Distributed Flexibility and the value of TSO/DSO cooperation

A working paper for fostering active customer participation

1. Introduction

This working paper contributes to proposing concrete options for the integration of distributed flexibility resources (DFR) for balancing and congestion management, highlighting the value for the end-customers and DFR owners, and the importance of the cooperation between Transmission System Operators (TSOs) and Distribution System Operators (DSOs) to release this value.

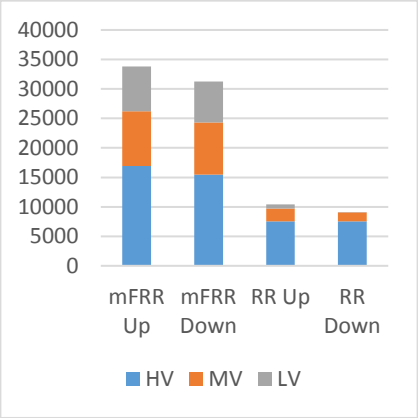

Figure 1 shows the volume in MW of assets connected to the DSO grid (different voltage levels across countries) prequalified to offer balancing products to TSOs summed up over AT, BE, DK, F, D, GB, HU, NL and ES.

Flexibility in a power system is the active management of an asset. Flexibility deployment can impact system balance or grid power flows on a short-term basis, i.e. from day-ahead to real-time. A wide range of assets that already participate in today's electricity market can provide such flexibility: from current conventional generation plants to industrial or small consumers dispersed in the system with demand management capability, including storage facilities and manageable RES, etc... Such flexibilities connected to the distribution network are understood as DFR.

An increasing amount of DFR will become available with the ongoing transformation of the European power system, driven by the realization of the internal energy market, the shift towards clean energy resources and the empowerment of consumers. All markets and processes need to ensure full-value deployment of DFR for their owners and to unlock DFR potential to help solving today's challenges and become building blocks of the future European power system. Only then will active participation from DFR increase liquidity in electricity balancing and congestion management processes, thus driving down costs from which final customers will benefit (see example in figure 2).

DFR can be used by market parties in day-ahead and intra-day markets, in dynamic price supply contracts and in the optimization of a Balance Responsible Party's (BRP) portfolio. Moreover, DFR offered by market parties to TSOs and DSOs can be used by TSOs in form of balancing capacity or balancing energy bids, and by TSOs and DSOs in the congestion management processes. DFR is already traded on day-ahead and intra-day markets. In some European systems, significant amounts of DFR are already participating in the balancing and congestion management processes (see Figure 1).

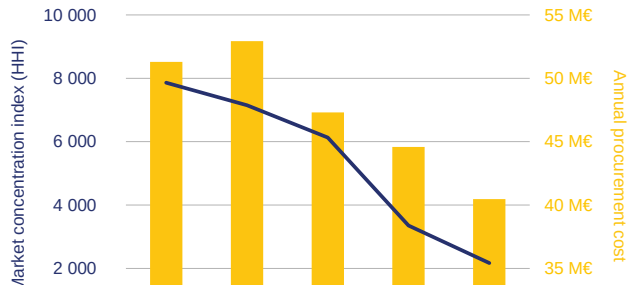

Figure 2: In France, Distributed Flexibility Resources (generation, DR and storage) provided 32% of the contracted manual balancing capacity in 2016. This participation started in 2012 and is identified as a main factor of a 20% decrease in the manual balancing capacity procurement costs.

This paper describes how the integration of DFR could be organized in the future for balancing and

congestion management. Its concrete implementation will depend on national decisions and it will have to be further detailed and adjusted in line with the respective regulatory frameworks. The focus is on the integration of DFR for the three following System and Grid Services and the interaction of those flexibilities in the TSO-DSO interfaces:

1. for electricity balancing from Frequency Restoration Reserves (FRR) and Replacement Reserves (RR),
2. for internal or cross-border congestion management in the transmission network and
3. for congestion management in the distribution network.

2. Moving from static to dynamic grid management

With the on-going transformation, TSOs and DSOs (together SOs) may need to use dynamic solutions to deal with grid constraints using active system management. Potentially those actions will be taken close to real time and could significantly overlap with the balancing timeframes. As a first step, DSOs will need to state the foreseeable needs for DFR in their network, primarily the amount of DFR needed, length and activation time, reliability, number of activations, etc. Such needs should be compared with existing and foreseeable capacities of the possible providers and attract the interest of market parties. Describing the needs would contribute to identify synergies with TSOs' needs and existing solutions.

Taking both SOs' needs and flexibility providers' interests into account, suitable products should be jointly defined by DSOs and TSOs before NRA approval. For efficiency purposes, harmonization must be sought, although a certain degree of openness in the parametrization must be kept.

An important criterion to define the type of products and the process for congestion management should be the minimization of the impact on the liquidity for day-ahead, intraday and balancing markets, and therefore the question of how to organise these markets is of relevance.

Local/national pilot projects are a good step forward as they allow to test different strategies within a fast-evolving framework. National regulatory frameworks, including balancing market terms and conditions, allow for efficient experimentation (several examples can be found across EU, e.g. on DFR integration). Nevertheless, economic efficiency principles must be considered at an early stage to avoid developing solutions that are inconsistent with EU market design principles: DFR integration should not lead to market fragmentation nor competition distortion, but should respect neutrality, confidentiality and transparency.

3. Distributed flexibilities should be used in compliance with system security criteria

EU legislation in the Guideline on System Operation foresees that TSOs and DSOs have the right to put restrictions on balancing bids, during prequalification or before activation, to avoid security issues on their grid. Likewise, the market design shall allow TSOs and DSOs to set limitations or to activate flexibility to solve congestions, considering the geographical location of the assets used in a bid if needed. To achieve this, bids or internal schedules within an aggregation must allow the inclusion of locational information if deemed necessary for network security.

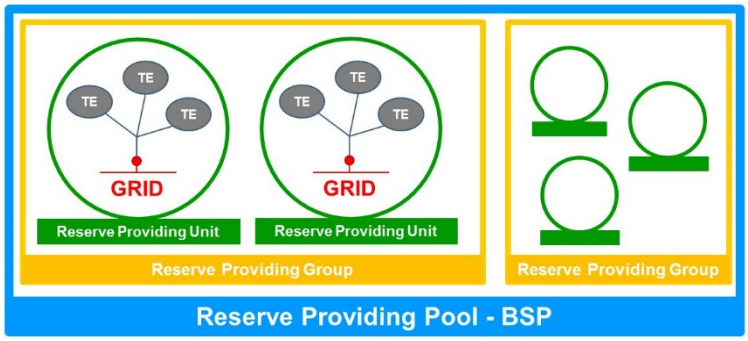

Figure 3: In Austria, Technical Entities (TE) are connected to a grid connection point creating a reserve providing unit. Thus, the TSO and DSO can guarantee that the activation of the reserve providing unit does not cause congestions. Furthermore, a contract between TE and the DSO sets out the conditions for injection, consumption and limitations.

Activation of DFR within one process, balancing or congestion management shall be performed assuring that it will not negatively impact the other processes (for example, activation of a bid for mFRR should not trigger a new need for congestion management in the DSO network), nor should activation negatively impact the flexibility value for the resource owner. For what purpose or by whom the bid will be activated should not be a matter to the owner.

Processes for balancing and congestion management shall assure coordination to prevent double activation of bids for both processes. Based on the requirements of the Guideline on Electricity Balancing (GL EB), if the DFR capacity for balancing is affected by congestion management, meaning that a balancing capacity from an individual DFR cannot be activated for balancing anymore, the TSO must be aware as soon as the impact is detected. The TSO will need to take this into account to meet the security criteria e. g. in prequalification, in dimensioning or in the procurement of balancing capacities.

4. Liquidity is a key success factor for future market design

Liquidity for balancing and congestion management resources should be sufficient to foster competition between service providers and to ensure the ability of TSOs and DSOs to cover their respective operational needs at the lowest cost. Liquidity on this market can be improved by increasing the supply of flexibility services in number of suppliers and volume of offers. Notably, the future market organization should not prevent DFR from participating neither in the balancing and congestion management mechanism, nor in day-ahead and intra-day markets; the overarching market design should be user-friendly for the DFR provider and enable its flexibility to be offered for any purpose it is fit for. This includes new entrants, new flexibility services and aggregators pooling resources.

To unlock the maximum potential of DFR for its providers, system needs and the technical capabilities, as well as commercial interests of the providers, need to be considered from a local view to a wider system scale.

It must be noted that, in some countries, TSOs operate also high voltage grids between 50 and 150 kV, which have the same needs for congestion management products as DSOs operating grids of that voltage in the same or in a different member state.

DFR may be used for balancing and congestion management. The market design should strive to minimize the number of different bidding processes to answer all needs. At least, all congestion management needs, both for TSO network needs and DSO network needs, should be fulfilled by a common bid submission process, in coordination with the balancing bidding process. This will ensure:

- Homogeneous access to the market for all participants and simple implementation for market parties, since the congestion management in the TSO or DSO network will use the same type of products or bids.

- Maximum harmonization of congestion management products and lower transaction costs by adaptation of congestion management products for the TSOs and DSOs to use. Moreover, TSOs and DSOs will gain access to the same merit order lists (MOLs).
- Better fulfilment of the congestion management needs, as a result of simultaneous combination of different harmonized products for the same DFR that may be used by TSOs and DSOs.

5. Coordination to ensure an optimal allocation of flexibility

The market framework shall ensure optimal allocation of flexibilities and incentivize that DFR are used in the process in which they have maximum value, removing unnecessary barriers and market fragmentation.

Flexibility providers should be able to place their DFR in balancing and congestion management processes so that it can be activated where it has the highest value to them. This requires clear and unequivocal procedures to determine settlement prices for each process that enables DFR providers to bid in their flexibility at competitive prices, and thus maximising their value without requiring inefficient mark-ups in their bid prices. Coordination is therefore essential between the balancing and congestion management processes. Pricing rules need to avoid inconsistent activation orders and settlement prices, and avoid perverse incentives to DFR providers, DSOs and TSOs:

- Before the balancing capacity Gate Closure Time (GCT) it is up to the BSPs managing DFR to coordinate updating their bids in the processes where GCT has not yet been reached and where bids are not compatible with the capacity contracted in another process.
- Between the balancing capacity and the balancing energy, GCTs contracted bids need to be coordinated by the BSPs or the TSOs and DSOs depending on the market design applicable to the corresponding member state. In the event the energy bids do not correspond to the contracted capacity, or so-called free bids, coordination shall be ensured by the BSP.
- Most importantly, after GCT has been reached for all processes, different MOLs will run in parallel, some of them at European level, as established by the GL EB. Coordination between the processes or platforms is needed to the extent possible to eliminate the risk of DFR being activated in opposite directions in two different bidding processes. Such coordination allows TSOs and DSOs to set limitations on DFRs activating bids for congestion management issues, thus automatically updating bids in the other MOLs without the intervention of the flexibility provider.[1]

It must be noted that the GL EB indicates limitations for TSOs to remove bids from European MOLs once their GCT has been reached. The TSO is assigned a responsibility to ensure the global system stability to which it must respond. A fair allocation of costs according to GL EB Article 15.3 should be implemented to cover this financial responsibility of TSOs when a bid already in the European MOLs is no longer available in the TSOs network, as a result of congestion management actions.

[1] This coordination process is often referred to as linked bids.

6. DFR should be able to participate in all processes directly

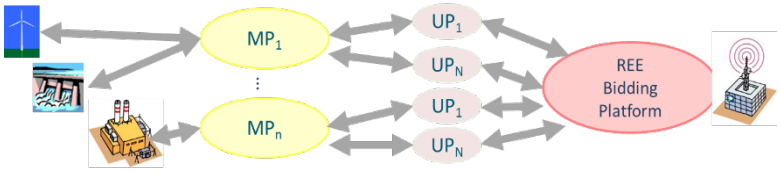

Figure 4: In Spain market participants (MP) submit bids (programming units, UP) to the bidding platform from REE. UPs can be physical units or aggregating several small facilities. In case a bid causes congestion, the TSO or DSO can send limitations up to real time to the bid via the bidding platform.

Market procedures shall ensure transparency, neutrality and non-discrimination, minimizing risk premiums, limiting market power and other gaming opportunities and avoiding inefficient implementations, so that bid prices reflect the true marginal flexibility value. Each SO shall have direct access to DFR, both technically, direct activation path from the SO to the BSP, and contractually, the provider submits bids directly and the settlement is done directly. The market management tools should guarantee cost efficient implementation, minimising transaction and IT development costs and ensuring that benefits significantly outweigh the implementation costs.

In the following paragraphs, one recommended design to reach the above principles is described:

A single marketplace for collecting and selling flexibilities could be a practical answer to the different challenges raised in this paper: ensuring liquidity, building a level playing field for different service providers and allowing the coordination of different market processes such as balancing and congestion management.

A single flexibility marketplace collects bids from flexibility service providers for both balancing and congestion management processes. These bids can be distinct for balancing and congestion management but could also be the same. Both TSOs and DSOs interact with this system to receive capacity and energy bids to be used for balancing or congestion management and communicate the necessary limitations to their networks. As to ensure a European-wide balancing market foreseen in the GL EB, the TSO forwards the relevant balancing bids to the common European balancing MOLs for mFRR and RR. Then, the TSOs and DSOs send activations to the flexibility providers and the information on activated bids is automatically updated and, thus, all the processes coordinated.

This single flexibility marketplace would give both the TSO and DSOs access to all bids, including their locational information that can be used for congestion management in the relevant areas. At the same time, TSOs and DSOs remain responsible for their respective processes and manage directly the MOLs related to their needs. Also, activation of bids from the flexibility service providers can be performed either directly from the SOs or from the single flexibility marketplace, depending on the adopted implementation decisions.

One possible scheme for such a single flexibility marketplace is shown in Figure 5.

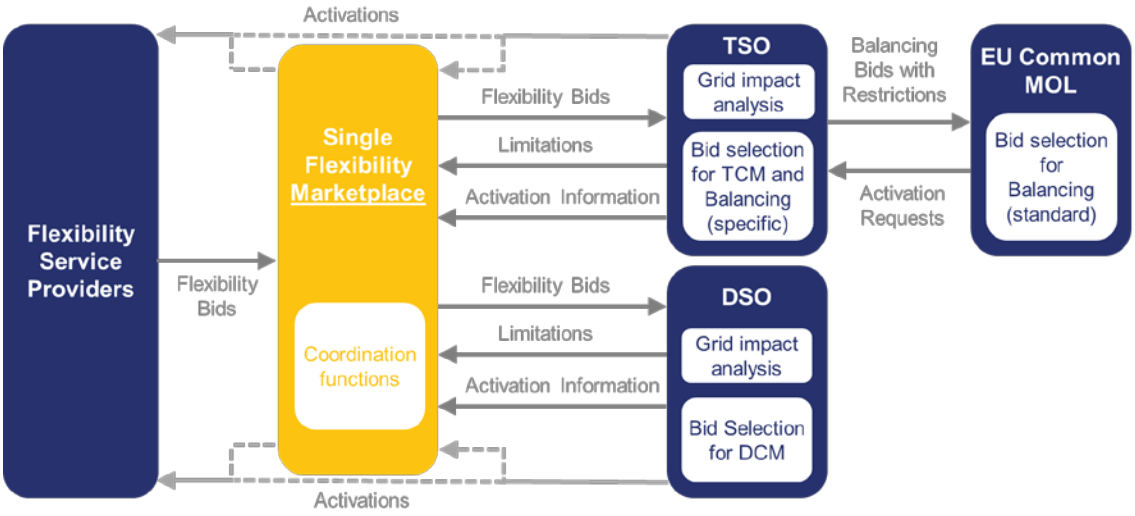

Figure 5: Example of a single flexibility marketplace for balancing and TSO and DSO congestion management processes.

ENTSO-E strongly recommends avoiding implementations in which DFR interacts only with its corresponding DSO and bids and activations can only be exchanged with this DSO, a scheme known as cascading principle. Such scheme leads to fragmentation of liquidity, places unnecessary barriers to aggregation, unnecessarily reduces the pool of options for grid operators, increases communication costs, limits the use of DSO connected flexibility to solve congestions in the TSOs' network and vice-versa, and obliges distributed flexibility providers to bid in different platforms, one for the TSO and one or more for each DSO to which their assets are connected. Moreover, such an approach ignores that in some countries, TSOs have already made accessible significant DFR from distribution grids.

7. Way forward

Distributed flexibilities should be able to be used where they provide the most value to the whole electricity system, not the TSO network or the DSO network alone. Coordination between day-ahead and intra-day market is key to ensure proper security of supply at all timeframes. Likewise, coordination between the balancing and congestion management processes is needed to assure that both TSOs and DSOs have the necessary information to be aware of the security of their networks and to avoid double or counter-activation on both processes at the same time.

The market design should strive to minimise the number of different bidding processes and non-coordinated products to fulfil all needs of achieving maximum liquidity while fitting system requirements, technical capabilities and commercial interest of the providers.

A single flexibility marketplace for both balancing and congestion management allows TSOs and DSOs alike to access all bids, including their locational information, enables coordination, simplifies access to all markets for DFR and ensures all possibilities for DFR to participate in all processes collecting the maximum value for their flexibility. While acknowledging the implementation and concrete design questions of such a flexibility marketplace relies on national decisions, ENTSO-E strongly recommends setting overarching market design principles that will ensure a direct relation between the buyer and the seller of a product and avoid a fragmentation of market depending on voltage level. In that sense, DFR should be able to interact both with DSOs and TSOs, depending on whom the service is sold to: implementations in which DFR interacts only with its corresponding DSO should be avoided, as it fragments liquidity and impedes

system wide aggregation in the balancing process among consequences. This is a key aspect to ensure a coherent and integrated wholesale and retail market that allows for cross-border features.