TSO – DSO REPORT

AN INTEGRATED APPROACH TO ACTIVE SYSTEM MANAGEMENT

WITH THE FOCUS ON TSO – DSO COORDINATION IN CONGESTION MANAGEMENT AND BALANCING

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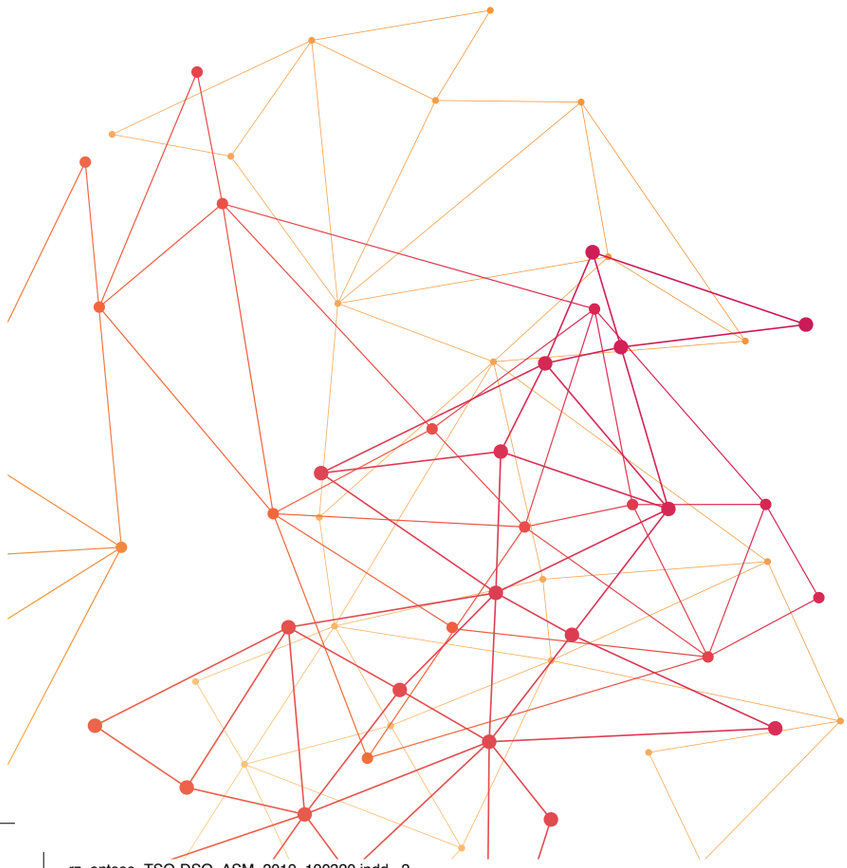

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1 INTRODUCTION

The constant increase in distributed renewable generation and in storage, and the expected rise of active customers engaging in demand response and electric mobility, trigger a key question to be addressed to support the energy transition: how to integrate the flexibility services provided by these new assets and actors into the energy market and use their services for congestion management and further in balancing, while ensuring efficient and reliable system operation and enabling the market uptake for flexibility resources? Only the latter part of this key question, focusing on the roles – assigned to DSOs and TSOs through the national regulatory framework – will be treated in this report.

Network codes and Guidelines, currently under implementation, provide the first basis for congestion management and balancing (especially SO GL and EB GL).

Furthermore, it is expected that the Clean Energy Package (Electricity Directive, article 32.1) gives the possibility to the DSOs to procure non-frequency ancillary services to manage, among others,congestion on their grid. DSOs shall procure these services in a transparent and market-based approach, when this represents the most cost-effective way to do it.

The increasing electrification and share of decentralised resources entail a need for the extension and reinforcement of the distribution and transmission grids to avoid congestions; distributed energy resources can also be made available for DSOs and TSOs using new 'Active System Management techniques', enhancing the need for DSOs and TSOs to co-ordinate closely for grid and system needs.

WHAT IS ACTIVE SYSTEM MANAGEMENT?

Active System Management (ASM) is a key set of strategies and tools performed and used by DSOs and TSOs for the cost-efficient and secure management of the electricity systems. It involves the use and enhancement of smart and digital grids, operational planning and forecasting processes and the capacity to modulate, in different timeframes and distinct areas, generation and demand encompassing flexibility instruments (toolbox) to tackle challenges impacting system operation, thus ensuring proper integration of Renewable Energy Sources (RES) and a high share of Distributed Energy Resources (DER), as well as the integration with energy markets.

The services for different purposes that can be delivered by flexibility, which is part of ASM, are depicted in figure 1.

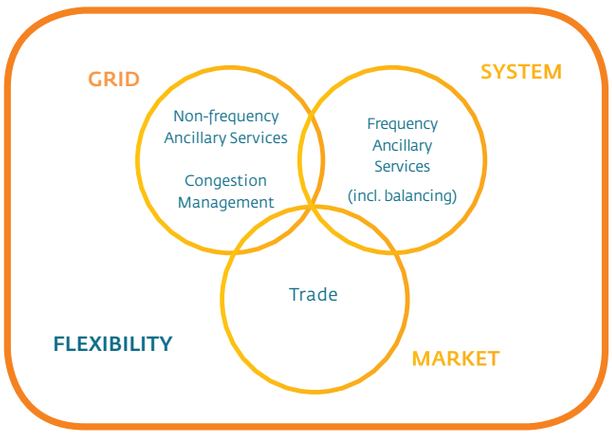


Figure 1: Flexibility services

The energy transition has led to the installation of renewable energy generation, mostly variable. It is to a large extent connected to the distribution grids, while it impacts power flows and voltage stability across all grids. Distributed generation provides new opportunities for active management also in the distribution grids while improvements and cost reduction of ICT technologies allow DSOs to improve significantly the supervision of their grids at reasonable costs. Both factors have raised the opportunity and the necessity at the same time, due to fluctuating power flows, to perform active power and reactive power management also in the distribution grids. Furthermore, distributed generation should have equal opportunities as transmission-connected generation to increase their value and their revenue by participating in balancing and congestion management in the transmission grid, through proper coordination mechanisms agreed between TSOs and DSOs. The recent proposals for European regulatory developments and the Clean Energy Package support these new activities and the use also by DSOs of flexibility services for congestion management and non-frequency ancillary services in the distribution grids, when the national framework permits.

Ancillary services are services provided to DSOs and TSOs to keep the operation of the grid within acceptable limits for security of supply and are delivered mainly by third parties (i.e. control power for frequency control, reactive power for voltage control, black-start capabilities) or by the TSOs and DSOs themselves (topology changes and integrated network components).

Ancillary services are classified as:

a) frequency ancillary services (mainly for balancing);

b) services for congestion management;

c) non-frequency ancillary services such as voltage control and grid restoration, among others.

ASM refers to these processes in general, basically to the actions taken by TSOs and DSOs to monitor and ensure that the grid operational parameters are within satisfactory ranges. It encompasses the operational planning processes, the required observability and controllability of the grid, the necessary data exchanges and the interaction with market parties delivering those services.

A TOOLBOX FOR ASM

To realise efficient and co-ordinated electricity grids, DSOs and TSOs need a toolbox comprising different types of solutions for undertaking congestion management and balancing. These include the following:

- Technical solutions using grid assets: reconfiguration of the grid topology to alter power flows, including reactive power flows, and achieve a more desirable system state.
- Tariff solutions: the use of grid tariffs to trigger implicit flexibility that is able to react to prices. These tariffs can take many forms and can include aspects such as time, direction, capacity and location.
- Market-based solutions: market-based activation of explicit flexibilities that are able to alter power flows in all directions.
- Connection agreement solutions: connection agreements with certain grid users so that they provide a certain service needed.
- Rule-based solutions: rule-based curtailments as a consequence of the implementation of technical requirements from connection codes that are available in last-resort or emergency situations.

Note that reinforcement is the traditional method for solving issues relating to grid capacity, by building a bigger and stronger grid. This will continue to be a solution for grids, particularly as existing assets come to the end of their lifetime and potentially as a result of large demands connected to the grid (e.g. due to the electrification of heating and transportation). Reinforcement should always be compared with getting flexibility from the resources in the system and the optimal solution should be determined. Typically, non-frequent congestion could be more efficiently treated with the activation of flexibility whereas prolonged or high levels of congestion could call for a system reinforcement.

TSOs and DSOs will develop all these options to ensure reliable system operations, but we will focus on market-based solutions in this report, specifically on exploring the needs and options for implementing this solution and the corresponding required DSO – TSO coordination.

THE FOCUS OF THE REPORT

In the present report, active power management, as a part of ASM is described and analysed from the perspective of a close collaboration of TSOs and DSOs, for congestion management in both distribution and transmission grids and system balancing when such services are provided in a market-based approach by flexibilities owned and operated by third parties. Many other ASM solutions coexist as mentioned in the toolbox above, but they are not analysed in the present report. In addition, reactive power management has been left out of the report. The reason to concentrate first on congestion management and balancing services provided by third parties is the importance of TSO – DSO coordination for these processes to ensure the security of supply. In a later stage, other elements or purposes of ASM could be commonly investigated by DSOs and TSOs.

A NEED FOR TSO – DSO CO-OPERATION TO ENSURE EFFICIENT INTERACTION WITH MARKET PARTIES

A framework is necessary for structuring the discussion around market integration on congestion management. It is essential that this framework, which unveils the flexibility potential, is based on an integrated electricity system approach that considers the following principles:

- The electricity system is essential for our modern society and thus shall be sustainable, reliable and affordable for all customers.
- The customer shall be empowered and put at the centre, have the freedom to connect to the system respecting technical limits and participate in all available markets on a level playing field.
- A market design with low entry barriers shall be available for providers to bid in their capabilities. Economic efficiency and liquidity of markets shall be ensured.

In that context, DSOs and TSOs need to co-ordinate closely for the use of flexibility to fulfil their missions as defined in regulation, while creating conditions for the uptake of new services without endangering the reliable provision of electricity.

Flexibility, which is the modification of generation injection and/or consumption patterns in reaction to an external signal (price signal or activation) to provide a service within the energy system[1], can only be used efficiently if the right coordination mechanisms are put in place and the appropriate data and information are exchanged between DSOs, TSOs, customers and market players. Unleashing the flexibility potential also means respecting the roles and responsibilities of each party, taking into due consideration to the different realities across Europe, and aiming for an efficient allocation between the different uses of flexibility. Effective coordination between DSOs and TSOs and resilient, efficient and effective 'signalling' (information sharing) become increasingly important to ensure cost-efficient, sustainable and reliable system and grid operation as well as facilitating markets throughout Europe. Besides the co-operation of DSOs and TSOs with market parties, co-operation with consumer organisations is also very important to secure the development of trustful and engaging market models.

This report considers all voltage levels. However, further digitalisation is a prerequisite for smart grid operations and for making flexibilities available through market mechanisms. The costs of this transition on lower voltage levels are expected to be high in the beginning.

1 Definition from the 2015 EG3 report 'Regulatory Recommendations for the Deployment of Flexibility'.

PILOTS AND DEMONSTRATION PROJECTS

The provision of ancillary services including services for congestion management by grid users connected to the distribution system has been the core of numerous research and development projects as well as recent regulatory developments in some European Member States. These examples, and more to follow, provide already very useful insights to the TSO – DSO coordination schemes or regulatory changes to unlock the potential of distributed flexibility for congestion management or balancing provision. These examples include the following:

- EU wide R&D projects;
- Member State or regional pilot projects (including commercially funded projects);
- Member State regulatory frameworks.

For the time being, implementation questions also remain. In Europe, many pilots are taking place today, reflecting that we are still in a learning phase, which is stimulated by the European Commission (H2020) and the Member States.

Local and national pilot projects are good steps forward as they allow testing of different strategies within a fast-evolving framework. Economic efficiency principles must be considered at an early stage. It must also be ensured that solutions are consistent with EU market design principles.

Therefore, the challenge is to allow pilot development offering concrete solutions and fostering innovation, while respecting common guidelines early enough in the process, so as to avoid too heterogeneous and misaligned developments leading to market fragmentation.

THE OBJECTIVE OF THE WORK AND PROCESS

A dedicated TSO – DSO active system management Project Team (short: Project Team) composed of experts from associations representing DSOs (CEDEC, EDSO for smart grids, EURELECTRIC and GEODE) and ENTSO-E has consolidated this report, which has formally been approved by all participating associations and made available to the European Commission, while being shared with a broader audience through publication. The Project Team's work was organised around the following four main objectives:

- Share views, increase mutual understanding, identify core questions and outline possible solutions on ASM for TSOs and DSOs. Through several workshops and expert meetings, TSOs and DSOs together focused on the process of congestion management and its different phases.
- Focus on the problem definition and analysis, followed by an evaluation of problem solving and modes of service acquisition.
- Discuss in an open way with the main stakeholders, sharing TSOs' and DSOs' needs and obtaining views of the other parties and their needs related to flexibility services. Stakeholder workshops were organised to acquire knowledge on the needs, views and considerations of the broadest group of possible system services providers.
- Elaborate overarching principles and get a shared view of congestion management and its interaction with balancing, consolidated in the current report outlining which main principles can be extracted and how they could be included in EU legislation and which are the choices to be left for national implementation.

In addition, in March 2018, associations representing DSOs jointly provided their agreed views in the report 'Flexibility in the Energy Transition – A toolbox for electricity DSOs'[1] with dedicated chapters on the need for enhanced TSO – DSO co-operation and a dedicated model overview for service acquisition for congestion management. ENTSO-E also published a paper on the same topic in December 2017, named 'Distributed flexibility and the value of TSO/DSO co-operation'[2].

1 Check out the CEDEC, EDSO for smart grids, EURELECTRIC or GEODE websites.

2 Check out the ENTSO-E website.

2 SUMMARY AND RECOMMENDATIONS

2.1 GENERAL

2.1.1 AN INTEGRATED SYSTEM APPROACH: A STARTING POINT

- An integrated electricity system approach is the basis, in which TSO and DSO roles and responsibilities as system operators and as neutral market facilitators are recognised and respected.
- An efficient level playing field for market parties is required, fostering new services and valuing flexibility services; neutral market facilitators will keep ensuring non-discrimination towards market parties.
- TSOs and DSOs shall co-ordinate mutual processes and agree on data exchanges[1] between them to guarantee a reliable, efficient and affordable operation of the electricity system and grid, and to guarantee non-discriminatory and efficient market operation.

RECOMMENDATIONS:

- TSOs and DSOs should pursue an integrated system approach when developing new solutions and should avoid any isolated solution.
- TSOs and DSOs shall use those flexibility tools that are effective, cost-efficient and that suit their needs.

1 Cf. TSO – DSO Data management report, 2016, cf. SO GL article 40.7.

2.1.2 GUIDING LONG-TERM VIEW FOR CONGESTION MANAGEMENT

System operators have the long-term view (excluding emergency situations) that all congestions should be solved through a market-based allocation of flexibility services in combination with an adequate grid reinforcement where justified and economically and technically feasible rather than compulsory limitation procedures. Market-based procurement of flexibility can either be through free or mandatory bidding. Cost-based mechanisms can be included in a market-based approach when necessary and considered appropriate by the Regulator.

In the intermediate model, a market-based procurement is foreseen, although the delivery of a product can be limited to take into account the physical reality of the grid. Compensation schemes may be considered. TSOs and DSOs are aware that the mandatory limitations should be kept to a minimum to allow market parties' access within their connection agreement and therewith to allow them to act freely on the market with all connected units.

RECOMMENDATIONS:

So as to foster competition and new services in the European electricity market, the long-term view of system operators is that congestion should be solved through a market-based allocation of flexibility services (voluntary or mandatory bidding, possibly in combination with cost-based regulation when considered appropriate by the Regulator) where technically feasible and cost-efficient, rather than compulsory limitation procedures. The design should be developed with the stakeholders in a stepwise and pragmatic manner.

2.2 CONGESTION MANAGEMENT PROCESS AND INFORMATION EXCHANGE

The congestion management process can be described in different phases, involving different parties, actions and information exchange. The objective is not to define a fully harmonised and standardised European process, but to illustrate in a general way how congestion management could be implemented. This would be used as a tool to identify the key areas regarding the development of flexibility services and their value. Congestion Management can be broken down into different phases, respecting both TSOs' and DSOs' operational processes.

1. Preparatory phase: Product definitions and initial pre-qualification.
2. Forecasting phase: Planning of grid utilisation and identifying potential congestions.
3. Market phase: Bids collection and evaluation, both in long-term and short-term contracts (availability or capacity products) and short-term products/services (activation of energy products), up until real time.
4. Monitoring & activation phase: Activation of bids for congestion management and system operator co-operation up to real time.
5. Measurement & settlement phase: Validation of delivery.

To support information exchange, a flexibility resources register could be developed to collect information of the connection points that can provide flexibility services to system operators, to ensure a better vision for the system operators of the flexibility capabilities connected to different voltage levels. The flexibility resources register would also have the potential of supporting aggregated bids.

RECOMMENDATIONS:

Some general EU principles can be developed but the intra-zonal congestion management processes details should be established and implemented on a national level.

- TSOs and DSOs should optimise their processes and actions in collaboration.
- There should be an incentive for market parties to provide good schedules with relevant locational information to the system operators, which is crucial to get a proper forecast for congestion management.
- System operators should properly communicate their needs in the different timeframes.
- Information on flexibility resources that are pre-qualified or are seeking participation in congestion management and balancing should be shared and available (typically nationally) for both TSOs and DSOs, through a flexibility resources register. TSOs and DSOs jointly recommend that the concept of flexibility resources register should be acknowledged at the European level and the implementation should be decided on a national level.

2.3 PRODUCTS AND BIDS

Flexibility products for different purposes should be sufficiently aligned (interoperable), to permit the market-based allocation of flexibility services with the objective of an efficient allocation that maximises the value of the flexibility to enable bids by market parties. Such flexibility products can either be an option (availability) or direct activation. As a first step of designing products, a common defined list of attributes could be used, from which all Member States can choose only those attributes required for the specific product definition. Any product standard that can be used for congestion management must necessarily include locational information, which by nature is essential for congestion management, while at the same time complying with privacy regulation (GDPR).

RECOMMENDATIONS:

- Products for congestion management should comply with the needs of system operators within the different timeframes (from long-term to real time) and take into account the possibilities of the market parties, including retail. Existing tools and services should be considered.
- Product definition should allow for aggregation as much as technically feasible.
- Products should be designed in a dialogue with stakeholders to assess possibilities and needs, at least at a national level. Special attention should be given to avoiding too numerous and diverse products, while considering local specificities.
- A general EU harmonisation of the products for congestion management is not required, as long as this does not lead to a distortion of the level playing field. However, different products for portfolio optimisation, balancing and congestion management should be sufficiently aligned to allow an efficient market-based allocation of flexibility. This implies standard national requirements of the congestion management product.

2.4 PRE-QUALIFICATION

Product pre-qualification is about checking whether the unit can (technically) deliver the product it wants to sell/deliver. Grid pre-qualification is about whether the unit(s) connected to the grid can realise the product delivery, considering the technical characteristics of the unit and the capabilities of the grid. In addition to firm pre-qualification commitments from the connecting system operator, there are two ways of enabling more flexibility service providers being qualified: a. conditional grid pre-qualification, where the pre-qualification is dependent on certain conditions being met, or b. dynamic grid pre-qualification, where the pre-qualification can change over time, however, the aim is to increase the pre-qualified capacity, when new information on the grid is available.

RECOMMENDATIONS:

- In addition to regular pre-qualification commitments from the connecting system operator, there are two ways of enabling more flexibility service providers being qualified: a. conditional grid pre-qualification, where the pre-qualification is dependent on certain conditions being met, or b. dynamic grid pre-qualification, where the pre-qualification can change over time. The aim of both concepts is to increase the pre-qualified volume on the market.
- The pre-qualification process should be user friendly, striving to minimise the different steps and standardise them when possible.
- Pre-qualification could take place on an aggregated/portfolio level if technically acceptable.

2.5 MARKETPLACE

Because it is recognised that full deployment of Active System Management is yet to be enabled, innovation should be encouraged and, at this point in time, TSOs and DSOs would recommend avoiding prescribing a standardised European solution (as also the current situations in the Member States differ). However, some fundamental principles should be defined and agreed at the EU level, and implementation should be emphasised at a national level, taking these principles as a starting point.

THESE FUNDAMENTAL PRINCIPLES ARE:

- **System operators have a key responsibility for neutral market facilitation.** System operators should ensure market access and secure operations, clearly define their needs, facilitate the participation of all market parties including retail, while complying with EU and national privacy regulations, to ensure a fair level playing field by delivering transparency on grid and system needs, and on rules for requesting, selecting, validating and settling flexibility services. System operators shall remain neutral towards all flexibility service providers.
- **TSOs and DSOs support a market-based congestion management approach.** System operators (TSOs and DSOs) have a key responsibility for market facilitation. TSOs and DSOs suggest a market-based congestion management approach as a long-term target if technically feasible and cost-efficient. However, TSOs and DSOs also develop other 'toolbox' options not further analysed in this report (technical solutions, tariff solutions, connection agreements solutions, rule-based solutions). The approach should be designed in dialogue with stakeholders; special attention should be given to a clear allocation of costs (e.g. separation of balancing from congestion management costs).
- **Flexibility services can be traded in different markets and a user-friendly mechanism should be set up to enhance flexibility services.** Flexibility services can be traded in different marketplaces to value the services at most, such as the wholesale market from day-ahead to intraday, the balancing market or the congestion management market(s). These markets may operate in overlapping timeframes and may concern similar or distinct products. A single entry point to different market processes could be a concept to pursue, although interoperability and coordination functions would be a more realistic and pragmatic solution. Intermediaries such as aggregators are part of the solution to enhance all customer participation and to generate additional value. Overall efficiency (technical and economical) should be ensured: there are different options to set a common framework of analysis at the European level. The feasibility and pros/cons of each option should be assessed at a national level, taking into account local specificities and their interaction with the global electricity system and market.
- **Transparency of market processes and rules should be in place.** The market operator should ensure a level playing field for trading, and the system operator role as (single) buyer should be regulated. Clear rules of bids gathering and selection shall be established at a national level. The bids selection should be made transparent towards market parties. Beyond economic merit order, technical aspects such as the geographical location of the provider will be considered in bids selection, so as to ensure grid and system security.
- **The liability and contractual relation between the buyer and the seller should be clear.** A market process should ensure a direct relationship between the buyer and the seller of a service and any intermediary should be agreed by both parties.
- **Interoperability of solutions is essential.** It is of utmost importance that, no matter how many platforms will eventually be used, they are interoperable at least at Member State level to ensure sufficient liquidity (e.g. no lock-in) and coordination. It should be noted that coordination relies on data and information exchange, as well as ICT solutions.
- **TSO – DSO coordination and information exchange are essential.** TSOs and DSOs adopted this principle to avoid any mutual harmful interference when invoking balancing and/or congestion management actions on a system level, therefore TSO – DSO coordination and information exchange are essential.

RECOMMENDATIONS:

- TSOs and DSOs should agree and support the above fundamental principles.
- A conceptual framework is a useful tool for structuring the discussion around market interaction on congestion management: a clear definition of roles and responsibilities, market model options, coordination options and platform options. It is recommended that TSOs and DSOs agree on the usage of this conceptual framework on the EU level, without impairing national specificities and allowing the selection of options on a national level.
- When assessing market model options, implementation through different platforms options should be considered, as both issues are linked. This would allow assessing more concretely the consequences of the market design selected: making the right choices may lead to very effective solutions, whereas making non-aligned choices may lead to very complex and costly solutions. It is recommended that TSOs and DSOs at a national level jointly discuss these options in dialogue with stakeholders, taking into account national specificities.
- Timings of most market processes (day-ahead, intraday, balancing) are evolving towards an alignment on a European target model. However, the timing for congestion management can differ at a national level, depending on local specificities. It is recommended that these markets are compatible with the markets at the EU level, but that the corresponding timeframes are defined on a national level. This would ease the effort of TSO – DSO coordination.
- The different options for market models, coordination and platforms give a European framework, which is recommended to be the basis for the Member States to discuss, and after taking into account their national specificities, agree on Member State level on implementation. Irrespective of the options chosen, system operators should always exchange all the relevant information from their grid and the relevant connected assets, from structural data (potential flexibility services and their characteristics) to more dynamic data (forecast and activation of bids): this is needed to allow efficient flexibility procurement without creating issues on the grid.
- The activation of bids for congestion management creates an imbalance that shall be counteracted to maintain system balance. This can be done by: a. the service provider, who delivers the bid and takes responsibility for the imbalance created, b. the system operator performing the congestion management action, meaning a redispatch, or c. the TSO, who combines this with its balancing task.

2.6 PLATFORM OPTIONS

Today, in Europe, many market actors and also DSOs and TSOs have started to consider and/or to develop platforms for trading and procuring flexibility. Therefore, it is relevant to also address flexibility and active system management from this perspective.

A digital platform is defined as a (distributed) software functionality, needed by actors to perform their tasks, corresponding to their roles and responsibilities, which as part of an ecosystem interacts with other relevant actors in the energy system.

RECOMMENDATIONS:

- Access should be easy for the customer: For both end-consumers as well as market parties offering flexibility to system operators, easy access should be facilitated irrespective of the platform arrangement (e.g. whether separate or joint platforms are created).
- Interoperability with other platforms must be ensured: Platforms developed by TSOs, DSOs or jointly should always respect and ensure a level playing field for the market. This will require coordination and (an) agreed interface(s) between the regulated and commercial domains.
- Platforms must avoid harmful interference and conflicts beyond their associated grids: Platforms should contain a functionality to ensure that any TSO or DSO interaction does not create any harmful impact on their respective grids or on the system as a whole. This requires correct and timely data exchange between platforms and a set of well-designed algorithms.
- TSO – DSO coordination and mutual data exchange are an activity in the regulated domain: As both TSOs and DSOs carry system responsibility to ensure the security of supply and system stability, any coordination and data exchange between TSOs and DSOs that is required to avoid harmful interference is the responsibility of TSOs and DSOs. This will also ensure that the whole system is operated as efficiently as possible, and the value to the customer is maximised.
- Platforms solutions should be technology agnostic: In defining platforms and solutions, TSOs and DSOs should be technology and hardware agnostic.

3 CONGESTION MANAGEMENT PROCESS

As discussed in Chapter 1, TSOs and DSOs will have a toolbox for congestion management and how this is used will depend on the regulatory framework in the country, the amount of distributed flexibility resources at hand, the local situation and the relevant timeframe. Ultimately, the solution chosen by the system operator should be selected based on the most optimal solution for the whole electricity system and its customers, taking into account factors such as cost, security and sustainability. Each solution has its own advantages and disadvantages and legislation should therefore be open to a range of models that enable system operators to access and use flexibility. This chapter is focusing on the use of flexibility for congestion management through market-based solutions as defined in the introduction. However, a description and common understanding of the general congestion management process is necessary for further descriptions and evaluation of how ASM can be further developed.

According to the Commission Regulation (EU) 714/2009 on conditions for access to the grid for cross-border exchanges in electricity, the term congestion is defined as follows:

- 'Congestion' means a situation in which an interconnection linking national transmission networks cannot accommodate all physical flows resulting from international trade requested by market participants, because of a lack of capacity of the interconnectors and/or the national transmission systems concerned.

The same concept was generalised afterwards, due to lack of capacity in any element of the grid, in the Commission Regulation (EU) 2015/1222 establishing a Guideline on Capacity Allocation and Congestion Management:

- 'Market congestion' means a situation in which the economic surplus for single day-ahead or intraday coupling has been limited by cross-zonal capacity or allocation constraint;
- 'Physical congestion' means any network situation where forecasted or realised power flows violate the thermal limits of the elements of the grid and voltage stability, or the angle stability limits of the power system;

- 'Structural congestion' means congestion in the transmission system that can be clearly defined, is predictable, geographically stable over time and frequently reoccurring under normal power system conditions.

In this report congestion and congestion management refer to 'physical congestion' with focus on active power.

The aim here is to develop new tools for congestion analysis and management, to support a market-based approach where possible. A prerequisite for developing such market-based tools are clear and transparently co-ordinated processes and rules on information exchange between the system operators established at a national level, which are in charge of the secure operation of their own grid. These rules must be agreed and implemented at Member State level.

3.1 OVERVIEW

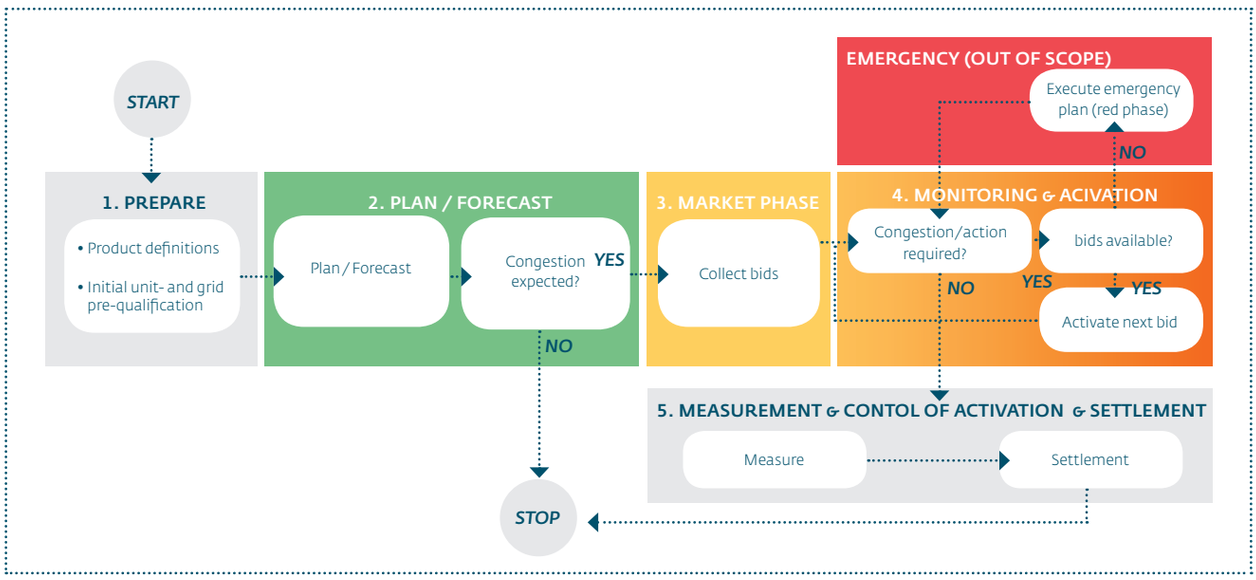
The process of congestion management is broken down into different phases, considering both TSO and DSO operational processes.

The objective is not to define a fully harmonised and standardised European process but rather to illustrate in a general way how congestion management could be implemented. This will help to identify the key areas regarding the development of flexibility services and their value:

- The necessary design of needs and products.
- The need for information exchange.
- Required interaction and coordination between system operators.
- Interaction between system operators and market parties.
- The coordination between different market processes.
- Selection criteria for the most suitable product addressing the identified need.

The figure below illustrates the main phases of the congestion management process with respect to market-based solutions. The flow charts for the different phases (depicted below in coloured boxes) are also included in this section. Please note that these figures are for illustration purposes only and shall not be seen as a recommendation or description of the current congestion management process across Europe.

Figure 2: CM process overview



1. PREPARATORY PHASE

The preparatory phase of the market-based congestion management process includes flexibility needs and product definition and initial pre-qualification. This is depicted in the flowchart below. The pre-qualification is done in two parts: the product pre-qualification, to determine whether the unit can actually perform according to the requirements set by the system operator (SO) and grid pre-qualification, to determine whether the grid can transport the delivered energy or if limitations on the product are required. Once the services and the providers are qualified, the system operators can use the bids of these parties to solve congestions. Both aggregated and non-aggregated units should be able to participate in the delivery of the product, which will allow a wider range of market players to participate.

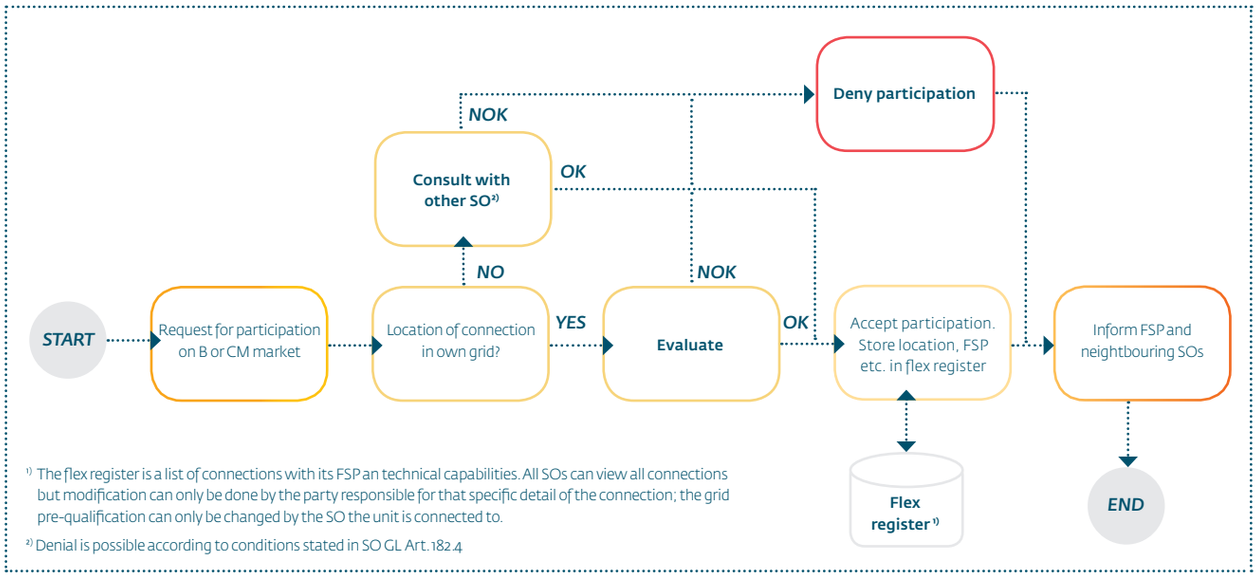


Figure 3: Preparatory phase – Initial grid pre-qualification

2. FORECASTING PHASE

In the forecasting phase, planning of grid reinforcement (year and months ahead) and grid utilisation forecast (months ahead, weeks ahead, day-ahead and intraday) is taken into account. If the capacity of the electricity grid is insufficient to cope with the expected rise in consumption or production of electricity, or new usage patterns start impacting normal grid operation, grid reinforcement is being planned. As a complement to the necessary grid reinforcement measures, flexibility services (implicit and explicit) can be used for dealing with congestion.

Forecasting is undertaken in different timeframes. The accuracy of the predicted flow of electricity in a certain area typically improves with the time passed. Some forecasts consist of long-term planning analysis made years in advance (before the preparatory phase) and some forecasts are updated and performed up until real time (for example using real-time weather data and remote monitoring devices on the grids).

It is necessary for system operators to have access to good schedules with relevant locational information, to perform proper forecast for congestion management and make efficient and secure decisions.

3. MARKET PHASE

The market phase starts when congestion is expected. For capacity products, this can be months ahead, and for energy activation products, the bids can be collected closer to real time. The focus here is on the collection and evaluation of bids from the market, including long-term and short-term capacity products, as well as short-term products/services (energy products), up until real time. The process can be seen in the flowchart below. Note that it is possible that the system operator has contracts with certain Flexibility Service Providers (FSPs), where the FSP is obliged to make a certain offer once it is requested by the system operator; so-called contracted bids.

weather forecasts could be the start of procuring congestion management services. In certain situations DSOs may also have to solve congestion closer to real time. The outcome of the market phase is the acquisition of flexibility products.

The process for evaluating bids can be seen in the flowchart below. When evaluating and before activating bids connected to other grids, the system status and system needs in neighbouring electricity grids must be considered. Information from the flexibility resources register could be helpful in this step (see Chapter 4). Once a bid has been accepted or rejected, the FSP is informed.

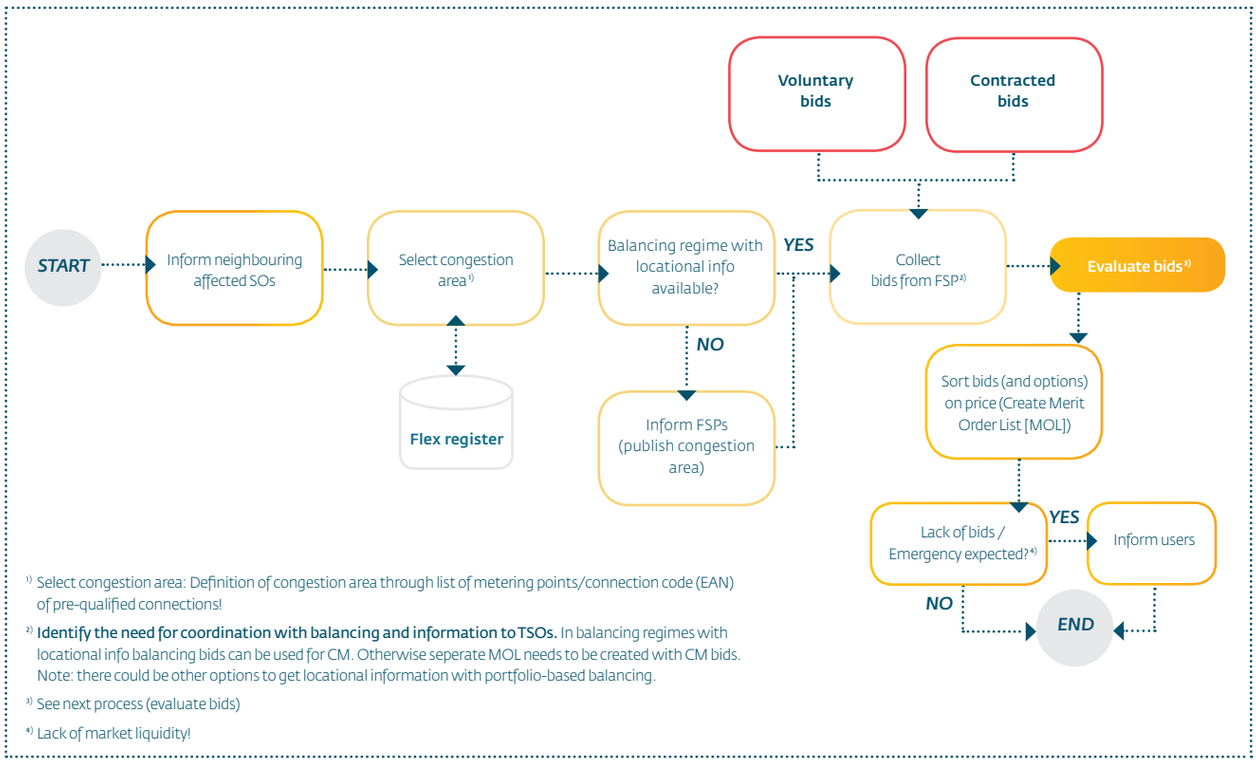


Figure 4: Market phase

The timing for the mentioned products can be different for TSOs and DSOs. In many cases TSOs start calculating the congestion once market parties' schedules, based on wholesale markets obligations, are known. Typically, DSOs would like to solve predicted congestion in their grids before real time, as they are often caused by wind or solar production, and in such cases the availability of predictable

Once evaluated, available bids are efficiently sorted in a merit order list to ensure economic efficiency. The evaluation of the bids is done by the system operator to whose grid the flexibility providing unit is connected.

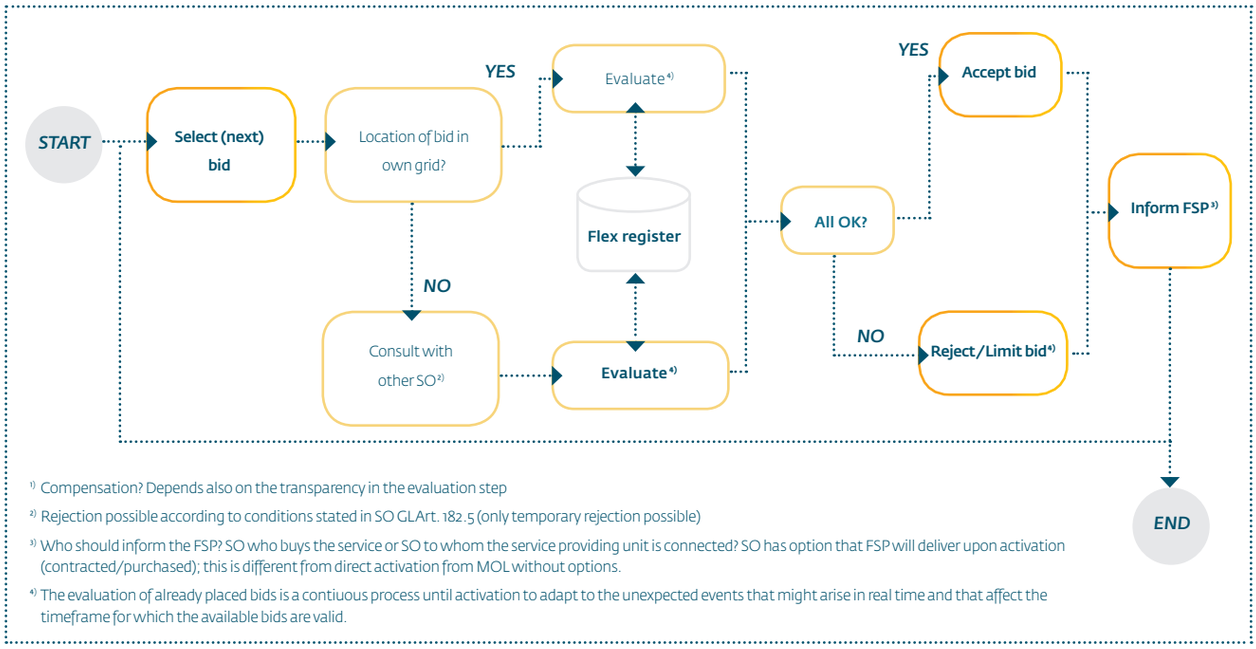


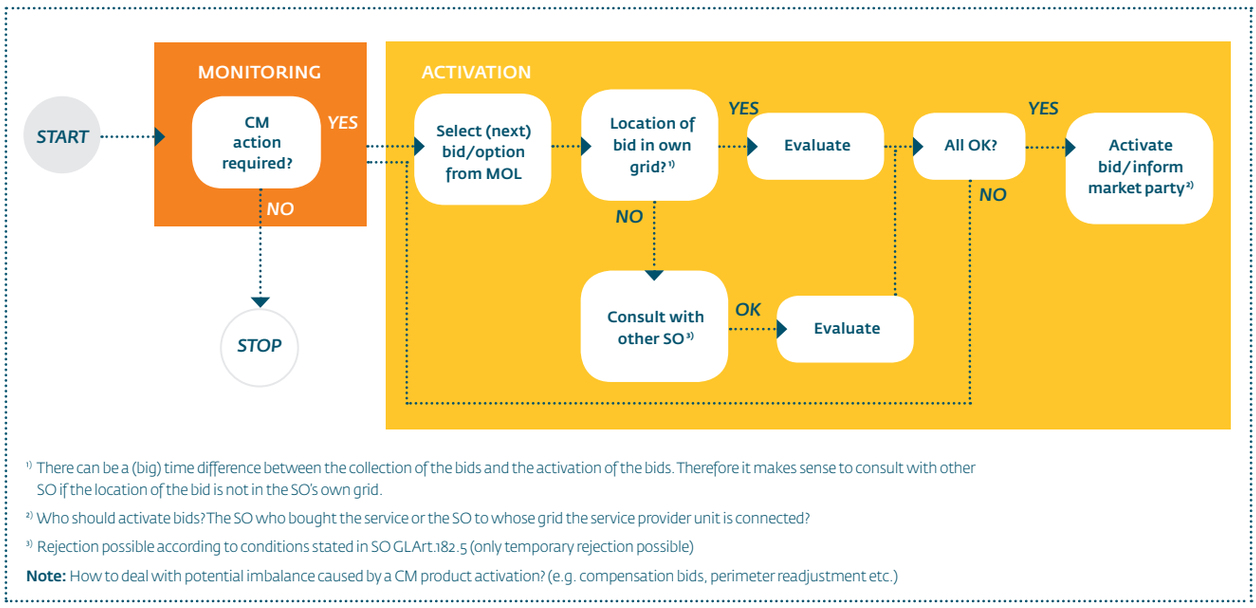
Figure 5: Market phase – Evaluate bids

4. CLOSE TO REAL TIME/REAL TIME MONITORING & ACTIVATION PHASE

After collecting and evaluating the bids in the market phase, the flexibility bids are activated, and the congestion is monitored. System operators should avoid activating flexibility bids in an already congested area. The evaluation of bids will continue up until activation, to adapt to unexpected events that may arise, or potentially invoke more optimal system solutions. Usually this is done based on real-time or close to real-time measurements.

The emergency actions that can occur during or following this phase are kept out of scope.

Figure 6: Close to RT/RT monitoring & activation phase



5. MEASUREMENT & CONTROL OF ACTIVATION & SETTLEMENT PHASE (VALIDATION OF DELIVERY)

The measurements of the activated flexibility should show whether the service is actually delivered. When a service is delivered by an FSP, the amount of flexibility must be established, and the flexibility must be paid for by the system operator. If the service is not delivered or does not respect the agreed parameters, a penalty is possible. The amount of flexibility delivered is determined by evaluating the meter reading (the measurements) at the connection point and compared with a baseline or a schedule.

It is possible that both an FSP and a supplier are active at the same time on one connection. In that case, clear rules must be defined, at a national level, to determine how much energy should be allocated to the FSP and how much energy should be allocated to the supplier. If there is only one meter at the connection point, a baseline must be determined. The baseline is the total energy, without the flexibility invoked.

The difference between the baseline and the measurements is allocated to the FSP. The amount determined by the baseline is allocated to the Balance Responsible Party (BRP) of the supplier. The baseline might be different for different types of assets.

Once the energy volumes of all connections have been calculated, and all the energy is allocated to the relevant market parties, the settlement of the volumes and the delivered services can start. To settle the correct volumes and services to the relevant parties, it is necessary to know which supplier and BRP are active on which connection.

4 INFORMATION EXCHANGE

If market access for distributed flexibility is to be unlocked, the TSOs and DSOs need to agree, under the applicable national framework, on a common process for information exchange to ensure the following objectives:

- Avoid actions that would put operations of either transmission grid, distribution grid or system security/ frequency at risk.
- Enable the participation of market parties from all grid connection levels.

To reach these goals, rules on how information must flow between system operators and market participants in the different phases of the balancing and congestion management process are needed.

The SO GL clearly mentions the need for TSOs and DSOs to agree on information exchange between them. Implementing the KORRR methodology for data exchange will be an important first step in determining how this information exchange might be dealt within the different Member States. To achieve the goals set out for a co-ordinated, efficient and secure ASM process, setting up a common flexibility resources register could be recommended. Such a concept is described further in the following section.

Furthermore, providing necessary information to the system operator is part of the contract for entering the market. The information that system operators can give back to the market participant must be carefully examined to avoid sharing commercially sensitive information and avoid the potential for gaming and abuse of market power. On the other hand, being as transparent as possible will reduce the possibilities for gaming and abuse of market power because the information would become visible for all parties including competitors and the regulator.

4.1 FLEXIBILITY RESOURCES REGISTER

WHAT IS THE FLEXIBILITY RESOURCES REGISTER?

The flexibility resources register contains structural information on the location of connection points that can provide flexibility services to system operators. It is also possible to use the register in the future for the registration of connections and for the settlement of flexibility services between market parties.

The objective of the flexibility resources register is to gather and share relevant information on potential sources of flexibility. In this report, the focus is only on the provision of flexibility services provided to system operators.

The qualified connections would be registered in the flexibility resources register by the connecting system operator. This connection is visible to all relevant system operators. In this way, if a DSO or TSO has a congestion, they have visibility of all potential flexibility resources at all voltage levels.

Therewith, the flexibility resources register will support the ASM process of each Member State. In this register, all data needed by the system operators to use the flexibility from customers would be available. Responsibility for entering and maintaining the data of the register should be decided at national level. However, the system operator to whose grid the unit is connected stays responsible for the correct representation of the connection data.

Although not treated here, there are more possibilities for the flexibility resources register and those should be considered at the national level; it can for example also be developed into an important source of information for market platforms. Already existing tools should be considered when assessing and developing a flexibility resources register.

WHY IS THE FLEXIBILITY RESOURCES REGISTER ADVISED?

A flexibility resources register will allow system operators to have visibility of which flexibility resources are connected to their own grid and to their connected grids, so they know what resources they potentially have available when solving congestion.

The flexibility resources register can be used in the market phase to evaluate bids from FSPs. For system operators to solve local congestion, the location of the units providing the flexibility services must be provided. In the monitoring and activation phase, the flexibility resources register could be used to assess the impact of activating the resource in relation to the current status of the grid.

The flexibility resources register can also be used in the settlement phase. The information in the flexibility resources register could be used to verify if and how much energy is delivered when comparing the measurements of the meter to the baseline of the unit; this could also be performed for aggregated bids.

The possibility of aggregation is essential for providers and requesters of the flexibility services; the flexibility resources register could be developed to support information exchange on aggregated bids.

HOW COULD IT WORK?

The flexibility resources register would, as a minimum, contain data as agreed and evaluated in the pre-qualification process. This is technical information on the flexibility resource and includes information such as location, approved capacity limits, duration, ramp rates, mode of activation, flexibility provider, baseline information. The attributes depend on the type of service required by the system operators. A flexibility resource can deliver multiple flexibility services to system operators (e.g. congestion management, balancing, etc.). Once a resource is qualified to provide a service, its connection point is flagged as a potential provider of a specific flexibility service in the register. Deciding on how this process should work for aggregated bids in a meshed and congested grid is a challenge and must be undertaken in a co-ordinated way between DSOs, TSOs and FSPs.

The flexibility resources register can combine different data sources (e.g. connection register, GIS data) and create different views for different system operators and other users.

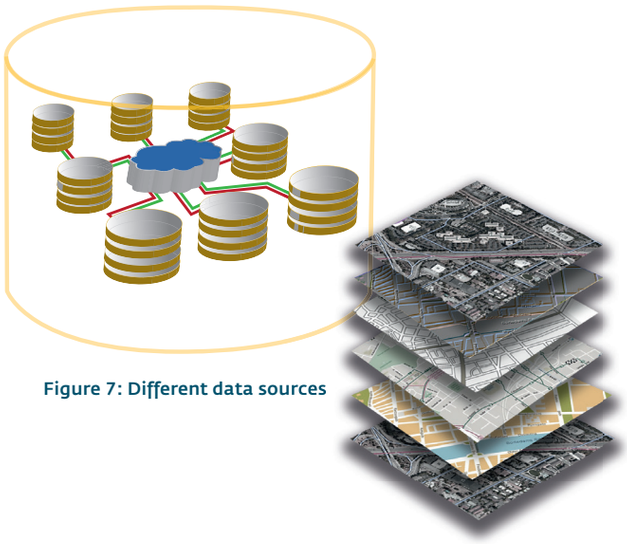


Figure 7: Different data sources

WHAT COULD BE THE BENEFITS FOR MARKET PARTIES?

The benefit for an owner of a flexibility resource / flexibility service provider is that they are not only visible to the system operator to which they are connected but also to all system operators to which they could provide a service. This would improve competition.

Through a flexibility resources register, it could also be possible for the system operator to provide the market with information, for example if a congestion is expected. This would give stakeholders more visibility of potential revenue streams. The flexibility resources register could support the use of balancing bids for congestion management if the locational information is available.

4.2 TRAFFIC LIGHT CONCEPT

The traffic light concept is a method for signalling congestions in the grid. The concept can be useful when exchanging information between the system operator and market parties in all phases of the congestion management process: planning, forecasting, market and activation phase. The general process is as follows:

- If the traffic light is green, there is no congestion expected.
- When the traffic light is orange, a congestion is expected. In that case the system operator requires the services from the FSPs to steer the affected area of the grid back to the green state. In this report, this state is called the market phase for procuring flexibility. If the system operator is not successful in bringing the affected area of the grid back to the green state, the system will enter the red state.
- The red state is the emergency state. In this state, system operators follow different rules. However, this state is seen as out of the scope of this report.

As the activation of flexibility requires coordination and sufficient signalling, we can assume that a red state on a part of the distribution grid would require immediate corrective actions by DSOs, to bring the grid back to a secure state of operation (e.g. ensure local voltage stability).

To prevent entering the emergency state, DSOs can communicate and use the yellow state to encourage market parties to enter bids in the congestion management market. Appropriate measures must be taken to avoid market power abuse and gaming risk.

Currently, different DSOs in Europe have set up trials to use this approach in demonstration projects - usually based on forecasting and a local flexibility platform or (local) order books in portfolio-based market designs. As energy flows become increasingly bidirectional, this approach can also be used to reduce the amount of curtailed energy due to upstream and downstream constraints.

5 PRODUCTS AND BIDS

The main focus of this chapter will be on how products should be defined and delivered, and how bids should be used and activated. The interaction between system operators and market parties is also described.

5.1 GENERAL

There is a general agreement that products have to comply with the needs of system operators to perform economically efficient congestion management. These requirements should be clearly specified to enable successful product design and development. This cannot be successfully performed without a sufficient degree of transparency to enhance the mutual understanding of system operators' requirements and market parties' capabilities.

Flexibility products for portfolio optimisation, balancing and congestion management should be sufficiently aligned to permit the market-based allocation of flexibility between these different purposes with the objective of an efficient allocation that maximises the value of the flexibility services.

This does not necessarily require identical products, but interoperability between the products that enables the exchange between markets. In this report, a specific focus is made on the link between balancing products and congestion management products.The product should be either an option (available capacity) that enables the purchasing system operator to demand, which can be a deviation from a baseline or setting upper or lower limits for generation/consumption at a specific time (activation), or just a direct activation. This option can always be forfeited if there should be no necessity to activate the product for congestion management.

Availability products have to be designed properly to avoid a decrease in market liquidity due to non-activation of contracted products.Furthermore, different situations in different Member States might require either more short- or more long-term products or a combination of both. Long-term availability of short-term products like day-ahead or intraday could be guaranteed through forward markets, which trade short-term products for specific periods in advance. To ensure the right balance between availability and market liquidity, DSOs and TSOs will agree on how to coordinate on this.

5.2 PRODUCT DESIGN

The flexibility products for congestion management need to be sufficiently standardised to enable bids by market participants. It is expected to be explicitly addressed by the European Commission through the Clean Energy Package (Art. 32 (1) of the Electricity Market Directive).

It is recommended that such standardisation is implemented at least at the Member State level to limit the costs for market participants in offering the products. However, as congestion management is addressed through different mechanisms in different Member States, a European harmonisation of the products for congestion management is not required. However, in any case there should be minimum common ground with cross-border balancing and wholesale markets. It is also possible that harmonisation requirements might increase over time. However, a common terminology for product specifications in Europe could help those market participants that operate in more than one Member State. The sound regulatory principles deliver value by enabling the quick establishment of flexibility markets. They should include high-level rights and responsibilities while respecting different conditions in the Member States.

A limit to product standardisation is the necessity to keep the products open to future development. Such dynamic product development will be the result of the joint activities of system operators, market participants, market operators and regulatory authorities. Nevertheless, standards must not only be open to evolvement but also to certain trials by all parties involved, which could then in turn lead to a modification of the product standard. This implies that any standard must be rigid enough to provide a common base for products but should also enable a dynamic development. As a first step for this way of designing products, a common defined list of attributes could be used, from which all Member States can choose only those attributes required for the specific product definition. A list of attributes that can be thought of, although not exhaustive, is the following (and coming from the report 'Flexibility in the Energy Transition - A toolbox for electricity DSOs' and from Guideline Electricity Balancing [GL EB]):

- Minimum/maximum bid size
- Direction of deviation (up/down)
- 'partial' or 'all or none' bid
- Minimum/maximum duration (e.g. 15 min/60 min)
- Definition of congestion point (identification of the congested area/locational information)
- Bidding period: time granted to the market parties to offer bids
- Selection period: time required by the system operator to select the bids which will be activated
- Activation period: time before activation signal and ramp up period (1 h, 15 min, 0 s)
- Maximum ramping period (15 min, 5 min, …)
- Minimum full activation period (15 min, 30 min, …)
- Mode of activation (automatic, manual)
- Availability window (per day, per week, per year)
- Frequency: Maximum number of activations (per day, per week, per year)
- Recovery time: Minimum time between activations
- Recovery conditions
- Baseline methodology
- Measurement requirements
- Unit-based or portfolio-based within a certain geographical area
- Penalty for non-delivery (fixed or dependent on the bid size and/or duration, …)
- Certificate of origin
- Level of availability of the bid (due to the uncertainty of RES)

An important aspect of product development is the possible combination of different sources of upward and downward flexibility by aggregators. This possibility of aggregation is essential for providers and requesters of the flexibility services and will most likely increase the liquidity of the market. If the aggregation of a bid for a specific product is well chosen by the FSP, a bid could potentially be used for multiple purposes, like for example for both congestion management and balancing.

Any product standard that can be used for congestion management must necessarily include locational information, which by nature is essential for congestion management, while at the same time complying with privacy regulation (GDPR). The exact specification of this information should be left to Member State specific rules, which should in any case allow as much portfolio optimisation as possible.

TSOs and DSOs are convinced that flexibility product design is not only important for the implementation and the extension of markets for congestion management but could in some cases trigger the establishment of such markets.

The imbalance settlement period is the time unit for which the imbalance of the balance responsible parties (BRPs) is calculated. Several countries already have 15 minutes settlement periods. A change in the settlement period will provide further incentives for BRPs, including suppliers, to be active in intraday markets using demand response. When designing products, especially looking at the delivery period, for flexibility products the imbalance settlement period could be considered. Linking new product attributes with existing wholesale and balancing markets will make settlement and trade between markets and market participants easier and provide further liquidity in all markets.

6 PRE-QUALIFICATION

Pre-qualification is the process in which a potential provider shall demonstrate that it complies with all the technical requirements that have been established for the provision of the flexibility product (product pre-qualification) and the ability of the grid to which it connects to deliver the required product (grid pre-qualification). It includes all information and communication technology, data exchange needs, tests, etc. required for the provision of the service. Pre-qualification is known to take place on a unit level, however, it could also take place on an aggregated/portfolio level in case this is technically feasible. Furthermore, apart from the pre-qualification of the individual or aggregated flexibility providers, the pre-qualification of the market party that provides the service is necessary as well to ensure that it has a settlement account, enough financial liabilities, complies with the legal provisions, etc.

6.1 PRODUCT PRE-QUALIFICATION

The pre-qualification for a product, in this report, is defined as checking whether the unit can (technically) deliver the product it wants to sell/deliver. TSOs and DSOs believe that the party performing this product pre-qualification is the system operator that needs this product and will eventually be the party purchasing the product. Pre-qualification is currently described in SO GL, however, the question is whether compliance with this code will suffice for future developments. The SO GL and the network codes developed under the third energy package are based on an understanding that distributed resources can contribute in the TSOs' balancing market, even if the use of distributed flexibility for congestion management for both TSO and DSO is not properly dealt with.

At the same time, the GL leaves the Member States an opportunity for finding good solutions on how the data flow might take place between grid users, DSOs and TSOs.

The requirements for the product pre-qualification of balancing products used by TSOs is described in Art. 155, 159 and 162 of the SO GL. The framework guidelines elaborated by ACER to guide the drafting of the SO GL included the need that the SO GL already considered the possible participation of all possible providers including small distributed generation and demand resources as well as distributed storage (Section 2.1 New Applications of the Framework Guidelines on Electricity System Operation, December 2011).

In case multiple system operators are buyers of the same product, the product pre-qualification process should be agreed between the system operators wanting to buy this product to avoid the pre-qualification being done twice, once for the TSO and once for the DSO.

6.2 GRID PRE-QUALIFICATION

The pre-qualification for the grid, in this report, is defined as checking whether the grid can manage the delivery of the product that the unit wants to sell/deliver (both congestion management and balancing products), according to the agreement and applicable framework between the different system operators on pre-qualification. TSOs and DSOs believe that the party performing this grid pre-qualification is the system operator of the grid the unit is connected to and (where applicable) the intermediate DSOs[1] (also stated in SO GL article 182). The reason for this is that only this specific system operator knows what the grid can manage and at which moments in time it is possible and when it is not, due to specific constraints.

With more renewable generation, electric vehicles, storages, etc. in the system, grid constraints may arise at specific moments in time, for example when the sun is shining (e.g. streets with a lot of solar panels installed) or when people return from work (e.g. many electric cars charging at the same time). Therefore, the system operators have to establish clear guidelines for the grid pre-qualification in such a way that market behaviour may not lead to even more severe grid conditions (e.g. EV-charging peaks).

Two possibilities for more flexible grid pre-qualification exist, which would enable more market participants to obtain access to the relevant markets. The two not mutually exclusive options are the following:

- Dynamic grid pre-qualification, which re-examines the possibility of improved grid access for flexibility resources at regular intervals. Argumentation: Timeframes need to be clearly defined, from long-term to close to real time, rather at a national level.
- Conditional grid pre-qualification, which grants improved grid access for flexibility resources according to criteria clearly specified in advance. Argumentation: Situations in which grid pre-qualification cannot be granted are (mostly) known, which makes it easier to pre-qualify on a conditional basis. However, without a dynamic reassessment, the limitation (conditionality) may be too conservative in case the grid conditions change over time.

Both options can be applied, and the choice will be made depending on the specific situation.

1 An intermediate DSO is the DSO between the grid of the buyer of the product and the grid the unit is connected to.

7 MARKETPLACE FOR CONGESTION MANAGEMENT

As an objective, it is generally agreed by all stakeholders that distributed flexibility resources should be used where they provide the most value to the whole electricity system, while guaranteeing quality of service and security of supply: whether it be in portfolio optimisation and trading for market parties at day-ahead and intraday markets, in congestion management for solving transmission and distribution grid issues, or as balancing resources for TSOs.

This chapter addresses this challenge and provides principles, commonly agreed by TSOs and DSOs for an overarching design and common European guidelines, explaining possible options. These principles should stimulate market parties to engage actively in providing flexibility to ensure that the future sustainable electricity system can be operated in a reliable and affordable way.

This chapter also defines the framework that could be used on the EU level for assessment leaving the choices to be made by the Member States.

7.1 PRINCIPLES AGREED BY TSOs AND DSOs

A. SYSTEM OPERATORS HAVE A KEY RESPONSIBILITY OF MARKET FACILITATION

In that respect, they should:

- Ensure market access and secure operations.
- Define clearly their needs from an operational perspective to allow the market parties to develop sound products (consider existing ones and the need to develop new ones).
- Facilitate the participation of all market parties and lower entry barriers; ensure a fair level playing field by delivering transparency on the grid and system needs, on the rules for calling services, selecting them, validating and settling these services.
- Comply with privacy regulation, according to European (GDPR) and national regulation, which is protecting customers' privacy and data when delivering market facilitating services to market parties.
- Enable any service provider to sell its service in all markets, by facilitating physical connection and data access and delivery. Ensure liquid markets to use the potential of the flexibility services to the full extent.

B. TSOs AND DSOs SUPPORT A MARKET-BASED CONGESTION MANAGEMENT APPROACH

TSOs and DSOs support a market-based congestion management approach if technically feasible and cost-efficient. This implies a call for action to market parties to be ready in time and to develop mature flexibility markets that address the needs of concerned system operators for congestion management, with sufficient liquidity.

This market-based approach would limit and possibly avoid compulsory limitation procedures of flexibility bids. In case of limitation, compensation schemes may be considered.

Timely grid expansion (depending on the reliable forecast of all market actors), when affordable and when providing a better business case than market-based flexibility procurement, should be regarded as a basis.

To pursue the implementation of the European internal electricity market, trading of flexibility services should be possible from a very local level to European cross-border scale. Unnecessary fragmentation of the market should be avoided:

- Limiting the number of marketplaces to procure system and grid services could be a solution, because a myriad of markets could be an entry barrier for potential suppliers.
- However, trading in different marketplaces for different market purposes is also a possibility as long as arbitrage between them is possible and easy for market parties, so as to ensure the maximum value of flexibility. Streamlined and sound coordination between the different market processes is, however, needed to ensure economic efficiency (e.g. avoiding countereffect of several activations of bids) and system and grid security (ensure liability of bids availability, avoid double activation of the same asset).

C. FLEXIBILITY SERVICES CAN BE TRADED IN DIFFERENT MARKETPLACES

Flexibility services can be traded in different marketplaces, such as the wholesale market from day-ahead to intraday, balancing market or congestion management markets. These markets may operate in overlapping timeframes, and may concern similar or distinct products, which are depicted in the figure below.

Congestion management can be performed over all timeframes. Furthermore, congestion management can either be combined with one or multiple existing markets (i. e. wholesale or balancing) or be a market on its own, completely separated from the existing markets or only coordinated: the different theoretical options are described further.

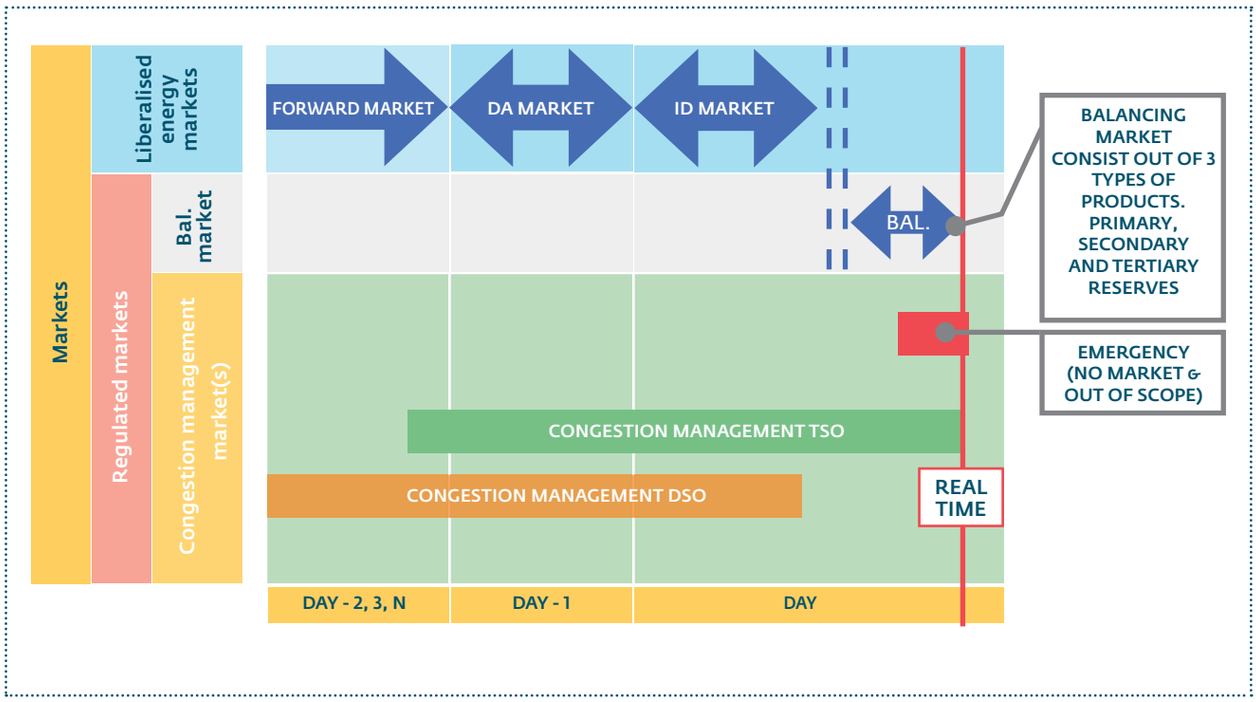


Figure 8: Different markets in the different timeframes

D. CLEAR, NON-DISCRIMINATORY AND TRANSPARENT RULES OF THE MARKETPLACE SHOULD BE IN PLACE

Regardless of the model chosen for the congestion management marketplace, it should be ensured that rules for collecting, selecting and validating bids are clearly defined and made transparent towards market parties.

- The bids shall be selected respecting an economic merit order and a 'technical merit order' (being the effectiveness of the bid in relation to the congestion point). Given the specific needs of ensuring grid and system security, technical aspects must be considered in the selection process, and may lead to specific choices.
- Grid pre-qualification is a first step in the process to ensure that physical reality is taken into account before activating a bid, however, closer to real time technical constraints may influence the bid selection. The process and its results should be made transparent to market parties, including the option of dynamic grid pre-qualification.
- Price formation and financial bids settlement should be defined clearly and separately for each market process.
- Consistency between rules of different market processes should be sought (gate opening/closing time, coordination etc.).
- Risk of gaming and exercising market power should be considered when setting the market rules.
- Incentives should be in place to stimulate market parties to improve load forecast for grid areas which are indicated by system operators as possible congestion areas.

E. THERE IS A LIABILITY AND CONTRACTUAL RELATIONSHIP BETWEEN BUYER AND SELLER

A market process should ensure a direct relationship between the seller and the buyer of a service, and any intermediary should be agreed by both parties.

- This would avoid any lock-in of flexibilities for a specific purpose and fragmentation of the market depending on the location of grid connection or to whom the service is sold. This is also very important to ensure the possibility of system-wide aggregation for relevant purposes such as balancing.
- A flexibility service provider should be able to interact with a market operator, another market party, DSO or TSO, depending on to whom the service is sold.
- The seller is liable for non-delivery and the buyer for non-payment.
- When seller and buyer exchange privacy sensitive data, they should elaborate a bidirectional GDPR compliant agreement.
- Terms and conditions of any intermediary power exchange supporting the process between the seller and buyer (being DSOs and TSOs) should accommodate the role of the affected grid operator on their platform.
- If the seller of a product offers its bids both on the DA and/or ID market to market parties for portfolio optimisation and to grid operators for congestion management, any price difference should be justifiable and subject to regulatory oversight. This is valid only when the price setting of the congestion bid is free.

F. INTEROPERABILITY OF SOLUTIONS IS ESSENTIAL

It is of utmost importance that, no matter how many platforms will eventually be used, they are interoperable to ensure sufficient liquidity (e.g. no lock-in) and coordination. It should be noted that coordination relies on data and information exchange, as well as ICT solutions.

G. TSO – DSO COORDINATION AND INFORMATION EXCHANGE IS ESSENTIAL

TSOs and DSOs adopted the principle to avoid any mutual harmful interference when invoking balancing and/or congestion management actions on a system level, therefore, TSO – DSO coordination is essential. Independent of the model chosen (as defined in paragraph 7.2) to perform congestion management and trade active power services for grid and service needs, system operators should exchange all the relevant information from their grid and the relevant connected assets, from structural data (potential flexibility services and their characteristic) to more dynamic data (forecast and activation of bids): this is needed to allow flexibility procurement without creating issues on the grid.

7.2 MARKET MODELS FOR BALANCING AND CONGESTION MANAGEMENT

A market is defined as a Merit Order List (MOL) combining specific products for a specific timeframe. The separated markets mean separate MOLs, a combined market means a combined MOL (a subset MOL is regarded as a combined MOL).

One single asset, if pre-qualified, might be able to provide a product both for congestion management in the DSO grid, for congestion management in the TSO grid or for balancing performed by the TSO.

There are three possible main options for market models[1] depending on how the MOLs of bids are managed, from fully separated to fully combined, as described in the figure below:

Depending on the link between MOLs for different purposes, three main options can be derived; possibilities and limitations that each model brings along should be assessed at a national level.

1 Separated means separated MOL. Combined/overlapping means combined MOL.

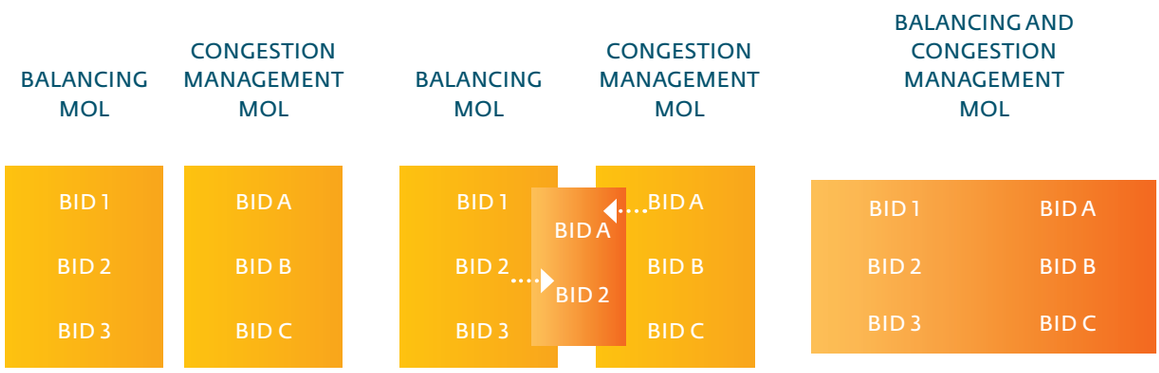


Figure 9: Main options for market models

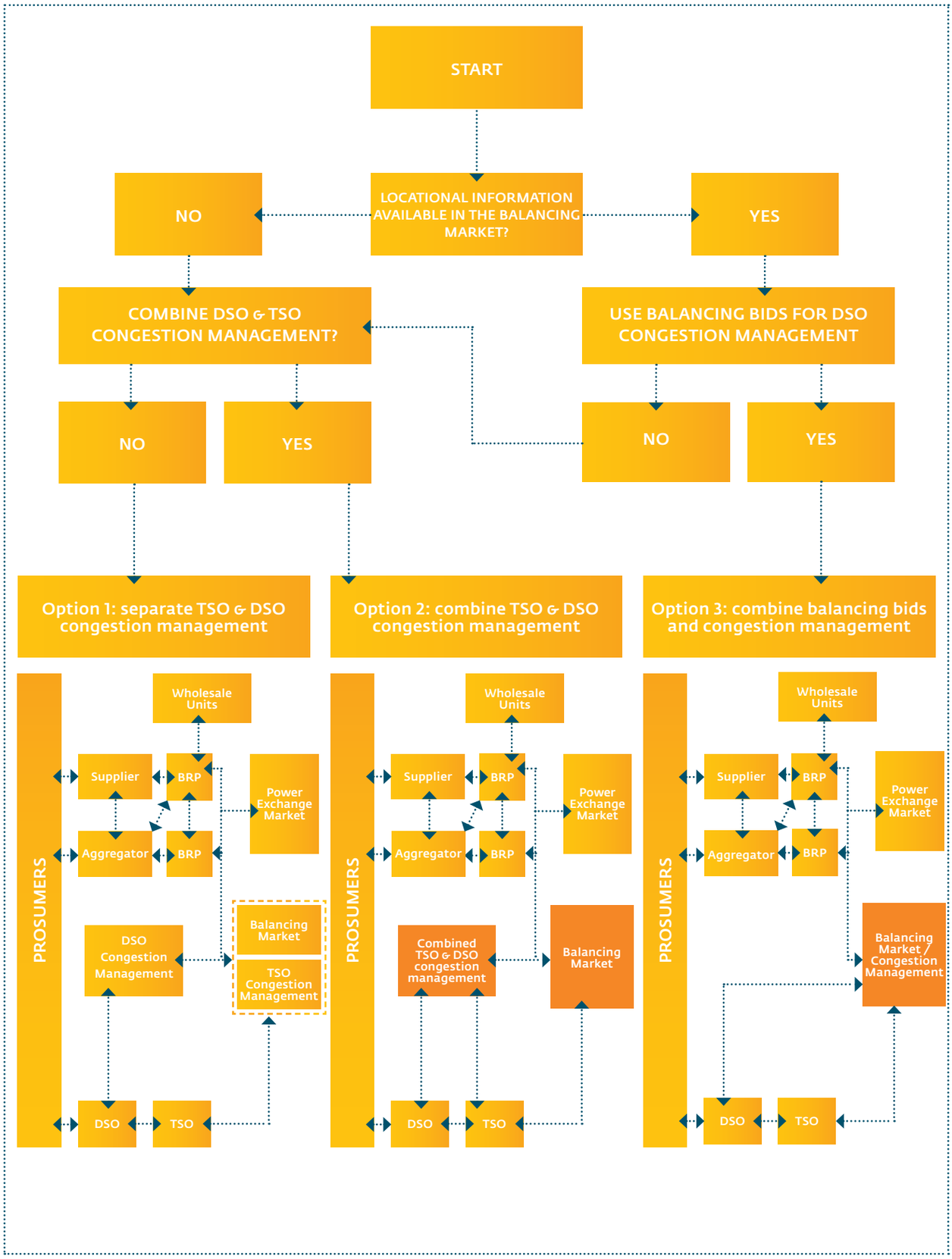


Figure 10: The three possible models for market coordination

OPTION 1: SEPARATED TSO AND DSO CONGESTION MANAGEMENT

In this model, local congestion management markets may emerge as dedicated solutions to DSO congestion management and separated from TSOs congestion management and balancing (note that in this option TSOs can separate (option 1a) or merge (option 1b) their congestion management with the balancing). This model may be needed to trigger market-based congestion management offers. However, coordination between market processes (CM, BM, ID) should be a focus to avoid market fragmentation in the long run.

OPTION 2: COMBINED TSO AND DSO CONGESTION MANAGEMENT, WITH SEPARATED BALANCING

In this model, a specific congestion management market process is created, gathering TSOs' and DSOs' needs, which may overlap. This would contribute to building a congestion management market process, streamlining the needs expressed towards market processes and the rules of the game (time schedule, data exchange, rules of activation, settlement, etc.).

OPTION 3: COMBINED BALANCING AND CONGESTION MANAGEMENT FOR ALL SYSTEM OPERATORS TOGETHER

In this model, all balancing and congestion management bids and actions are combined in an integrated market-based process. When the current trend is to build a pan-European platform for balancing, an option could be to integrate congestion management and new related needs in the same process as the existing balancing. A single marketplace at the national level for collecting and activating flexibility services would allow TSOs and DSOs to access all bids from market parties and mutually to coordinate activations. It is important to realise that using balancing bids for congestion management is only possible when there is locational information available, as the case for example in Norway, Spain or France, to allow the combination with congestion management.

Portfolio bidding and locational information

Locational information can be compatible with portfolio bidding as long as there is a nomination by the balance service providers of the locational information regarding the activated or bid resources. This locational information may be supplied by including in the nomination how the portfolio schedule is shared between the physical providers: by having information (in a flexibility register) on where they are located or by receiving information about how the schedule or the bid is shared per transmission system node (or lower voltage node if needed).

Link with the intraday market

The options above refer to different solutions for how market solutions for congestion management could be linked with balancing. These options do not describe in which timeframe the markets will operate and the link with products and solutions currently traded on power exchange platforms. Some TSOs currently buy resources for redispatch in the ID timeframes. It is also possible to plan and perform congestion management before the balancing timeframe. For this reason, it is possible within the models above to explore solutions where congestion management is traded on ID markets operated by a power exchange.

The options described above are part of a European framework. The objective is not to favour one model over the others but to assess the pros and cons of each one. National specificities will then be a driver to decide which model to choose.

Besides, several governance schemes could be applied in each option, but the purpose of the report is to focus on TSO – DSO coordination mechanisms and not on governance issues, which depend on national situations and should thus be treated at that level.

OPTION 1: SEPARATED TSO AND DSO CONGESTION MANAGEMENT

ADVANTAGES:

- Flexibility to change product requirements and timing: congestion management products can be tailored per voltage level specificities without mutual interference.
- Clear division between the two processes of balancing and congestion management.
- Separated governance (no agreement is needed between TSO and DSOs).
- Low entry barriers for small local market parties (aggregators) and technical solutions.
- Clear congestion management costs.

DISADVANTAGES:

- Probably less liquidity in small markets, and probably higher prices: market parties can only participate in the TSO or DSO congestion management market. Participation for aggregators on TSO and other DSO congestion markets is more difficult: participating in the TSO market for congestion management results in other product definitions and interfacing with other IT systems.
- Market fragmentation: when DSOs build several different local markets that are not interoperable, flexibility resources may be 'locked' in local markets (especially if long-term availability products are agreed), and therefore not available for other market services.
- Coordination between TSO and DSO is more difficult: coordination between TSO and DSO requires interaction between two MOLs. Discrepancies such as possible double activation of the same asset bidding in two separated market processes.
- Possibly extra interfaces (e.g.: IT) for existing market parties (because of different bidding systems).

OPTION 2: COMBINED TSO AND DSO CONGESTION MANAGEMENT, WITH SEPARATED BALANCING

ADVANTAGES:

- Flexibility to change product requirements and timing dedicated to congestion management.
- More flexibility and competition leading to lower costs.
- It provides a single-entry gate to market parties for congestion management services.
- Easier participation for the market parties (no coordination by themselves between two congestion management processes).
- Coordination between TSO and DSO is more efficient.
- Clear division between the two processes of balancing and congestion management and clear congestion management costs.

DISADVANTAGES:

- Need to agree on product specifications applicable for both TSO and DSO needs, which may differ.
- Governance to be shared.
- When the balancing regime contains locational information, this option could have less liquidity than in option 3 and probably higher costs for congestion bids.
- Possibly one extra systems interface (e.g.: IT) for existing market parties is required.

OPTION 3: COMBINED BALANCING AND CONGESTION MANAGEMENT FOR ALL SYSTEM OPERATORS

ADVANTAGES:

- When the balancing regime contains locational information, this option may appear as a practical answer to different challenges (at least from the TSO perspective): 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.
- Easy access for existing market parties: existing market parties are familiar with this market, therefore, they have an easy access to the congestion management market; the product specifications and the rules for the provision of services are unique. It provides a single-entry gate to market parties for system and grid services and it avoids a myriad of markets.
- Liquidity: the balancing market is well established, therefore, the liquidity is high, however, that does not mean that every bid can be used to solve a congestion.
- Cost of congestion bids: because congestion management bids can be merged with a well-established balancing market, the costs for congestion management bids are likely to be low.

DISADVANTAGES:

- Complex governance: because the balancing market is well established and agreement between market parties, TSOs and DSOs could be complex (although this also depends on the existing scheme in each country); moreover, the implementation of European balancing platforms would add complexity.
- Complex implementation: it would require an overall optimisation and bid selection system that may be very cumbersome to achieve starting from scratch.
- Product definition: need to agree on product specifications applicable for both TSOs' and DSOs' needs, which may differ, and consider existing balancing products which cannot be changed. This excludes capacity products for congestion management.
- Mixing balancing costs and congestion management costs: clear settlement rules are needed because financing balancing and congestion bids is different. The imbalance is paid by the market party who creates the imbalance, whereas the redispatch is paid by the system operator. Mixing bids will create confusion and trigger debates from market parties.
- Timing: balancing is usually close to real time, and the congestion management process needs to start further ahead.
- It is not a solution for the Member States with a balancing regime without locational information.

Because congestions are a local issue, meaning that the congestion management is dealt with locally and thus locational information is needed in the bids, the third option introduces additional complexity. Furthermore, also the complexity behind it (e.g. optimisation algorithm) and the operation and ownership of such an integrated market, and eventually also the possible different platforms to manage this, is an additional challenge. It is, therefore, of utmost importance that, in the case that more than one platform is used (no matter how many platforms will eventually be used), they are interoperable to ensure sufficient liquidity (e.g. no lock-in) and coordination. It should be noted that coordination relies on data and information exchange, as well as ICT solutions.

The coordination schemes and related market models should be up to the Member States, although it should be taken into account that the balancing systems will be harmonised over Europe and more cross-border interaction is foreseen. Furthermore, there are remaining open questions on how to move forward with these models and which one to choose. It would be recommendable to deep-dive further into the different models before making a choice because the impact of the models is yet unknown.

7.3 MODELS FOR COORDINATION BETWEEN BALANCING AND CONGESTION MANAGEMENT

In any of the different market models described, an important feature is how the coordination between different market processes is ensured. It should be noted that coordination relies on data and information exchange, as well as ICT solutions. The main coordination models are the following:

- Coordination by flexibility service providers: This is the rule when the market processes are fully separated (options 1 and 2). The flexibility service provider chooses the market process in which to bid (could be several in parallel) and takes the responsibility to install the related devices/systems to be sure that there is coherence between all congestion management and balancing bids submitted to prevent any double activation in opposite directions (or he is subject to penalisation). However, different types of products (availability/capacity or energy-only), different timing for gate opening/closure may create discrepancies. This option must be used when there is no locational information (no link between the market for TSO and DSO congestion management and balancing).

- Coordination by the party operating the market: This is the rule where the market processes are co-ordinated or combined (options 2 and 3). A flexibility service provider submits its bids only once, and the market process ensures it is used where most valued through coordination or combination of MOLs. For this coordination scheme, two different options can be imagined:

  - Coordination by a market operator in the commercial domain (e.g. power exchange): In trading flexibility between market parties for portfolio optimisation and unlocking flexibility offers to TSOs and DSOs for congestion management and/or balancing.

  - Coordination by the system operators (regulated): Especially in processes close to real time such as balancing and congestion management, where the system operator could be in charge of coordinating bids activation for purposes related to the system and grid needs, such as congestion management and balancing. This would avoid any counter activation (creating opposing effects), or double activation of the same bid (creating a potential shortage of a needed service), and would, in a balancing regime with locational information, take advantage of the global view of the system and grids that system operators have. In any case, coordination between system operators on activation of flexibility providers' bids and possible limitations is essential, especially close to real time. In balancing regimes without locational information, adding locational information can jeopardise the liquidity in the balancing market.

The coordination scheme can depend on the timing (e.g. the system operator takes the responsibility close to real time) and on the national situation. It should be noted that coordination between TSO and DSO always resides in the regulated domain, as it is the responsibility of system operators to ensure system stability and reliability.

When the coordination is done by the party operating the market, it can be done through two main options:

- Skipping bids: In case the activation of a specific balancing bid can cause a congestion (only possible to know when locational information is available), the balancing bid could be skipped in the MOL and the next cheapest bid activated instead.

- Co-optimisation of the processes: When both congestion management and balancing are performed in the same timeframe, an overall assessment can be done using both balancing and congestion management bids. This could be feasible if MOLs are linked or even combined, which however, is only possible in unit-based regimes.This could, overall, decrease TSO and DSO costs and avoid any discrepancies like counter activation or double activation of bids.

Fair remuneration and compensation systems, if any, should be defined; costs of balancing and congestion management should be clearly separated and made transparent.

7.4 OPTIONS FOR COUNTERBALANCING CONGESTION MANAGEMENT ACTIONS

Whenever an energy flexibility product that is based on the deviation from a baseline resulting from an external impulse is activated, this will initially solve a system imbalance. However, these actions can create a negative portfolio imbalance. If the market parties cannot solve it themselves, the imbalance should be counteracted by someone else to restore the portfolio and therewith system balance. This could be done in three different ways:

1. BY THE SERVICE PROVIDER (IF POSSIBLE)
2. BY THE SYSTEM OPERATOR USING THE FLEXIBILITY PRODUCT (DSO OR TSO)
3. BY THE TSO (IN ALL CASES)

In the first case, there are multiple options who would be responsible for correcting the imbalance. It could be the flexibility service provider. In this case the flexibility product as sold to the system operator would include the correction of the imbalance and would have already taken into account this effect when pricing the product. There should also be an incentive not to perform the compensating action in the same congested area to not counteract the intentional effect.

The second option would be that the system operator contracting the flexibility would be responsible for the correction.

This could have the advantage of preventing a correction that directly contravenes the original product, for example by being activated in the same area that is affected by the congestion. This option is often used in the current systems of redispatch for congestion management on the TSO level if the market party cannot compensate by itself because the transport prognoses are fixed.

The third possibility could be to assign the responsibility to the TSO, in view of the larger portfolio available, which could permit additional netting of effects. Of course, this is only true when the location of the unit is known by the TSO. However, this netting would be guaranteed by markets in any case. The question arises though who will pay for this action by the TSO and this question needs to be clarified. Although it is clear that the parties paying for their imbalances (usually the BRPs) are not willing to pay the extra cost due to the unavailability of a competitive bid due to congestions.

It is possible that multiple correction responsibility systems exist next to each other for different congestion management flexibility products or markets and timeframes. In particular, correction by system operators might be more suitable in real time, while day-ahead or intraday activation would permit flexibility service providers to perform the correction themselves. Furthermore, when there is competition on both the upward and downward bids, this may improve the cost efficiency.

8 IMPLEMENTATION OF MARKET MODELS: PLATFORM OPTIONS

Today, in Europe, many market actors and also DSOs and TSOs have started to consider and/or to develop platforms for trading and procuring flexibility. Therefore, it is relevant to also address flexibility and active system management from this perspective.

However, market model options have not been selected and the way that TSOs and DSOs implement their mutual coordination is not yet fully clear. This chapter, therefore, addresses a definition of platforms, where background considerations are given, and options and implementation issues are identified. From this, principles and the definition of future work are derived.

The objective of this chapter is to start to understand the possible relationships between market models and coordination options with these platforms. Making the right choices may lead to very effective TSO – DSO coordination solutions, whereas misaligning choices may lead to very complex and costly solutions.

8.1 PLATFORMS

A digital platform in this context is defined as a (distributed) software functionality, needed by actors to perform their tasks, corresponding to their roles and responsibilities, which as part of an ecosystem interacts with other relevant actors in the energy system. Hardware and associated IT systems will of course be required in terms of physical implementation, including new technologies which enable more efficient interactions (e.g. blockchain) but these are not described in this report and will be determined at a national level.

Digital platforms in the context of this report typically contain the functionality needed for (aggregated) asset control and selling (FSPs), bidding, trading, clearing and settlement (trading organisations), identification of needs, activation and buying (TSO, DSO, market parties), as well as data exchange with other actors in the value chain. Platforms containing (parts of) these functionalities are emerging both in the commercial and in the regulated (TSO – DSO) domain.

These functionalities are depicted in Figure 11 on the following page, where the reference points (RPs) are identifying which data exchanges could take place.

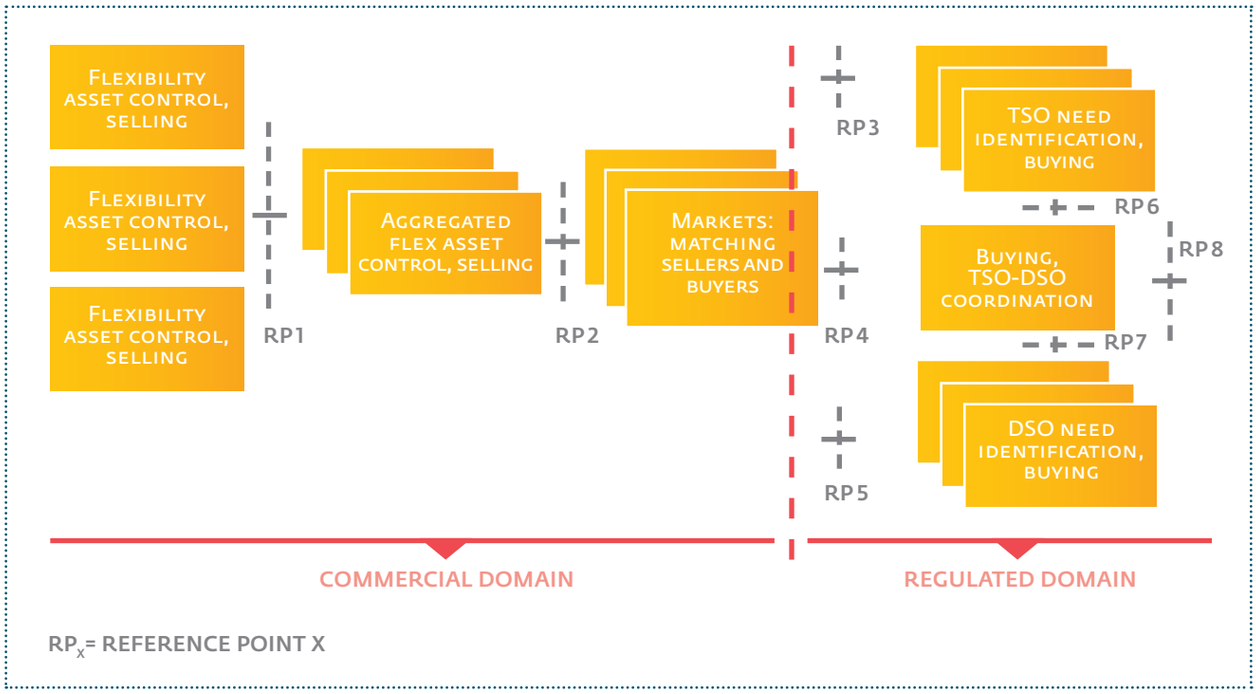


Figure 11: Reference points (RPs) identifying data exchanges in both the commercial and regulated domain

COMMERCIAL DOMAIN

The number and types of platforms that will emerge in the commercial domain will be highly dependent on competition. Inherently, this may create a risk of market fragmentation, which in time, however, may be solved by the market itself (through competition), by coordination of the different market platform operators (voluntary or mandatory) or by the market parties (sellers and buyers). Consistency in TSO – DSO data and market interaction (ensuring a level playing field) could help reduce the risks of fragmentation as well.

REGULATED DOMAIN

In the regulated domain, balancing platforms are examples of existing platforms operated by TSOs, who act as a single buyer. Platforms for congestion management at both local and national levels are being created to enable increased procurement of flexibility services, and these platforms could be run by TSOs, DSOs, TSOs & DSOs jointly, or by third parties (e.g. a power exchange). These platforms, which receive data from multiple decentralised sources, could interact with commercial market trading platforms or with FSPs directly.

In addition, it is important to note that a platform can be thought of as a way to bring together TSOs and DSOs efficiently, as well as the commercial and regulatory domains, including a defined and secure data exchange methodology between participants. This is similar to an Application Programming Interface (API) in computer programming, which defines a set of clear methods of communication among various components.

8.2 PLATFORM OPTIONS IN THE REGULATED DOMAIN

In the regulated domain for TSOs and DSOs, a number of options for platforms exist:

OPTION A:
DSOs and TSOs interact via their own separately developed platforms (D-CM, T-CM, BAL platforms) with FSPs in the market, directly or via market trading platforms (e.g. in the day-ahead or the intraday timeframe). Coordination between TSOs and DSOs is realised by direct information exchange between these platforms.

OPTION B:
DSOs interact with FSPs in the market directly or via market trading platforms through their own separate platform (D-CM), and the TSO uses the balancing platform also for T-CM. Coordination between TSOs and DSOs is realised by direct information exchange between these platforms.

OPTION C:
DSOs and TSOs interact with the market via a combined platform for D-CM and T-CM, through which TSO – DSO coordination for congestion management might also be realised (e.g. algorithms to avoid conflicts and double-dispatch of flexibility). TSOs operate a separate platform for balancing. The coordination between TSOs and DSOs is realised by direct information exchange between the balancing and congestion management platforms.

OPTION D:
TSOs and DSO interact with market FSPs or market trading platforms via a joint platform for D-CM, T-CM and BAL. This platform could still consist of decentralised TSO and DSO data requirements and a defined and secured data exchange.

In Options A, B and C, data exchange with the TSO balancing platform would be required to ensure that both congestion management and balancing actions do not impose mutually harmful interference and conflicts, for example double-dispatch of flexibility. In Option D, a well designed set of algorithms should ensure no harmful interference between grids or between congestion management and balancing.

European platforms for balancing energy

Rules established within the third energy package form the basis for establishing common European balancing markets. The aim is to ensure the security of supply and enable the use of the least costly balancing energy resources, even when located in a different areas.

Congestion management services can, in principle, due to their local nature, not be traded across Europe, however, redispatch actions as part of a congestion management service could have a cross-border impact. In addition, activating balancing bids can have an effect on congestions.

The TSOs are working on establishing platforms for exchanging both manually and automatically activated reserves. The restrictions due to internal bottlenecks are today not included directly in the algorithm. However, the design of the congestion management processes should allow resources connected to the distributed grid to be made available on the European balancing platforms as well. This requires data exchange between congestion management and balancing platforms, to avoid congestion in the distribution grid as a result of a balancing action that leads to subsequent activation of distribution connected resources.

8.3 PRINCIPLES

Based on the above, DSOs and TSOs agree on the following principles:

- **Access should be easy for the customer.** For both customers as well as market parties offering flexibility to grid operators, easy access should be facilitated irrespective of the platform arrangement (e.g. whether separate or joint platforms are created).
- **Interoperability with other platforms must be ensured.** Platforms developed by TSOs, DSOs or jointly should always respect and ensure a level playing field for the market. This will require coordination and (an) agreed interface(s) between the regulated and commercial domains (RP3, RP4, RP5 in Figure 11).
- **Platforms must avoid harmful interference and conflicts beyond their associated grids.** Platforms should contain a functionality to ensure that any TSO or DSO interaction does not create any harmful impact on their respective grids or on the system as a whole. This requires correct and timely data exchange between platforms and a set of well designed algorithms.
- **TSO – DSO coordination and mutual data exchange is an activity in the regulated domain.** As both TSOs and DSOs carry system responsibility to ensure the security of supply and system stability, any coordination and data exchange between TSOs and DSOs that is required to avoid harmful interference is the responsibility of TSOs and DSOs. This will also ensure that the whole system is operated as efficiently as possible, and the value to the customer is maximised.
- **Platforms solutions should be technology agnostic.** In defining platforms and solutions, TSOs and DSOs should be technology and hardware agnostic.

8.4 RECOMMENDATION FOR FUTURE WORK

As work relating to platforms is in its early stages, future work will be required. Therefore, it is recommended that the following is realised:

- TSOs and DSOs co-operate in defining the interface between the commercial and regulatory domain (which could include good practices for the API) and disseminate this interface to the market to ensure a level playing field. This interface should support the congestion management processes as described in Chapter 3 (including pre-qualification, forecasting, requesting, receiving and accepting bids, validation and settlement). It is recommended to initiate this work on Member State level, and to monitor progress and analyse results at the EU level, the latter with the aim to identify synergies and commonalities that might be exploited at the EU level.
- Understand what is required for platforms to work together at a distribution and transmission level. It is recommended to create a joint working group on Member State level to address this and to monitor progress and analyse results on EU level by the TSO and DSO associations, aiming to learn from best practices and agreeing on EU common practices, where relevant.
- Work with industry to understand requirements for the commercial domain and how grid operators could help to facilitate this, for example by sharing of data and defining the communication interfaces.

9 GLOSSARY

ACTIVE SYSTEM MANAGEMENT (ASM)

A key set of strategies and tools performed and used by DSOs and TSOs for the cost-efficient and secure management of the electricity systems. It involves the use and enhancement of smart and digital grids, operational planning and forecasting processes and the capacity to modulate, in different timeframes and distinct areas, generation and demand encompassing flexibility instruments (toolbox) to tackle challenges impacting system operation, thus ensuring proper integration of Renewable Energy Sources (RES) and a high share of Distributed Energy Resources (DER), as well as the integration with energy markets.

ANCILLARY SERVICES (AS)

Services provided to DSOs and TSOs to keep the operation of the grid within acceptable limits for security of supply and are delivered mainly by third parties (e.g. control power for frequency control, reactive power for voltage control, blackstart capabilities, storage) or by the TSOs and DSOs themselves (topology changes and integrated network components). Ancillary services are classified as:

a) frequency ancillary services (mainly for balancing);

b) services for congestion management;

c) non-frequency ancillary services such as voltage control and grid restoration among others.

APPLICATION PROGRAM INTERFACE (API)

A set of routines, protocols and tools for building software applications. Basically, an API specifies how software components should interact. In addition, APIs are used when programming graphical user interface components.

BALANCING (BAL)

All actions and processes, on all timelines, through which TSOs ensure, in a continuous way, the maintenance of system frequency within a predefined stability range, and compliance with the amount of reserves needed with respect to the required quality[1].

BALANCING MARKET (BM)

The entirety of institutional, commercial and operational arrangements that establish market-based management of balancing[2].

BALANCE RESPONSIBLE PARTY (BRP)

A market participant or its chosen representative responsible for its imbalances[3].

BID

An offer by a market party (voluntary or mandatory) to buy or sell electricity/flexibility.

CONGESTION MANAGEMENT (CM)

Activating a remedial action to respect operational security limits. In this report there is a differentiation between distribution congestion management (D-CM) and transmission congestion management (T-CM).

DAY-AHEAD (DA)

A market timeframe in which commercial transactions are executed one day ahead of the day of delivery of traded products.

DISTRIBUTED ENERGY RESOURCES (DER)

Refer to small, geographically dispersed generation resources, such as solar, wind or combined heat and power, installed and operated on the distribution system at voltage levels below the typical bulk power system.

1 For a more accurate/detailed description, please see the Electricity Balancing Guideline Art. 2 (definitions).

2 From *Electricity Balancing Guideline* Art. 2 (definitions).

3 From *Electricity Balancing Guideline* Art. 2 (definitions).

ELECTRICITY BALANCING GUIDELINE (EB GL)
Refers to Commission's Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing.

FLEXIBILITY
The modification of generation injection and/or consumption patterns, on an individual or aggregated level, often in reaction to an external signal, to provide a service within the energy system[1].

FLEXIBILITY PRODUCT
Refers to a product that can be used for different purposes and should be sufficiently aligned (interoperable), to permit the market-based allocation of flexibility services with the objective of an efficient allocation that maximises the value of the flexibility to enable bids by market parties. Such flexibility products can either be an option (availability) or direct activation.

FLEXIBILITY RESOURCES REGISTER
Contains structural information on the location of connection points that can provide flexibility services to system operators.

FLEXIBILITY SERVICE PROVIDER (FSP)
A market participant providing flexibility services to either the wholesale market or to system operators.

GDPR
General Data Protection Regulation.

GRID PRE-QUALIFICATION
Checking whether the grid can manage the delivery of the product that the unit wants to sell/deliver (both congestion management and balancing products), according to the agreement and applicable framework between the different system operators on pre-qualification.

INTRADAY (ID)
A market timeframe, starting after the day-ahead gate closure time and ending at the intraday gate closure time, where commercial transactions are executed prior to the delivery of traded products.

KORRR
Key organisational requirements, roles and responsibilities in relation to data exchange. Following from SO GL.

MARKET
A regular gathering of people/parties for the purchase and sale of commodities (electricity in this report).

MERIT ORDER LIST (MOL)
A list of (electricity) bids sorted in order of their bid prices, used for the activation of those bids[2].

PRODUCT PRE-QUALIFICATION
Checking whether the unit can (technically) deliver the product it wants to sell/deliver.

PLATFORM
A (distributed) software functionality, needed by actors to perform their tasks, corresponding to their roles and responsibilities, which as part of an ecosystem interacts with other relevant actors in the energy system.

REAL TIME (RT)
The actual time in which a process or event occurs, the actual moment of operation.

SYSTEM OPERATION GUIDELINE (SO GL)
Refers to Commission's Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation.

1 From EG3 report *Regulatory Recommendations for the Deployment of Flexibility (2015)*.

2 Based on *Electricity Balancing Guideline*.

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