research I did specifically on provision of primary control (FCR) by batteries and other resources with limited energy storage capacity.

After reading the proposal and participating in the ENTSO-E workshop, I have come to the conclusion that the proposal has fundamental flaws that must be addressed, and that the CBA in its current form needs to be rejected and redesigned. The CBA is not able to correctly evaluate the benefits and costs of provision of primary control by limited energy resources. Two main issues I will elaborated on are

1) The CBA does not specify which state-of-charge (SoC) management strategy, if any, is chosen. The SoC management or recharging strategy has essential implications on the interaction with other balancing services, and on overall system stability

SoC management is out of scope and LER energy capacity will be assumed completely available within the standard frequency range.

2) The CBA assumes one large control area; however, this simplification ignores elemental parts of the interaction of balancing service, specifically in the highlighted situation of long-lasting frequency deviations.

We are aware of this. The methodology is a simplification in which an unlimited amount of FRR in a synchronous area is assumed, but only in case of counteracting deterministic frequency deviations in combination with outages of generating units. This assumption is realistic because it is, on the other hand, unrealistic to assume that multiple outages of generating units take place in the same control area. Such outages rather take place dispersed over many control areas and thus not surpass the available amount of FRR in each of them. As to long lasting frequency deviation, they indeed stem from FRR saturation and the CBA methodology, contrary to your assumption, does not postulate an unlimited amount of FRR in this case.

3) Less relevant, but still noteworthy, the CBA ignores relevant positive effects of participation of energy constrained units (ECUs) in primary control provision

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If energy constrained FCR units, as you described them, “cease to react to the frequency signal when a frequency deviation persists for a long period of time”, they will not be certified as FCR providers with limited energy reservoirs (LER). To pass the certification, FCR LER providers have to demonstrate permanent power output in normal operation and in alert state during a time period to be determined by the CBA. It is assumed in GL SO that this duration is sufficient to counteract all frequency deviations that could endanger the system operation (i.e. also long lasting frequency deviations). Therefore, the additional features of energy constrained FCR units are welcome, but not essential. This means that the CBA does not ignore, as you say, the “relevant positive effects of participation of energy constrained units (ECUs) in primary control provision”. The CBA simply does not have the task to deal with this kind of additional capability.

1 RECHARGING STRATEGIES AND IMPLICATION FOR SYSTEM STABILITY

The CBA avoids clarifying which recharging strategies are permissible or are assumed for the analyses. While this is understandable concerning the current uncertainty and lack of harmonization in the regulation, it prevents any form of useful analysis: different recharging strategies lead to very different outcomes in terms of system stability and system security, and hence to different outcomes in the costs. Also, well-designed recharging strategies are proven to put minimal stress on the system and minimize system costs of FCR provision.

1.1 Recharging strategies need to be specified

To underline this point, I briefly discuss 4 different recharging strategies:
1) immediate recharging on reaching a SoC limit,
2) no recharging,
3) unspecified recharging,
4) moving-average recharging.

1.1.1 Immediate recharging

This “dumb” strategy indeed puts the system at additional risk. Not only does the battery completely stop provision of reserves, it also immediately puts an additional strain on the balancing resources, further deteriorating the situation. If several assets with similar parameters use this strategy, they would concurrently impose this stress on the system, potentially leading to a black out. This strategy must not be used.

1.1.2 No recharging

If – for the sake of the CBA – no recharging is assumed, this effectively leaves the system without reserves after some time. The consequences for system security are severe, as additional faults can no longer be handled. This effect would, to my understanding, not be taken into account in the current CBA design. Independent of if this is handled by the CBA or not, a strategy of not recharging would not realistically be used by any ancillary service provider

1.1.3 Unspecified recharging

A similar issue arises with unspecified recharging: effectively the CBA cannot make any meaningful statement on system stability if the asset behavior is not specified.

1.1.4 Moving-average recharging

A moving average strategy continuously recharges the asset by the average consumption or production of the last, e.g., 15 minutes. This strategy has several properties

- The battery SoC always stays close to the reference point
- The asset always responds with full capacity and full ramping rate to any change in system frequency, hence providing exact the response that the system needs to stay stable
- The recharging operating point (power) changes only slowly, even after a step in system frequency
- The recharging is predictable for other parties, such as the TSO, without real-time communication between the asset and the TSO, as long as the parameters of the storage system are known.
- The recharging energy must be provided by a third party. If it is consumed as balancing energy, 1) the total amount of energy is very small compared to the provision of balancing energy by FRR resources; and 2) since the change in set point is smooth and slow, it does not increase requirements on ramping rates of FRR.

This strategy was proposed in a paper from 2013 [1], and is currently being applied for example by the utility EKZ in Switzerland since (I think) 2014. The EKZ system is participating in the Swiss ancillary service market without pooling with a dispatchable power plant [3].

1.1.5 Summary

From the above it should be clear that the choice of recharging strategy is essential, and that smart, predictable recharging strategies exist.

1.2 Smart recharging puts only limited stress on the system

As described above, a recharging strategy based on a moving average can be used for SoC management. Even if an asset using this strategy is not pooled with a dispatchable plant nor explicitly buys energy on intra-day markets, but rather recharges by consuming (or producing) balancing energy, the detrimental effects on FRR are negligible.

In a study [2] using frequency and area generation control (AGC) data for a time horizon of one year, we could show that

- the additional energy requested by FRR is on the order of 1% of the average energy provision by FRR resources
- no additional ramping requirements arise
- no additional capacity requirements arise

Furthermore, the asset would be required to pay for the consumed balancing energy, thus financing the additional energy provision by FRR. As mentioned, this approach is used since several years by a utility in Switzerland and in accordance with Swissgrid.

To conclude, I have highlighted 1) why the choice of recharging is essential, and 2) that smart recharging methods exist, are in use, and are proven to work both from simulations and years of practical experience.

2 LIMITED ENERGY RESOURCES IN SYNCHRONOUS SYSTEMS WITH SEVERAL CONTROL AREAS

The CBA methodology as proposed takes into account only one aggregated control area for each synchronous area. This simplification makes it impossible to investigate and understand the quite complex interaction between energy constrained resources providing FCR and those providing FRR. The main points in the argument are 1) FCR is a global control, while FRR is a control-area wide control, 2) long-lasting frequency deviations stem always from saturation of FRR in one or several control areas, 3) todays system is not secure when it is in alert state, and 4) energy constrained resources with a well-designed recharging strategy actually improve system security in situation with lasting frequency deviations. While going through these arguments, it will become evident that an aggregated modelling of FRR is not sufficient for the purpose of the CBA.

2.1 FCR and FRR have different scopes not only in time, but also in space

FCR is an inherently system wide response. It is a proportional response to the frequency assumed to be synchronous in a synchronous area. Except for dynamic effects on time scales much faster than those considered here, it can be assumed that all FCR resources receive the same input signal and respond in unison to a frequency deviation.

Secondary control or FRR is an inherently local control only concerned about the balance of each control area. In fact, the Area Control Error (ACE) is the main input, and it takes into account the exchanges with neighboring areas, as well as the frequency response in the own area by FCR resources and natural damping. Hence it will exclusively respond to local imbalances.

2.2 Ignoring that the scope of FRR is limited to the local control area masks the basic effects that should be investigated, rendering the analysis meaningless

To substantiate this claim, I will highlight only two points: 1) long lasting frequency deviations stem from the effect that FRR is saturated in one control area, and the remaining FRRs are not supporting that area; 2) if one would aggregate all areas, the lasting frequency deviation would vanish.

A lasting frequency deviation ensues when one control area is out of balance, and the local FRR can no longer handle the imbalance. Since the neighboring control areas compute the ACE in such a manner that they only respond to imbalance in their own areas, they are not being activated despite the remaining imbalance. Hence the frequency will deviate until the global FCR response covers the imbalance.
If one would now look at one large system with the same imbalance in one area, but aggregate the FRR response, the imbalance would be handled by this larger capacity of control reserves.

While the CBA methodology is trying to take this into account by only looking at changes in frequency and changes in activation, the over-simplified approach of the CBA methodology cannot capture the interaction between FCR provision by energy constrained units, nor the effect on tie-line flows if energy-constrained units provide FCR, and hence the actual activation pattern of FRR in such situations is not represented. Refer to [2] for an alternative approach.

2.3 Todays' system is not secure in alert state, as FCR resources are blocked

During a lasting frequency deviation, todays' system can no longer react to a design fault. This is because the FCR resources, which are the only resources able to provide power capacity quickly enough after a

fault (and after the inertial response), are occupied by support a lasting, slowly changing imbalance in the system which could easily be handled by FRR resources. Hence, in case of an additional outage, FCR would not provide the required response and the system might collapse. This issue arises, as FRR is designed in such a way that it only reacts to imbalances within the control area.
Please be reminded, that this describes todays situation with unconstrained resources providing FCR. The issue in the current design of balancing services is, that in case of lasting frequency deviations primary control is activated, even though this would be a task much better suited for secondary control.

2.4 Counter-intuitively, energy-constrained units providing FCR can improve system security during lasting frequency deviations by forcing FRR to be activated
With a well-designed recharging strategy, the behavior of energy constrained FCR providers forces FRR resources to be activated during lasting frequency deviations. This is a more appropriate behavior than todays' response described above.

This happens because of the following effects:
a) A lasting frequency deviation occurs due to an imbalance and saturation of FRR in area A. During this event FCR will be activated in both area A and all other areas B.
b) However, the ACE in areas B will be zero, as the sum of measured frequency deviation and unscheduled tie-line flows, driven by FCR provision, cancel out. FRR in areas B is not activated.
c) If a frequency deviation persists for a long period of time, energy constrained FCR units will cease to react to the frequency signal. Accordingly, the ACE in all areas B with energy constrained units will differ from zero, as the frequency deviates from nominal but no unscheduled tie-line flows persist.
d) Hence, FRR in areas B will be activated up to the point of the previous FCR provision by energy constrained units

Importantly, if the recharging algorithm is designed appropriately, we have the following behavior

a) All energy constrained FCR units are still able to react to sudden changes in frequency, in either direction
b) Ceasing provision of balancing energy during the steady-state deviation happens in a smooth way, allowing the slower FRR reserves to take over

Exactly this behavior is guaranteed by the moving-average recharging strategy mentioned above. Please find also a full analysis of the described effect and related issues in [4], Chapters 11 and 12.

3 OTHER ISSUES
The CBA methodology also ignores a number of other potential benefits of provision of FCR by energy constrained units. The main effect ignored is the fact that most ECUs can react much faster than conventional power plants or even hydro power plants. This fast response might become more and more relevant in the future, especially as the overall inertia in the system decreases. The need for either virtual inertia or faster FCR resources is already recognized by the TSOs in the Nordics, and by EirGrid in Ireland. While acknowledging that this is an effect that is hard to quantify at this stage, it should be taken into account in a qualitative CBA.

4 CONCLUSION

It is the task of the TSOs to ensure a secure and economic provision of energy to all consumers. Hence the question of FCR provision is a very relevant topic, and the consideration of costs and benefits of using alternatives for FCR provision to the existing approaches should be taken with utmost care.

In this response, I pointed out two main faults in the current CBA methodology:

1) The recharging strategy of ECU providing FCR is not defined, despite the elemental effect on system security and interaction with FRR
2) Modeling the system as one area is insufficient, as FRR is an inherently control-area wide control strategy, while FCR covers the whole synchronous area. The interaction between these scopes must not be ignored.

I further pointed out that well designed recharging strategies exist and are currently being used in both pilot and commercial projects.
I hope that ENTSO-E will take the points raised in this response into account. I also would like to request that the sources below are being cited if the CBA is updated accordingly.

With kind regards,
Dr. Theodor Borsche

[1] T. Borsche, A. Ulbig, M. Koller, and G. Andersson, “Power and Energy Capacity Requirements of Storages Providing Frequency Control Reserves,” in IEEE PES General Meeting, Vancouver, 2013.
[2] T. Borsche, A. Ulbig, and G. Andersson, “Impact of Frequency Control Reserve Provision by Storage Systems on Power System Operation,” in 19th IFAC World Congress, Cape Town, 2014.
[3] Michael Koller, Theodor Borsche, Andreas Ulbig and Goran Andersson, Review of Grid Applications with the Zurich 1MW Battery Energy Storage System, Electric Power Systems Research (EPRS), volume 120, pages 128–135, March 2015
[4] Theodor Borsche, Impact of Demand and Storage Control on Power System Operation and Dynamics, Doctoral Thesis, ETH Zurich, 2015. Available at:
https://www.research-collection.ethz.ch/bitstream/handle/20.500.11850/117223/eth-49281-02.pdf?sequence=2

17. Comment by: EKZ Elektrizitätswerke des Kantons Zürich

I hereby reply to the proposal on the assumptions and methodology for a cost-benefit analysis to be conducted, in order to assess the time period required for FCR providing units or groups with limited energy reservoirs.

I am the Chief Technology Officer (CTO) of Elektrizitätswerke des Kantons Zürich (EKZ) in Switzerland. We are a prequalified ancillary services provider and provide FCR with Li-Ion batteries since 2014.

Looking at the proposal I would suggest revision to the following points of the methodology:

1) Looking at historic frequency measurements and events is a reasonable and practical approach. However, one should remove all the periods from the time series during which FRR in one of the control zones did not perform according to grid codes an requirements leading to a lasting frequency deviation. Those instances of FRR failure should not be covered by FCR but be fixed by enforcing the existing ENTSO-E quality requirements in all control zones. This would surely be more cost effective (not to mention more just) than larger duration requirements for FCR.

FCR is the most important line of defense of the power system. We agree that acting on alleviating the root causes is the best solution, but until we see a significant improvement, we cannot exclude these events. Currently, there is no profound evidence that long lasting events and deterministic frequency deviations have been alleviated.

2) The evaluation should explicitly include the energy balancing strategies of LER providing FCR and their effect on system stability, FRR activation and LER duration requirements. Recommendations regarding recharging strategies should follow from the analysis in regard to their positive or negative effects on the overall cost benefit analysis

Recharging strategy when alert state is not triggered is out of scope of this methodology.

3) FRR modeling should be multi-zonal in order to examine effects of recharging strategies of LER providing FCR. A closed loop analysis of a multi-zone system is necessary for safe recommendations.

Recharghing strategy, with the exception of what explicitly defined in art. 156(13)(b), is out of scope of this methodology.

The methodology proposes a simplification in which an unlimited amount of FRR in a synchronous area is assumed, but only in case of counteracting deterministic frequency deviations in combination with outages of generating units. This assumption is realistic because it is, on the other hand, unrealistic to assume that multiple outages of generating units take place in the same control area. Such outages rather take place dispersed over many control areas and thus not surpass the available amount of FRR in each of them. In addition considering the exhaustion of FRR by the means of long lasting frequency deviation, allows to avoid taking into account the saturation of FRR in the single LFC area.

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4) The cost benefit analysis disregards one of the potential key benefits of many LER technologies. Faster response times than currently required by the grid code could provide big benefits for faults occurring during low inertia hours with a large share of the generation coming from inverter coupled renewables (mainly wind and solar). Faster response times would minimize the magnitude of the transient frequency excursion and prevent the system from reaching critical frequency thresholds by reaching the steady state frequency deviation much faster. This dynamic analysis of the potential benefits of LER should be evaluated (for example 5 seconds to full activation instead of 30 seconds).

FCR dynamics for LER FCR providers is not taken into account considering that:

- System inertia and FCR dynamics will be neglected since the aim of the methodology is to evaluate the energy content of frequency transients over 15-30 minutes (or even more) duration.
- The subsistence of system inertia is out of the scope of this methodology;

Failure to include remedies to address the issues mentioned above will result in a skewed cost benefit analysis disfavoring LERs over conventional FCR units. Since LERs are to a large degree novel technologies this would not only lock out new market participants from a competitive market but also limit the diffusion of these technologies in continental Europe compared to geographies such as a variety of synchronous zones in North America or in the UK and in the long run put the continental European power system at a technological disadvantage.

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18. Comment by: Statkraft

Dear Alexander,

Please find herewith our contribution to the consultation on the CBA for the requirements related to Article 156 of the SOGR. I would really appreciate if you can still take the comments into account, and we do not expect an official answer.

Statkraft would like to first underline that:

1. Priority must be given to international harmonisation of balancing products (including FCR products) to facilitate cross-border participation and thus a better functioning power market.

Harmonization is not comprised within the scope of the CBA tasks

2. Equal treatment of all assets and technologies (including generations, storage and demand response) is a prerequisite as otherwise competition would be distorted which would result in inefficiencies and ultimately higher costs.

Yes, different technologies of LER are taken into account. Non LER different technologies are also taken into account in the costs assessment.

Secondly, Statkraft wonders whether the cost estimation (as described in section 5.6) can be performed with sufficient accuracy. The FCR costs for non-LER plants as described in section 5.6.1.1, are opportunity costs. It can be questioned whether these are the only costs to consider. More importantly, it is questionable whether these opportunity costs can be calculated correctly. For example, which "energy price" and "marginal production costs" will be chosen? If it is the day-ahead price, then one should add opportunity costs and outage risks in the marginal production costs. These opportunity costs and outage risk costs are related to changing intra-day and imbalance prices. These considerations also apply to the quantification of the FCR costs for LER plants.

Methodology will take into account a modelling of market curve for FCR provision (note: the methodology does not implement a complete market model of FCR and FRR): all assumptions about these topics will be released at the implementation stage.

Finally, it is extremely hard to estimate the impact of innovations on FCR costs both in terms of new technologies as well as in new business models to exploit decentralised FCR providers.

The methodology approach is an estimation of costs for a short term scenario. If a significant evolution regarding the CBA assumptions occurs, the methodology will be applied again in order to propose a Time Period in accordance with this evolution.

Therefore, Statkraft is of the opinion that:

1. The technical requirements (so also on the time period for FCR providing units to remain available) must be primarily based on the needs of the system.

Since in the methodology is envisaged to calculate an increased FCR dimensioning in order to fulfill the needs of the system, a proper cost assessment is needed. The cost assessment is requested in Article 156 (11) of SO GL.

2. Market participants must be able to pool assets when delivering FCR. In this way individual assets that cannot meet the 30 min requirement can still provide value through such pooling.

It is possible. It is up to the aggregator to fulfill the requirements for FCR qualification.

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19. Comment by: Ørsted A/S

System security:
It is important to note that the FCR product is crucial to the stability of the grid and to avoid blackouts. The system security should therefore never be at risk. It is hence important that the sufficient amount of FCR is present in the system at all times. It is therefore critical if this is not the case because some reserves deplete too early. With this in mind we have the following concern:

- It is described that the initial condition for the LER is half the equivalent energy capacity and the model starts calculating the activated energy/residual energy when the standard frequency range is crossed (changing from green to yellow area in figure slide 35 in the presentation from the workshop). To our opinion it is not sufficiently conservative to assume that the LER is optimally placed regarding energy reservoir at that instant of time. In practice the reservoir will in practice not be at its optimum, a reservoir reduction of some percentage should be included for instance because of the activation from 0 to -50 mHz and generally because of the activation the preceding period (~1-2 hour) before the instance. Which in practice results in a too early depletion.

SoC management is out of scope and LER energy capacity will be assumed completely available within the standard frequency range.

Correct cost curves are crucial:
Correct cost curves are crucial to obtain the correct dimensioning of the FCR reserves. We are for the reasons stated below concerned about the result due to huge inaccuracies on the used cost assumptions.

As we are sure you know, batteries are well suited for provision of very fast reacting frequency response. Furthermore, the costs of batteries have declined rapidly and is expected to continue to do so in the future. Therefore, the costs of providing very fast responding reserves are likely to decline significantly – and probably faster than other technologies that can provide frequency response. This evolution needs to be captured accurately in the CBA as that may change the results concerning the most cost efficient way of ensuring overall system stability (ie. it may change the optimal share of fast responding reserves).

It is also important to capture the correct cost of conventional Non-LER FCR resources. Calculating it as a simple must run cost and an opportunity cost is too simple. A variety of different types of FCR resources exist which has another cost structure and are subject to constraints which results in the described model is not valid:

- Hydro power plants are typically not
- Plants subject to district heating production do not necessarily operate at low load at low DA-prices due to forced district heating production.
- Combination of different technologies (eg. downwards/upwards reserves) results in much more cost effective ways to provide FCR reserves.
- …

The proposed approach for calculating the costs of conventional non-LER is considered as an adequate approximation of real costs of FCR for non-LER. More complex models for a restricted amount of providers will not be considered in order to avoid an excessive modelling complexity to deal with.

20. Comment by: REstore

Firstly, REstore strongly calls for the Cost Benefit Analysis undertaken by the TSOS in application of article 156 of System Operation Guideline to aim at setting a harmonized number of minutes to be requested from limited energy reservoir assets in FCR in TOTAL, and not only during alert state.
As presented by the TSOs during the workshop held on January 15, Pursuant to Art.156(9) the time period shall be ensured "as of triggering the alert state and during the alert state", but in reality the storage capacity associated to a time period is exploited also in pre-alert state. To reflect this, it is likely that TSOs will request reservoirs taking this into account, i.e asking for the required number of minutes in alert state from the CBA + a certain amount to cover pre-alert state.
The key ambition of this CBA should be in the end to get a harmonized requirement implemented for all LER assets participation in FCR in continental Europe. Indeed, if the CBA limits its scope at a number of minutes for alert state, and ignoring the pre-alert state mode, then in the end each individual TSO can end in requesting different pre-qualification requirements for LER in terms of reservoir size. As the procurement of FCR is increasingly done at a European level, having different requirements would lead to significant and unacceptable differences between control areas: the cost of investing and developing a LER asset is highly dependent on the size of the reservoir requested.
As REstore has underlined in the ENTSO-E consultation closed on February 15 on the design of the FCR cooperation, it is key that such requirements are harmonized as soon as possible to avoid such distortions. We believe this CBA analysis is a very relevant project to seek for harmonized requirements on LER assets regarding the size of their reservoirs. As a illustration, would the CBA conclude that 15 minutes for alert state only is a good value, then each TSO in Europe could set requirements ranging from 15 minutes only to 30 minutes (15+15) or even more, and therefore costs of investing in LER assets being 100% higher in a control area compared to another which would not be acceptable.

We understand the rationale of the comment. Pre-alert state is normal state, out of scope of this methodology. The harmonization of the FCR product is not comprised within the scope of the CBA tasks but the definition of the Time Period for alert state is the aim of this process.

Secondly, REstore strongly argues that the approach chosen by the TSOs should not lead to size the reservoir of LER assets in FCR to cope with inefficiencies of other parts of the market: just because FCR is one of the last resort reserve, it should not be designed just for the sake of covering other issues (like unavailability of aFRR for whatever reason). As presented during the workshop on January 15, what is at stake here are the situations where the system faces lengthy frequency deviations, where the energy content is relevant (and not the speed of the response or the inertia). What is required from FCR providers should stick to the features of the product, i.e containing the frequency after an incident (and not restoring it, which is the job of FRR and RR reserves). FCR should in no way be charged to cover all the potential failures of other market segments. If TSOs feel they need an additional insurance, then they should call for the implementation of additional reserves, or increase the amount of relevant ones to cover energy content incidents.

FCR regulation operates in order to contain frequency deviation and does not restore frequency to its nominal value after a power imbalance occurs.

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SO GL art 156 (11) requests to consider prolonged or repeated frequency events. The frequency statistics of long lasting events of the last years doesn't show a clear trend of better frequency quality, hence it is proposed, in order to properly reflect the present scenario, not to mitigate the statistics of the frequency, being the FCR the most important, the first and the last line of defense of the power system available to TSOs. Moreover a specific disclaimer has been added and clarifies that as soon as the scenario is not representative anymore the CBA will be run again.

Finally, REstore underlines that the elements of response brought to the proposed methodology shall not be used afterwards by the TSOs in order to comfort or discard one or the other of the results obtained. At this stage, it is very difficult to provide answers on the methodology only, without being able to fully assess their impact and the potential results. We therefore reserve ourselves the right to complete our response and comments further on in the process, once the TSOs will present concrete results and hypothesis following the CBA, and before submitting to NRAs a concrete value.

We acknowledge your comment.

The input data and hypothesis for the methodology will be published.

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21. Comment by: SmartEn

To whom it may concern,

Thank you for providing us the opportunity to comment on the “Proposal for a Cost Benefit Analysis methodology” consultation.

If you have any more questions or feel that we can assist you in any way, please don’t hesitate in contacting us.

SmartEn would like to comment and provide suggestions on the following topics of the Cost Benefit Analysis methodology:

1. A clear definition is needed on what constitutes a “unit or group with limited energy reservoirs”. Neither the consultation document nor the Commission Regulation 2017/1485 of 2 August 2017 includes a definition concerning limited energy reservoirs (LER).
Without a clear definition, non-battery technologies might be excluded from this category that wouldn’t be otherwise. For example (pumped) storage power plants and run of river power plants, as none of them have unlimited energy reservoirs. Not only batteries have a limited energy reservoir, and these technologies would be left outside of the cost-benefit analysis.

We acknowledge the comment. TSOs of CE and Nordic are working in order to clearly define LER FCR provider

2. Any change in the FCR activation time will have an influence in the aFRR activation and its cost. For this reason, any analysis performed has to take into account the influence and impact that any modifications to the FCR activation will have on the aFRR, and keep this impact to a minimum.

As described in the proposal the aFRR will be considered in the dynamic model without saturation. We don’t take into account any impact on aFRR activation and costs because the increase of activation of aFRR due to LER presence occurs only in case of their depletion and it is expected to be negligible both in terms of costs and volumes.

3. The proposed model doesn’t take into account the bid size, but only the bid price. If the activation time is increased, it affects the bid price and the bid size. Taking into account the different technologies, the influence of the activation time can be stronger on the bid size than on the bid price.

For existing LER plants, methodology will also take into account the possibility to reduce the FCR amount offered

4. The current SOGL drafting is not comprehensive. The cost-benefit analysis gives only a defined number of minutes for the alert state, between 15 and 30 minutes, while it should provide with a total amount of time requested for limited energy reservoir assets to serve in FCR.

SmartEn asks the TSOs involved in this project to be more ambitious and propose a harmonized amount of total minutes, that will be implemented by other TSOs through the prequalification process.

Definition of Prequalification process is out of scope.

5. We are of the opinion that the cost-benefit analysis should guarantee that the FCR is dimensioned in an appropriate way for its purpose and not as a catch-all to cover inefficiencies in other markets. We strongly oppose an over dimensioned FCR that provides coverage to other issues that should be addressed by their own mechanisms, for the only reason that it serves as one of the last resort reserves.

FCR dimensioning is out of scope of the CBA proposal. The impact of an FCR increased amount will be taken into account in the CBA as requested by SO GL 156(11). FCR is the most important line of defense of the power system. We acknowledge that there may be solutions to improve other issues, but until we see a significant improvement, we cannot exclude these events. Currently, there is no profound evidence that long lasting events and deterministic frequency deviations have been alleviated.

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22. Comment by: BVES – German Energy Storage Association

Introduction

The German Energy Storage Association BVES is the leading industrial association of German energy storage companies that is open to all technologies in the areas of electricity, heat, gas and mobility. Our association represents companies and institutes along the whole value chain of energy storage (R&D, industry, aggregators, operators).

General Comments

BVES appreciates the endeavour to constitute a transparent, and balanced approach that will allow TSOs to minimise FCR costs while safeguarding operational security.

For BVES market transparency and uniform prequalification requirements for all market participants are of first priority. Batteries can provide their highest accuracy within milliseconds and are able to deliver FCR better than any other technology.

The fact, that batteries are classified as "technical units with a limited energy reservoir" (LER) and have to fulfil higher technical requirements to be able to enter the market, clearly contradicts the technologically open approach according to the European law. Thus, BVES underlines, that it is indispensable to have a market design which is open to all technologies.

CBA methodology is technology neutral as it considers different kind of technologies representing LER, not only batteries. LER do not have to fulfil higher technical requirements.

In its proposal for a Cost Benefit Analysis methodology to assess the frequency containment reserve, ENTSO-E introduced two main approaches:

- An analytic approach to size FCR and determine the time period for this service, based on Monte Carlo simulations using historical data of frequency deviations in the European transmission network;
- An economic approach to evaluate the cost-benefit impact of the FCR provision, according to the following criteria:
  - The FCR cost for non-LER technologies: difference between the energy price and the marginal cost of the technology.
  - The FCR cost for LER technologies: according to the investment cost of the solutions.

Together with the European Association for Storage of energy BVES has evaluated this methodology focusing on proposing improvements to enhance the proposed methodology. In detail, BVES would like to propose the following amendments and clarifications:

1. Clear definition of parameters

Normal state, pre alert state and emergency state parameters should be clearly defined in the draft methodology. The pre alert state, that ENTSO-E mentioned, is not included in the system operation guidelines. Moreover, as according to the system operation guideline, it seems that the time period neither greater than 30 minutes nor smaller than 15 minutes is only referred to the alert state, it is absolutely necessary to achieve transparency in the pre alert state definition in order to correctly size the LER-FCR reservoirs.

Pre alert is normal state; nevertheless only when dealing with long lasting frequency deviations that triggers alert state the assumption is that energy use starts above frequency deviations higher than standard frequency range in order to represent the reality of energy depletion of LER. Recharging strategy when alert state is not triggered is out of scope of this methodology. The result of the methodology is then to be applied to alert state and to be considered as equivalent full activation time.

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.

As described in the proposal the aFRR will be considered in the dynamic model without saturation. The FAT of FRR will be a weighted average of the FATs among LFCBs of each SA.

2. Data base and time frame

There should be more transparency regarding the relevant frequency profiles and historical data used to determine the different scenarios and Monte Carlo sampling assumptions.

When implementing the CBA methodology, frequency statistics will be published.

- 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, being the reference incident defined as 3,000 MW in positive and negative direction and a worse case established according to probabilistic criteria. ENTSO-E has established this probabilistic procedure as a Monte Carlo simulation process.

Please note that the probabilistic approach for FCR dimensioning described in SO GL art. 153 is not mandatory and the Monte Carlo simulation proposed for the CBA methodology aims to assess the stability risk in presence of LER with a probabilistic approach.

- In addition, if there has been a worse incident in the last 20 years, this incident must be considered. Regarding the establishment of a worse case according to probabilistic criteria, the detailed definition of the probabilistic procedure to determine this worse case should be included in the ENTSO-E approach. That is why it is not necessary to develop the proposed Monte Carlo approach because it is less transparent and it complicates the assessment.

The use of Monte Carlo method has the aim to explore a large part of all the possible combinations of the uncertainties sources in the future.

A probabilistic approach is more consistent than a deterministic approach that determines - with a "a priori" criterion - the edges of the distribution.

- In the last years, the technology evolution has changed dramatically, with a big impact on the generation and demand behaviours. Additionally, more cooperation between the TSOs has been

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achieved. As this evolution has a great effect on the incidents that could occur in the electricity network, it would be appropriate to evaluate FCR time period taking into account only incidents from the last 10 years. Incidents older than 10 years should not be taken into consideration, because they do not reflect the current electricity system behaviour.

15 years of data have been chosen for representing an adequate amount of data for the statistics of frequency and also mitigate model assumptions: incidents are not foreseeable and can happen again.

Considering what above mentioned and that the frequency statistics of the last years doesn't shows a clear trend of better frequency quality the TSOs of SA CE and Nordic proposes, in order to properly reflect the present scenario, not to mitigate the statistics of the frequency, being the FCR the most important, the first and the last line of defense of the power system.

3. Uniform approaches for cost determination

Regarding the economic approach needed to evaluate the cost-benefit impact of the FCR provision, more information should be given in order to determine those costs. A detailed and complete cost evaluation method should be provided by ENTSO-E. Additionally, a real discount rate should be used in order to estimate the NPV of the investments, instead of a new one based on societal criteria (4%).

The information provided by ENTSO-E to determine the cost of the system according to delivery schemes for LER, horizon year, LER share and minimum LER-FCR time period is not enough to clarify the methodology implemented to calculate the costs.

Defining the price range used for FCR cost of LER resources and the type of evolution of FCR cost (linear, piecewise linear, quadratic, etc.) is necessary. In addition, the partiality of LER-FCR investment costs considering that LER resources could also provide other services, shall also be defined.
The cost methodology differentiates between two procedures to estimate the cost of FCR provision, one for non-LER and other for LER technologies:

- The method considers that the FCR cost for non-LER technologies is the difference between the energy price and the marginal cost.

- However, the method does not take into consideration the cost of the capacity to provide the service (available capacity).

- The method considers that the FCR cost for LER technologies is proportional to the investment costs.

- However, this approach neither includes the percentage of the investment cost to allocate the MWh to provide the FCR service, nor the procedure to do it and/or to obtain the revenue.

Within the FCR context, the CBA has to determine if and how system costs change, taking into account a competitive setting, where no forms of distortion are present. For instance, this analytical setting implies that bids are the mere presentation of marginal opportunity costs.

The investment costs for LER shall be considered only if they are sustained in order to qualify for FCR provision. As described in the methodology, in case of storage revenue stacking the investment cost should be associated only to the share sustained for FCR provision.

4. The importance of SOC-management

To give the complete picture, BVES wants to point out as well the importance of SOC-management, which is essential for the successful operation of storage in FCR.

In particular, SOC management enables a fast bi-directional functionality by quickly absorbing or releasing energy in both directions. It must therefore be taken into account when simulating the "long lasting frequency deviation". In fact, in previous operating experience such events could be fully compensated by the SOC management (e.g., January 2017, 7h frequency deviation around 50mHz).

As well in the occasion of an interrupted communication connection, the storage entity can provide FCR independently and decentrally. On top it also includes an emergency reloading management which autonomously controls loading or unloading as a function of the SOC.

SOC-management is out of scope. Harmonization of SOC-management is not comprised within the scope of the CBA tasks

Please also consider that only an adequate energy/power ratio of FCR obligation can avoid the depletion in case of prolonged or repeated unidirectional frequency deviations during alert state, whereas the SOC management of a LER in such conditions could not be sufficient.

5. Fair level-playing field for all participating market parties

BVES clearly underlines the necessity of a technology neutral approach and transparent process.

CBA is technology neutral as it considers all kind of technologies representing LER, not only batteries.

The described simulation method could discriminate batteries because it is assumed that deterministic frequency deviations (meaning hourly peaks) are simply accepted. However, these are caused by power plants that have simultaneously provided the entire FCR. In fact, at an hourly change, we have a loss of most of the FCR reserve and an exhaustion of the other part. With a higher proportion of batteries, this effect would be eliminated as they are providing exclusively FCR being available at all times. Thus, the deterministic frequency response would have to be adjusted in the simulation.

As above, CBA is technology neutral. Deterministic frequency deviation is linked to ramping behavior and not related to the loss of technology providing FCR.

As a second point, BVES wants to clarify emphatically, that a CBA result of only an allowed LER share of a certain percentage in the FCR market would not be acceptable. In particular, this raises the central question of how a LER limitation could get implemented in a later market design and how this could be in accordance with the European law.

The implementation of the market design is out of scope of the CBA.
The methodology provides a matrix of possible solutions based on which all TSOs will make a proposal for a time period to NRAs for approval considering these main key factors:

- FCR amount
- Total FCR costs estimated
- LER share

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23. Comment by: ENGIE

ENGIE welcomes and appreciates the consultation on the CBA Methodology Proposal. We expect the public consultation as a starting point for some alignments in the requirements to provide FCR from units with limited energy reservoir (LER), which shall be implemented in full dialogue with both market participants and National Regulatory Authorities.
ENGIE is active on the FCR market from our portfolio (including production units but also batteries, pump-storage power plants) in France, Belgium, the Netherlands and Germany. ENGIE is also man-aging several projects in order to deliver FCR from new technologies (batteries, load,..). ENGIE is in favor of a market as large and diversified as possible in order that FCR need could be provided in an optimum way. Our main feedback deals with the following topics:
- analysis of the system needs
- assumptions and the grid model
- costs calculation
- consultation process

Analysis of the system needs

The main objective of the CBA is the selection of a minimum time period between 15 minutes and 30 minutes when LERs remain available during Alert State. According to the System Operation Guideline (SOGL), the transmission system is considered in alert state when the absolute value of the steady state system frequency deviation has continuously exceeded 50 % of the maximum steady state frequency deviation for a time period longer than the alert state trigger time or the standard frequency range for a time period longer than time to restore frequency. Thus, the Alert State may be unlimited in time. Nevertheless, in case of LERs, the availability of the unit may come to an end after a time period between 15 minutes and 30 minutes if the system is in Alert State. In other words, in case of a frequency deviation of +/- 200 mHz in the Continental European Synchro-nous Area (+/- 500 mHz , in the Nordic Synchronous Area), LERs are supposed to be able to be fully activated during the first 5 minutes (alert state trigger time), and, in addition, a time period to be selected between 15 minutes and 30 minutes. In this methodology LER might be requested to pro-vide its maximum capacity during 35 minutes in the worst case scenario.

It must be highlighted that taking into account the energy consumption before the actual trigger of alert state does not imply any over dimensioning of the LER reservoir according to SO GL Art.156. The energy provided by LER before the moment in which the alert state is triggered is accounted for in the calculation of the energy requested in the alert state as an equivalent full activation Time Period. Please take into account that also long lasting events triggering alert state will be considered for the energy evaluation.

However, in the period of time of 15 minutes (time to restore frequency), the TSOs are able to fully activate aFRR and mFRR. As a consequence, this proposal does not focus on the minimum FCR re-quirements for LER in alert state, but also requirements to deliver other reserves such as aFRR and mFRR. This is not acceptable. ENGIE is in favor of defining few standard products of which the min-imum requirements are differentiated without any doubt.

We understand this point, but it is not within the scope of this methodology to develop these products. As a result, we base our analysis on the current situation. Please also consider that the CBA methodology has been amended: the future scenarios have been moved out to reduce uncertainties and a specific disclaimer clarify that as soon as the scenario is not representative anymore the CBA has to be run again.

In our understanding, introducing a definition of an alert state may allow TSOs align their technical requirements on LER once the alert state has been triggered (taking into account that the time to restore frequency is 15 minutes). On one hand, the system needs common rules in order that a single balancing area (with "interruptible" FCR capacity because of storage constraint) does not jeopardize the safety of the whole grid. On the other hand, common rules will make the FCR mar-ket larger and more efficient. The first step is conducting a full technical analysis about the system response in alert state. This may lead to an assessment of a need in energy in alert state, and then a minimum time period for LERs. In any case, assessing a time period of availability in Alert State is not enough, because this is not just a question of time, but also a question of capacity. Since the time to restore frequency is 15 minutes, for ENGIE, the period of time when the FCR capacity remains fully activated cannot be more than 15 minutes.

Article 18 of System Operation Guideline gives a clear definition of the alert state. The proposed CBA methodology includes an analysis of cases where the system is in alert state. However, the dynamics of the system have been excluded since the methodology aims at defining the energy content of the FCR product in terms of a Time Period which shall not be greater than 30 or smaller than 15 minutes, according the SO GL requirements.

assumptions and grid model

In the proposal, the study will bring to the force the link between the share of LER in the FCR pro-vider mix and the time period that shall be ensured by LER as of triggering the alert state and during the alert state. The energy depletion of LER is simulated following these two assumptions:

- The LER are considered without energy limitation while frequency remains inside the standard frequency range
- Once the simulated frequency exceeds this range, the model starts to calculate the activat-ed energy and the residual energy in the reservoir.

In practice, because of long lasting frequency deviation events, the need in energy storage is above the requirement of full FCR activation during 15 minutes. Actually, these long lasting frequency de-viation events do not trigger the alert state, and LERs are required to provide FCR continuously. As a consequence, it is possible to assume that LERs do not have energy limitations in normal state. However, in the model, the energy consumption of LERs is taken into account starting from +/- 50 mHz in the Continental Europeans Synchronous Area (+/- 100 mHz in the Nordic Synchronous Ar-ea), which is not the alert state. Following this methodology, the need of energy storage to be en-sured during the alert state will be over-estimated.

Some hypothesis may be assumed for the period before the alert state, and for the FRR contribution. But the methodology shall assess the accuracy of these assumptions, and the confidence in-tervals of the results. The need of energy during the alert state has to be assessed only during the alert state.

According to article 156.4 SO GL, FCR should be constantly available in normal state. Because of this assumption, the CBA methodology ignores the long lasting events that do not trigger alert state, assuming a theoretical no impact on the energy consumption. The methodology will then take into account only long lasting frequency deviations that trigger alert state: in this case the assumption is that energy use starts above frequency deviations higher than standard frequency range. Recharging strategy when alert state is not triggered is out of scope of this methodology. The energy amount calculated this way will then be used to calculate an energy equivalent Time Period of full activation.

In the proposal, the criterion of LER depletion acceptance is the following: in case of LER depletion, the missing FCR is replaced by residual non-LER. However, in practice, the availability of the full capacity of FCR is ensured by local specifications. Some FCR capacities still remain available in the system for the TSOs, in addition to the total needed FCR volume. As a consequence, this criterion will overestimate the impact of LER depletion in the system.

The CBA methodology takes into account the FCR requirements according to Synchronous Area (SA) dimensioning rules provided by the SO GL. Local needs with no SA obligation can't be taken into account.

Moreover, when LER share on total FCR provider increases, the model will calculate that the time period will increase from 15 minutes to 30 minutes. In the meantime, the previous LER qualified for FCR (with a lesser time period) will be pushed out of the market, which will tend to decrease the available capacities in the system, and at the end the safety of the grid. ENGIE understands that this is just a modelling that might illustrate some links, but it is not accurate enough in order to assess a time period that will be implemented.

We understand the rationale of the comment. However the definition of the description of the full FCR product and market is out of scope of the CBA methodology.

Cost calculations

According to the proposed methodology, on one hand, a smaller time period might entail lower investments costs for the LERs, and, as a result, LER will offer their capacity at a lower price On the other hand, the required FCR volume could increase to fulfil the condition of replacing a LER deple-tion.
In our understanding, these assumptions are questionable. First it is necessary to define the scope of the market studied in this analysis. The proposal focuses on the capacity market. However, the methodology seems to assess the minimum energy that LERs shall deliver in alert state. As a consequence, in practice, it is necessary to take into account in LER costs not only the investment costs (like it is proposed), but also the energy cost necessary to manage the energy reservoir.

FCR is a service that is continuously activated on both directions. As a result, the energy content during a specific duration of the service is close to 0. It is true that the energy price of charging LERs in order to maintain their setpoint is not necessarily the same as the price for discharging for the same reason. As a

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result, LERs could have a small positive or negative cost during a specific procurement period. However, this cost/profit may be equalized by the other procurement periods. This is a level of detail that is not expected to significantly change the results especially in a case where not the actual costs are interested but the cost difference.

FCR market is a niche market. In spite of the minimum technical requirements, the market design and the product definition have a huge impact on FCR price. The time period may change the current competition and the attractiveness of the FCR market. Moreover, the scope of the methodology is not large enough. Writing common rules for LER in alert state will increase the safety of the system, will improve the competition thanks to the entrance of new capacities, and will expand the market for new investments (reducing the cost of the capacities). However, if the time duration is not relevant with the current capacities, and/or with the standard products (such as aFRR, and mFRR), this will increase the costs of the system. As a consequence, TSOs should work in full dialogue with market players on this modelling. This part of the CBA is a second step. The different assumptions (costs, social welfare benefits, market model) shall be established in working groups.

The scope and timing of this analysis is defined by art 156.11 of SO GL. The CBA methodology has been amended: the future scenarios have been moved out to reduce uncertainties and a specific disclaimer clarifies that as soon as the scenario (including FRR product development) is not representative anymore the CBA has to be run again.

Consultation process

The System Operation Guideline (SOGL) prescribes in article 156 (9) that "where no period has been determined, each FCR provider shall ensure its FCR providing units with limited energy reser-voirs are able to fully activate FCR continuously for at least 15 minutes, or in case of frequency devi-ations 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."

But, the SOGL notes that if a time period has been determined, each FCR provider shall ensure that its FCR providing units or groups with limited energy reservoirs shall be able to fully activate FCR continuously in alert state for that time period assessed. As a consequence, the results of this pro-posed CBA will have a huge impact on the LERs already in operations, and the development of LERs in the Continental European and the Nordic synchronous areas.

TSOs shall publish the data used in the analysis (both technical and market data) and shall launch working groups that will, among other things, address the various issues raised during the study (definition of the time period, local implementation, impact on the current system).

The detailed adopted assumptions will be defined during the implementation phase. Data will be published, also in terms of market curves modelling.

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