MARKET ENABLING INTERFACE TO UNLOCK FLEXIBILITY SOLUTIONS FOR COST-EFFECTIVE MANAGEMENT OF SMARTER DISTRIBUTION GRIDS

Deliverable: D2.2

Business Use Cases to unlock flexibility service provision

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Executive Summary

This deliverable is developed in the context of the EUniversal project which aims to overcome existing limitations in the use of flexibility by DSOs. EUniversal aims to achieve this objective by implementing a Universal Market Enabling Interface (UMEI) to facilitate the use of flexibility services and to interlink active system management and DSOs with electricity markets.

To develop such an UMEI, insights into information and other requirements needed for the provision of flexibility services are needed. This report therefore describes the Business Use Cases (BUCs) of flexibility delivery in the three demonstrators of the EUniversal project. For this, the standardized use case methodology (IEC-62559 standard) is applied. This helps to gain a common understanding of functionalities, actors and processes in the different BUCs.

Within the EUniversal project, there are three different demonstrators in which different BUCs have been identified. In the German demo, there are two BUCS. In the Polish and Portuguese demo there are four BUCs. The majority of the BUCs is focusing on local flexibility markets for the DSOs to acquire flexibility. To implement these markets, in the project, two different types of market platforms are being tested: the NODES market platform and the N-SIDE market platform. The reason why both platforms are tested is to compare different market approaches and as such to evaluate UMEI for data exchange between multiple markets.

Given the project's focus on local flexibility markets, the deliverable also gives an overview of the market design characteristics in each BUC. From the market design, it becomes clear that the BUCs focus on the delivery of congestion management and voltage control grid services through active and reactive power. In the deliverable itself, more detailed overview of the different market designs can be found (explaining among others activation details, market openings and closures, pricing schemes, auction types, geographical scoping, market horizon…). A summary of which BUCs focus on which market mechanisms and which market platforms is given below.

Demo	BUC ID	BUC name	Service	Mechanism	Market Platfor m
Germany	DE AP	Congestion Management & Voltage Control with market-based active power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES
Germany	DE RP	Congestion Management & Voltage Control with market-based reactive power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES
Poland	PL AP	Congestion Management & Voltage Control with market-based active power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES
Poland	PL RP	Congestion Management & Voltage Control with market-based reactive power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES

Poland	PL DLR	Congestion management using permissible line capacity based on Dynamic Line Rating (DLR) system.	- Congestion management	- Local Flexibility market (one FSP, RES competition)	NODES
Poland	PL FS	Voltage Control with the use of flexstation solutions	- Voltage control	- Bilateral contracts	NA
Portugal	PT1	Congestion management in MV grids for the day-ahead market (or between 1 to 3 days in advance)	- Congestion management	- Local Flexibility market	NODES / N-SIDE
Portugal	PT2	Integrated Voltage Control in MV and LV grids for the day-ahead market (AP+RP)	- Voltage control	- Local Flexibility market	NODES / N-SIDE
Portugal	PT3	Contracting flexibility services for avoiding voltage and/or congestion issues during planned maintenance action in MV grids	- Congestion management - Voltage control	- Local Flexibility market	NODES / N-SIDE
Portugal	PT4	Voltage Control and Congestion Management for medium and long-term grid planning through market mechanisms	- Predictive congestion management - Predictive voltage control	- Local Flexibility market	NODES / N-SIDE

As this table shows, in the Polish demo, two BUCs will not test a traditional local flexibility market but will instead focus on a market with only one FSP, and on delivery of services through bilateral contracts. The usage of bilateral contracts also implies no market platform is required. Furthermore, within the Portuguese demo, both market platforms will be tested simultaneously to compare the different platforms. The Portuguese demo is also testing the procurement of flexibility on the long term, implementing both short term and long term markets). The later is done in the context of including flexibility in operation and maintenance planning to improve network operational resilience to increase the capacity to deal with unexpected events.

Finally, the BUCs describe interactions between the different roles involved in the different BUCs. To ensure a common understanding of the different roles involved, a role model providing common definitions for different roles is developed. In total, seven roles were considered for the flexibility service delivery (DSO, TSO, flexibility market operator, resource aggregator, resource provider, flexibility services provider, and producer).

Note that all BUC descriptions are made based on current knowledge, discussions and decisions in the demonstrators. This implies that for some aspects (for instance of the market design) descriptions are still general as they will be further clarified in the rest of the project.

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Abbreviations

API	Application Programming Interface
BUC	Business Use Case
DA	Day Ahead
DE	Germany
DEMO	Demonstrator
DSO	Distribution System Operator
EV	Electric vehicle
FMO	Flexibility Market Operator
FSP	Flexibility Service Provider
GDPR	Data privacy and security requirements
h	hour
HEMRM	Harmonised Electricity Role Model
HV	High Voltage
ID	Intra Day
IEC	International Electrotechnical Commission
kV	Kilo Volt
LV	Low Voltage
MoL	Merit Order List
MV	Medium Voltage
MVar	Mega Volt Ampere Reactive
P	Producer
PL	Poland
PT	Portugal
PV	Photovoltaic
RA	Resource Aggregator
RES	Renewable energy sources

RP	Resource Provider
SME	Small and Medium sized enterprises
SUC	System Use Case
TSO	Transmission System Operator
UMEI	Universal Market Enabling Interface
UML	Unified modelling language
V	Volt
W	Watt

1. Introduction

1.1. EUniversal project

The European Union is aiming at transforming the energy system towards a sustainable, low-carbon and climate-friendly economy, while among others putting consumers at its center. To enable this transformation by putting consumers at its centre and dynamically utilize these distributed resources, distribution grid operators will face new challenges in the ways they operate. In order to be able to safely host more renewable energy sources (RES) and to integrate new types of load patterns (such as electric vehicles and heat pumps) and consumer behavior (e.g. with the advent of energy communities or the introduction of dynamic electricity pricing), they will need to rely more on **flexibility** and smart-grid solutions. Flexibility in the grid has been identified as a key enabler towards a more sustainable, low-carbon and climate-friendly electricity system. In such a scenario, consumers become crucial players due to their potential to relieve grid constraints by adapting their consumption behaviour, reflecting one of the most important Energy Union priorities. Yet, at the same time, flexibility will create complexity and unpredictable power flows in the distribution networks, and thus demand new solutions to transform the challenges in real opportunities for the sector and to society.

The primary goal of the EUniversal project is to overcome existing **limitations in the use of flexibility** by Distribution System Operators (DSOs). As such, the project goal is (among others) to enhance flexibility use in distribution grids which will need to operate in an overall context of 50% electricity production from renewables in 2030. Furthermore, the EUniversal project aims to further guarantee security of supply while avoiding unnecessary network investments.

Therefore, within the EUniversal project, a **Universal Market Enabling Interface (UMEI)** will be implemented to facilitate the use of flexibility services and interlink active system management of distribution system operators with electricity markets. A set of market-oriented flexibility services from Distributed Energy Resources (DERs) will be implemented to serve DSOs' needs in a cost-effective way, supporting the energy transition.

1.2. Scope and objectives of this document

This report is part of the second work package of the EUniversal project. The operative objective of WP2 is to develop the standardized interface – UMEI (adaptable interface (API)) – to achieve an integrated solution, which fits into the context of energy systems across Europe and evolves over time to address new challenges. Market platforms, smart grid systems and interfaces, **need to be adapted to the new requirements demanded for the provision of flexibility services and the exchange of information alongside the process**, respecting data privacy and security requirements (GDPR). The system architecture ensures standardization of the processes and transactions independently of the operating context or chosen governance model.

As part of WP2, this report describes the Business Use Cases of the different pilot demonstrators in the project to guide the development of the standardized interface. **Business Use Cases (BUC)** describe business processes/activities, the needed interactions between the involved stakeholders and their associated information requirements. They describe business needs and rules related to the implementation of a specific 'business' service. As such, BUCs help to define, model and capture **requirements of a system.** The BUC definitions are followed by the System Use Cases (SUCs) (see deliverable 2.3) which identify clear functional specifications of the operational prototypes in the project test environments. By describing DSO services, business processes and functions, a BUC therefore helps to understand requirements regarding market development, regulations, other technologies and helps to identify necessary adaptations and opportunities regarding market development, regulations, other technologies…

The Business Use Cases will be designed to be adaptable to the different regulatory contexts, particularly, but not limited to, the ones corresponding to the countries where the demonstration pilots are located. The BUCs are generic, making use of a common business role model and are technology neutral, in the sense that all types of flexible units are considered to deliver the studied flexibility services on a level playing field. This helps to replicate and apply the similar approaches in other locations and will facilitate cross analysis between BUCs.

To describe the BUCs, a standardized use case methodology (IEC-62559 standard) will be applied. Within the project, **3 different DEMO sites** (located in Portugal (PT), Germany (DE) and Poland (PL)) will be run to validate the project solutions. The BUCs described in this report will be tested afterwards in these DEMOs.

2. Methodology

2.1. Use cases and related concepts

A **Use Case** is a sequence of events that describes the use of a particular system. It describes how a particular user or set of users interact with a given system to reach (or fail to reach) a specific goal while defining the system, process and product requirements. Within a use case, there are four key concepts (system, users, requirements and goals):

A **system** is a "set of interrelated elements considered in a defined context as a whole and separated from their environment" (IEC, 2013, p. 9).

When it comes to the **goals** of such a system, it should be noted that goals can be at different levels (i.e. business or functional). **Business Use Cases (BUC)** describe the steps in a process that achieve a business goal. It encompasses all the activities necessary to achieve what the user wants. **System Use Cases (SUC)** describe the behavior of a system that automates a BUC. These are typically things we can readily imagine as being done in a single step in the BUC (non-manual activities). Therefore, as visualized in Figure 1, a BUC focusses on the functions/activities/steps that are needed to execute a business process. It does not focus on how such processes should be implemented from a more technical perspective. Note that the SUCs are worked out in a separate deliverable (D2.3) in the EUniversal project.

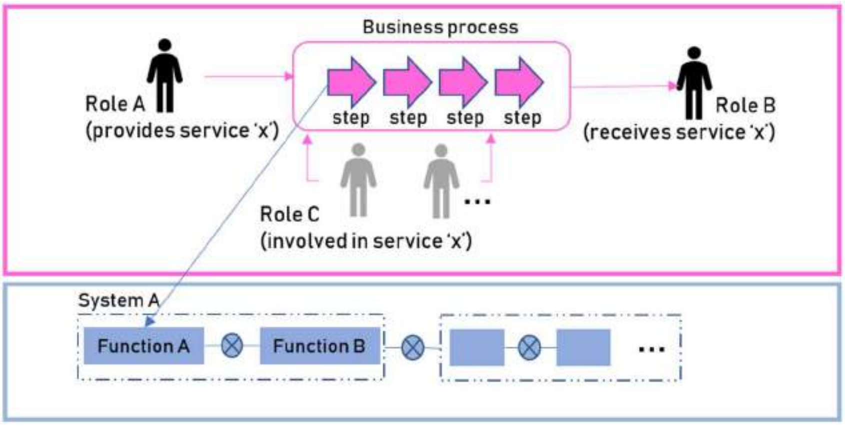


Figure 1 - Link between BUC and SUC (figure own elaboration)

When it comes to **users**, or actors, it is therefore important to understand that this can include physical components, information systems, persons and/or roles. Within a BUC, business operations are traditionally executed by roles, while in a SUC, functions are more likely to be executed by systems (i.e. information systems, physical components…). As this concept is very important in BUCs, we will dedicate a separate section to the role model used in the BUCs (see section 3.5).

Finally, with regard to requirements, there are two types of requirements: **functional and non-functional requirements**. BUCs and SUCs only focus on functional requirements. These are requirements that are needed before a system can perform (services, tasks, functions…). It therefore details what a specific user or system must do. Non-functional requirements on the other hand are more general and detail performance requirements, security requirements, data management requirements, interoperability issues… Non-functional requirements are often also more product- or technology specific which would make a BUC or a SUC less generic.

2.2. Use Case Methodology

A standardized use case methodology (IEC-62559 standard) will be applied to support replicability of the use cases. IEC is the International Electrotechnical Commission, which is a worldwide organization for standardization with the objective to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. The international IEC-62559 standard is created to achieve standardization. (IEC, 2013)

Standardization is needed as more and more complex systems such as smart grids are facing challenges with managing system requirements, which in their turn have to be broken down further in specifying standards to support these system level functions. This standardized use case methodology therefore helps to share ideas and requirements of new use cases (e.g. functions, systems). (IEC, 2013)

The IEC-62559 standard makes use of use case templates which define the structure of a use case. It is defined for various purposes, even though the general template was originally developed for the usage in the energy system / smart grid systems. Figure 2 provides an overview of the use case template and its content.

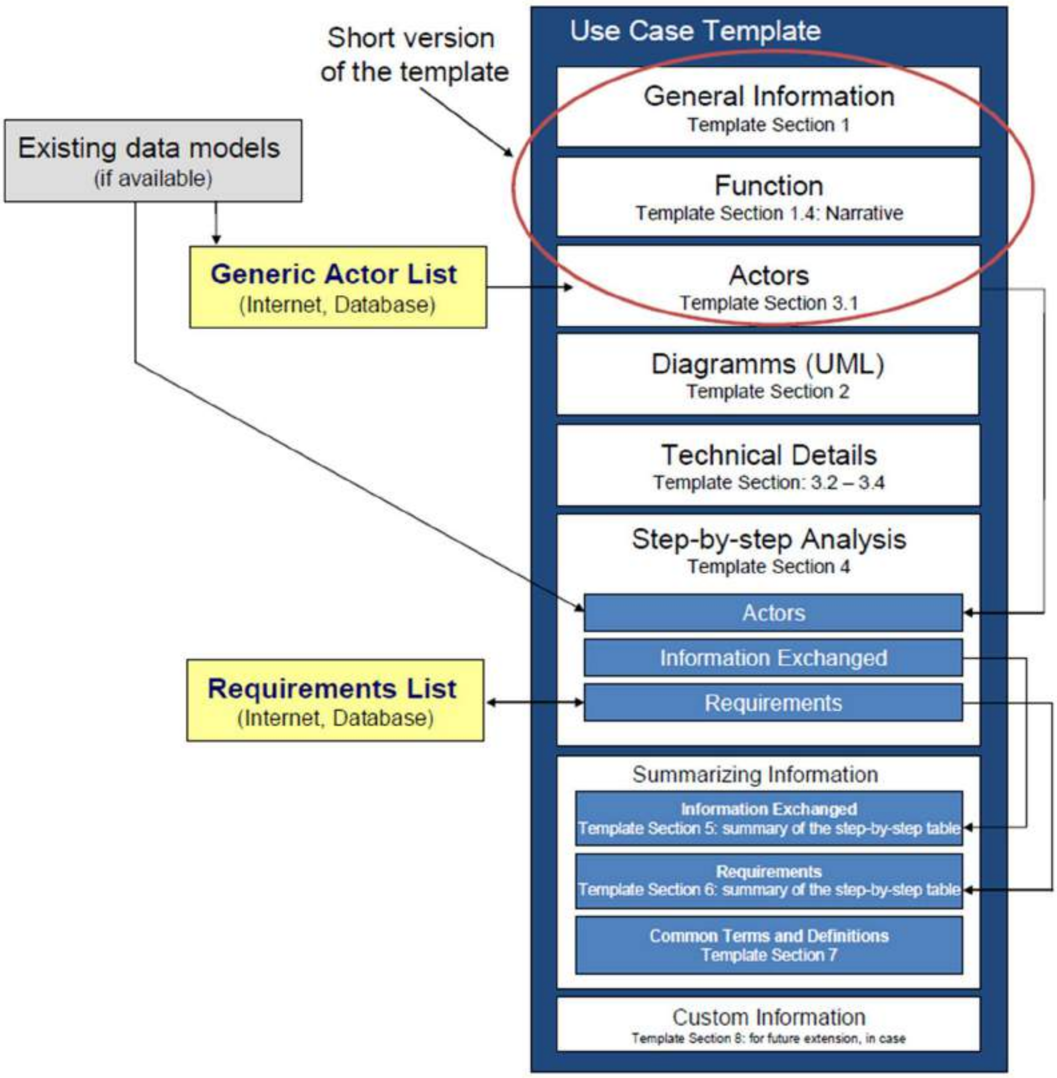


Figure 2 - Overview of the use case template (source (IEC, 2013))

The EUniversal project has adapted this template to a certain extent to make it more fit to the level of detail needed within the BUCs and the project. BUCs are mostly textual descriptions, yet, they also contain some diagrams to visualize the use cases. The making of such diagrams can only take place after the textual description has been finalized. Moreover, the writing of BUCs is an iterative process and when continuing the work, it might be necessary to take a step back to review previous business processes or functions.

Annex I – contains an example of the questionnaire templates with a description of different building blocks of the questionnaire.

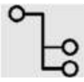
2.3. Organization of the work

As could be seen in Figure 2, it is possible to combine certain blocks of template-questions together in separate sub-templates (e.g. short version of template). By splitting up the required information in multiple smaller questionnaires, demonstrators can build up their knowledge on their BUCs step by step. As such, it provides an easy starting point.

This is also the approach taken in this report. The work has been split up in multiple smaller sub-tasks which facilitated the work. Table 1 gives an overview of the main steps in the process and the tools used.

Table 1 - Organization of the work

	3 questionnaire templates have been set up according to the IEC-62559 standard. The first questionnaire aimed to obtain more contextual information on the demonstrator itself, the second questionnaire retrieved information about the needs and grid services within the demo BUCS, and the third questionnaire aimed to retrieve more detailed information on the step by step activities in the BUC. By splitting up the questionnaires as such, the demonstrators had more time to shape their BUCs and to build up the knowledge and experience within their BUCs step by step. The usage of adapted standardized IEC-62559 use case templates helped to harmonise the BUCs and to retrieve consistent information. Filling in the questionnaires is done by the DSO responsible(s).
	For each questionnaire, a draft 'reference' template was filled in as an example, which assisted the demonstrators for correct interpretation of the questions and which further increased the harmonization in answers between different BUCs. All questionnaires were also reviewed by an independent party.
	Filling in the templates requires defining a list of roles (role model) which are involved in the use cases. In order to harmonize information over all BUCs, one common list of roles was set up to harmonize the different roles of the different BUCs and to avoid double roles with similar names. To achieve this, the team discussed possible roles in a workshop dedicated to the topic. The role model and the approach taken will be discussed in more detail in section 3.5. During the task, the role model was revised regularly to ensure it was still in line with new insights gained by the different BUCs.
	To be able to describe the different Business Use Cases, it is important that the market design of the different BUCs is clear. This is important for both the internal discussions, as for the external reader to be able to better understand the BUCs. While the market design description is not the main task of this deliverable, it is

	important for proper development of the Business Use Cases. Therefore, the deliverable is also providing an overview of the markets of the different BUCs. The market design will be worked out in more detail in later stages of the project.
	The textual description of the use cases is visualized through some use case diagrams. More specifically, this report opted to visualize the step by step analysis by developing sequence diagrams. The IEC-62559 standard recommends UML (unified modelling language) to do so. UML is a graphical modelling language for the specification, construction, and documentation of parts of software and other systems (IEC, 2013). However, as the project partners did not have sufficient experience with UML, PowerPoint was used to make the diagrams manually.
	Finally, for all demos, a market design description was set up to support internal discussions and alignment between the demos, and to guide external readers of the document to better understand assumptions and background facts on the different BUCs.

All these sub-tasks were followed-up and coordinated by the task leader who set up regular meetings with the entire team or who (where necessary) focussed on sub-teams to coordinate the task to discuss potential issues. In addition, other project partners, for instance the partners responsible for the development of the market platforms were also involved in the task to ensure harmonization with the development of these platforms.

3. Introduction to the EUniversal Business Use Cases

3.1. Context and challenges DSOs

The transition to a decarbonized power sector will have a large impact on distribution grids and their management. Not only will there be more decentralized and less predictable RES connected to the grid, also the number of electrical loads (EVs, heat pumps…) will increase. There will not only be changes in the way electricity is produced, but also in the way electricity is consumed. Power flows are not one-directional anymore, but flow in two directions between multiple actors and devices. Furthermore, Europe is enforcing Member States to provide incentives to DSOs to procure flexibility services in distribution networks according to market-based procedures (Article 32 of the Directive (2019/944) [1]).

This implies that the general context in which DSOs operate is changing significantly. Yet, while the working environment of DSOs is becoming more challenging, their core responsibilities remain approximately the same. Apart from technical grid solutions, DSOs are therefore in need of more flexibility to be able to better manage and control their grids in a reliable and operational secure manner.

In D2.1 of the EUniversal project, all DSO **needs** in different time frames, from real time operation to long-term planning were identified. The different type of events that occur in distribution grids and specific technical issues and requirements were mapped. For each of these needs, **flexibility services** were identified to solve those needs. Table 2 provides an overview.

Table 2 - DSO needs and grid flexibility services identified in T2.1

Needs / scarcities	Flexibility Service
Physical congestion	Corrective and Predictive Congestion Management
Voltage violation	Corrective and Predictive Voltage Control
Support to network planning	Support to Network Planning
Phase balancing	Corrective and Predictive Voltage Control
Support to planned and unplanned operations	Corrective and Predictive Congestion Management, Corrective and Predictive Voltage Control, Islanding, Emergency Load Control and Mobile Generation Capacity
Support to extreme events	Corrective and Predictive Congestion Management, Corrective and Predictive Voltage Control, Islanding, Black Start, Emergency Load Control and Mobile Generation Capacity
Provide services even when network fails	Islanding

Implementing such flexibility services might, however, not be an easy task. DSO's original "network follows demand" approach did not require sophisticated control and/or supervision systems. Nevertheless, flexibility will create complexity and unpredictable power flows in the distribution networks, thus demanding new solutions that transform the challenges in real opportunities for the sector and society.

There are therefore clear limitations in the use of flexibility by DSOs. For instance, coordination and information exchange between different system operators and flexibility actors is needed because the simple activation of flexibility by other market parties could lead to issues for the DSO (double flexibility activations could lead to distribution grid congestion). As a result, DSOs should be able to oversee, utilize and coordinate the impacts of flexibility operations on their networks. It is important that flexibility resources offer viable solutions, and do not cause problems related to congestion or other operational problems. (CEDEC et al., 2018)

As part of the main goal, the EUniversal project aims to develop a universal approach to the use of flexibility by DSOs and their interaction mechanisms to acquire flexibility. **A Universal Market Enabling Interface (UMEI) will be implemented to foster the provision of flexibility services and interlink active system management of distribution system operators with electricity markets.** As such, the UMEI system will help to link the DSO with its external parties. In the following section, we zoom in on the UMEI, and explain how this deliverable helps in its development.

3.2. BUC and UMEI

EUniversal aims at implementing a modular and adaptable interface that is going to work as the link between the DSO and the external parties, defining the rules and routines for the stakeholders to exchange data and services with the distribution system operator, unlocking the flexibility service provision. Specifically, UMEI will be defined as a set of open generic Application Programmable Interfaces (API) addressing flexibility related data exchange between DSOs and:

- Flexibility market operators (FMO)
- Resource aggregators (RA)
- Resource providers (RP)
- TSO

UMEI will bring an innovative potential to modulate different use cases and adapt them to different operating contexts, increasing the replicability of the project solutions. The UMEI aims to be universal, defining generic APIs for each role in the value chain, independent of any specific platform each one of them may have. The APIs will be public, allowing for its use by any interested stakeholder. Furthermore, by relying on a publicly available API, capable of addressing all communication between the DSO and the other stakeholders, this approach is agnostic of any type of organization, since it avoids the need for a manageable intermediate platform.

For DSOs, the new UMEI approach will unlock the usage of flexibility services offered by market parties through proper communication standards for the exchange of flexibility services. Thanks to the fact that UMEI helps to couple different tools and different market parties, UMEI indirectly will also help to improve monitoring and controllability of the smart grid environment in terms of state estimation, congestion forecast, distributed control strategies for local microgrids and energy communities. Furthermore, it will help increasing resilience through self-healing tools and automation schemes, guarantee security of supply and use of flexibility products.

To be able to develop UMEI, UMEI development and implementation requires further knowledge and information on different aspects of the demonstrators. As such, an open set of business use cases designed to answer DSOs' needs for flexibility, spanning from long-term to real-time operation, ensuring interactions with solution and market providers, and the cooperation mechanisms with other stakeholders is needed. For a selection of the grid flexibility services summarized in Table 2, the BUCs will be developed. The BUCs (and later on the SUCs) will provide important information to develop the APIs referred to above. The APIs will be developed integrating all the message exchange needed to implement the BUCs and, subsequently, the SUC.

This report presents tailor-fit use cases for each demonstrator. The use cases will, among others, help in better understanding the relationships between different stakeholders. Such understanding of the stakeholder relationships is important for the design of the interface. Furthermore, the use cases will allow DSOs to further assess the flexibility impact on the power grid. UMEI will also help to evolve the communication between DSOs and market players by innovative data communication interfaces. This will help to validate transactions in local energy markets, to solve distribution grid unbalances and inefficiencies and to coordinate with other parties such as TSOs. The use cases will provide insights into which type of requirements are needed to make this work.

3.3. Market organization & mechanisms

D.5.1 of the EUniversal project identified all the available options for DSOs to acquire flexibility.

The mechanisms to acquire grid services analysed in D5.1 are:

- Dynamic or non-firm access and connection agreements, which are agreements between the system operator and the FSP, in which the latter agrees to have the connection curtailed in some periods.
- Dynamic network tariffs, which concern time- (and location-dependent) differentiated network tariffs, which can be adjusted to reflect the necessary temporal and spatial cost variations.
- Local flexibility markets, which include long-term and short-term pools, in which offers are received from FSPs; the market is cleared according to the match between the demand for flexibility and the offer. In the third Polish BUC, there is an exception to this as there the DSO offers flexibility and the FSP takes the role of a buyer.
- Bilateral contracts, which are binding agreements between the DSO and FSPs. Regarding grid services, one side (demand side) is represented by the system operator while the other (supply side) is the FSP.
- Cost-based remuneration, which deals with the remuneration of the flexibility provided by the FSP based on the actual costs of providing a service.
- Obligations, which is an obligation mechanism for flexibility provision and requires mandatory service provision from the FSP.

The majority of the BUCs is therefore focusing on local flexibility markets. In this regard, the UMEI and its API extensions will aim to ensure correct functioning of the market. Within the EUniversal project, there are two different types of market platforms that can be supplemented with grid tools, API extensions and the UMEI. One market platform is called the NODES market platform, a second is the N-SIDE market platform. The reason why both platforms are tested is to compare different market approaches and as such to evaluate UMEI as a universal interface for data exchange between multiple markets.

The NODES market platform is an open, transparent, and independent marketplace that is positioned at the centre of the market framework to facilitate a coordinated exchange and interaction among the various market agents covering all market-relevant processes related to registration and prequalification, trading and post-trading processes, i.e. validation and settlement. NODES market is designed to run with minimum data and information exchange requirements to allow for a neutral and transparent operation of the marketplace. This set-up ensures the equal treatment of all flexibility buyers and sellers, thereby respecting the business responsibilities and information exchange restrictions of all stakeholders, and reduces the incentive and probability of success for abusive behaviour by market participants.

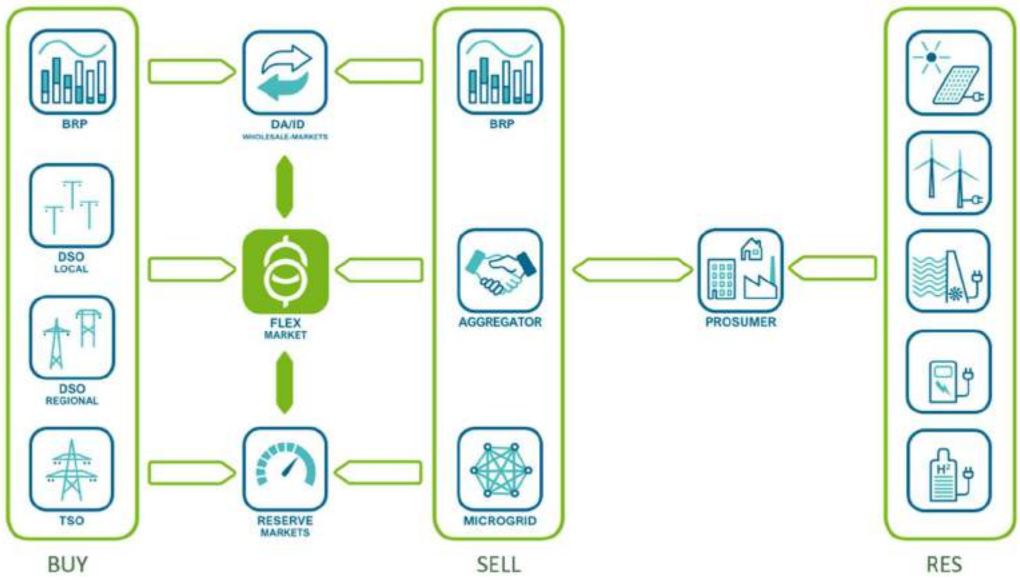


Figure 3 - NODES Bottom-up integrated market design

According to general market guidelines, asset owners of flexibility can stack revenues across the different market necessities and sell flexibility directly to the local/regional DSO, or national TSO depending on the market design. The FSP can characterize its assets through location and asset parameters, and further define the product (flexibility) using order (Limit order, Fill or Kill, Fill and Kill) and time parameters.

FSPs can submit offers across various markets without any restriction, however ensuring that they can match the delivery obligation in case one or several offer(s) are accepted. System operators are enabled to buy flexibility that ensures the most effective solution in the grid in terms of asset and flexibility type, time, location, and price to an existing or pre-identified constraint. In order to comply with data and information exchange limitations, the sensitivity (locational impact) of an asset to a grid node is only indirectly applied by adapting the granularity of the grid area on the Market platform and hence the number of grid nodes.

The purchase of flexibility can be performed across different market horizons and simultaneously, thereby allowing for the selection of the most suitable product with regard to the type of system operator (TSO/DSO), their operational processes and the problem to be solved.

Through the **NODES ShortFlex market**, FSPs can offer their assets where the different technologies can compete on a level playing field against each other and where flexibility can be bought by the DSO/TSO to address an immediate need.

Via the **NODES LongFlex market** the DSO/TSO can reserve flexibility via an availability payment to secure the option to have access to flexibility over a defined time period in the future to ensure system security and stability. According to the agreements in the LongFlex contract between an FSP and a system operator the seller of flexibility commits to always submit ShortFlex orders according to the agreed contract details enabling the DSO (or TSO) to activate the reserved flexibility if needed. If the reserved flexibility is not activated by the DSO/TSO the offer in the ShortFlex market remains available, enabling other buyers to activate the available flexibility, and thus ensuring the most (cost-) effective use for all stakeholders.

NODES market design applies a **continuous market clearing (pay-as-bid)**. Orders are matched continuously following the standard merit order principle with price and quantity as predominant discriminating parameters. Nonetheless, if determined in the specific market design deadlines for offer submission can be defined. Once the deadline is met the DSO can submit the necessary orders to activate the flexibility that is needed. Contrary to auctions, however, where only the clearing price will be published, the price and quantity of each offer is visible to all market participants.

The N-SIDE market platform

N-SIDE Local Market Platform can be operated in two distinct ways in EUniversal context, either as a ***Local Flexibility Market*** *or as an* ***Optimal bid recommender/selector for market participants***[1]***.***

In both cases, the purpose of the *N-SIDE Local Market Platform is to ease the* link between FSPs/aggregators and DSO bids through an auction-based mechanism taking into account basic grid constraints in addition to individual operating constraints coming from market participants.

To do so, the N-SIDE Local Flexibility Market reveals its strengths through its market clearing process. Thanks to state-of-the-art optimization models and methods, it is able to concentrate the liquidity of the market with a closed-gate mechanism, before clearing it by maximizing the social welfare while respecting constraints shared by FSPs and system operator(s).

The key capabilities of the N-SIDE Local Flexibility Market are the following ones:

- It is **impartial** by offering a *neutral* market where network companies and flex sellers can win contracts for services
- It can be used **for reserve and/or energy** by proposing auctions for *reserve* and *utilization* over various time horizons
- It allows the participants to share **price signals**: buyers and sellers can chase price signals and expose their *best price* in a transparent way without regrets
- Market participants influence the clearing through **price sensitive orders**: sellers and buyers can submit *locational price sensitive orders***,** ensuring the compatibility of the platform with other procurement sources as well as the importance of flexibility need/offer location. In that way, a seller will ensure to receive the best price possible while being sure not to sell below a threshold. The same applies for a buyer which will protect him to pay as few as possible while not going upper than a threshold which could be the price this buyer is sure to buy some flexibility through another mean (such as a bilateral contract with a fixed price. In that case, the buyer will benefit from the market only if it is better from its personal point of view)
- The N-SIDE Local Flexibility Market supports several **pricing rules**: both pay-as-clear (uniform pricing) and pay-as-bid pricing can be used while clearing auctions
- Asset operation constraints can be considered through **product parameters**. Asset constraints included in the market platform ensure that contracts are *feasible*, reducing *risk premiums* and more generally *smoothing the operations* for asset owners (e.g. 1% bid acceptance can be avoided for assets with high fixed cost, ramping constraints or downtime required periods can be considered by the clearing algorithm to ensure the best economic output for each market participant individually)
- By considering network data, the N-SIDE market clearing process can ensure that reserved and activated contracts are fully compliant with **grid constraints**
- N-SIDE Local Flexibility Market can also integrate a **TSO/DSO coordination** flexibility procurement to ensure that TSO contracts are *not jeopardizing* distribution network

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[1] In the context of the BUCs description we will focus on the Local Flexibility Market perspective. As the Optimal bid recommender/selector for market participants is an internal tool for the DSO, it will thus be described in detail in the deliverable D2.3 on SUCs, including a more operational presentation.

- Although not applicable to the foreseen DEMOs, it could also take into account **switching possibilities** of the grid to decide the optimal grid configuration to adopt while clearing the market to improve even further the social welfare.

3.4. Phases

For a selection of the grid flexibility services (summarized in Table 2), the business use cases will describe the complete process for the delivery of the service (e.g. Prequalification, bidding/selection, Delivery, Settlement) by defining the interactions between different roles, including the corresponding information exchange.

The BUCs will describe the different phases in more detail. However, in what follows, we give a short description of the different phases that are used in the BUCs.

Phase	Description
Registration and Prequalification	Different flexible resources (RA/RP) can qualify for the flexibility market. RA/RPs can request qualification when their assets meet market access requirements as defined by the DSO and the FMO. If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market. If the prequalification is not successful, the RA/RP cannot register the assets nor create offers on the flexibility market. In this phase, it is also assumed that the DSO registers on the market platform as a buyer and defines grid areas to determine the locations of flexibility potential in all BUCs.
Bidding and selection	In this phase, planning of grid utilisation and identifying potential grid issues is taking place. This is followed by bid and baseline submission, evaluation, and matching. In essence, this implies that the DSO first needs to forecast grid issues, and then the available flexibility needs to be determined. Only FSPs that are prequalified can submit bids. When bids are matched, flexibility of the local market is used to address the DSO needs.
Delivery and monitoring	This implies the activation of bids and the monitoring of delivery. Once the bids are matched on the flexibility market, a trade confirmation and activation signal are sent to the FSP who then needs to provide the flexibility to eliminate the identified grid issue. The proof of delivery is provided by metering data. Together with the baseline, this forms the basis for settlement.
Settlement	Finally, when the services are delivered, based on respective baselines for the specific offers, and active metering systems, it is calculated how much the DSO needs to pay to the FSP for the flexibility delivery. As such, the delivered and/or reserved flexibility is remunerated.

In the Polish demo, slightly different phases are used for the BUC DLR. Specific phases that are analyzed in their case are summarized below:

Phase	Description
Operational activities	In this phase, the flexstation is autonomously controlled through the activation of the central controller. The flexstation monitors the network parameters at dedicated measurement points and compares them with the acceptable values. As such, it is ensured that the voltage in the network is maintained within the acceptable limits.
Registration and Prequalification	Before a producer (in this case a wind-farm) can apply for temporary enhancement of power generation when he might exceed the connection power agreement, he needs to register and prequalify through the FMO. The process in this case is similar as for the other BUCs that consider a local flexibility market. The DSO can register on the market platform as a seller and define grid areas to determine the locations of flexibility potential.

3.5. Role model

A use case describes how several actors interact, within a system, to achieve (a) specific goal(s). Actors are therefore at the core of the use case. However, there are many concepts related to the concept of an actor. In this report, we will only define and make use of roles. Table 3 details the different concepts related to "actor" and explains their differences. This is also visualized in Figure 4. The table comes from the EU-SysFlex project (Marino et al., 2019) whom base themselves on (CEN-CENELEC-ETSI Smart Grid Coordination Group, 2014).

Table 3 - Concepts related to actors and roles (source (Marino et al., 2019), (CEN-CENELEC-ETSI Smart Grid Coordination Group, 2014))

Responsibility	*Responsibilities define external behaviour to be performed by parties (ex: Nominate Energy, Operate a grid, Determine the market energy price after applying technical constraints...).*
Role	*A Role represents the intended external behaviour (i.e. responsibility) of a party. Parties cannot share a role. Parties carry out their activities by assuming roles, e.g. system operator, trader. Roles describe external business interactions with other parties in relation to the goal of a given business transaction (ex: Balance Responsible Party, Grid Operator, Market Operator…).*
Party	*Parties are legal entities, i.e. either natural persons (a person) or judicial persons (organizations). Parties can bundle different roles according to their business model (ex: real organizations, stakeholders…)*
Actor	*An Actor represents a party that participates in a (business) transaction. Within a given business transaction an actor performs tasks in a specific role or a set of roles (ex: Employee, Customer…). The term Actor can be used in other contexts within smart grids methodology, particularly discussions around technology. If it helps, in the context of the discussion, the type of actor can be qualified, such as business actor in the role model of the BUC and system actor when referring to technological systems.*

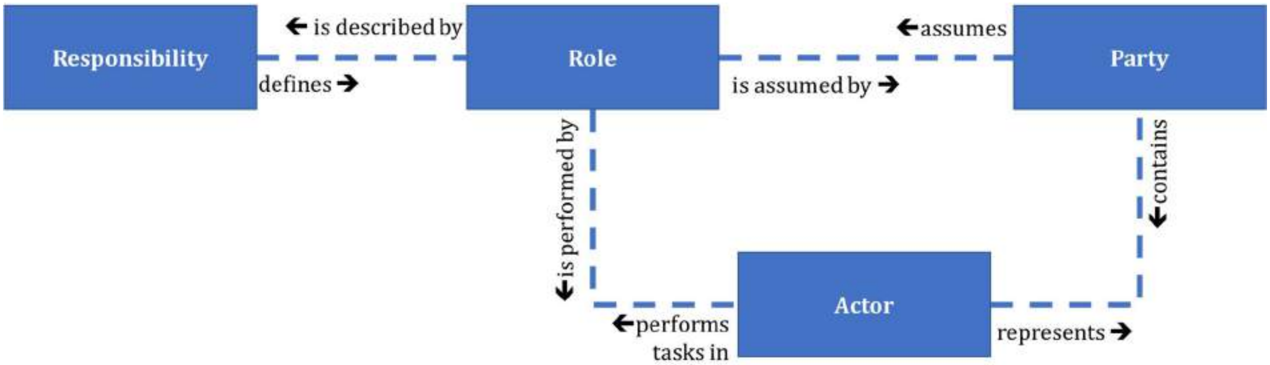


Figure 4 - Concepts related to actors and roles (source (Marino et al., 2019), (CEN-CENELEC-ETSI Smart Grid Coordination Group, 2014))

From the previous explanation it becomes evident that a role is a unique combination of responsibilities that cannot be shared between different actors. One actor, on the other hand, can have several roles. And different actors can be given the same role. This implies that in case we would be defining parties and actors in the BUCs, it would not be clear what their exact responsibilities are. Choosing for roles instead of actors or parties, also contributes to the BUCs being more generic as a role can be filled in by different actors in BUCs all over Europe.

3.5.1. EUniversal Role model

For this report, a specific role model has been set up. A role model provides a common definition of the roles and domains employed in a given market which enables people to use a common language in the development of information interchange.

In order to set up the role model, the team looked in the first place at existing roles and their definitions. This was done either by taking the European electricity directives, and the HEMRM[2] (Harmonised Electricity Role Model) developed by ENTSO-e as a starting basis. However, the HEMRM is highly focussing on transmission networks and therefore does not contain all roles necessary for the EUniversal project (which is focussing rather on distribution networks). As a result, for the EUniversal BUCs, some modifications to some roles and the creation of new roles was necessary.

[2] https://www.entsoe.eu/digital/cim/role-models/

Table 4 gives an overview of the roles developed by and used in the EUniversal project. In what follows, some clarifying information is given with regard to some of the different roles.

For the DSO, the definition from Art. 31 from the EU directive recast internal market for electricity (2019/944) has been adapted to ensure more specific responsibilities for flexibility markets are added. Furthermore, it was decided to include the role of the meter data operator in the description of the DSO-role as in practice this role is today taken up by the DSOs in the demos. A further split up in responsibilities regarding data was also considered not necessary for the purpose of the BUCs.

For the FMO, it should be noted that the team did not stick to the HEMRM role of "market operator" as this role is specifically focusing on wholesale markets. Furthermore, we also did not consider a separate role for validation and settlement as this will not be tested in the demos.

The role of the producer is considered as a separate role in one of the demos as this is a type of party (renewable energy wind farms) that is specifically needed in the Polish demo.

Finally, note that the BUCs focus specifically on flexibility service delivery. As such, only roles that are needed for the flexibility service delivery are considered. This explains why numerous roles mentioned in HEMRM are not mentioned.

Table 4 - EUniversal Role Model

No.	Role name	Role description	Reference
1	Distribution System Operator (DSO)	The DSO shall be responsible for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity, for operating, maintaining and developing under economic conditions a secure, reliable and efficient electricity distribution system in its area with due regard for the environment and energy efficiency. (Art. 31, par. 1) The DSO ensures a transparent and non-discriminatory access to its distribution network for each user. The DSO is responsible for optimizing its distribution grid by (combined) means of switching and the use of flexibility. The DSO assesses impacts, at a relevant distribution grid level, of a flexibility/balancing order or action to guarantee grid security and its correct operation. The DSO acts as a neutral market facilitator and provides to the different market players data needed for flexibility/wholesale market operations. The DSO is responsible to ensure grid optimization, among others through identifying flexibility needs, technical validation of the solutions provided by the market and grid state estimation. The DSO is responsible for collecting, storing, administrating and validating metered data, and distributing them to authorized users in a transparent and nondiscriminatory manner.	Based on Art. 31 DIRECTIVE (EU) 2019/944 (recast internal market for electricity) Specific responsibilities for flexibility markets are added by EUniversal
2	Flexibility Market Operator (FMO)	The FMO is a neutral party that transparently provides a central service between buyers and sellers to facilitate the communication and coordination of all processes related to the procurement of capacity and/or energy bids, i.e. grid or asset registration on its market place, matching of bids, validation (through market monitoring) and settlement.	EUniversal definition
3	Resource Aggregator (RA)	The RA aggregates resources for usage by a service provider for energy market services.	HEMRM
4	Resource Provider (RP)	The RP manages a resource and provides production/consumption schedules for it, if required.	HEMRM
5	Flexibility Services Provider	The FSP offers explicit flexibility services of one resource managed by a Resource Provider or multiple resources aggregated by a Resource Aggregator to system operators,	Adapted from Bridge

	(FSP)	directly via bilateral agreements or through market operators.	
6	Producer (P)	A natural or legal person that generates electricity.	Based on Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU, Article 2 (Definitions).
7	Transmission System Operator (TSO)	The TSO is responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity.	Based on Art. 2 (35) DIRECTIVE (EU) 2019/944 (recast internal market for electricity)

3.6. Market design terminology

Most of the BUCs will test a local flexibility market. In this section we will introduce some terminology which will be used to characterize the market design that will be implemented in the different demonstrators. The market design description per demonstrator will be explained in chapter 4 where the table below will be filled in per demonstrator.

Table 5 - Definition of Market design characteristics

Characteristic	Explanation
Buyer(s) of flexibility	Explains which stakeholder(s) buy(s) the flexibility to answer a certain need.
Service	Explains which flexibility service(s) is (are) being procured on the local flexibility market for the specific BUC. For the service definition we refer to D2.1 of the EUniversal project (Falcão et al., 2021).
Product	The product traded in the BUC can be Active Power and/or Reactive Power products[3].
Activation	The activation can be manual or automatic, depending on whether flexibility is activated manually by an operator by sending an activation signal or automatically in a closed-loop manner. (European Commission, 2017)
Need location	Indication of the location where the need, which is solved by the provided service, is located. This will have a direct impact on the market size.
Network information in market clearing	The answer here can be No or Yes. The answer is yes if information is included in the market clearing about the network (for instance network sensitivity factors). If not, the answer is no.
Locational information in the bids	The answer here can be No or Yes. The answer is yes if information about the location of the need is included in the bid. If not, the answer is yes.
Auction type	Explains whether a Call market (closed-gate auction) or a Continuous market (with/without fixed time windows for trading) is used.
Pricing scheme	The pricing scheme can be Pay-as-clear (accepted bids are settled at the same market clearing price) or pay-as-bid (accepted bids are settled based on their bid price).

[3] It should be noted that within EUniversal active and reactive power are always procured separately, in separate markets.

Trading type	Trading can be done Unit-based or Portfolio-based. We assume that a portfolio has more than one asset.
Reservation of capacity[4]	The answer here can be Yes or No. If Yes, this means that not necessarily all reserved capacity will be activated. If No, this means that was is procured will also be activated.
Remuneration	Remuneration can be done based on availability [€/MW/h] and/or based on activation [€/MWh].
Market opening	Indication of the time from which orders can be submitted. This can be a fixed timing or dynamic according to the general understanding of DA/ID-Markets and can be aligned with the wholesale markets.
Market closing	Indication of the time up to which orders can be submitted. This can be a Gate Closure Time deadline for order submission (up to h-30 min…), or fixed time windows for trading if defined for a certain BUC)[5].
Trading Time Unit	Indication of the time unit used for trading (15 minutes, 1 hour).
Single period versus multi-time period market	Single time period versus multi-time period market. A single time period market is one that runs over one defined time interval, i.e. one trading time unit, while a multi-period market is one that runs over multiple trading time units (e.g. including block orders).
Bid selection	Method to select the bids which will be accepted on the local flexibility market (Merit order List (MoL), techno-economic MoL, DSO optimization and selection…)

[4] In the BUC considered in this deliverable the reservation of capacity is considered weeks ahead or even year(s) ahead.

[5] Make a distinction between market opening and closing times for reserved / non-reserved capacity where appropriate.

4. Demonstrators

In order to demonstrate the services generated in the development phase of the project, 3 different DEMO sites (located in Portugal (PT), Germany (DE) and Poland (PL)) will be run to validate the project solutions. The demo selection is done as such to cover a broad range of distribution grid typologies and to test the solutions in distinct regulatory environments and in alignment with national plans for the energy transition in 2030. All DEMO sites include the overarching goal of connecting DSO infrastructure to the market layer via the universal interface (UMEI).

The following tables gives some general insights into the different demos, their geographical location, the network under study, the grid users and flexibility providers, and the available flexibility technologies and smart grid infrastructure.

Table 6 - Overview demonstrations

	Portugal (PT)	Germany (DE)	Poland (PL)
Grid	LV and MV grid	LV (and MV) grid	LV, MV and HV grid
Grid topology	Radial	MV = meshed/ring LV suburban area = ring/radial LV rural area = radial	HV = meshed/ring MV = mix of radial and meshed LV urban area = meshed LV rural area = radial
Voltage levels	• MV: 10kV, 15kV and 30kV; • LV: 400 V	• MV: 10, 15 or 20 kV; • LV: 400 V	• HV– 110 kV; • MV – 15 and 30 kV; • LV – 400 V
Area	Rural, sub-urban and urban	Rural, sub-urban	Rural, sub-urban
Grid users	Residential and EV stations (possibly also commercial, industrial, agricultural)	Residential, small commercials	Residential, SME, wind, solar and biogas generation
Flexibility technologies	• Electric Vehicles • PV Systems • Storage Systems (to be confirmed) • Heat Pump •	• Electric Vehicles • PV Systems • Batteries • Heat Pump • Heat Storages • CHPs	• Li-Ion batteries • Microgrids • Distribution network flexible assets and control • Dynamic Line Rating (DLR) • Active power control of RES
Main roles involved	• DSO: E-Redes; • Producers and Prosumers: LV or MV customers; • Market platform provider: NODES and N-SIDE; • Flexibility providers: households, industrial consumers and EV fleet;	• DSO: Mitnetz; • Flexibility Market Operator: NODES; • Flexibility Service Provider: Centrica • Resource Provider: Grid users in the area of Mitnetz	• DSO: ENERGA-OPERATOR SA; • IT company, SCADA /DMS system provider: Mikronika; • Research institute: Institute of Power Engineering; • Producer: Wind farms • Individual market participants: customers,

	• Technological partner: INESC; • Aggregator: Centrica	• Technological partner: INESC, KUL, VITO, N-SIDE	prosumers, DER generation
Available Smart Grid Infrastructure and solutions	• Smart meters at LV and MV consumers • HEMS in LV consumers	• Sensors for three-phase power measurements • Gateway installation at participating customers • Both will be installed during the project	• Smart meters on customer side • MV/LV substations equipped with balancing meters

The following table summarizes the solutions to be tested in each group of demonstrators and the complementary between the different pilots. In total, for these 3 demonstrators, 10 BUCs have been identified.

Table 7 - Overview of the business use cases per demonstrator

Demo	BUC ID	BUC name	Service	Mechanism	Market Platform
Germany	DE AP	Congestion Management & Voltage Control with market-based active power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES
Germany	DE RP	Congestion Management & Voltage Control with market-based reactive power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES
Poland	PL AP	Congestion Management & Voltage Control with market-based active power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES
Poland	PL RP	Congestion Management & Voltage Control with market-based reactive power flexibility	- Congestion management - Voltage control	- Local flexibility market	NODES
Poland	PL DLR	Congestion management using permissible line capacity based on Dynamic Line Rating (DLR) system.	- Congestion management	- Local Flexibility market (one FSP, RES competition)	NODES
Poland	PL FS	Voltage Control with the use of flexstation solutions	- Voltage control	- Bilateral contracts	NA
Portugal	PT1	Congestion management in MV grids for the day-ahead market (or between 1 to 3 days in advance)	- Congestion management	- Local Flexibility market	NODES / N-SIDE
Portugal	PT2	Integrated Voltage Control in MV and LV grids for the day-ahead market (AP+RP)	- Voltage control	- Local Flexibility market	NODES / N-SIDE

Portugal	PT3	Contracting flexibility services for avoiding voltage and/or congestion issues during planned maintenance action in MV grids	- Congestion management - Voltage control	- Local Flexibility market	NODES / N-SIDE
Portugal	PT4	Voltage Control and Congestion Management for medium and long-term grid planning through market mechanisms	- Predictive congestion management - Predictive voltage control	- Local Flexibility market	NODES / N-SIDE

4.1. German Demo

4.1.1. General description

The German demonstration will take place in a LV-Grid of the German DSO MITNETZ. The supply area of MITNETZ is in the East of Germany in South Brandenburg, South Saxony-Anhalt and in West and South of Saxony. The region is home of 2.3M inhabitants in an area of 30.804 km^2. The length of the grid is about 6,000 km in HV, about 24,000 km in MV, about 44,000 km in LV Level. MITNETZ operates and maintains about 17,000 substations with an installed capacity of more than 5,000 MVA. Therefore, the grid provides a broad variety of scenarios and different population densities (ranging from villages to cities). An adequate grid section with a relevant infeed of RES and customers with flexible resources (e.g. battery storages, heat pumps) will be chosen in WP8 of EUniversal.

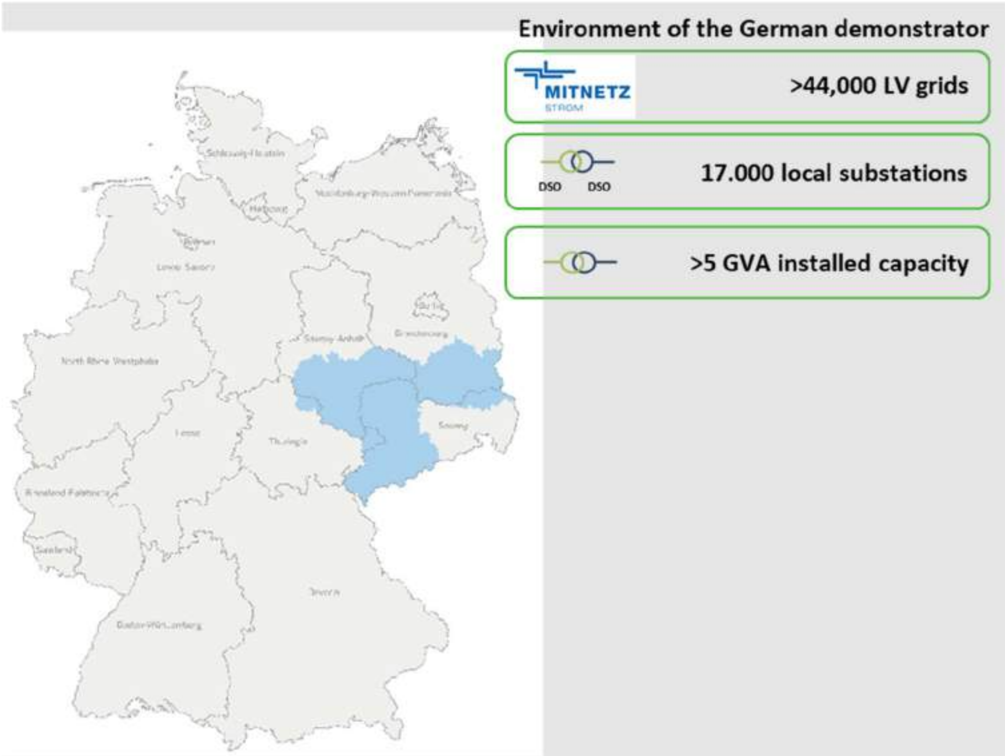


Figure 5 - Local classification of the German demonstrator

Specifically, for this demo, the network under study is the low voltage level. Apart from the focus of testing the operational capability of flexible resources for congestion management in LV grids, an evaluation of the available / transferable flexibility from low voltage for medium voltage is being examined. The final decision which grids are considered depends on the recruitment of flexibility providers. Starting from the local network station, the grid topology will usually consist of radial grids, divided into several feeders that supply streets or groups of houses in the immediate vicinity. By changing the switching position, however, the simulation of ring or even meshed topologies would be possible. Furthermore, the aggregated potential for the upstream medium voltage ring shall be analyzed. The low voltage network is constructed with 400 V (phase-phase) systems. The voltages of the medium-voltage level have different designs, e.g. 10, 15 or 20 kV.

The main part of grid users in the demo will consist of households, though SMEs will also be included. Industrial users will be the exception, if represented at all. Typical flexible resources are

PV, battery systems, heat pumps and heat storages and some EV existing at household level. Any connected grid user who has a flexible resource and wants to participate in the project will be allowed. Resource owners will be contacted to participate within the Demo. However, the opportunity of communication technology connections to the user is another point that needs to be considered and for which solutions must be found in the project. If the connection to the aggregator is not possible, this would be an exclusion criterion.

The German demo faces specific grid conditions which require solutions. In particular, the following situations are conceivable:

a) RES feed-in during the day can lead to an increase of voltage in the LV grid above the permissible value;
b) Additional load due to loading of storage units e.g. electric vehicles, batteries, which can lead to a voltage drop below the minimum permissible limit;
c) Combination of a) + b) - particularly interesting in case of mismatch between the generation of local RES and the consumption of flexible assets;
d) A high load on only one phase can lead to imbalances in the network;
e) Feedback effects from the higher voltage levels.

The German demo does not have an extensive smart grid infrastructure. Basically, local network stations and measuring points in the network are equipped with sensors for three-phase power measurements, and there are gateway installations planned at participating customers.

Finally, aggregation is foreseen in the demo. Specially, there are two different aggregation aspects:

1. There is aggregation of flexible resources in the LV grid. This implies that several flexibility resources participate in it. How this is done exactly is determined by the FSP and depends also on the participating customer base.
2. Secondly, there is a technical aggregation of potential flexibility in LV grids to the MV level (pred. load flow, pred. flex. potential). Thus, as long as no other limits are violated, congestions in the medium-voltage grid can be resolved by resources connected in the low-voltage.

4.1.2. Demo problem situation

The German DSO is facing some specific challenges and problems in the grid area under study. At present, the low-voltage grid is not monitored at all or only to a limited extent. With the increasing number of renewable generation and the addition of new flexible loads, congestions and voltage problems in the grid are becoming more frequent and observability needs to be increased. The German demo builds further on experiences acquired partially in the EU-Sysflex[6] project (https://eu-sysflex.com/) where congestion algorithms for meshed grids are developed, considering only generation as flexible potential.

Therefore, the main objectives of the demonstrator are to increase observability and to develop technical solutions for the congestion management and voltage control in the LV-Grid with the help of flexibility markets. The solutions developed must comply with the legal framework such as Redispatch 2.0.

With regard to the scoping of the demo, the implementation is framed by a schedule-based congestion management. The calculations start day ahead and are carried out iteratively until

[6] The H2020 project EU-SysFlex aims at a large-scale deployment of solutions, including technical options, system control and a novel market design to integrate a large share of renewable electricity, maintaining the security and reliability of the European power system. One aspect of the project is to demonstrate how resources connected to the distribution system can help address system needs by providing ancillary services to the transmission level and at the same time meet the requirements of both TSO and DSO while, also, improving the coordination between these two actors.

shortly before real time. In practice, however, the current legal framework does not allow for loads to participate in congestion management. These would need to be supplemented for effective implementation. For the procurement of flexibility for grid services, a continuous flexibility market is implemented to demonstrate the use of active and reactive power flexibility in distribution grids. Other options such as switching operations are not considered for the EUniversal project despite of being valid alternatives to be evaluated in real operation. Overall, the most cost-effective option would then be selected.

4.1.3. Demo Market design

A general description of the market platforms is provided in section 3.6. In the German demo, the NODES market platform will be tested facilitating the communication and procurement of flexibility between the FSPs and the DSO. A special characteristic is the connection to the Redispatch 2.0 process, which requires information on planned flexibility calls at certain points in time.

Table 8 - Market design description German BUCs

Characteristic	DE AP	DE RP
Buyer(s) of flexibility	DSO only	DSO only
Service	Congestion management, voltage control	Congestion management, voltage control
Product	AP	RP
Activation	Manual	Manual
Need location	DSO determines the geographic scope according to its needs by defining grid areas defined by a grid node or a set of grid nodes	DSO determines the geographic scope according to its needs by defining grid areas defined by a grid node or a set of grid nodes
Network information in market clearing	No, market area corresponds to a grid area	No, market area corresponds to a grid area
Locational information in the bids	Yes (grid node)[7]	Yes (grid node)[7]
Auction type	Continuous market	Continuous market
Pricing scheme	Pay-as-bid	Pay-as-bid
Trading type	Unit-based trading and portfolio based	Unit-based trading and portfolio based
Reservation of capacity	No	No
Remuneration	Activation fee	Activation fee

[7] In the case of portfolio bids, the common grid node to which the assets which are part of the portfolio are connected would be communicated in the bid.

Market opening	Day ahead	Day ahead
Market closing	Several hours before real time (exact times are still open). An adjustment based on field test results is conceivable.	Several hours before real time (exact times are still open). An adjustment based on field test results is conceivable.
Single period versus multi-time period market	Can be single period or multi-time period	Can be single period or multi-time period
Bid selection	Technical and economic optimization of existing orders	Technical and economic optimization of existing orders
Trading Time Unit	15 minutes	15 minutes

As can be seen in Table 8, the German demonstrator has two business use cases. The market design for both business use cases is similar, apart from the products being traded (either active or reactive power). The other characteristics of the market are similar for both BUCs. That is, the flexibility market in the German demonstrator is implemented as a market with continuous trading with the DSO as the single buyer. Power adjustments (flexibility) on both the load and generator side are taken into account. For EUniversal, the local flexibility market is the only studied procurement mechanism for congestion management and voltage control. Bids are selected by the DSO based on technical and economic optimization of the existing orders.

Other options such as switching operations are not considered for the German Demo, although these are alternatives to be evaluated in real operation. Overall, the most cost-effective option between technical, regulatory, and market-based measures is the goal and would be selected. However, questions about the feasibility of this comparison in different scenarios are outside the scope of this research project. The procured flexibility is activated manually, and the geographical scope is determined according to the needs in the demonstrator, i.e. the targeted market area is linked to a location which is defined by a grid node[8] or a set of grid nodes whereby the flexibility within that area can solve the identified need. The market clearing is done at the market area level.

The market starts with the end of the wholesale market day ahead and runs until intraday just before real time. Market closure is thus initially set a few hours ahead of real time so as not to jeopardize the delivery process. Market closure can still be adapted depending on the project results. Products are traded in portfolios of variable size for 15 minutes segments (Trading Time Unit) and are described with the parameter's capacity quantity, regulation direction, price and assigned grid node. Bids can be submitted for one or multiple trading time units. Bids can be submitted by either the buyer or seller and will be delivered provided the bid is matched by the other side of the market. The flexibility provider is remunerated based on the flexibility activated according to a pay-as-bid pricing scheme. There is no reservation of capacity, so what was procured will also be activated.

[8] A grid node (in this context) is a selection of meter points determining which flexible assets have an impact on a given grid constraint. Grid nodes are defined in a hierarchy by the DSO.

4.2. Portuguese Demo

4.2.1. General description

The Portuguese demonstration will take place in MV and LV grids of the Portuguese DSO E-Redes. In this demonstration, the selected grids will be in different regions of the country, ensuring a wide set of scenarios and contexts. The sites where the tests will be performed still need to be confirmed as they can be changed in accordance with participant acceptance. However, the following sites are currently foreseen to be part of the demonstration:

- Valverde (a small village located in a suburban area of Évora district);
- West zone of Portugal (urban areas: Mafra and Caldas da Rainha);
- Alcochete (near Lisbon)
- E-REDES EV charging infrastructures in urban areas.

Typically, the distribution grids have a radial grid topology, although they can normally have open points to be used in case of contingency for fast service restoration. In any case, the MV and LV grids in the Portuguese demonstration will be considered under a radial structure in normal operating conditions. The voltage levels considered in the Portuguese distribution grid are 400V for the LV grid, and 10kV, 15kV and 30kV for the MV grid.

The grid users connected to the Portuguese demo will be mixture of different users. In the first place, the demo will be done in sites including residential consumers equipped with several technologies (solar PV, heat pumps and EVs). In addition, commercial consumers (SME) at the LV level and MV industrial consumers can also be considered. The service sector will also be represented through E-REDES EV fleet charging stations in those places.

The Portuguese demo builds further on experiences acquired over the last years through several EU projects such as InteGrid (https://integrid-h2020.eu/), Sensible (https://www.projectsensible.eu/), UpGrid (http://upgrid.eu/) and EU-SysFlex (https://eu-sysflex.com/).

The Portuguese demo faces specific grid conditions which require solutions. In particular:

a) The feed-in of RES during the day can lead to an increase of voltage in the LV grid above the permissible value;
b) Additional loads due to loading of storage units (e.g. electric vehicles) lead to a voltage drop below the minimum permissible limit;
c) The combination of a) + b) is particularly challenging at local network stations with outgoing circuits that behave in different directions;
d) A high load on only one phase can lead to imbalances in the network;
e) Feedback effects from the higher voltage levels. The increased use of nonlinear loads (electrical vehicles charging stations) implies higher perturbations, like harmonics, in the electrical power grid, which have negative effects on the connected consuming devices.
f) Contingency cases can lead to overload of transformers and conductors in the MV grid;
g) Contingency cases can also lead to increase voltage in the MV grid above the permissive value due to RES feed-in.

Within the Portuguese demo, flexibility will be provided by multiple grid users and different flexibility technologies will be tested. With regard to grid users, any grid user can be a potential provider of flexibility as long as they have resources (both production and consumption resources) to help the DSO solve grid constraints. During the project, it should be discussed how those resources can participate: as single units or aggregated. The flexibility technologies vary from electric vehicles and PV systems, to storage systems (although to be confirmed), heat pumps and water heaters.

There are still some points to be clarified in the demo. For instance, regarding aggregation, the demo will aim to test aggregated flexibility from the LV grid provided by residential consumers to support MV grid operation. Furthermore, not all participating resource providers are registered yet and still need to be contacted to participate.

4.2.2. Demo problem situation

The Portuguese DSO is facing some specific challenges and problems in the grid area under study, as listed in 4.2.1. In the demo, they intend to analyze how the penetration of large amounts of distributed energy resources (EV, microgeneration, distributed storage) can support the grid operation in terms of congestion management and voltage control in MV and LV grids. Moreover, they intend to analyze those problems when they arise due to a contingency. The aim is to solve grid constraints by establishing an exchange between the DSO and aggregators via a flexibility market and thus to make decentralised flexibility solutions accessible for grid services. In particular at the LV level, the imbalances on a three-phase system as a result of high load on only one phase need to be studied.

Specifically, for the Portuguese Demo, congestion management and voltage control in MV and LV grids are the main issues to be addressed. The objective is first to anticipate the problems and then to use local flexibility markets to solve them.

With regard to the scoping of the demo, the day-ahead market (or several days in advance for maintenance actions in the distribution grid) will be considered to solve grid problems identified through forecasting tools. Furthermore, the medium- and long-term flexibility market can be adopted for grid planning purposes. The regulatory framework does not consider the participation of customers in the flexibility markets, limiting the flexibility potential.

4.2.3. Demo Market design

A general description of the market platforms is provided in section 3.6. In the Portuguese demo, in line with the EUniversal objectives, the focus is on the implementation of local flexibility markets. Only in specific cases connection agreements are considered, for instance between the DSO and a generation entity. In the Portuguese demo, both the NODES and N-SIDE market platform will be tested in parallel. The NODES platform includes ShortFlex and LongFlex markets (specific Nodes terminology) with continuous trading of flexibility across distinct timeframes. The most cost-efficient solution is selected and validated by the DSO to solve the predicted grid congestion. N-SIDE's Local Flexibility Market platform aims to help solve grid problems by offering an auction-based mechanism that facilitates the matching of the DSO's expressed needs with the FSPs/aggregators' offers through an algorithm aiming to maximize the social welfare. It is the intention to test each BUC with each market platform.

Table 9 - Market design description Portuguese Demonstrator

Characteristic	PT1	PT2	PT3	PT4
Buyer(s) of flexibility	DSO only	DSO only	DSO only	DSO only
Service	Congestion management	Voltage control	Congestion management, and voltage control	Congestion management and voltage control
Product	AP	AP and/or RP[9]	AP and/or RP[9]	AP
Activation	Manual[10]	Manual[10]	Manual[10]	Manual[10]
Need location	DSO identifies downstream network of the location of need (MV feeder, secondary substation, LV grid) according to network configuration	DSO identifies downstream network of the location of need (MV feeder, secondary substation, LV grid) according to network configuration	DSO identifies downstream network of the location of need (MV feeder, secondary substation, LV grid) according to network configuration	DSO identifies downstream network of the location of need (MV feeder, secondary substation, LV grid) according to network configuration
Network information in market clearing	NODES - No N-SIDE - partially shared by DSO	NODES - No N-SIDE - partially shared by DSO	NODES - No N-SIDE - partially shared by DSO	NODES - No N-SIDE - partially shared by DSO
Locational information in the bids	Yes (grid node)[11]	Yes (grid node)[111]	Yes (grid node)[111]	Yes (grid node) [111]
Auction type	NODES - Continuous market (with fixed time windows for trading) N-SIDE - Call market (closed-gate auction)	NODES - Continuous market (with fixed time windows for trading) N-SIDE - Call market (closed-gate auction)	NODES - Continuous market (with fixed time windows for trading) N-SIDE - Call market (closed-gate auction)	NODES - Continuous market (with fixed time windows for trading) N-SIDE - Call market (closed-gate auction)

[9] AP and RP are always procured separately

[10] The FMO sends an activation signal to the FSP/aggregator who then still can activate the assets manually or automatically

[11] In the case of portfolio bids, the common grid node to which the assets which are part of the portfolio are connected would be communicated in the bid.

Pricing scheme	NODES - Pay-as-bid N-SIDE - Pay-as-bid or Pay-as-clear[12]	NODES - Pay-as-bid N-SIDE - Pay-as-bid or Pay-as-clear	NODES - Pay-as-bid N-SIDE - Pay-as-bid or Pay-as-clear	NODES - Pay-as-bid N-SIDE - Pay-as-bid or Pay-as-clear
Trading type	Unit-based trading and portfolio based	Unit-based trading and portfolio based	Unit-based trading and portfolio based	Unit-based trading and portfolio based
Reservation of capacity	No	No	Yes	Yes
Remuneration	Activation fee [€/MW]	Activation fee [€/MW] and/ or Activation fee [€/MVar]	Availability [€/MW/h] and [€/MVar/h] and/or activation fee [€/MW] and [€/MVar]	Availability [€/MW/h] and activation fee [€/MW]
Market opening	72 hours before activation	72 hours before activation	Long term: 3 weeks before activation Short term: 72 hours before activation	Long term: Y-3 before activation Short term: D-3 before activation
Market closing	24 hours before activation	24 hours before activation	Long term: 2 weeks before activation Short term: 24 hours before activation	Long term: Y-2 before activation Short term: D-1 before activation
Single period versus multi-time period market	Can be single period or multi-time period	Can be single period or multi-time period	Can be single period or multi-time period	Can be single period or multi-time period
Bid selection	NODES - DSO optimization and selection N-SIDE -FMO's welfare maximization algorithm	NODES - DSO optimization and selection N-SIDE -FMO's welfare maximization algorithm	NODES - DSO optimization and selection N-SIDE -FMO's welfare maximization algorithm	DSO optimization and selection – NODES FMO's welfare maximization algorithm – N-SIDE
Trading Time Unit	30 minutes	30 minutes	30 minutes	1 hour

[12] To be confirmed which scheme will be used.

As can be seen in Table 9, the Portuguese demonstrator has four business use cases. These will be tested for each market platform, leading in total to four BUCs which are described for two platforms. In the table, per BUC, differences between the different platforms are indicated where necessary.

For the first two BUCS (PT1 and PT2), the market design is rather similar apart from the fact that PT1 is focussing on congestion management (and therefore only trades Active Power), while PT2 is focusing on voltage control (and therefore trades both Active and Reactive Power). The other characteristics of the market are similar over these BUCs. BUC PT3 and PT4 also have some similarities with the first two BUCs, but they differ in a couple of market aspects. Both of them focus on congestion management and voltage control. PT3 hereby procures both Active and Reactive power, while PT4 only procures AP. Note that for active and reactive power, two different markets are considered for each product separately, but they are considered together in the grid analysis. The orders are thus divided in two distinct markets to allow the independent trading of active and reactive power.

For all the four BUCs, the flexibility market in the Portuguese demonstrator is implemented as a market with continuous trading when the NODES platform is used, and a closed-gate auction when the N-SIDE platform is used. The DSO is always the single buyer. The procured flexibility is activated manually by the FMO who sends an activation signal to the FSP/aggregator who then has the option to activate the assets manually or automatically. The geographical scope is determined by the DSO who identifies the downstream network of the location of its needs. This is done according to the network configuration (MV feeder, secondary substation, LV grid…). In the bids, at grid node level, locational information is included. To preserve the DSO role and responsibilities, it has been decided not to give access to the full representation of the network for the market clearing operated by the FMO. However, a part of the network constraints will be shared to the N-SIDE market platform after a pre-analysis done by the DSO in order to reveal the most important limits of the network.

For BUC PT1 and PT2, the market starts 72 hours before and closes 24 hours before activation. Power flexibility products are traded in portfolios or in single units for 30 minutes segments (Trading Time Unit). Bids can be traded during one or multiple trading time units. Orders can be made by either the buyer or seller and will be delivered provided the order is matched. Trading proceeds as pay-as-bid or as pay-as-clear. The flexibility provider is remunerated based on the flexibility activated[13] (€/MWh and/ or €/MVarh). Capacity is not reserved.

For BUC PT3, there is both a long run and a short run market. The timeline for these markets is indicated in Figure 6 and Figure 7. A long-term mechanism is considered in order to extend the market timeframe to accommodate the needs of the DSO for grid constrain mitigation during planned maintenance. The long-term market starts 3 weeks before and closes 2 weeks before activation. However, throughout the project, the exact timing here might still be adapted. The short-term market opens 72 hours before and closes 24 hours before activation. The later is in line with BUC PT1 and PT2. Bids can be submitted for one or multiple trading time units. Power flexibility products are traded in portfolios or in single units for 30 minutes segments (Trading Time Unit), however, this can still be adapted throughout the project depending on new insights. Capacity is reserved in BUC PT3 and PT4. As capacity is reserved in BUC PT3 and PT4, there is also an availability fee in these BUCs (in €/MWh and/or in €/MVar).

For BUC PT4, as for BUC PT3, there is both a long run and a short run market. A long-term is considered during planning phase, in order to accommodate the DSO needs to mitigate grid predicted constraints and defer investment. The long-term market starts 3 years before activation, when capacity is reserved, and reservation fees are applied, but for demo purposes a shorter timeframe will be considered. The short-term market opens 72 hours before and closes

[13] It should be noted that the product traded is power, while the remuneration considers energy.

24 hours before activation, in line with BUC PT1 and PT2 for active power. The timeline for these markets is indicated in Figure 8and - Timeline Long Term and Short term flexibility market with the N-SIDE platform (BUC PT4).

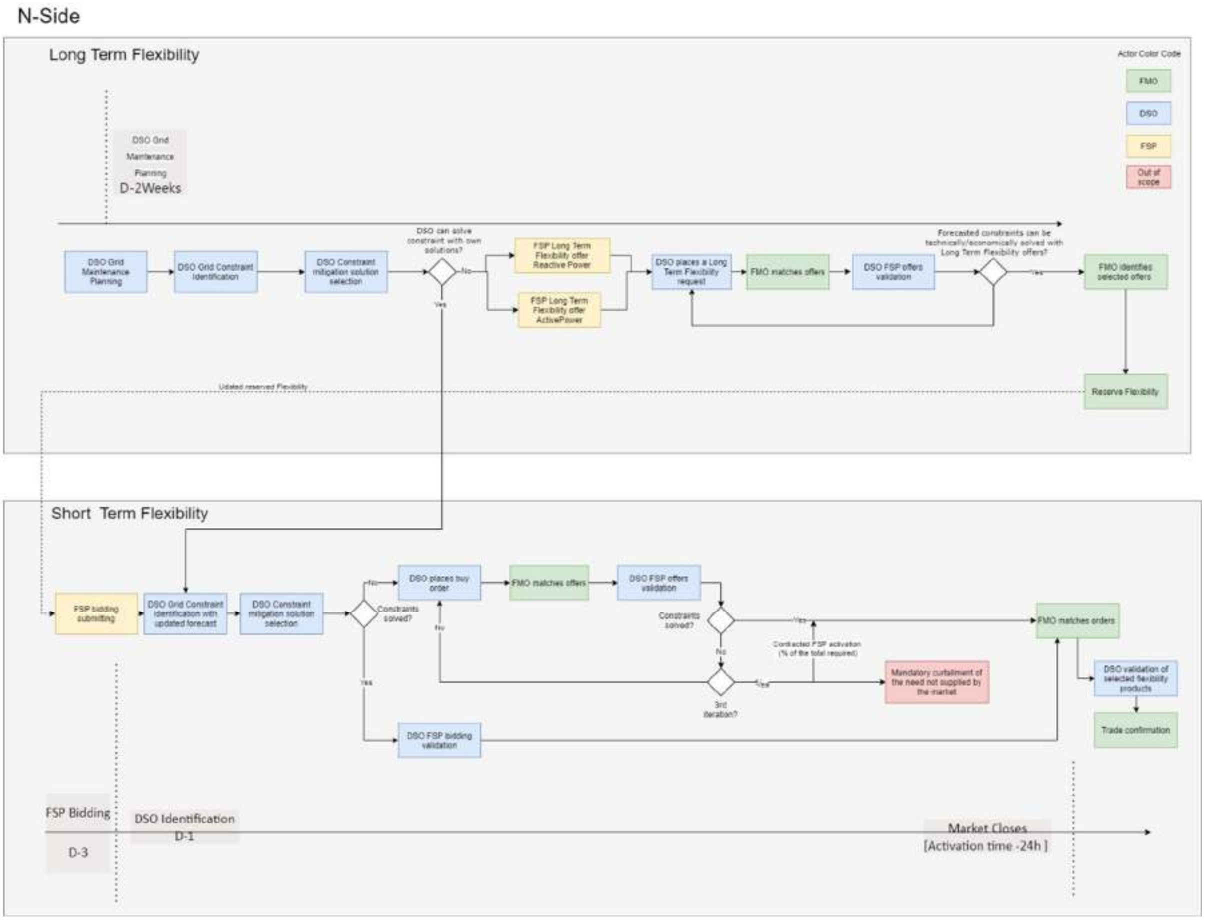


Figure 6 - Timeline Long Term and Short-term flexibility market with the N-SIDE platform

The Long-Term Flexibility Market Platform starts 3 weeks before and closes 2 weeks before activation and allows FSPs to place long term flexibility offers for both Active and Reactive Power after the DSO identifies grid constraints when planning grid maintenance. The FMO then matches the offers that, after being validated by the DSO, are reserved for later activation. In the short-term market there will be reserved offers derived from the long-term market and also potential new ones, submitted in the short-term market. The Short-Term Flexibility Market Platform opens 72 hours before and closes 24 hours before activation and matches the DSO's expressed needs with the FSPs/aggregators' offers in an iterative process that, after validation by the DSO, results in traded flexibility to solve the grid constraints.

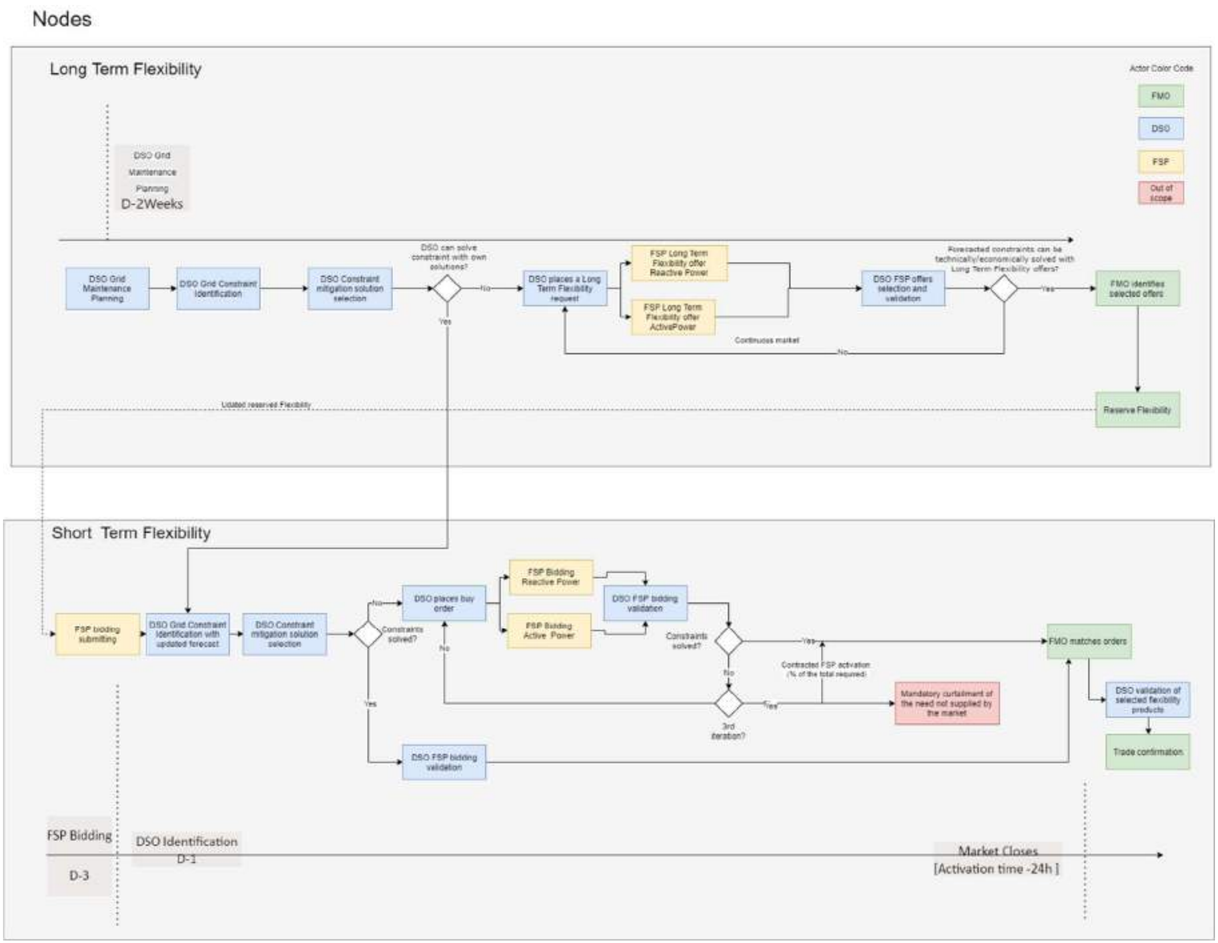


Figure 7 - Timeline Long Term and Short-term flexibility market with the NODES platform

Nodes' LongFlex platform starts 3 weeks before and closes 2 weeks before activation and allows a continuous market in which, the DSO defines an activation price cap and submits requests for the FSP to answer. After validation, the optimal flexibility solution is selected by the DSO and reserved for activation in the ShortFlex market. In the short-term market there will be reserved offers derived from the long-term market and also potential new ones, submitted in the short-term market. The ShortFlex platform opens 72 hours before and closes 24 hours before activation and allows the bidding and the continuous matching of sell and buy orders that are then selected and validated by the DSO to solve the predicted congestions.

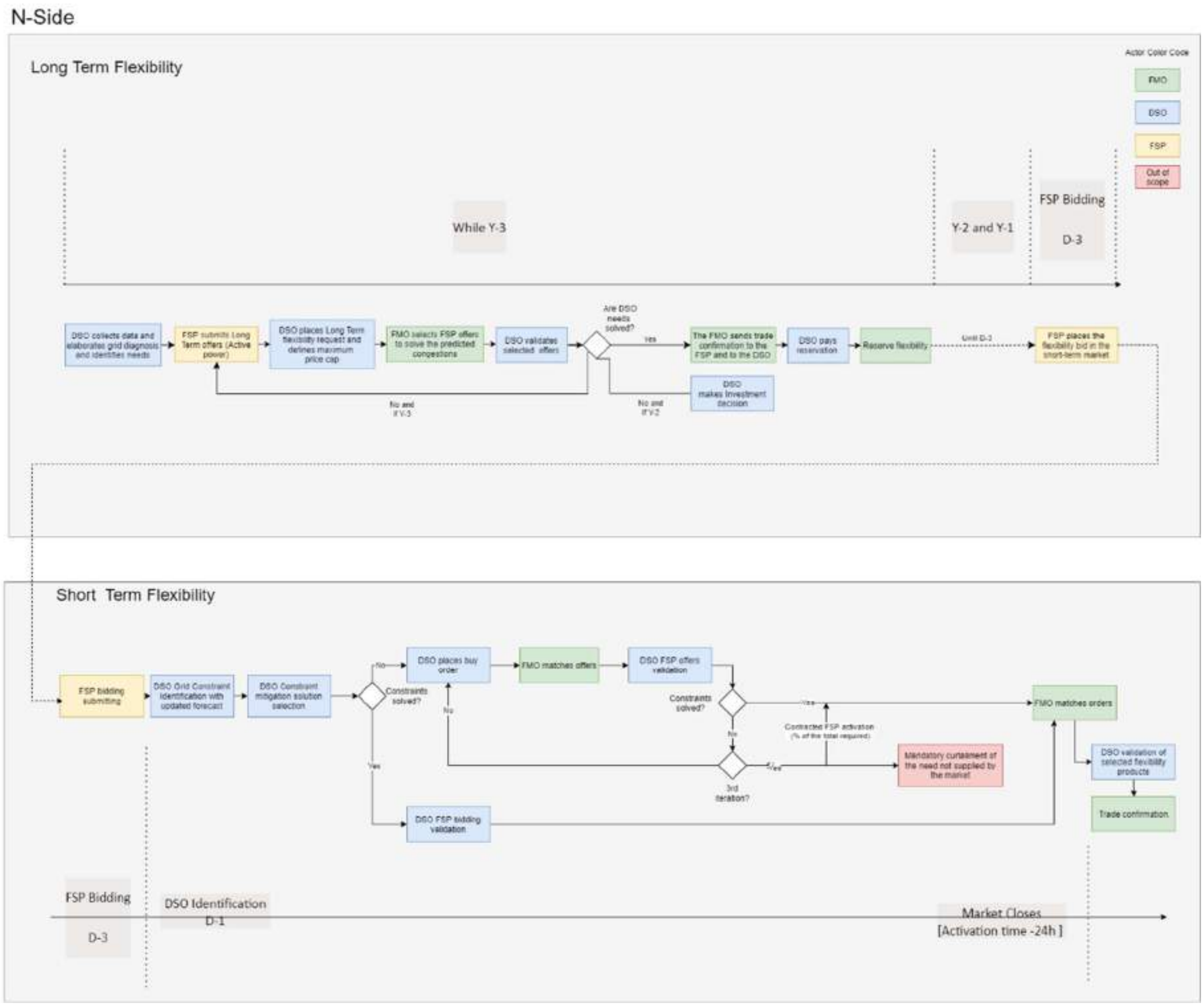


Figure 8 - Timeline Long Term and Short term flexibility market with the N-SIDE platform (BUC PT4)

N-SIDE's Long-Term Platform starts 3 years before activation. The FSP submit Long Term offers for active power and the DSO places Long Term flexibility request and defines maximum price cap. The FMO then matches the offers that, after being validated by the DSO, are reserved for Short Term activation. In the short-term market there will be reserved offers derived from the long-term market and also potential new ones, submitted in the short-term market. The Short Term Flexibility Market Platform opens 72 hours before and closes 24 hours before activation and matches the DSO's expressed needs with the FSP offers in an iterative process that, after validation by the DSO, results in traded flexibility to solve the grid constraints.

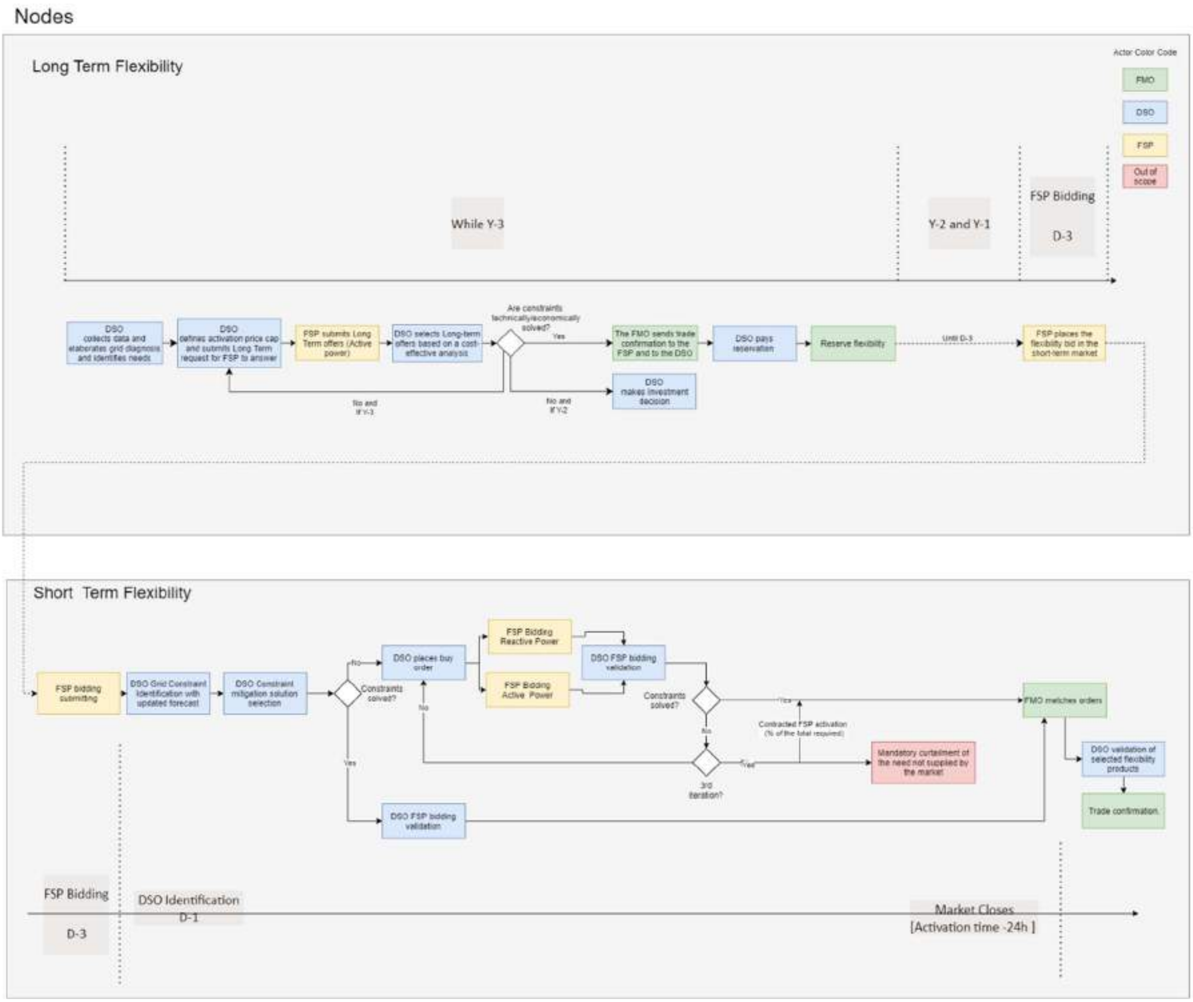


Figure 9 - Timeline Long Term and Short Term flexibility market with the Nodes platform (BUC PT4)

Nodes' LongFlex platform starts 3 years before activation and allows a continuous market in which the DSO defines an activation price cap and submits requests for the FSP to anwser. After validation, the optimal flexibility solution is selected by the DSO and reserved for activation in the ShortFlex market. The ShortFlex platform opens 72 hours before and closes 24 hours before activation and allows the bidding and the continuous matching of sell and buy orders that are then selected and validated by the DSO to solve the predicted congestions.

4.3. Polish Demo

4.3.1. General description

The Polish demo will be developed in the North and Central parts of Poland. The MV part of the demo will be located in the North, near the city of Wladyslawowo (flexible services for MV network). The LV part in the demo will include 3 MV / LV stations located in the Region of Plock, Kalisz, and Gdansk (new flexible substation). Additionally, the polish demo will cover the entire ENERGA-OPERATOR's HV network in term of using the DLR functionality (which operates in ENERGA-OPERATOR on the entire HV network) to increase network flexibility. This is a specific case that is present only in the Polish demo and is described later in the document, in particular in BUC3.

The network under study will be the HV, MV and LV grid. With regard to the HV grid, the whole ENERGA-OPERATOR's HV network will be considered. With regard to the MV grid, the area supplied from one primary substation GPZ Władysławowo is taken into account. In the MV network, there are 81 substations, 7000 customers, and there is a peak demand of 6 MW in winter. Finally, with regard to the LV grid, 3 MV/LV substations are considered, along with the LV network supplied from these stations. In the LV grid, 400 kW PV is already installed.

The HV network (110 kV) is a meshed network, mostly a closed loop. The MV network (15 and 30 kV) is a mixed network with both radial and meshed elements. The primary DSOs strategy is to develop the MV network as a meshed network, yet this is not always achievable. As such, some parts of the network end up being radial. Nevertheless, the meshed MV network works as a radial network through the usage of tie points.

In urban areas, the LV network (400 V) is in most cases built as a meshed network. Yet, it works as if it was radial (with the possibility to supply customers from another secondary substation due to tie points). In the case of rural areas, the LV network is built as a radial network.

Different types of grid users (residential, SMEs, and wind-, solar- and biogas generators) are connected to the grid.

The Polish demo faces specific grid conditions which require solutions. The autumn and winter season are periods of intensified wind and increased generation from large numbers of wind farms located in the north of Poland. Once a year, most often during winter, specifically in December and January, large storms often occur causing massive network failures due to wind and weather phenomena. During Christmas and Easter, there is a reduced demand for energy, which, combined with the increased generation from wind farms, makes it necessary to introduce generation limitations.

Within the Polish demo, flexibility will be provided by multiple grid users and different flexibility technologies will be tested in the demo. Potential grid users that can provide flexibility are:

- Energy storage owners - Currently, one energy storage, owned by the demo leader, is connected to the distribution network of ENERGA-Operator. As part of the DEMO, they will control it by simulating its use by an independent entity;
- A biogas power plant in Swarzewo of 2* 400 kW;
- The DSO's 110 kV lines as a source of flexibility based on their DLR.

However, most of the tests and studies on the possibilities of increasing the flexibility of the distribution network will involve the use of available resources owned by ENERGA-OPERATOR SA and technological solutions developed within the project. For the test use cases, where FSPs will be required, ENERGA-OPERATOR SA will contact them for this project.

The flexibility technologies that can be deployed and tested in the demo are:

- Li – Ion Batteries;

- Microgrids (which are dedicated LV networks autonomously managed by a flexible substation);
- Distribution network flexible assets and control (Medium and low voltage control, using new flexible MV/LV secondary substation, equipped with new technical solutions, i.e. on-load tap changer, voltage regulator, advanced control algorithm);
- Dynamic line rating (DLR);
- Active power control of RES in case of LV, which they will try to use as additional devices to control the power output of PV plants. For the MV network they will cooperate with the owners of the RES (most of the time it will be the wind farms) to perform the tests during the project.

Currently, no aggregation is foreseen in the demo.

Presently within the demo area, numerous smart grid solutions are already present. For years, ENERGA-OPERATOR SA developed systems for monitoring and controlling the distribution network. At the moment, almost 1 million smart meters are installed on the customers' side (which is about 1/3 of the total number of customers). Furthermore, 90% of the MV/LV substations are equipped with balancing meters. The HV and MV networks are managed by SCADA systems that operate remote-controlled switches and use data from fault current indicators. In one project´s pilot area of the MV network, there is energy storage using the lithium-ion technology (750 kVA of power and 1,5 MWh capacity). Within the EUniversal project, the Polish demo has planned to further build 3 new MV / LV stations in a digital standard, equipped with full LV network monitoring, and using data from customer smart meters accessed through AMI data concentrator. Each MV / LV station is equipped with a transformer with OLTC (online tap changer) used for mitigation voltage violation caused by PV installations.

4.3.2. Demo problem situation

The Polish DSO is facing some specific challenges and problems in the grid area under study. Specifically, its grids are overloaded due to over-generation from renewable sources at all voltage levels. There are problems with maintaining the voltage level within the required limits due to large generation from renewable sources (mainly PV connected to the LV grid) and high electricity consumption by consumers in areas with poorly developed networks (LV). Furthermore, the limited capacity of the HV and MV networks results in limited conditions for connecting additional generation sources (mainly wind farms). Poorly developed TSO network in the North of the country limits the possibilities of performing scheduled maintenance operations related to power off some of the HV lines and network elements.

Therefore, the key objective of the Polish demo is to maintain the voltage level of the grid within the required limits, even if there is a large generation from renewable sources, especially PV installations connected at the low voltage level. In addition, the demo aims to increase the flexibility of the distribution network (mainly HV and MV grids) to ensure the possibility of connecting a greater number of renewable sources in the area despite growing problems due to limited network capacity.

With regard to the scoping of the demo, for voltage control, the demo will focus on real time operation, and with regard to capacity issues, it will focus on both short term and operational planning. Furthermore, at the moment, the Polish energy law is being updated significantly, and it is not clear what this will imply for the (future) demo. With regard to the market mechanisms used during the demo, the Polish demo will make use of a flexibility market.

Finally, the Polish demo builds further on experiences acquired over the last years through other demo projects (e.g. the H2020 Upgrid project and Local Balancing Area project (Lokalny Obszar

Bilansowania), developed as part of the research program of the National Center for Research and Development (NCBR)).

4.3.3. Demo Market design

A general description of the market platforms is provided in section 3.6. In the Polish demo, the NODES market platform will be tested as the main market platform linking the FSPs and DSO.

In total, the Polish demonstrator has four business use cases. However, only three of them apply a flexibility market. The market design for the first two business use cases is similar, apart from the products being traded (either Active or Reactive power). The other characteristics of the market are similar for both BUCs. That is, as can be seen in Table 10, the flexibility market in the Polish demonstrator is implemented as a market with continuous trading and the DSO as a single buyer. Power adjustments (flexibility) on both the load and generator sides are taken into account. Other options such as switching operations are not considered, although these represent alternatives to be evaluated in real operation.

Table 10 - Market design description Polish Demonstrator

Characteristic	PL AP	PL RP	PL DLR
Buyer(s) of flexibility	DSO only	DSO only	Producers
Service	Congestion management, voltage control	Congestion management, voltage control	Congestion management via flexibility of the line capacity
Product	AP	RP	RES generation above connection agreement limit
Activation	Manual	Manual	Automatically
Need location	DSO determines the geographic scope according to its needs by defining grid areas defined by a grid node or a set of grid nodes	DSO determines the geographic scope according to its needs by defining grid areas defined by a grid node or a set of grid nodes	DSO determines the lines for which the DLR is performed
Network information in market clearing	No	No	No
Locational information in the bids	Yes, Grid Node	Yes, Grid Node	Yes, Grid Node
Auction type	Continuous market	Continuous market	Continuous market
Pricing scheme	Pay-as-bid	Pay-as-bid	Pay-as-bid
Trading type	Unit-based trading	Unit-based trading	Unit-based trading

Reservation of capacity	No	No	No
Remuneration[14]	Activation fee	Activation fee	Activation fee
Market opening	Day ahead	Day ahead	Day ahead
Market closing	One hour before delivery (To be verified during field tests)	One hour before delivery (To be verified during field tests)	1h ahead
Single period versus multi-time period market	Can be single period or multi-time period	Can be single period or multi-time period	Multi period
Bid selection	DSO technical optimization and selection	DSO technical optimization and selection	Bid selection outside the market platform based on DSO technical algorithm
Trading Time Unit	15 minutes	15 minutes	1h

The procured flexibility is activated through automatic matching, and the geographical scope is determined according to the needs in the demonstrator, i.e., the targeted market area is linked to a location which is defined by a grid node or a set of grid nodes whereby the flexibility within that area can solve the identified need. In the market clearing process of the market platform, no network information is considered. The bids, therefore, do not include detailed information on the grid node and infrastructure they are connected to. Bid selection is done through a technical optimization of the DSO.

The market starts one day ahead and runs until intraday just before real time. Market closure is thus initially set one hour ahead of real time so as not to jeopardize the delivery process. Market closure can still be adapted depending on the project results. This will be verified during the field tests. Power flexibility products are traded per unit for 15 minutes segments (Trading Time Unit) and are described with the product parameters capacity quantity, regulation direction, price, and assigned grid node. Bids can be submitted for one or multiple trading time units. Orders can be submitted by either the buyer or seller and will be delivered provided the order is matched by the other side of the market. Trading proceeds as pay-as-bid. The flexibility provider is remunerated based on the flexibility activated. Capacity is not reserved.

The third BUC of the Polish demonstrator is different from the previous BUCs.

For the implementation of BUC3, which explores the potential of dynamic flow rating (DLR) methodology to increase the line capacity, the same NODES platform as for the other BUCs can be applied. However, with regard to the standard BUCs, the market design and the roles associated with the market participant change.

The DSO can use the platform to communicate its flexibility in increasing the line capacity if any (so, the DSO can be seen as “a flexibility seller”). The producer can use the platform to communicate it’s need for additional capacity (so, the producer becomes a “buyer of flexibility”).

[14] Settlement is not implemented in the field test, instead only the theoretically achieved remuneration for flexibility is determined.

The allocation of additional line capacity to the FSPs is done outside the market platform according to the optimal power flow calculations by the DSO.

The procured flexibility is activated automatically by matching a buy and a sell order. There is a single seller (DSO) and in most cases also a single buyer (producer of renewable energy).

As a continuous market is considered, there is an option to negotiate the price and the generation profile on the market platform.

The producer (RES-WF owner) applies for temporary enhancement of power generation by submitting a buy order. The producer can issue a buy order at any time of the day (intraday), until 60 minutes before the real-time operation. The DSO performs a day-ahead power flow calculation and a forecasted capacity assessment with the DLR system of the 110 kV line, based on the weather condition forecast. The DSO estimates possible line congestion (bottleneck). DSO submits sell order to FMO with appropriate power generation profile and price values.

5. German Demo Business Use Cases

5.1. BUC1 Germany

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

ID	***Name of use case*** Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use "verb + description", e.g., operate the distribution's congestion management market or submit flexibility bid to the distribution's congestion management market.
DE-AP	Congestion Management & Voltage Control with market-based active power flexibility

What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.
The Use Case deals with short-term grid operation and comprises a day ahead and an intraday process. It is theoretically applicable for all voltage levels. However, for the demonstrator the BUC focus is the low voltage grid and the transition from low to medium voltage (meaning the provision of aggregated LV flexibility for the MV level). The UC explains how active power flexibility in distribution grids can be exploited through a market platform while being compatible with mandatory processes such as redispatch.
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.

• Solving/mitigating physical congestions (overloading of lines/transformers, voltage band violations) using market-based active power flexibility in a cost and grid-efficient way
• Ensuring that flexibility activation of market bids (local market) will not create grid congestions
• Ensuring that the local market design enables the trade of aggregated flexibilities at the level of a grid area (e.g. defined by a feeder / substation or by a set of grid nodes), provided that:
    • the DSO gets the right visibility to check that a contract will not worsen a congestion
    • the aggregated flexibility products are delivered as agreed in the trade in relation to the specified network area and total quantity
    • the FSP can re-optimize the dispatch of the resources (part of his Virtual Portfolio) while fulfilling his contract at the aggregated grid area level.
• Aligning and coordinating the use of voluntary and mandatory active power flexibility for the process of redispatch

What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
General: • The process must be compatible with mandatory processes e.g. redispatch • DSO and FSP need to be connected to the same market and grid area to trade flexibility products with each other; Grid areas where a registration of resources to the flexibility market is possible are known • Prequalification conditions agreed between FMO and DSO are in place and available for potential FSPs to view • The DSO is responsible for ensuring a secure network operation and therefore takes the final decision on the activation of flexibility • The success is dependent on the voluntary participation of customers • DSO relies on emergency actions only when no market solution is available or insufficient • The use case is based on the assumption that grid congestion can be forecasted (at least approximately) in terms of location and quantity • In the market clearing process, the most efficient flexibility option (based on sensitivity and price) to solve/mitigate the forecasted congestion is selected. The DSO has the final decision on the bids that will be activated. • The DSO declares which grid data can be shared with the market based on the regulatory framework. • In the German demonstrator, sensitivities remain in the sphere of the DSO. Based on forecast results the DSO can set limits for active power flexibility products at the LV/MV transformer. Specifically, for the German Demo, the DSO is responsible for contacting customers.

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
• Grid with sufficient measurement technology to detect congestions and/or voltage problems (including all power lines, switches, transformers…) • A tuple of flexible applications in terms of the adjustability of active power (These could be, among others: batteries, heat storages, heat pumps, PV systems, EVs…) with the necessary ICT for control by an aggregator or FSP

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
Interactions could arise with the • use case of market-based use of reactive power flexibility • switching operations and other measures in the grid that may influence the power flow

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.

Congestion management and voltage control are implemented to remedy physical congestions and voltage violations by the use of market-based active power flexibility.

Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional).

- **Examples**:
  - Obligatory / mandatory, optional, nice to have
  - Political target / business need / prioritization from standardization point of view
  - Time scale to deployment / timing, benefit, answer to new challenges

Obligatory

For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).

- Services:
  - Congestion management
  - Voltage control
- Used Market Mechanisms for the services:
  - Local flexibility markets with continuous trading
  - Cost-based mechanisms / Obligation ⍰ Redispatch (out of scope for demonstration)

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
With the help of iterative network calculations and transmitted baselines, a forecast of possible congestions is made. In event of a congestion, the DSO can find and select active power flexibility via a market platform, which helps him to ease the congestion by changing load/generation. The Use Case is divided into the 4 phases Prequalification, Selection/Bidding, Delivery and Settlement: 1. Registration and Prequalification: Product definitions and initial pre-qualification including framework agreement with baseline delivery requirements 2. Selection/Bidding: State estimation and prediction of congestions. Active power flexibility products are offered on a market platform by Flexibility Service Providers using resources from Resource Aggregators or individual Resource Providers. The DSO uses the flexibility market to solve the congestion by either matching offers already present at the market (in case there is already a good offer of an FSP) or creating a buy order for the congested location on the market platform. The flexibility needs to be within the grid area where the need is located. The FSP is notified about the selected resources. 3. Activation/Delivery and monitoring: Flexibility resources are activated. The selected flexibility is delivered. The DSO measures the activated flexibility. 4. Settlement: The DSO transmits the metering data to the FMO, who validates the delivery based on the metering data and the pregiven baselines. Invoices are sent and payments are made.
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., “main success scenario”) from a domain expert user’s point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions. While writing the narrative, please consider the following:[15] • Use “just one sentence form”: ▪ Use present tense. ▪ Use active verb in the active voice. ▪ Describe actions that move the process forward. ▪ For instance, “customer enters card and pin into ATM”

[15] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

- Keep it simple and to the point so that non-domain experts can understand it.

Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.

We suggest including the following aspects into the narrative:

  - Type of mechanism used (Market or other – please be specific)
  - Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system")
  - Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA)
  - Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)
  - Relevant phase (e.g., pre-qualification, procurement, activation, settlement)

Registration and Prequalification phase:

- The RP registers the resources on the market himself or through an aggregator. In the second case, the RA gets access to the resources and is responsible for registration.
- To register resources on the market, compliance with the pre-qualification conditions must be demonstrated
- If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can then create offers on the flexibility market and will be visible to the DSO

Selection/Bidding:

- State estimation and forecasts of congestions.

  a) Day ahead

  - Active power flexibility products are offered on the flexibility market. These can be based on two scenarios:

    1) DSO uses offers already present at the flexibility market

       - The FSPs can create offers on the market for the following day and have to provide baselines for the respective resources based on their estimated availability
       - The DSO uses forecasts to estimate grid states and predict congestions
       - The DSO extracts available sell orders from the market platform

    2) DSO motivates offers by stating a demand

       - Conclusion that there are not sufficient offers on the market

- DSO states need for active power flexibility products
- FSPs can create a matching offer to the DSO need on the market and have to provide baselines for the respective resources / portfolios based on their estimated availability -
- DSO evaluates the bids based on grid constraints to ensure a secure grid operation and selects the flexibility products, based on optimization methods to maximize social welfare/minimize activation cost.
- The DSO can use mandatory redispatch with involvement of the TSO to solve congestions (out of scope for the demonstration) or sends a buy order to the market for the offered flexibility
- Orders are matched based on location, price and volume and confirmations for the parties participating in the trade are sent
- The steps are iteratively repeated until the start of the intraday process

b) Intraday

- The steps of the day-ahead process are repeated but with a higher frequency until market gate closure

Delivery and Monitoring:

- Flexibility resources are activated by the FSPs following the information received from the DSO through the flexibility market platform. This right can also be relinquished to the DSO which implies that the DSO can then activate FSP resources directly.
- The flexibility is delivered.
- The DSO collects the metering data

Settlement:

- DSO transmits the metering data to the FMO
- FMO validates the delivery based on the metering data and the pregiven baselines
- The FMO sends an invoice to the DSO
- Payments are made from the DSO via the market platform to the FSP, which in turn remunerates the RA and resource provider[16]

[16] This part is integral to the overall process. However, no payments are foreseen for EUniversal as it is a research project.

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***
DSO	Role		
FMO	Role		
FSP	Role		
RP	Role		
RA	Role		
TSO	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define “success” or “failure” conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market	RA/RP	DSO creates Grid areas and Grid Nodes to open the market; New RA/RP wants to qualify new assets for flexibility market	RA/RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market and will be visible to the DSO If the prequalification is not successful, the RA/RP cannot register the assets nor create offers on the flexibility market

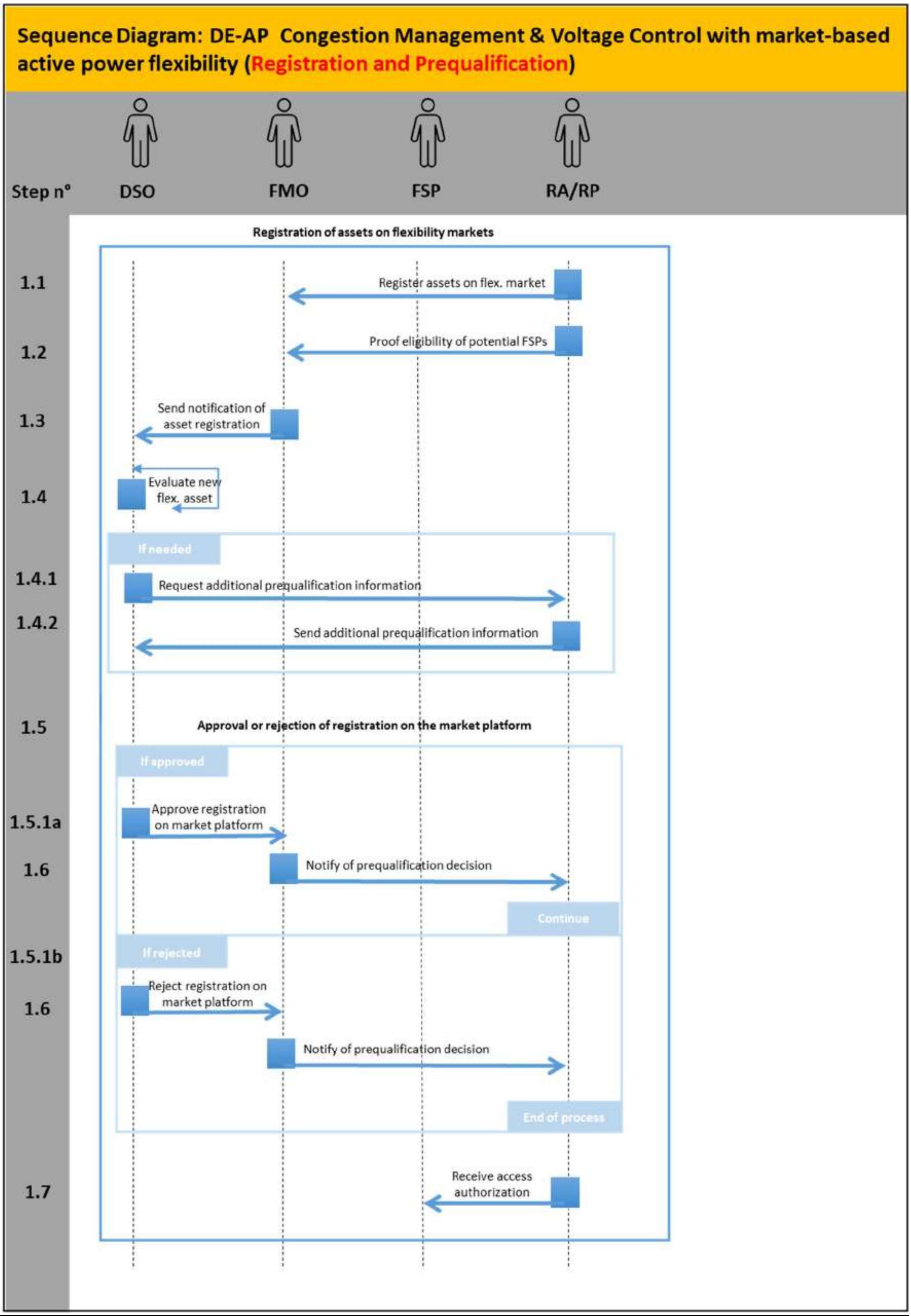
2	Selection/Bidding	Planning of grid utilisation and identifying potential congestions, followed by bid submission, evaluation, and matching	DSO, FMO, FSP	Congestion forecast, Available flexibility	Available active power flexibility connected; Prequalified FSPs	When bids are matched, flexibility of the local market is used for congestion management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP, FMO, DSO	Activation signal	Matching bids on the flexibility market	The actual provided flexibility is delivered. Congestions are eliminated. The delivery of flexibility is proven by metering data sent from the DSO to the FMO.
4	Settlement	Invoicing and Payments	FMO, DSO, FSP	The DSO pays the FSP for the flexibility delivery	Delivered active Power flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
    - Input to the use case from some external source that is not described in this use case,
    - Internal to the use case (although could be between different applications and systems within the use case),
    - Output from the use case that will be used by other actors / entities not included in this use case.
    - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification


Sequence Diagram: DE-AP Congestion Management & Voltage Control with market-based active power flexibility (Registration and Prequalification)
Step n°
DSO
FMO
FSP
RA/RP
Registration of assets on flexibility markets
1.1
Register assets on flex. market
1.2
Proof eligibility of potential FSPs
1.3
Send notification of asset registration
1.4
Evaluate new flex. asset
If needed
1.4.1
Request additional prequalification information
1.4.2
Send additional prequalification information
1.5
Approval or rejection of registration on the market platform
If approved
1.5.1a
Approve registration on market platform
1.6
Notify of prequalification decision
Continue
1.5.1b
If rejected
Reject registration on market platform
1.6
Notify of prequalification decision
End of process
1.7
Receive access authorization

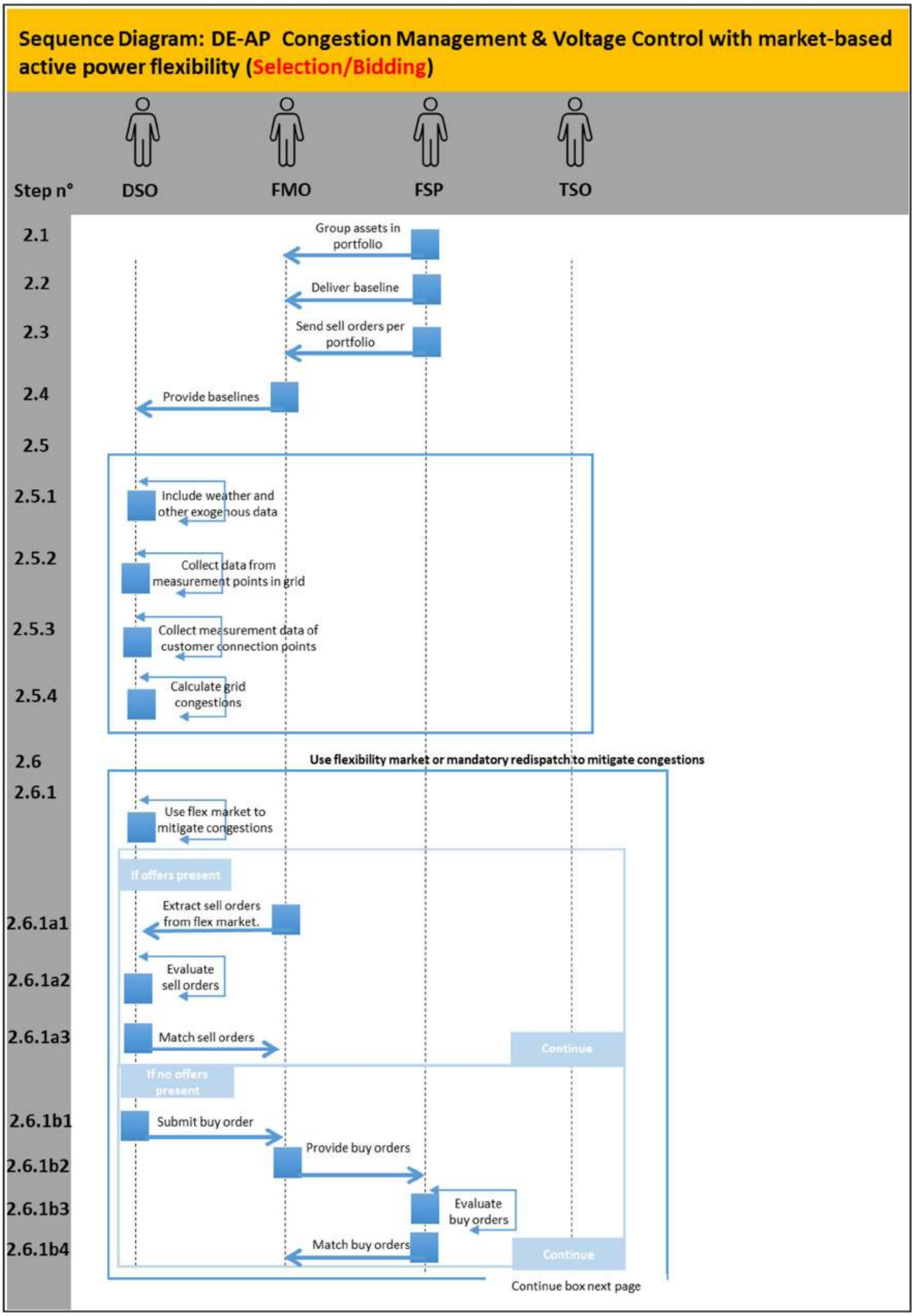
Scenario step by step analysis

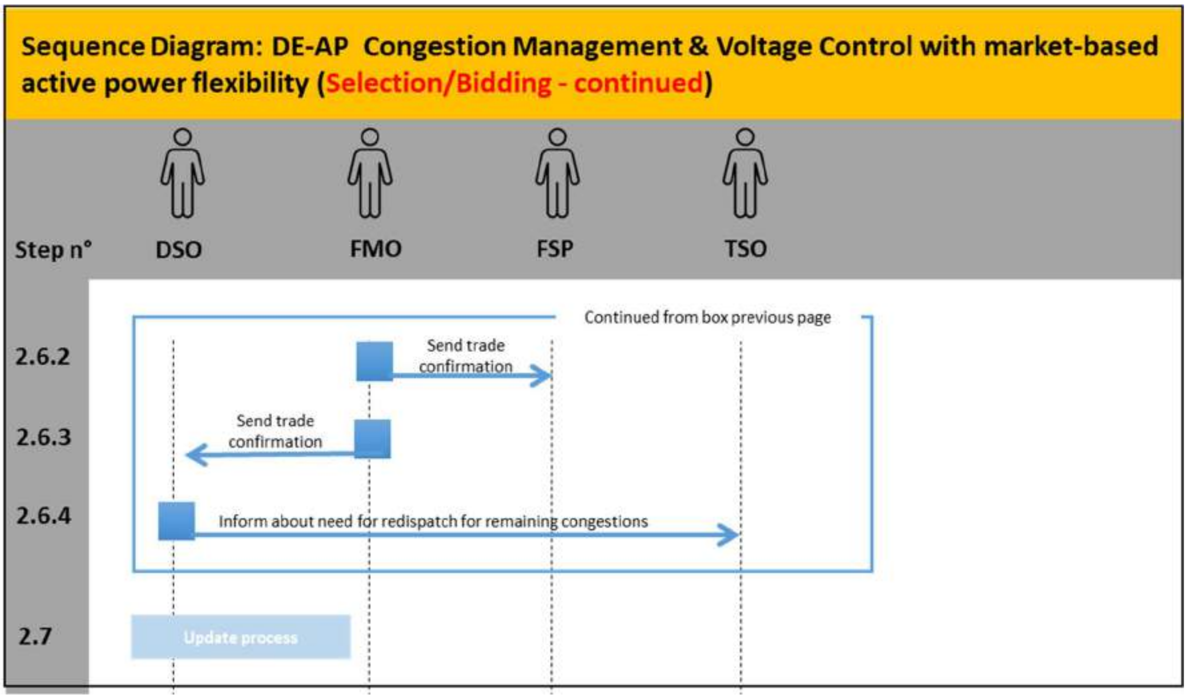
Scenario								
Scenario name	Registration and Prequalification							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions.	Registers	RA/RP	FMO		
1.2		Proof of eligibility of potential FSPs	RA/RP sends proof in compliance with the prequalification criteria by submitting the required documentation.	Sends	RA/RP	FMO	Info1	
1.3		Notification of a new potential FSP registration	FMO sends a notification to the DSO stating that a potential FSP is awaiting approval and gives access to the submitted documentation. DSO can consult information for approval to market on the platform.	Sends	FMO	DSO		
1.4		Evaluation of potential new flex. Asset	DSO evaluates the potential flexibility asset by the submitted documentation on the market platform and evaluates the flexibility offer and the need for additional information. A real flexibility activation test shall be performed. This can be an iterative process.	Evaluates	DSO			

1.4.1		Request of additional prequalification information	DSO can request additional information for the prequalification.	Requests	DSO	RA/RP		
1.4.2		Transfer of additional prequalification information	RA/RP sends additional information for the prequalification to the DSO.[17]	Sends	RA/RP	DSO	Info1	
1.5		Approval or rejection of registration on the market platform	The DSO needs to approve or reject the registration of the asset on the market platform.					
1.5.1a		DSO approval of new FSP registration	The DSO approves registration of the asset on the market platform. The corresponding asset can now participate in the flexibility market.	approves	DSO	FMO		
1.5.1b		DSO rejection of new FSP registration	The asset fails to meet the criteria and therefore does not receive admission to the market. The respective asset cannot take part in the flexibility market.	rejects	DSO	FMO		
1.6		Prequalification notification	RA/RP receives notification of the prequalification decision and can access the result on the platform.	sends	FMO	RA/RP	Info2	
1.7		Access authorisation	The RA/RP becomes FSP and can now create offers for the assets.	becomes	RA/RP	FSP		

[17] In the long term, it is desirable to retrieve all the information required for prequalification via the market platform. For the EUniversal project this will not be considered and direct communication between FSP and DSO will be used for all additional information required.

Selection/Bidding





Sequence Diagram: DE-AP Congestion Management & Voltage Control with market-based active power flexibility (Selection/Bidding - continued)
Step n°
DSO
FMO
FSP
TSO
Continued from box previous page
2.6.2
Send trade confirmation
2.6.3
Send trade confirmation
2.6.4
Inform about need for redispatch for remaining congestions
2.7
Update process

Scenario step by step analysis

Scenario								
Scenario name	Selection/Bidding							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.1		Grouping of FSP assets in portfolios	The FSP groups individual assets into portfolios. These can be composed of any combination of resource types within a certain grid area.	groups	FSP	FMO		
2.2		Delivery of FSP baselines per portfolio	For prequalification, the FSP must provide a Baseline. The baseline indicates the generation/load that users would have consumed without adjustment according to the flexibility market. The methodologies for baseline calculation are defined in the market design rules (Info3).	sends	FSP	FMO	Info3	
2.3		FSPs' offer of active power flexibility products	FSPs can offer the active power flexibility of their portfolios by submitting a sell order on the flexibility market. Therefore, the order parameters (Info4) are specified. Sell orders are submitted per portfolio.	sends	FSP	FMO	Info4	

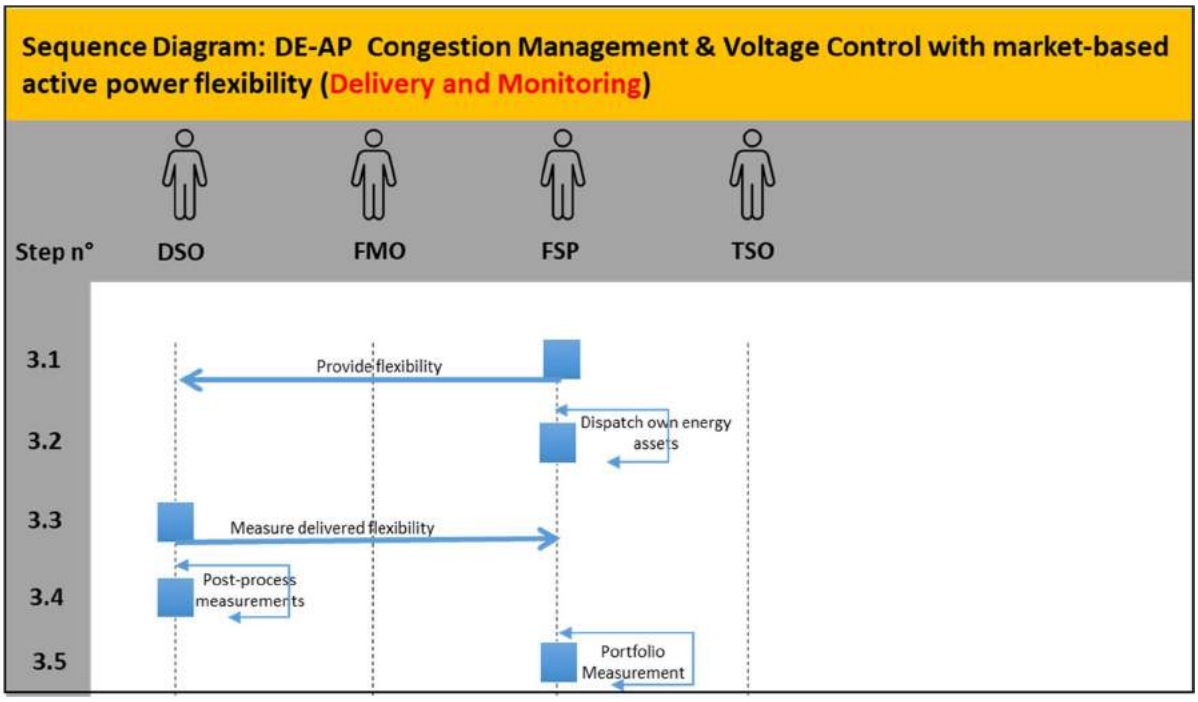
2.4		Retrieving of Baselines	The DSO has access to the market platform and can download load/generation baselines for the offered portfolios.	provides	FMO	DSO	Info3	
2.5		DSO evaluation of updated grid information and prediction of congestions	DSO collects exogenous data and performs grid evaluating algorithms using topology, measurement and market related data (cf. Info5-Info7). As such, the DSO can make predictions on congestion issues. This is also needed as the FSPs are only a small fraction of the total demand and supply. As such, all the needed information to do proper grid forecasting is assembled here.					
2.5.1		DSO inclusion of forecasts of exogenous data	Using statistical methods, the DSO includes exogenous data described in Info5.	includes	DSO	DSO	Info5	
2.5.2		DSO collection of measurement values	DSO collects measurements of electrical quantities such as voltage, current, cos(phi) from measurement points installed in the grid for usage in the analysis algorithms.	collects	DSO	DSO	Info6	
2.5.3		Collection of measurements at customer connection points	The DSO collects measurements of electrical quantities such as voltage, current, cos(phi) at customer connection points	collects	DSO	DSO	Info7	
2.5.4		Congestion calculation in DSO grid	Based on grid topology, generation and load forecasts (including exogenous data), state estimation and asset utilization are calculated.	calculates	DSO	DSO	Info8	

2.6		Mandatory redispatch or flexibility market to mitigate congestions	The DSO can use mandatory redispatch with involvement of the TSO to solve congestions (out of scope for the demonstration) or sends a buy order to the market for the offered flexibility. The selection of the process is based on the criteria described in Info10.				Info10	
2.6.1		Usage of available flexibility offers or creation of buy order	If there are suitable offers on the flexibility market, the DSO can select them directly or otherwise the DSO generates a buy order himself, specifying the order description (info4).		DSO	DSO		
2.6.1.a1		Extraction of sell orders from the flexibility market	If offers are present on the flexibility market, the DSO extracts them from the flexibility market.	extracts	FMO	DSO	Info4	
2.6.1.a2		Sell Order evaluation	The available orders on the market are evaluated. The evaluation is performed using optimisation algorithms while considering grid constraints, and sensitivities, and with the aim to maximize social welfare/minimize activation cost while ensuring the safe operation of the grid. Other options are also considered (such as switching options). However, for the field test, this is out of scope.	evaluates	DSO	DSO		
2.6.1.a3		Matching of FSP and DSO offer	Select flexibility by matching existing sell orders. Orders are matched based on the previously performed evaluations considering location, price and volume, order time and VPP constraints.	selects	DSO	FMO		

2.6.1.b1		Buy order submission	If there are not sufficient offers on the flexibility market, the DSO motivates offers by stating a demand on the market by submitting a buy order.	sends	DSO	FMO	Info4	
2.6.1.b2		Checking of flexibility buy orders on the flexibility market	The FSPs can extract buy orders from the market.	provides	FMO	FSP	Info4	
2.6.1.b3		Buy order evaluation	If the DSO has created an offer, the FSP can evaluate whether he can provide a suitable sell order.	evaluates	FSP	FSP		
2.6.1.b4		Matching of DSO and FSP offer	Orders are matched based on location, price and volume, order time and VPP constraints.	selects	FSP	FMO		
2.6.2		FSP Trade confirmation	The FMO sends a trade confirmation to the FSP. Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed.	sends	FMO	FSP	Info9	
2.6.3		DSO Trade confirmation	The FMO sends a trade confirmation to the DSO. Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed.	sends	FMO	DSO	Info9	
2.6.4		Remedy remaining congestions with information to the TSO through mandatory processes	Remaining congestions need to be solved through mandatory processes (Redispatch, curtailment, Feed-In Management, curtailment). The DSO needs to send this information to the TSO. OUT OF SCOPE FOR DEMONSTRATION	informs	DSO	TSO	Info10	

			(for detail see BUC DE-AP EU-Sysflex D6.1)					
2.7		Update process	The steps (2.1-2.6) of the Selection/Bidding phase are iteratively repeated with updated data until market gate closure.					

Delivery and Monitoring

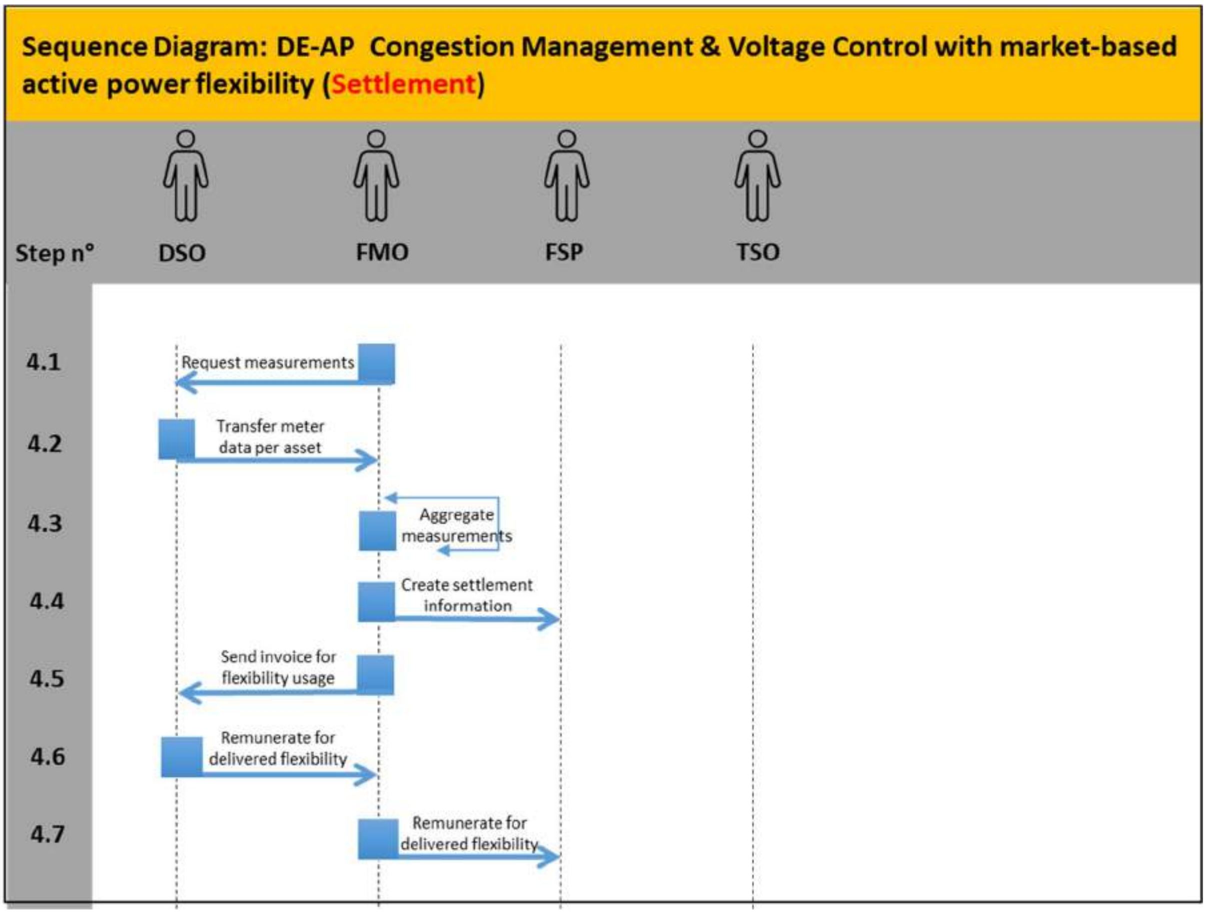


Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1.		Flexibility provision	The FSP activates the flex resources based on the matched offers and baselines.	provides	FSP	DSO		
3.2		FSP dispatch of own energy assets	FSP controls the individual resources of the portfolio and activates them based on the confirmed trade conditions.	dispatches	FSP	RA/RP		
3.3		Measurement of delivered flexibility	The meter data operator as part of the DSO role measures the dispatch of traded resources and, together with the baseline, this forms the basis for settlement.	measures	DSO	FSP	Info11	
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase.	prepares	DSO	DSO	Info11	
3.5		Portfolio measurement of FSP	FSP can measure the portfolios to serve its internal process and stores	measures	FSP	FSP		

			them for the case of contradictions with the DSO measurement						

Settlement


Sequence Diagram: DE-AP Congestion Management & Voltage Control with market-based active power flexibility (Settlement)
Step n°
DSO
FMO
FSP
TSO
4.1
Request measurements
4.2
Transfer meter data per asset
4.3
Aggregate measurements
4.4
Create settlement information
4.5
Send invoice for flexibility usage
4.6
Remunerate for delivered flexibility
4.7
Remunerate for delivered flexibility

Scenario step by step analysis

Scenario								
Scenario name	Settlement							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1		Measurements request	FMO requests the necessary energy readings for settlement from the DSO.	requests	FMO	DSO		
4.2		Transfer meter data per asset	The DSO sends the meter data of the individual resources to the FMO.	sends	DSO	FMO	Info11	
4.3		Measurement aggregation	FMO aggregates meter data per asset according to the portfolios.	aggregates	FMO	FMO	Info12	
4.4		Settlement information creation for FSP	FMO uses the measurement data to determine the delivery quantity and quality in relation to the baseline and calculates the payment flows. The result of the performance evaluation and the payment information is sent to the FSP.	sends	FMO	FSP	Info13	
4.5		Invoice for flexibility usage	The result of the settlement and the invoice for the used flexibility product are sent to the DSO, including a list with the flexibilities the FSP has activated.	sends	FMO	DSO	Info14	

4.6		FMO remuneration	The DSO settles the invoice and sends the payment to the FMO.	remunerates	DSO	FMO		
4.7		FSP remuneration	The FMO receives the DSO payment and distributes the funds to the individual FSPs.	remunerates	FMO	FSP		

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

- **Name of information**: Unique ID which identifies the selected information in the context of the use case.
- **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Asset Registration Data	Information needed for the prequalification assessment. At this stage in the project, only general information is required so far. That is: no upload of documents. Though, the topic was discussed also in the German demo to be implemented later	
Info2	Prequalification notification	Message about the outcome of the prequalification process	
Info3	Baseline	Baseline determination rules are defined in the market rules	
Info4	Order description	Information needed for the evaluation of the offered flexibility product. *Order parameters* are typically price, volume and direction (up or down regulation)	
Info5	Exogenous Data	External parameters that influence the power flow e.g. weather data and other variables influencing the power flow	
Info6	Grid Measurement Data	Existing measurements of electrical quantities in the grid	

Info7	Customer Measurement Data	Existing measurements of electrical quantities at the customer connection point	
Info8	Congestion Forecast	Generation and Load estimation based on exogenous Data and resulting power flow	
Info9	Trade Confirmation	Information on which resources are to be activated and the amount of the adjustment in active power	
Info10	Information for mandatory processes	Data exchange for mandatory processes such as redispatch	
Info11	Metering Data of individual assets	Contains metering data for individual assets for the billing process	
Info12	Aggregated Metering Data	Meter data per portfolio for the billing process	
Info13	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it	
Info14	Invoice	Address of invoice receiver, time frame of flexibility, activation, activated generation/load assets, specific flexibility costs in €/MWh per asset, total flexibility costs per asset in €, total flexibility costs in €, underlying regulation scheme	

5.2. BUC2 Germany

Use case description

<u>Use case name, scope, objectives, hypotheses and associated smart grid functions</u>

ID	***Name of use case*** Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use “verb + description”, e.g., operate the distribution’s congestion management market or submit flexibility bid to the distribution’s congestion management market.
DE-RP	Congestion Management & Voltage Control with market-based reactive power flexibility

What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market...), the associated sub-domains (network level, type of market, e.g., balancing market, ...), and time horizons (planning, real-time operations, ...) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.
The Use Case deals with short-term grid operation and comprises a day ahead and an intraday process. It is theoretically applicable for all voltage levels. However, for the demonstrator the BUC focus is the low voltage grid and the transition from low to medium voltage (meaning the provision of aggregated LV flexibility for the MV level). The UC explains how reactive power flexibility in distribution grids can be exploited through a market platform while being compatible with mandatory processes such as redispatch.
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.
• Solving/mitigating physical congestions (overloading of lines/transformers, voltage band violations) using market-based reactive power flexibility in a cost and grid-efficient way • Ensure that flexibility activation of market bids (local market) will not create grid congestions • Ensure that the local market design enables the trade of aggregated flexibilities at the level of a grid area (e.g. defined by a feeder / substation or by a set of grid nodes), provided that: - the DSO gets the right visibility to check that a contract will not worsen a congestion - the aggregated flexibility products are delivered as agreed in the trade in relation to the specified network area and total quantity - the FSP can re-optimize the dispatch of the resources (part of his Virtual Portfolio) while fulfilling his contract at the aggregated grid area level. • Align and coordinate the use of voluntary and mandatory reactive power flexibility for the process of redispatch

What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
General: ○ The process must be compatible with mandatory processes e.g. redispatch ○ DSO and FSP need to be connected to the same market to trade flexibility products with each other; Grid areas where a registration of resources to the flexibility market is possible are known ○ Prequalification conditions agreed between FMO and DSO are in place and available for potential FSPs to view ○ The DSO is responsible for ensuring a secure network operation and therefore takes the final decision on the activation of flexibility ○ Dependency on voluntary participation of customers ○ DSO relies on emergency actions only when no market solution is available or insufficient ○ The use case is based on the assumption that grid congestion can be forecasted (at least approximately) in terms of location and quantity ○ In the market clearing process, the most efficient flexibility option (based on sensitivity and price) to solve/mitigate the forecasted congestion is selected. The DSO has the final decision on the bids that will be activated. ○ The DSO declares which grid data can be shared with the market participants based on the regulatory framework. ○ In the German demonstrator, sensitivities remain in the sphere of the DSO. Based on forecast results the DSO can set limits for reactive power flexibility products at the LV/MV transformer. Specifically, for the German Demo, the DSO is responsible for contacting customers

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
• Grid with sufficient measurement technology to detect congestions and/or voltage problems (including all power lines, switches, transformers…) • A tuple of flexible applications in terms of the adjustability of reactive power (These could be, among others: batteries, heat storages, heat pumps, PV systems, EVs…) with the necessary ICT for control by an aggregator or FSP

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
Interactions could arise with the • use case of market-based use of active power flexibility • switching operations and other measures in the grid that may influence the power flow

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Congestion management and voltage control are implemented to remedy physical congestions and voltage violations by the use of market-based reactive power flexibility.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Mandatory
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
• Services: o Congestion management o Voltage control • Used Market Mechanisms for the services: o Local flexibility markets with continuous trading o Cost-based mechanisms / Obligation (out of scope for demonstration)

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
With the help of iterative network calculations and transmitted baselines, a forecast of possible congestions is made. In event of a voltage violation or congestion, the DSO can find and select reactive power flexibility via a market platform, which helps him to ease the congestion by changing load/generation.[18] The Use Case is divided into the 4 phases Prequalification, Selection/Bidding, Delivery and Settlement: 1. *Registration and Prequalification*: Product definitions and initial pre-qualification including framework agreement with baseline delivery requirements 2. *Selection/Bidding*: State estimation and forecasts to identify congestions. Reactive power flexibility products are offered on a market platform by Flexibility Service Providers using resources from Resource Aggregators or individual Resource Providers. The DSO uses the flexibility market to solve the congestion by either matching offers already present at the market or creating a buy order for the congested location on the market platform. The flexibility needs to be within the grid area where the need is located. The FSP is notified about the selected resources. *3. Activation/Delivery and Monitoring*: Flexibility resources are activated. The selected flexibility is delivered. The DSO measures the activated flexibility. *4. Settlement*: The DSO transmits the metering data to the Flexibility Market Operator, who validates the delivery based on the metering data and the pregiven baselines. Invoices are sent and payments are made.
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., “main success scenario”) from a domain expert user’s point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions. While writing the narrative, please consider the following:[19] • Use “just one sentence form”: ▪ Use present tense. ▪ Use active verb in the active voice. ▪ Describe actions that move the process forward.

[18] The choice between the use of active power or reactive power is made according to criteria of cost-effectiveness. Typically, active power is used rather for line congestion, while reactive power is used rather for voltage problems.

[19] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

- For instance, “customer enters card and pin into ATM”

- Keep it simple and to the point so that non-domain experts can understand it.

Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.

We suggest including the following aspects into the narrative:

- Type of mechanism used (Market or other – please be specific)
- Interaction between roles (we suggest that you focus on the roles’ intent bearing in mind that an action step reflects data circulating in one direction, e.g. “user enters name and address into the system”)
- Timeframe (e.g., local flexibility market opens at “x”. The GCT is at “y”. The clearing takes place 30 min. before the DA)
- Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)
- Relevant phase (e.g., pre-qualification, procurement, activation, settlement)

Registration and Prequalification phase:

- The RP registers resources on the market himself or through an aggregator. In second case, the RA gets access to the resources and is responsible for registration.

- To register resources on the market, compliance with the pre-qualification conditions must be demonstrated

- If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can then create offers on the flexibility market and will be visible to the DSO

Selection/Bidding:

- State estimation and forecasts of congestions

a) Day ahead

- Reactive power flexibility products are offered on the flexibility market. These can be based on two scenarios:

1) DSO uses offers already present at the flexibility market

- The FSPs can create offers on the market for the following day and have to provide baselines for the respective resources based on their estimated availability

- The DSO uses forecasts to estimate grid states and predict congestions

- The DSO extracts available sell orders from the market platform

2) DSO motivates offers by stating a demand

- Conclusion that there are insufficient offers on the market

- DSO states need for reactive power flexibility products

- FSPs can create a matching offer to the DSO need on the market and have to provide baselines for the respective resources based on their estimated availability

- DSO evaluates the bids based on grid constraints to ensure a secure grid operation and selects the flexibility products, based on optimization methods to maximize social welfare/minimize activation cost.

- The DSO can use mandatory redispatch with involvement of the TSO to solve congestions (out of scope for the demonstration) or sends a buy order to the market for the offered flexibility

- Orders are matched based on location, price and volume and confirmations for the parties participating in the trade are sent

- The steps are iteratively repeated until the start of the intraday process

b) Intraday

- The steps of the day-ahead process are repeated but with a higher frequency until market gate closure

Delivery and Monitoring:

- Flexibility resources are activated by the FSPs following the information received from the DSO through the flexibility market platform. This right can also be relinquished to the DSO. The DSO can then activate resources directly.

- The flexibility is delivered.

- The DSO collects the metering data

Settlement:

- DSO transmits the metering data to the FMO

- FMO validates the delivery based on the metering data and the pregiven baselines

- The validated metering data is transmitted to the FMO who sends an invoice to the DSO

- Payments are made from the DSO via the market platform to the FSP, which in turn remunerates the RA and resource provider[20]

[20] This part is integral to the overall process. However, no payments are foreseen for EUniversal as it is a research project

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***
DSO	Role		
FMO	Role		
FSP	Role		
RA	Role		
RP	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define "success" or "failure" conditions for each use case.

Scenario conditions

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market	RA/RP	DSO creates Grid areas and Grid Nodes to open the market; new RA/RP wants to qualify new assets for flexibility market	RA/RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market and will be visible to the DSO

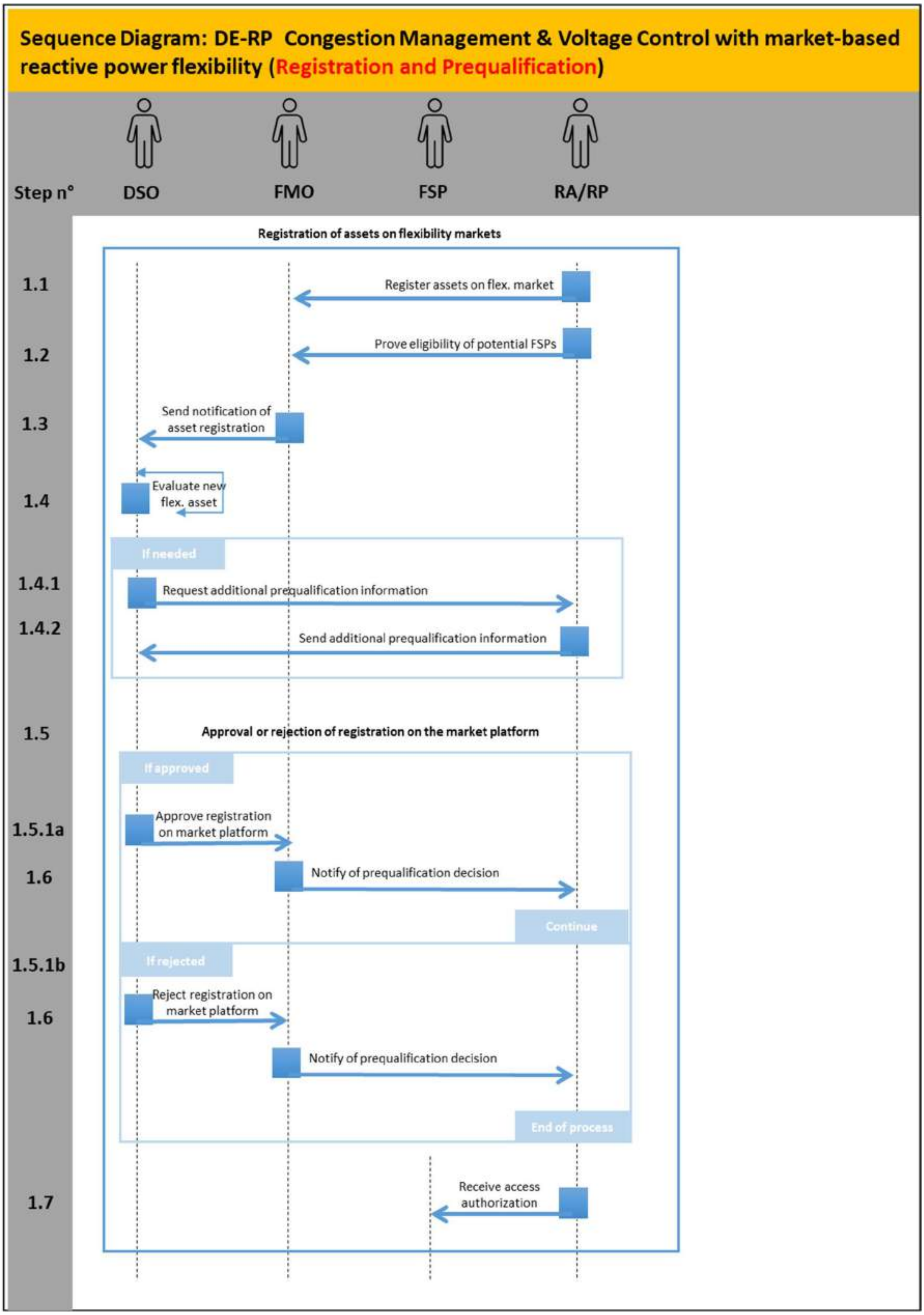
						If the prequalification is not successful, the RA/RP cannot register the assets nor create offers on the flexibility market
2	Selection/Bidding	Planning of grid utilisation and identifying potential congestions, followed by bid submission, evaluation, and matching	DSO, FMO, FSP	Congestion forecast, Available flexibility	Available reactive power flexibility connected; Prequalified FSPs	When bids are matched, flexibility of the local market is used for congestion management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP, FMO, DSO	Activation signal	Matching bids on the flexibility market	The aggregated flexibility is delivered. Congestions are eliminated. The delivery of flexibility is proven by metering data sent from the DSO to the FMO.
4	Settlement	Invoicing and Payments	FMO, DSO, FSP	The DSO pays the FSP for the flexibility delivery	Delivered reactive power flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
  - Input to the use case from some external source that is not described in this use case,
  - Internal to the use case (although could be between different applications and systems within the use case),
  - Output from the use case that will be used by other actors / entities not included in this use case.
  - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification



Scenario step by step analysis

Scenario								
Scenario name		Registration and Prequalification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions.	Registers	RA/RP	FMO		
1.2		Proof of eligibility by potential FSPs	RA/RP sends proof in compliance with the prequalification criteria by submitting the required documentation.[21]	Sends	RA/RP	FMO	Info1	
1.3		Notification of a new potential FSP registration	FMO sends a notification to the DSO stating that a potential FSP is awaiting approval and gives access to the submitted documentation. DSO can consult information for approval to market on the platform.	Sends	FMO	DSO		
1.4		Evaluation of potential FSP	DSO consults the potential FSP submitted documentation on the market platform and evaluates the flexibility offer and the need for additional information. A real flexibility	Evaluates	DSO			

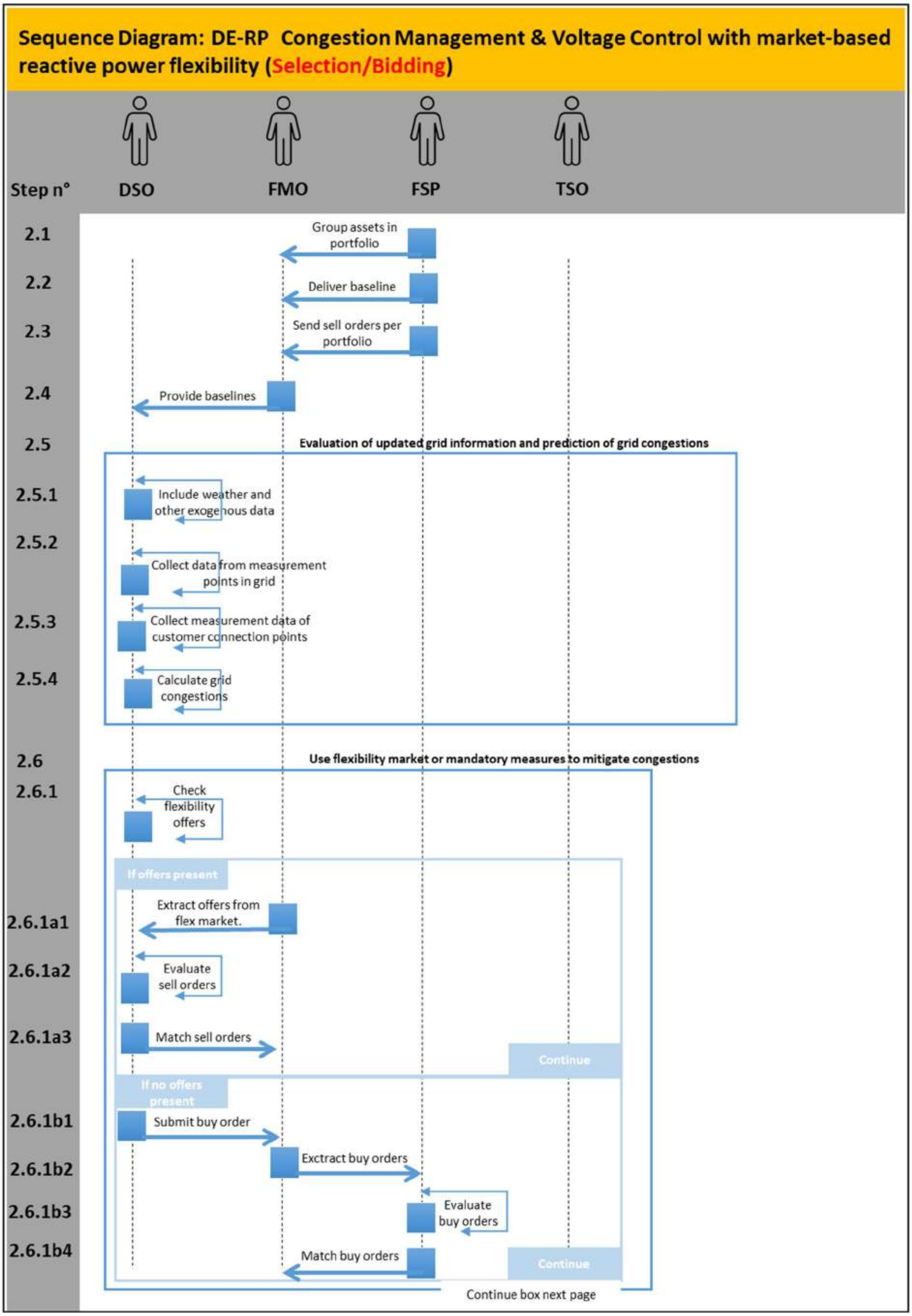
[21] In the context of the research project, the prequalification conditions are not further detailed and tested for completeness, since the used resources are known at the time of the field test, the usage here is also possible without this evaluation.

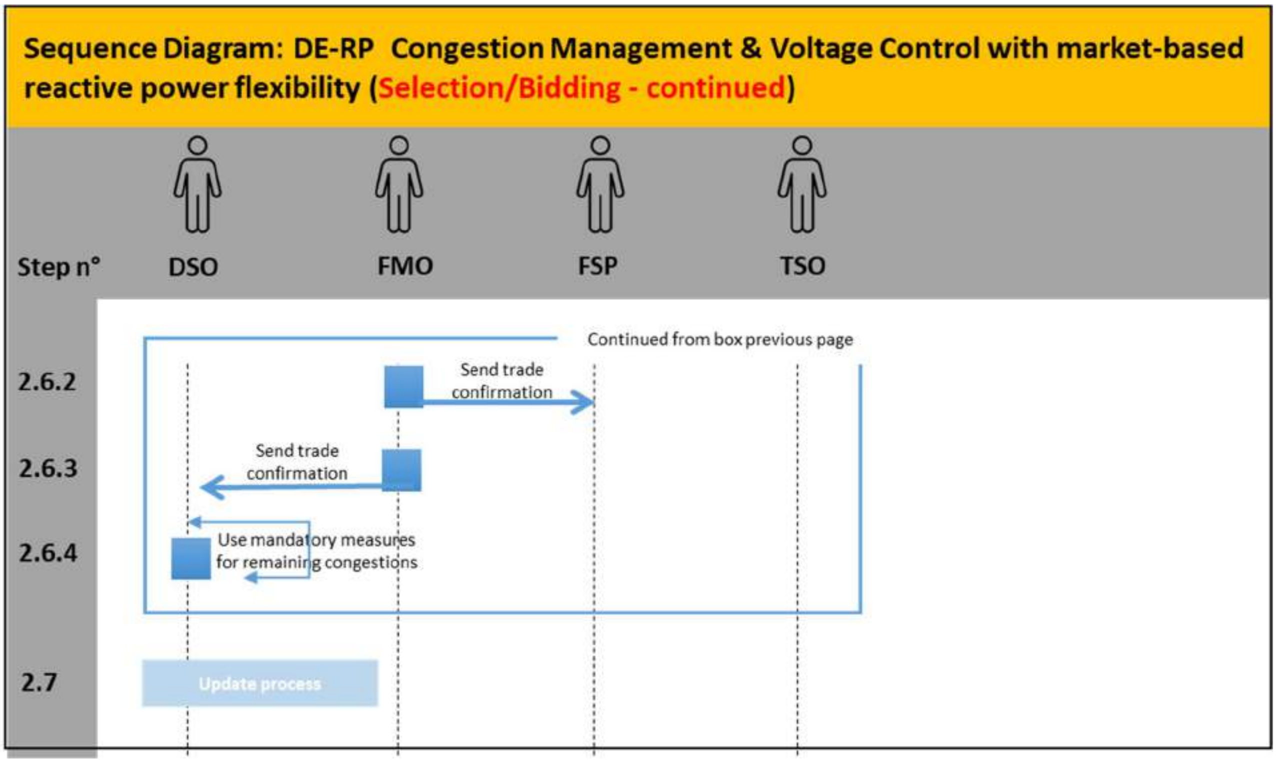
			activation test shall be performed. This can be an iterative process.					
1.4.1		Request of additional prequalification information	DSO can request additional information for the prequalification.	Requests	DSO	RA/RP		
1.4.2		Transfer of additional prequalification information	RA/RP sends additional information for the prequalification to the DSO.[22]	Sends	RA/RP	DSO	Info1	
1.5		Approval or rejection of registration on the market platform	The DSO needs to approve or reject the registration of the asset on the market platform when the required prequalification is not done.					
1.5.1a		DSO approval of new FSP registration	The DSO approves registration of the asset on the market platform when the required prequalification is done. The corresponding asset can now participate in the flexibility market.	approves	DSO	FMO		
1.5.1b		DSO rejection of new FSP registration	The asset fails to meet the criteria and therefore does not receive admission to the market. The respective asset cannot take part in the flexibility market when the required prequalification is not done.	rejects	DSO	FMO		

[22] In the long term, it is desirable to retrieve all the information required for prequalification via the market platform. For the EUniversal project this will not be considered and direct communication between FSP and DSO will be used for all additional information required.

1.6		Prequalification notification	RA/RP receives notification of the prequalification decision and can access the result on the platform.	sends	FMO	RA/RP	Info2	
1.7		Access authorisation	The RA/RP becomes FSP and can now create offers for the assets.	becomes	RA/RP	FSP		

Selection/Bidding


Sequence Diagram: DE-RP Congestion Management & Voltage Control with market-based reactive power flexibility (Selection/Bidding)
Step n°
DSO
FMO
FSP
TSO
2.1
Group assets in portfolio
2.2
Deliver baseline
2.3
Send sell orders per portfolio
2.4
Provide baselines
2.5
Evaluation of updated grid information and prediction of grid congestions
2.5.1
Include weather and other exogenous data
2.5.2
Collect data from measurement points in grid
2.5.3
Collect measurement data of customer connection points
2.5.4
Calculate grid congestions
2.6
Use flexibility market or mandatory measures to mitigate congestions
2.6.1
Check flexibility offers
If offers present
2.6.1a1
Extract offers from flex market.
2.6.1a2
Evaluate sell orders
2.6.1a3
Match sell orders
Continue
If no offers present
2.6.1b1
Submit buy order
2.6.1b2
Exctract buy orders
2.6.1b3
Evaluate buy orders
2.6.1b4
Match buy orders
Continue
Continue box next page


Sequence Diagram: DE-RP Congestion Management & Voltage Control with market-based reactive power flexibility (Selection/Bidding - continued)
Step n°
DSO
FMO
FSP
TSO
Continued from box previous page
2.6.2
Send trade confirmation
2.6.3
Send trade confirmation
2.6.4
Use mandatory measures for remaining congestions
2.7
Update process

Scenario step by step analysis

Scenario								
Scenario name		Selection/Bidding						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.1		Grouping of FSP assets in portfolios	The FSP groups individual assets into portfolios. These can be composed of any combination[23] of resource types within a certain grid area.	groups	FSP	FMO		
2.2		Delivery of FSP baselines per portfolio	For prequalification, the FSP must provide a Baseline and a reactive power specification (e. g. Q(P) characteristic). The baseline indicates the generation/load that users would have consumed without adjustment according to the flexibility market. The methodologies for baseline calculation are defined in the market design rules (Info 3).	sends	FSP	FMO	Info3	
2.3		FSPs' offer of reactive power flexibility products	FSPs can offer the reactive power flexibility of their portfolios by submitting a sell order on the flexibility market. Therefore, the	sends	FSP	FMO	Info4	

[23] Theoretically, portfolios of only individual resources are also possible

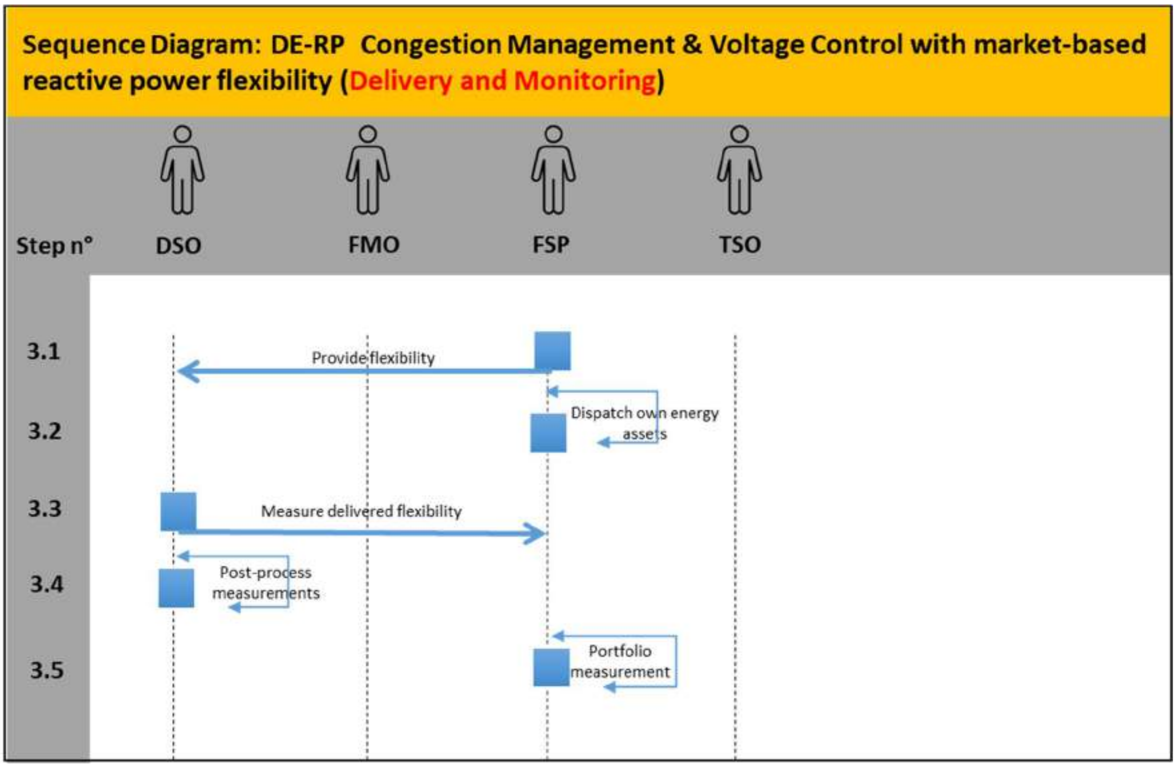
			order parameters (Info4) are specified. Sell orders are submitted per portfolio.					
2.4		Retrieving of Baselines	The DSO has access to the market platform and can download load/generation baselines for the offered portfolios.	provides	FMO	DSO	Info3	
2.5		DSO evaluation of updated grid information and prediction of congestions	DSO collects exogenous data and performs grid evaluating algorithms using topology, measurement and market related data (cf. Info 5- Info 7). As such, the DSO can make predictions on congestion issues. This is also needed as the FSPs are only a small fraction of the total demand and supply. As such, all the needed information to do proper grid forecasting is assembled here.					
2.5.1		DSO inclusion of forecasts of exogenous data	Using statistical methods, the DSO includes exogenous data described in Info 5.	includes	DSO	DSO	Info5	
2.5.2		DSO collection of measurement values	DSO incorporates measurements of electrical quantities such as voltage, current, cos(phi) from measurement points installed in the grid for usage in the analysis algorithms.	collects	DSO	DSO	Info6	
2.5.3		Collection of measurements at customer connection points	The DSO collects measurements of electrical quantities such as voltage, current, cos(phi) at customer connection points	sends	DSO	DSO	Info7	

2.5.4		Congestion calculation in DSO grid	Based on grid topology, generation and load forecasts (including exogenous data), state estimation and asset utilization are calculated.	calculates	DSO	DSO	Info8	
2.6		Mandatory measures or flexibility market to mitigate congestions	The DSO can use mandatory measures with involvement of the TSO to solve congestions (out of scope for the demonstration) or sends a buy order to the market for the offered flexibility. The selection of the process is based on the criteria described in Info 10.				Info 10	
2.6.1		Usage of available flexibility offers or creation of buy order	If there are suitable offers on the flexibility market, the DSO can select them directly or otherwise the DSO generates a buy order himself, specifying the order description (info4).		DSO	DSO		
2.6.1.a1		Extraction of sell orders from the flexibility market	If offers are present on the flexibility market, the DSO extracts them from the flexibility market.	extracts	FMO	DSO	Info4	
2.6.1.a2		Sell order evaluation	The available orders on the market are evaluated. The evaluation is performed using optimisation algorithms while considering grid constraints, and sensitivities, and with the aim to maximize social welfare/minimize activation cost while ensuring the safe operation of the grid. Other options are also considered	evaluates	DSO	DSO		

			(such as switching options). However, for the field test, this is out of scope.					
2.6.1.a3		Matching of FSP and DSO offer	Select flexibility by matching existing sell orders. Orders are matched based on the previously performed evaluations considering location, price and volume, order time and VPP constraints.	selects	DSO	FMO		
2.6.1.b1		Buy order submission	If there are not sufficient offers on the flexibility market, the DSO motivates offers by stating a demand on the market by submitting a buy order.	sends	DSO	FMO	Info4	
2.6.1.b2		Extraction of buy orders from the flexibility market	The FSPs can extract buy orders from the market.	extracts	FMO	FSP	Info4	
2.6.1.b3		Buy order evaluation	If the DSO has created an offer, the FSP can evaluate whether he can provide a suitable sell order.	evaluates	FSP	FSP		
2.6.1.b4		Matching of DSO and FSP offer	Orders are matched based on location, price and volume, order time and VPP constraints.	selects	FMO	FMO		
2.6.2		FSP Trade confirmation	The FMO sends a trade confirmation to the FSP. Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed.	sends	FMO	FSP	Info 9	

2.6.3		DSO Trade confirmation	The FMO sends a trade confirmation to the DSO. Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed.	sends	FMO	DSO	Info9	
2.6.4		Usage of mandatory measures for remaining congestions	Remaining congestions need to be solved through mandatory processes (curtailment). OUT OF SCOPE FOR DEMONSTRATION (for detail see BUC DE-AP EU-Sysflex D6.1)	uses	DSO	DSO	Info10	
2.7		Update process	The steps 2.1 - 2.6 of the Selection/Bidding phase are iteratively repeated with updated data until market gate closure.					

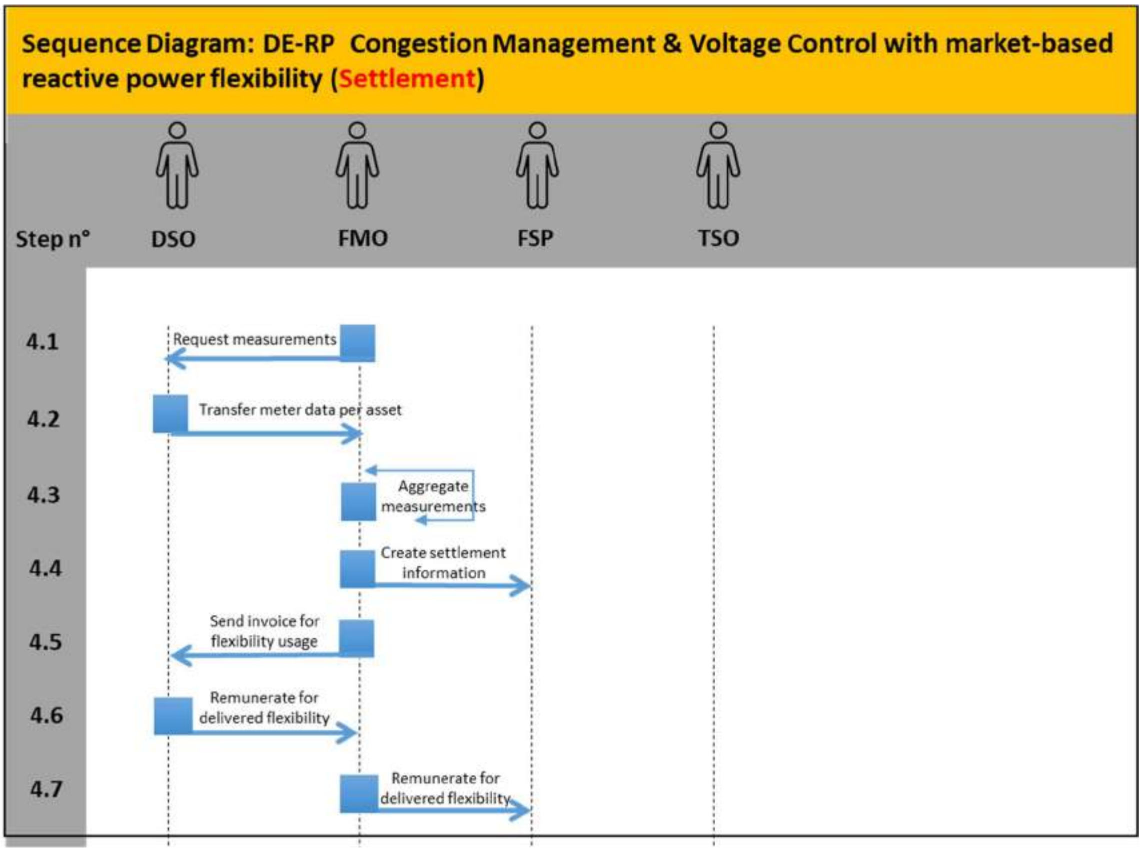
Delivery and Monitoring



Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1.		Flexibility provision	The FSP activates the flex resources based on the matched offers and baselines.	provides	FSP	DSO		
3.2		FSP dispatch of own energy assets	FSP controls the individual resources of the portfolio and activates them based on the confirmed trade conditions.	dispatches	FSP	RA/RP		
3.3		Measurement of delivered flexibility	DSO measures the dispatch of aggregated traded resources and, together with the baseline, this forms the basis for settlement.	measures	DSO	FSP	Info11	
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase.	prepares	DSO	DSO	Info11	
3.5		Portfolio measurement of FSP	FSP can measures the portfolios to serve its internal evaluations process and stores them for the case of contradictions with the DSO measurement	measures	RA/RP	FSP		

Settlement


Sequence Diagram: DE-RP Congestion Management & Voltage Control with market-based reactive power flexibility (Settlement)
Step n°
DSO
FMO
FSP
TSO
4.1
Request measurements
4.2
Transfer meter data per asset
4.3
Aggregate measurements
4.4
Create settlement information
4.5
Send invoice for flexibility usage
4.6
Remunerate for delivered flexibility
4.7
Remunerate for delivered flexibility

Scenario step by step analysis

Scenario								
Scenario name	Settlement							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1		Measurement request	FMO requests the necessary energy readings for settlement from the DSO.	requests	FMO	DSO		
4.2		Transfer meter data per asset	The DSO sends the meter data of the individual resources to the FMO	sends	DSO	FMO	Info11	
4.3		Measurement aggregation	FMO aggregates meter data per asset according to the portfolios.	aggregates	FMO	FMO	Info12	
4.4		Settlement information creation for FSP	FMO uses the measurement data to determine the delivery quantity and quality in relation to the baseline and calculates the payment flows. The result of the performance evaluation and the payment information is sent to the FSP.	sends	FMO	FSP	Info13	
4.5		Invoice for flexibility usage	The result of the settlement and the invoice for the used flexibility product are sent to the DSO, including a list with the flexibilities the FSP has activated.	sends	FMO	DSO	Info14	

4.6		FMO remuneration	The DSO settles the invoice and sends the payment to the FMO.	remunerates	DSO	FMO		
4.7		FSP remuneration	The FMO receives the DSO payment and distributes the funds to the individual FSPs.	remunerates	FMO	FSP		

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Asset Registration Data	Information needed for the prequalification assessment. A cos(phi) characteristic or any other active/reactive power correlation is additionally required for this use case[24]	
Info2	Prequalification notification	Message about the outcome of the prequalification process	
Info3	Baseline	Baseline determination rules are defined in the market rules	
Info4	Order description	Information needed for the evaluation of the offered flexibility product. *Order parameters* are typically price, volume and direction (up or down regulation)	
Info5	Exogenous Data	External parameters that influence the power flow e.g. weather data and other variables influencing the power flow	
Info6	Grid Measurement Data	Existing measurements of electrical quantities in the grid	
Info7	Customer Measurement Data	Existing measurements of electrical quantities at the customer connection point	

[24] At this stage in the project, only general information is required. That is: no upload of documents. Though, the topic was discussed also in the German demo to be implemented later

Info8	Congestion Forecast	Generation and Load estimation based on exogenous Data and resulting power flow	
Info9	Trade Confirmation	Information on which resources are to be activated and the amount of the adjustment in reactive power	
Info10	Information for mandatory processes	Data exchange for mandatory processes	
Info11	Metering Data of individual assets	Contains metering data for individual assets for the billing process	
Info12	Aggregated Metering Data	Meter data per portfolio for the billing process	
Info13	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it	
Info14	Invoice	Address of invoice receiver, time frame of flexibility, activation, activated generation/load assets, specific flexibility costs in €/MVArh per asset, total flexibility costs per asset in €, total flexibility costs in €, underlying regulation scheme	

6. Polish Demo Business Use Cases

6.1. BUC1 Poland

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

ID	Name of use case Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use "verb + description", e.g., operate the distribution's congestion management market or submit flexibility bid to the distribution's congestion management market.
PL-AP	Congestion Management & Voltage Control with market-based active power flexibility
What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.	
The Use Case deals with short term network operation and is divided into a day ahead and an intraday process. It is theoretically applicable for all voltage levels. However, the focus is on medium voltage. The UC explains how active power flexibility in distribution grids can be procured through the NODES market platform.	
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.	
- Alleviate physical congestions (overloading of lines/transformers, voltage band violations) with market-based active power flexibility in a cost-efficient way - Ensure that flexibility activation of market bids (local market) will not create grid constraints	
What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.	
General:	

- As there is currently no legal framework for the purchase of flexibility services in Poland, all settlements will be simulated - This BUC will focus on constraints which happen sporadically and which occur only in very specific and rare situations, e.g. the coincidence of large wind generation and underestimated consumption during weekends. Structural constraints are not considered in the demo. - The use case is based on the assumption that grid congestions can be forecasted - The DSO is responsible for ensuring a secure network operation and therefore takes the decision on the activation of flexibility

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
• Grid with sufficient measurement technology to detect congestions and/or voltage problems (including all power lines, switches, transformers…) • Local RES – wind farm and biogas plant, Battery Energy Storage (BES) System (DSO owned). Yet, for the demo, BES will be treated as a source of flexibility not owned by the DSO.

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
Interactions could arise with the • use case of market-based use of reactive power flexibility • switching operations and other measures in the grid that may influence the power flow

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.

Congestion management and voltage control are implemented to remedy physical congestions and voltage violations by the usage of market-based flexibility.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Mandatory
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
• Services: o Congestion management o Voltage control • Market Mechanisms: o Local flexibility markets

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
With the help of iterative network calculations and transmitted baselines, a forecast of possible congestions is made. In event of a congestion, the DSO can find and activate flexibility via a market platform, which helps him to alleviate the congestion by changing load/generation. The baseline is available to the DSO on the market platform and will be detailed in D2.3 (system use cases). The Use Case is divided into the 4 phases Prequalification, Selection/Bidding, Delivery and Settlement: 1. Registration and *Prequalification*: Product definitions and initial pre-qualification including` framework agreement with baseline delivery requirements on NODES market platform 2. *Selection/Bidding*: Forecasts of congestions are made. Flexibility products are offered on NODES market platform by Flexibility Service Providers using resources from Resource Providers The DSO uses the flexibility market to solve the congestion by either using already present FSP offers or placing a buy offer for the congested location. The flexibility needs to be within the grid area where the need is located. The FSP is notified about the results of the selection process. 3. *Activation/Delivery and Monitoring*: Flexibility resources are activated. The selected flexibility product is delivered. DSO validates the delivery. 4. *Settlement*: DSO transmits the metering data to the Flexibility Market Operator. Settlements are sent.
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., "main success scenario") from a domain expert user's point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions. While writing the narrative, please consider the following:[25] • Use "just one sentence form": ▪ Use present tense. ▪ Use active verb in the active voice. ▪ Describe actions that move the process forward. ▪ For instance, "customer enters card and pin into ATM"

[25] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

Keep it simple and to the point so that non-domain experts can understand it.   Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case. We suggest including the following aspects into the narrative: ○ Type of mechanism used (Market or other – please be specific) ○ Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system") ○ Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA) ○ Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data) ○ Relevant phase (e.g., pre-qualification, procurement, activation, settlement)
Registration and Prequalification phase: - The RP registers itself on the NODES market platform under conditions given by the FMO and DSO - After a positive DSO verification result, the RP becomes an FSP and gets full access to the market platform. *Selection/Bidding*: a) Day ahead - Active power flexibility products are offered on the flexibility market. These can be based on two scenarios: **1) DSO uses offers already present at the flexibility market** - The FSP can create offers on the market for the following day and has to provide baselines for the respective resources based on their estimated availability - The DSO uses forecasts to estimate grid states and predict congestions - The DSO extracts available sell orders from the market platform **2) DSO motivates offers by stating a demand** - This option is used in case there are insufficient offers on the market

- DSO states needs for active power flexibility products, i.e. places a demand flexibility bid (volume and price)

- FSPs can create a matching offer to the DSO need on the market and have to provide baselines for the respective resources based on their estimated availability

- DSO evaluates the bids based on grid constraints to ensure a secure grid operation and selects the flexibility products, based on optimization methods to maximize social welfare/minimize activation cost.

- Orders are matched based on location, price and volume and confirmations are sent to the parties participating in the trade

- The steps are iteratively repeated until the start of the intraday process

b) Intraday

- The steps of the day-ahead process are repeated but with a higher granularity until activation time

Activation/Delivery and Monitoring:

- Flexibility resources are activated by the FSPs following the information received from the DSO through the flexibility market platform.

- The flexibility is delivered.

Settlement:

- DSO collects the metering data and transmits it to the FMO

- FMO validates the delivery based on the metering data and the provided baselines

- FMO creates settlement information for FSP and DSO

Technical details

<u>Actors</u>

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	*Actor type*	*Description (if different from the EUniversal Role model)*	*Further information specific to this use case*
DSO	Role		
FMO	Role		
FSP	Role		
RP	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define “success” or “failure” conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market	RP	new RP wants to qualify new assets for flexibility market	RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market and will be visible to the DSO. If the prequalification is not successful, the RP cannot register the assets nor create offers on the flexibility market.
2	Selection/Bidding	Planning of grid utilisation and identifying potential congestions, followed by bid	DSO, FMO, FSP	Congestion forecast, Available flexibility	Available active power flexibility connected; Prequalified FSPs	When bids are matched, flexibility of the local market is used for congestion

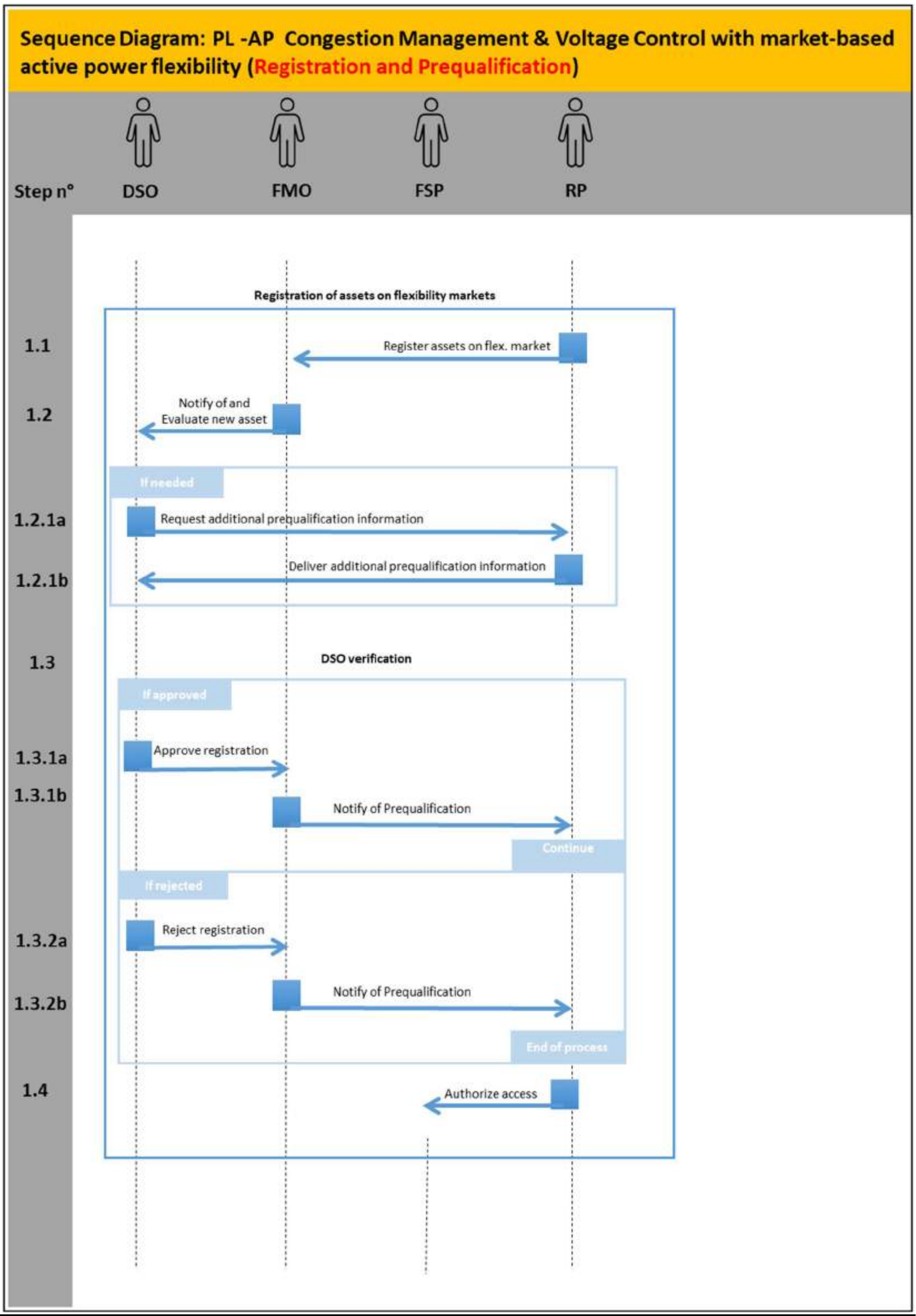
		submission, evaluation, and matching				management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP	Activation signal sent by FMO	Matching bids on the flexibility market	The actual provided flexibility is delivered. Congestions are eliminated. The delivery of flexibility is proven by metering data sent from DSO to the FMO.
4	Settlement (in the project as a simulation)	Invoicing and Payments	FMO, FSP, DSO	The DSO pays the FSP for the flexibility delivery	Delivered active Power flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which links to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
    - Input to the use case from some external source that is not described in this use case,
    - Internal to the use case (although could be between different applications and systems within the use case),
    - Output from the use case that will be used by other actors / entities not included in this use case.
    - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification

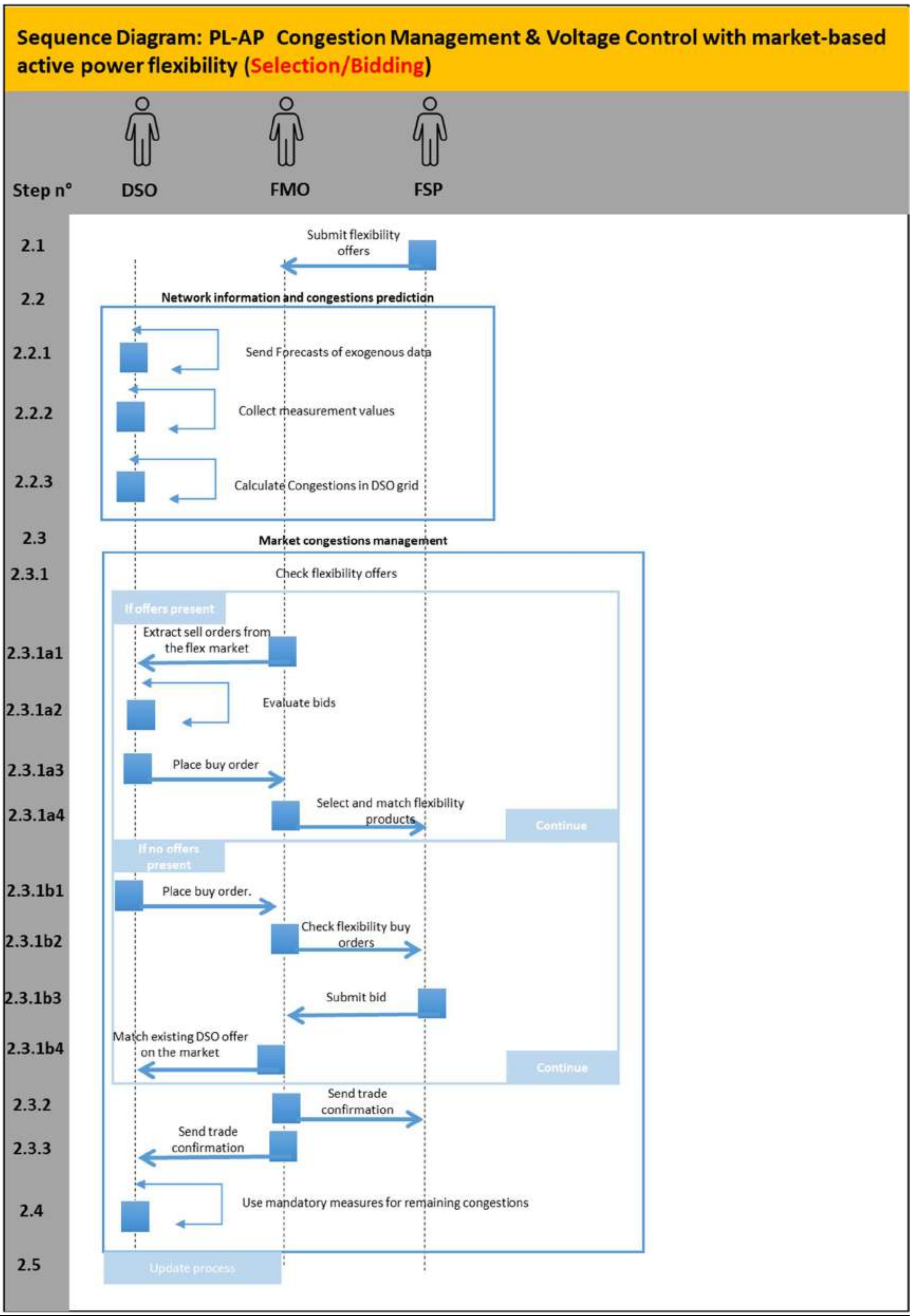


Scenario step by step analysis

Scenario								
Scenario name	Registration and Prequalification							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions and they prove their eligibility	Registers	RP	FMO		
1.2		New asset notification and evaluation	FMO sends notification that a new asset has been registered and needs to be approved. DSO can consult information for approval to market on the platform. DSO evaluates the potential flexibility asset by the submitted documentation on the market platform and evaluates the flexibility offer and the need for additional information. A real flexibility activation test shall be performed. This can be an iterative process.	Sends	FMO	DSO	Info1	
1.2.1a		Request of additional prequalification information	DSO can request additional information for the prequalification	Requests	DSO	RP		

1.2.1b		Delivery of additional prequalification information	RP sends additional information for the prequalification to the DSO	Sends	RP	DSO	Info1	
1.3		DSO verification	DSO verifies the new asset and assigns it to a location					
1.3.1a		DSO registration approval	DSO approves registration on the market platform. Corresponding asset can participate in the flexibility market	approves	DSO	FMO		
1.3.1b		Prequalification notification	The RP receives a notification about the outcome of the prequalification process of the new asset	sends	FMO	RP	Info2	
1.3.2a		DSO registration rejection	DSO rejects registration on the market platform. Respective asset cannot take part in the flexibility market	reject	DSO	FMO		
1.3.2b		Prequalification notification	The RP receives a notification about the outcome of the prequalification process of the new asset	sends	FMO	RP	Info2	
1.4		Access authorisation	RP becomes an FSP and gets full access to the market platform.	becomes	RP	FSP		

Selection/Bidding



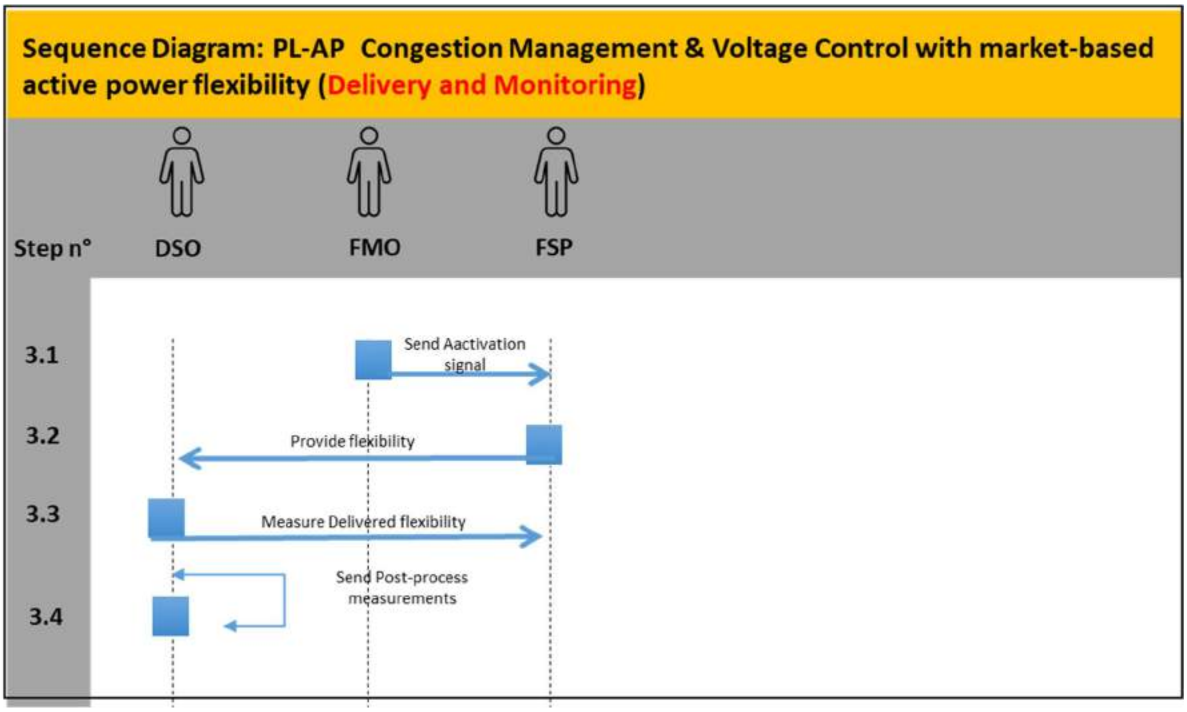
Scenario step by step analysis

Scenario								
Scenario name	Selection/Bidding							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.1		FSPs flexibility offers submission	FSPs submit flexibility offers and baselines for the respective resources based on their estimated availability	sends	FSP	FMO	Info3	
2.2		Network information and congestions prediction	DSO performs grid evaluating algorithms using topology, measurement and market related data					
2.2.1		Forecasts of exogenous data	Using statistical methods, the DSO predicts development of exogenous data	includes	DSO	DSO	Info4	
2.2.2		Collection of measurement values	DSO incorporates measurements of electrical quantities such as voltage, current, cos(phi) from measurement points installed in the grid for use in the analysis algorithms	collects	DSO	DSO	info65	
2.2.3		Congestions calculation in DSO grid	Based on grid topology, generation and load forecasts (including exogenous data), state estimation and asset utilization are calculated	calculates	DSO	DSO	Info6	

2.3		Market congestions management	The DSO uses the flexibility market to mitigate the congestions					
2.3.1		Checking of flexibility offers	If there are suitable offers on the flexibility market, the DSO can select them directly or otherwise generate a buy order himself, specifying the order description.					
2.3.1.a1		Extraction of sell orders from the flexibility market	If offers are present on the flexibility market, the DSO extracts them from the flexibility market	extracts	FMO	DSO	Info3	
2.3.1.a2		DSO evaluation of bids	The evaluation is performed using optimisation algorithms in consideration of grid constraints ensuring the safe operation of the grid	evaluates	DSO	DSO		
2.3.1.a3		DSO place a buy order.	DSO place a buy order.	sends	DSO	FMO		
2.3.1.a4		Selection and matching of flexibility products	Orders are matched based on the previously performed evaluations considering location, price and volume, order time and constraints	selects	FMO	FSP		
2.3.1.b1		DSO buy order	If there are not sufficient offers on the flexibility market, the DSO motivates offers by stating a demand on the market.	sends	DSO	FMO	Info3	
2.3.1.b2		Checking of flexibility buy orders	If the DSO has created an offer, the FSP can view it on the market and evaluate whether he can provide a suitable offer.	provides	FMO	FSP	Info3	

			FMO sends notification that a new buy order was placed.					
2.3.1.b3		FSP bid submission	If the DSO had created an offer, the FSP can evaluate whether he can provide a suitable sell order.	Submit	FSP	FMO		
2.3.1.b4		Matching of existing DSO offer on the market	Orders are matched based on location, price and volume, order time and constraints	selects	FMO	DSO		
2.3.2		Trade confirmation for the FSP	Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed	sends	FMO	FSP	Info7	
2.3.3		Trade confirmation for the DSO	Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed	sends	FMO	DSO	Info7	
2.4		Usage of mandatory measures for remaining congestions	Remaining congestions need to be solved through mandatory processes (curtailment, Feed-In Management, curtailment). OUT OF SCOPE FOR DEMONSTRATION	uses	DSO	DSO		
2.5		Update process						

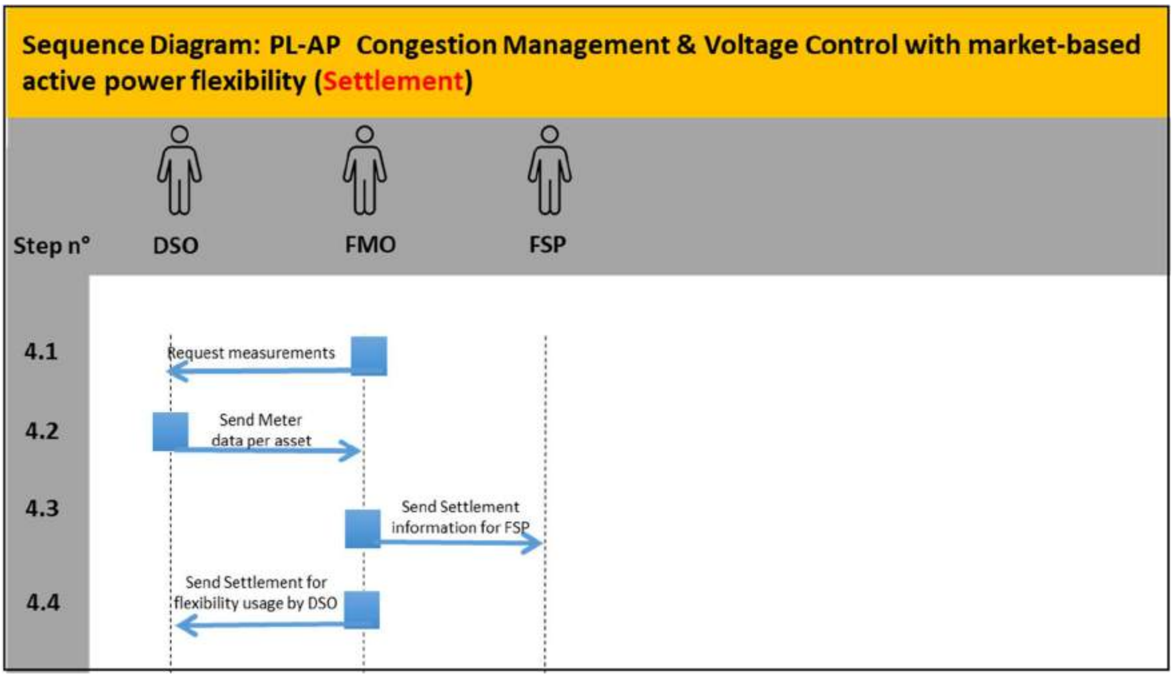
Delivery and Monitoring



Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1		Activation signal	Activation signal is sent to the affected parties	sends	FMO	FSP		
3.2		Flexibility provision	The FSP activates the flex resources based on the matched offers and baselines.	provides	FSP	DSO		
3.3		Delivered flexibility measurement	DSO measures the dispatch of traded resources and, together with the baseline, forms the basis for settlement.	collects	DSO	FSP	Info8	
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase	acquire	DSO	DSO		

Settlement



Sequence Diagram: PL-AP Congestion Management & Voltage Control with market-based active power flexibility (Settlement)
Step n°
DSO
FMO
FSP
4.1
Request measurements
4.2
Send Meter data per asset
4.3
Send Settlement information for FSP
4.4
Send Settlement for flexibility usage by DSO

Scenario step by step analysis

Scenario								
Scenario name	Settlement[26]							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1		Requesting measurements	FMO requests the necessary energy readings for settlement from the DSO	sends	FMO	DSO		
4.2		Meter data per asset	The DSO sends the meter data of the individual resources to the FMO	sends	DSO	FMO		
4.3		Settlement information for FSP	Based on the offer, baseline and meter data, FMO prepares the settlement of the service.	sends	FMO	FSP	Info9	
4.4		Settlement for flexibility usage by DSO	Based on the offer, baseline and meter data, FMO prepares the settlement of the service.	sends	FMO	DSO	Info9	

[26] Settlement is not implemented in the field test, this part will only be simulated.

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Asset Registration Data	Information needed for the prequalification assessment	
Info2	Prequalification notification	Message about the outcome of the prequalification process	
Info3	Order description	Information needed for the evaluation of the offered flexibility product. Order parameters are typically price, volume and direction (up or down regulation) but also support setting a separate price on reservation and activation of flexibility	
Info4	Exogenous Data	External parameters that influence the power flow e.g. weather data and other variables influencing the power flow	
Info5	Grid Measurement Data	Existing measurements of electrical quantities in the grid	
Info6	Congestion Forecast	Generation and Load estimation based on exogenous Data and resulting power flow	

Info7	Trade Confirmation	Information on which resources are to be activated and the amount of the adjustment	
Info8	Metering Data	Contains metering data for billing process	
Info9	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it	

6.2. BUC2 Poland

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

ID	Name of use case
ID	***Name of use case*** Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use "verb + description", e.g., operate the distribution's congestion management market or submit flexibility bid to the distribution's congestion management market.
PL-RP	Polish Demo - Congestion Management & Voltage Control with market-based reactive power flexibility

What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.
The Use Case deals with short term network operation and is divided into a day ahead and an intraday process. It is theoretically applicable for all voltage levels. However, the focus is on medium voltage. The UC explains how reactive power flexibility in distribution grids can be procured through a NODES market platform. In EUniversal, we do not take into account the connection of reactive power with active power. We will test both use-cases independently
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.
- Reduction of Physical Congestions (overloading of lines/transformers, voltage band violations) with market-based reactive power flexibility in a cost-efficient way - Ensure that flexibility activation of market bids (local market) will not create grid constraints
What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
General: - As there are currently no legal regulations regarding the purchase of flexibility services in Poland, all settlements will be simulated

- BUC will focus on constraints which happen sporadically and which occur only in very specific and rare situations, e.g. the coincidence of large wind generation and underestimated consumption during weekends. Structural constraints are not considered. - The use case is based on the assumption that grid congestions can be forecasted - The DSO picks the most efficient option (switching options for meshed grids, most appropriate offer on the market) to ease the forecasted congestion. - The DSO is responsible for ensuring a secure network operation and therefore takes the decision on the activation of flexibility

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
• Grid with sufficient measurement technology to detect congestions and/or voltage problems (including all power lines, switches, transformers…) • Local RES – wind farm and biogas plant, Battery Energy Storage (BES) System (DSO owned). Yet, for the demo, BES will be treated as a source of flexibility not owned by the DSO.

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
Interactions could arise with the • use case of market-based use of reactive power flexibility • switching operations and other measures in the grid that may influence the power flow

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Congestion management and voltage control are implemented to remedy physical congestions and voltage violations by the use of market-based reactive power flexibility.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have

» Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Mandatory
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).

• Services:
  o Congestion management
  o Voltage control
• Market Mechanisms:
  o Local flexibility markets

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
With the help of iterative network calculations and transmitted baselines, a forecast of possible congestions is made. In event of a congestion, the DSO can find and activate flexibility via a market platform, which helps him to ease the congestion by changing load/generation. The Use Case is divided into the 4 phases Prequalification, Selection/Bidding, Delivery and Settlement: 1. Registration and Prequalification: Product definitions and initial pre-qualification including framework agreement with baseline delivery requirements 2. Selection/Bidding: Forecasts of congestions are made. Flexibility products are offered on NODES market platform by Flexibility Service Providers using resources from Resource Providers The DSO uses the flexibility market to solve the congestion by either using already present FSP offers or placing a buy FS offer for the congested location. The flexibility service needs to be at the same location as the need. The FSP is notified about the selected resources. 3. Activation/Delivery and Monitoring: Flexibility resources are activated. The selected flexibility product is delivered. DSO validates the delivery. 4. Settlement phase: DSO transmits the metering data to the Flexibility Market Operator. Invoices are sent, and payments are made.
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., “main success scenario”) from a domain expert user’s point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the

service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions.

While writing the narrative, please consider the following:[27]

- Use "just one sentence form":
  - Use present tense.
  - Use active verb in the active voice.
  - Describe actions that move the process forward.
  - For instance, "customer enters card and pin into ATM"
- Keep it simple and to the point so that non-domain experts can understand it.

Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.

We suggest including the following aspects into the narrative:

- Type of mechanism used (Market or other – please be specific)
- Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system")
- Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA)
- Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)
- Relevant phase (e.g., pre-qualification, procurement, activation, settlement)

Registration and Prequalification phase:

- The RP registers itself on the NODES market platform under conditions given by the FMO and DSO

- The RP must perform regulation evaluations and tests. After positive DSO verification result, the RP becomes an FSP and get full access to the market platform.

Selection/Bidding:

a) Day ahead

[27] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

- Reactive power flexibility products are offered on the flexibility market. These can be based on two scenarios:

1) DSO uses offers already present at the flexibility market

- The FSP can create offers on the market for the following day and has to provide baselines for the respective resources based on their estimated availability

- The DSO uses forecasts to estimate grid states and predict congestions

- The DSO extracts available sell orders from the market platform

2) DSO motivates offers by stating a demand

- This option is used in case there are insufficient offers on the market

- DSO states needs for reactive power flexibility products

- FSPs can create a matching offer to the DSO need on the market and have to provide baselines for the respective resources based on their estimated availability

- DSO evaluates the bids based on grid constraints to ensure a secure grid operation and selects the flexibility products, based on optimization methods to maximize social welfare/minimize activation cost.

- Orders are matched based on location, price and volume and confirmations for the parties participating in the trade are sent

- The steps are iteratively repeated until the start of the intraday process

b) Intraday

- The steps of the day-ahead process are repeated but with a higher granularity until activation time

Activation/Delivery and Monitoring:

- Flexibility resources are activated by the FSPs. Following the information received from the DSO through the flexibility market platform.

- The flexibility is delivered.

Settlement:

- DSO collects the metering data (by means of a four-quadrant AMI meter) and transmits it to the FMO

- FMO validates the delivery based on the metering data and the provided baselines

- FMO creates settlement information for FSP and DSO

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	*Actor type*	*Description (if different from the EUniversal Role model)*	*Further information specific to this use case*
DSO	Role		
FMO	Role		
FSP	Role		
RP	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define "success" or "failure" conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market	RP	new RP wants to qualify new assets for flexibility market	RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market and will be visible to the DSO. If the prequalification is not successful, the RP cannot register the assets nor create offers on the flexibility market.

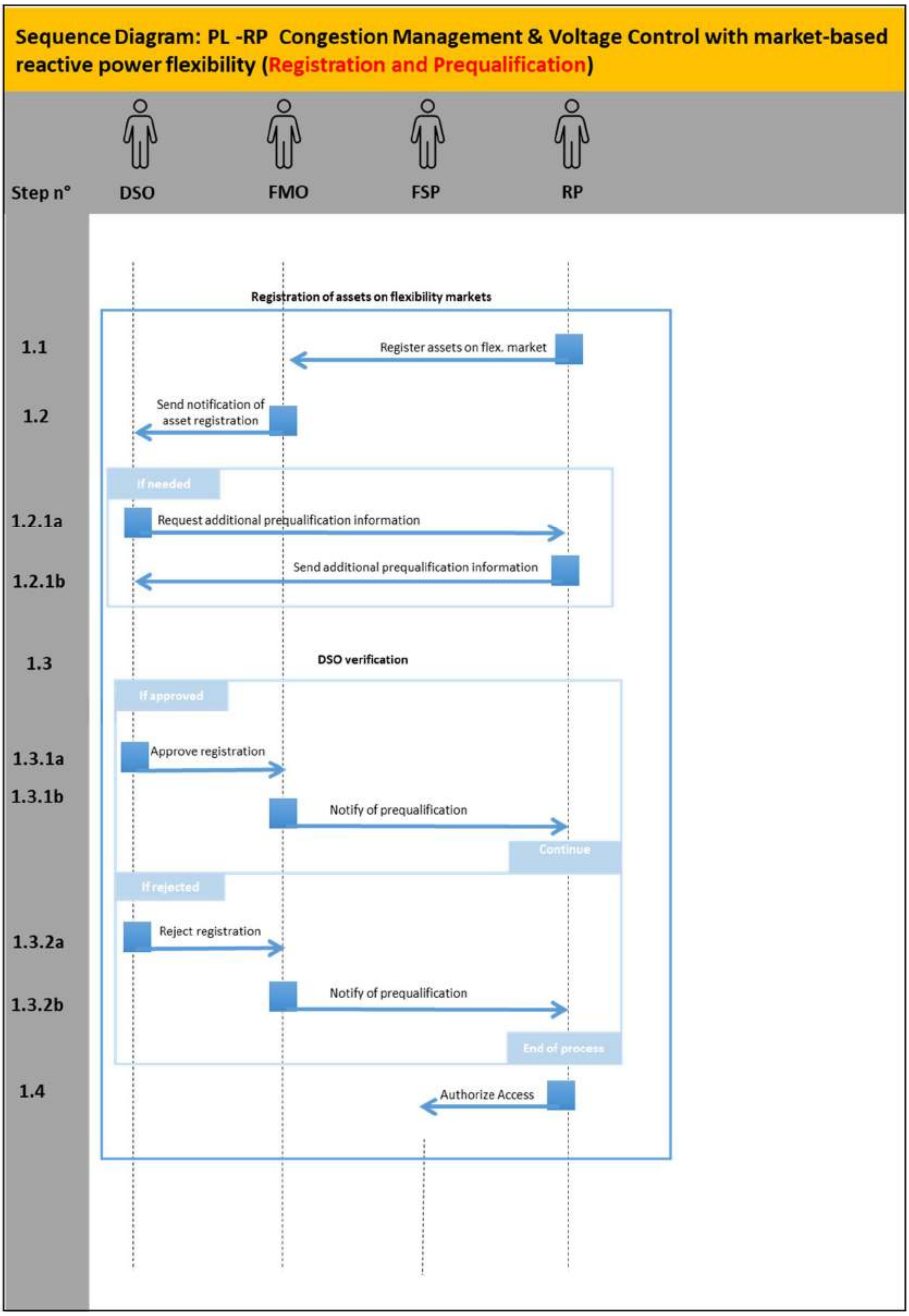
2	Selection/Bidding	Planning of grid utilisation and identifying potential congestions, followed by bid submission, evaluation, and matching	DSO, FMO, FSP	Congestion forecast, Available flexibility	Available active power flexibility connected; Prequalified FSPs	When bids are matched, flexibility of the local market is used for congestion management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP, FMO	Activation signal sent by FMO	Matching bids on the flexibility market	The actual provided flexibility is delivered. Congestions are eliminated. The delivery of flexibility is proven by metering data sent from DSO to the FMO.
4	Settlement (in the project as a simulation)	Invoicing and Payments	FMO, FSP, DSO	The DSO pays the FSP for the flexibility delivery	Delivered active Power flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
  - Input to the use case from some external source that is not described in this use case,
  - Internal to the use case (although could be between different applications and systems within the use case),
  - Output from the use case that will be used by other actors / entities not included in this use case.
  - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification

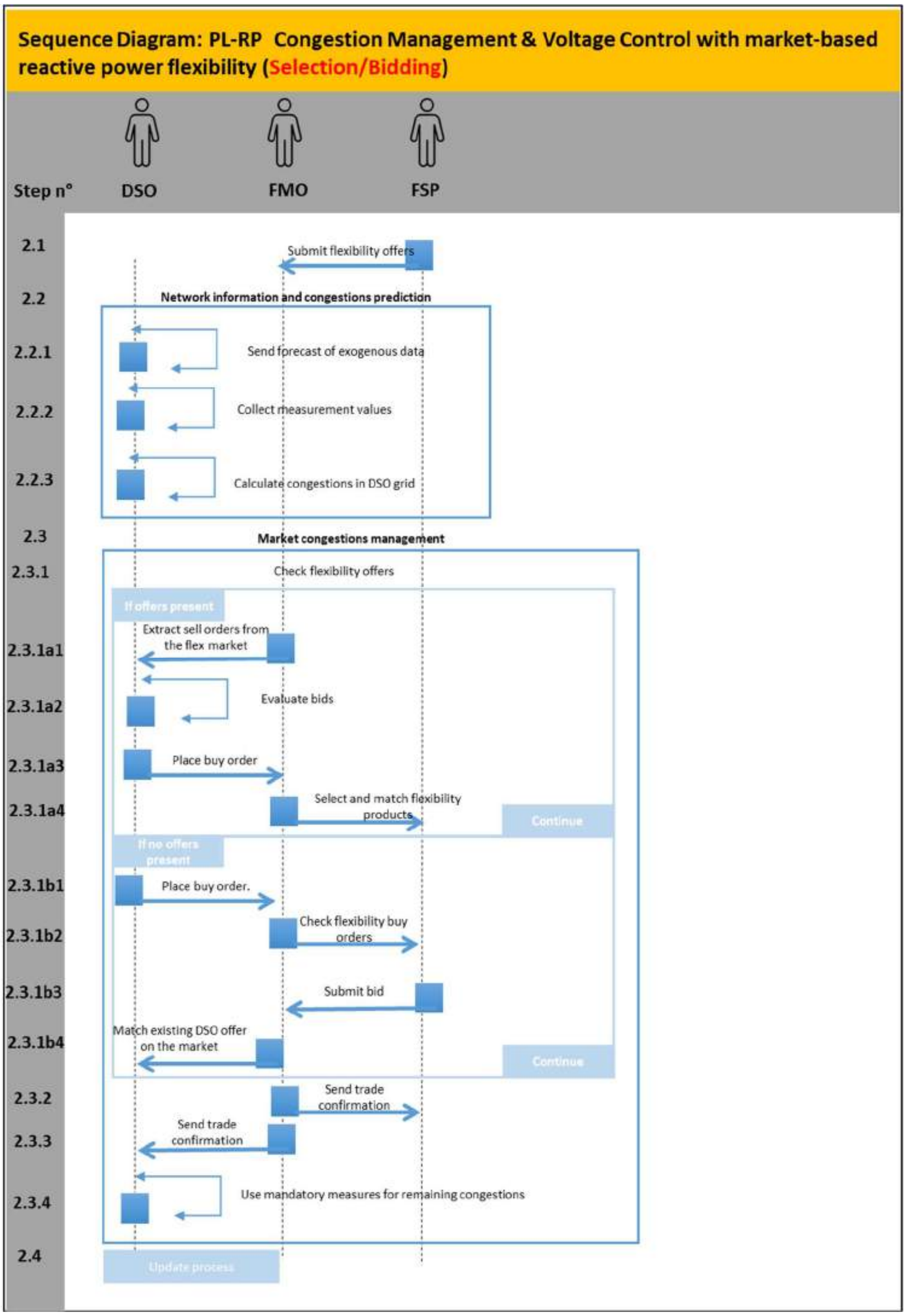


Scenario step by step analysis

Scenario								
Scenario name		Registration and Prequalification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions	Registers	RP	FMO		
1.2		New asset notification and evaluation	FMO sends notification that a new asset has been registered and needs to be approved. DSO can consult information for approval to market on the platform. DSO evaluates the potential flexibility asset by the submitted documentation on the market platform and evaluates the flexibility asset and the need for additional information. A real flexibility activation test shall be performed. This can be an iterative process.	Sends	FMO	DSO	Info1	
1.2.1a		Request of additional prequalification information	DSO can request additional information for the prequalification	Requests	DSO	RP		

1.2.1b		Delivery of additional prequalification information	RP sends additional information for the prequalification to the DSO	Sends	RP	DSO	Info1	
1.3		Asset verification	DSO verifies the new asset and assigns it to a location					
1.3.1a		Registration approval	DSO approves registration on the market platform. Corresponding asset can participate in the flexibility market	approves	DSO	FMO		
1.3.1b		Prequalification notification	The RP receives a notification about the outcome of the prequalification process of the new asset	sends	FMO	RP	Info2	
1.3.2a		Registration rejection	DSO rejects registration on the market platform. Respective asset cannot take part in the flexibility market	reject	DSO	FMO		
1.3.2b		Prequalification notification	The RP receives a notification about the outcome of the prequalification process of the new asset	sends	FMO	RP	Info2	
1.4		Access authorisation	RP becomes an FSP and gets full access to the market platform.	becomes	RP	FSP		

Selection/Bidding



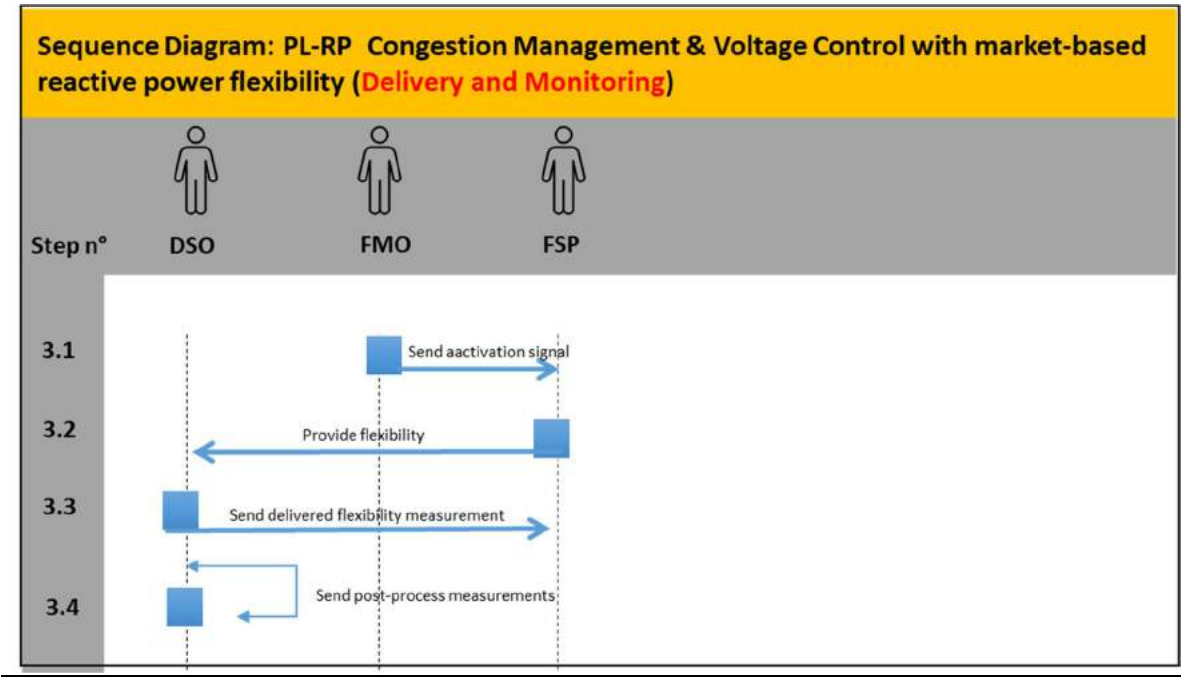
Scenario step by step analysis

Scenario								
Scenario name		Selection/Bidding						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.1		Flexibility offers submission	FSPs submit flexibility offers and baselines for the respective resources based on their estimated availability	sends	FSP	FMO	Info3	
2.2		Network information and congestions prediction	DSO performs grid evaluating algorithms using topology, measurement and market related data					
2.2.1		Forecasts of exogenous data	Using statistical methods, the DSO predicts development of exogenous data	includes	DSO	DSO	Info4	
2.2.2		Collection of measurement values	DSO incorporates measurements of electrical quantities such as voltage, current, cos(phi) from measurement points installed in the grid for use in the analysis algorithms	collects	DSO	DSO	info65	
2.2.3		Congestions calculation in DSO grid	Based on grid topology, generation and load forecasts (including exogenous data),	calculates	DSO	DSO	Info6	

			state estimation and asset utilization are calculated					
2.3		Market congestions management	The DSO uses the flexibility market to mitigate the congestions					
2.3.1		Checking of flexibility offers	If there are suitable offers on the flexibility market, the DSO can select them directly or otherwise generate a buy order himself, specifying the order description.					
2.3.1.a1		Extraction of sell orders from the flexibility market	If offers are present on the flexibility market, the DSO extracts them from the flexibility market	extracts	FMO	DSO	Info3	
2.3.1.a2		DSO evaluation of bids	The evaluation is performed using optimisation algorithms in consideration of grid constraints ensuring the safe operation of the grid	evaluates	DSO	DSO		
2.3.1.a3		DSO place a buy order.	DSO place a buy order.	sends	DSO	FMO		
2.3.1.a4		Selection and matching of flexibility products	Orders are matched based on the previously performed evaluations considering location, price and volume, order time and constraints	selects	FMO	FSP		
2.3.1.b1		DSO buy order	If there are not sufficient offers on the flexibility market, the DSO motivates offers by stating a demand on the market.	sends	DSO	FMO	Info3	

2.3.1.b2		Checking of flexibility buy orders	If the DSO has created an offer, the FSP can view it on the market and evaluate whether he can provide a suitable offer. FMO sends notification that a new buy order was placed.	provides	FMO	FSP	Info3	
2.3.1.b3		FSP bid submission	If the DSO had created an offer, the FSP can evaluate whether he can provide a suitable sell order.	Submit	FSP	FMO		
2.3.1.b4		Matching of existing DSO offer on the market	Orders are matched based on location, price and volume, order time and constraints	selects	FMO	DSO		
2.3.2		Trade confirmation for the FSP	Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed	sends	FMO	FSP	Info7	
2.3.3		Trade confirmation for the DSO	Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed	sends	FMO	DSO	Info7	
2.3.4		Usage of mandatory measures for remaining congestions	Remaining congestions need to be solved through mandatory processes (curtailment, Feed-In Management, curtailment). OUT OF SCOPE FOR DEMONSTRATION	uses	DSO	DSO		
2.4		Update process						

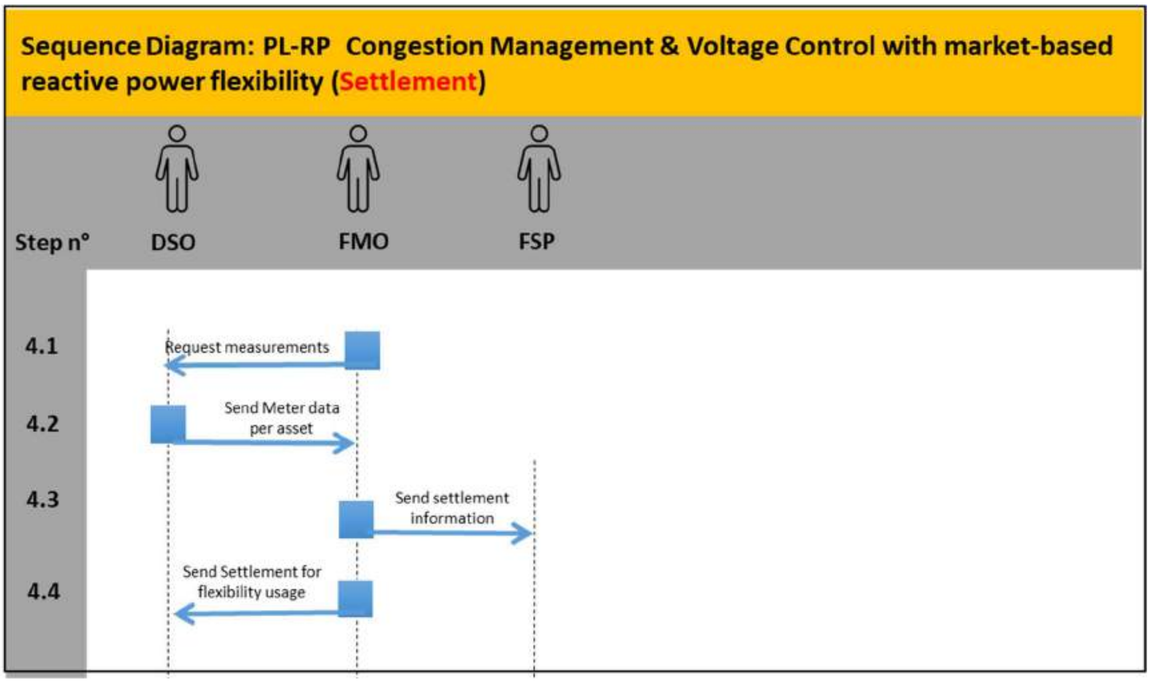
Delivery and Monitoring



Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1		Activation signal	Activation signal is sent to the affected parties	sends	FMO	FSP		
3.2		Flexibility provision	The FSP activates the flex resources based on the matched offers and baselines.	provides	FSP	DSO		
3.3		Delivered flexibility measurement	The DSO measures the dispatch of traded resources and, together with the baseline, forms the basis for settlement.	collects	DSO	FSP	Info8	
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase	acquire	DSO	DSO		

Settlement


Sequence Diagram: PL-RP Congestion Management & Voltage Control with market-based reactive power flexibility (Settlement)
Step n°
DSO
FMO
FSP
4.1
Request measurements
4.2
Send Meter data per asset
4.3
Send settlement information
4.4
Send Settlement for flexibility usage

Scenario step by step analysis

Scenario									
Scenario name	Settlement[28]								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1		Requesting measurements	FMO requests the necessary energy readings for settlement from the MDO	sends	FMO	DSO		
4.2		Meter data per asset	The DSO sends the meter data of the individual resources to the FMO	sends	DSO	FMO		
4.3		Settlement information for FSP	Based on the offer, baseline and meter data, FMO prepares the settlement of the service.	sends	FMO	FSP	Info9	
4.4		Settlement for flexibility usage by DSO	Based on the offer, baseline and meter data, FMO prepares the settlement of the service.	sends	FMO	DSO	Info9	

[28] Settlement is not implemented in the field test, this part will only be simulated.

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Asset Registration Data	Information needed for the prequalification assessment	
Info2	Prequalification notification	Message about the outcome of the prequalification process	
Info3	Order description	Information needed for the evaluation of the offered flexibility product. Order parameters are typically price, volume and direction (up or down regulation) but also support setting a separate price on reservation and activation of flexibility	
Info4	Exogenous Data	External parameters that influence the power flow e.g. weather data and other variables influencing the power flow	
Info5	Grid Measurement Data	Existing measurements of electrical quantities in the grid	
Info6	Congestion Forecast	Generation and Load estimation based on exogenous Data and resulting power flow	

Info7	Trade Confirmation	Information on which resources are to be activated and the amount of the adjustment	
Info8	Metering Data	Contains metering data for billing process	
Info9	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it	

6.3. BUC3 Poland

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

ID	***Name of use case*** Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use "verb + description", e.g., operate the distribution's congestion management market or submit flexibility bid to the distribution's congestion management market.
PL-DLR	Congestion management using permissible line capacity based on Dynamic Line Rating (DLR) system
What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.	
The Use Case deals with short-term network operation and covers both a day ahead and an intraday process. The Use Case refers to DSO flexibility service originating from full line capacity utilisation based on the dynamic line rating. A DSO-owned line capacity sell order is dedicated to the weather-dependent RES energy producers in the case when the forecasted renewable power generation hourly profile exceeds the power limit defined in the connection agreement.	
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.	
- In the short term, it allows more efficient power flow by avoiding the so-called "bottleneck" through monitoring the distances of the wires to the ground and thus estimating the capacity reserve resulting from normative limits of the distance to the earth. - The main objective is to sell the flexibility service to the RES energy producers in case their expected production exceeds the power limit defined in the connection agreement.	
What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.	
General:	

- The limiting line capacity factor is the safety of the line operation, which means that all the time in every span the clearance should be kept within the normative limit. The use case assumes that in the traditional approach, line capacity is limited by static line rating (SLR) values depending on the season of the year, while dynamic line rating (DLR) is based on actual short-term, i.e. day-ahead[29] forecasted weather conditions along the line, especially in the critical line spans. In most cases, DLR line capacity values are greater than the SLR values. DSO is authorised to limit RES generation in case if this condition is not fulfilled and there are no other means to provide the safety of the lines, no matter what static line rating values are there. Network code requirements: - In emergency situations, which could endanger system stability and security, system operators should have the possibility to instruct that the output of power-generating modules be adjusted in a way that allows system operators to meet their responsibilities for system security.

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
• DSO-owned 110 kV overhead lines involved in the power outlet from wind farms to the network. • Wind Farm (WF) power-generating module type D acc. Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators. The power-generating modules shall comply with the requirements based on the voltage level of their connection point. Generating module type D is specified as "connection point at 110 kV or above (type D)". Network code requirements: In emergency situations that could endanger system stability and security, system operators should have the possibility to instruct that the output of power-generating modules be adjusted in a way that allows system operators to meet their responsibilities for system security.

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
There are no interactions to other Use Cases.

[29] Lines capacity calculation DLR is done as frequently as the new weather forecast is delivered (usually every 6 h) with the 72 h horizon.

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Dynamic line rating of 110 kV lines is used as a flexibility service for congestion management alleviation caused by weather-dependent RES producers.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Optional - the use case may be deployed especially in this case when the DLR system is already utilised in the DSO IT environment Nice to have - it seems that it is the only use case among all demos where the DSO is at the seller side
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
• Services: o Congestion management • Market Mechanisms: o flexibility market Comments: For the physical reason, there is no competition on the market between 110 kV lines' flexible load capacity sellers, due to property rights. The only market factor is the price per MWh of extended (additional) Wind Farm generation which might be negotiated between the above-mentioned partners. DSO is the sole Flexibility Service Provider (FSP) (seller) while a Producer – (RES Wind Farm) with a capacity of more then 30 MW can be the only buyer of the rights to the extended generation, which in turn might be the result of the flexible line capacity calculated on the base of DLR.

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
The Use Case is divided into the 4 phases Authorization, Selection/ (Technical estimation), Delivery and Settlement: 1. Authorization: The Producer (RES-WF owner) and DSO are authorised to access the market platform on the basis of the existing connection agreement. The authorisation is a one-time process, e.g. once per year. It will be determined in the future how this process will proceed, with the intermediate role of the market platform operator or directly between the DSO and Producer. 2. Selection / (Technical estimation): The producer (RES-WF owner) applies for temporary enhancement of power generation by submitting a buy order. The producer can issue a buy order at any time of the day (intraday), until 60 minutes before the real-time operation. DSO performs a day-ahead power flow calculation and a forecasted capacity assessment with the DLR system of the 110 kV line, based on the weather condition forecast. DSO estimates possible line congestion (bottleneck). DSO submits sell order to FMO with appropriate power generation profile and price values. 3. Delivery and monitoring: Flexibility service is activated according to the matched buy and sell orders (and related product/service parameters). DSO monitors (supervises) lines load congestion and Producer generation. In case of the line security threat, the DSO takes appropriate action (out of the scope of this BUC). DSO and Producer measure the power generation delivery. 4. Settlement: FMO arranges settlement.

Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., "main success scenario") from a domain expert user's point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions.
 	
While writing the narrative, please consider the following:[30]
 	
• Use "just one sentence form":
  ▪ Use present tense.
  ▪ Use active verb in the active voice.
  ▪ Describe actions that move the process forward.
  ▪ For instance, "customer enters card and pin into ATM"

[30] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

- Keep it simple and to the point so that non-domain experts can understand it.   Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case. We suggest including the following aspects into the narrative: - Type of mechanism used (Market or other – please be specific)   - Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system")   - Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA)   - Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)   - Relevant phase (e.g., pre-qualification, procurement, activation, settlement)
Authorization phase: The Producer (RES-WF owner) and DSO are authorised to access the market platform on the basis of the existing connection agreement. The authorisation is a one-time process, e.g. once per year. It will be determined in the future how this process will proceed, with the intermediate role of the market platform operator or directly between the DSO and Producer. The buy order will be issued in the case when planned (forecasted) next day generation exceeds connection power agreed in "connection agreement" i.e., the contract between the relevant system operator (DSO). The sell order will be issued in the case when line capacity limits allow for the accommodation in the 110 kV network the production profile set in the buy order. *Selection/technical evaluation*: The producer applies for a temporary enhancement of power generation by submitting a buy order with the relevant requested generation profile and price proposal. This order can be placed until 60 minutes before real-time operation. DSO performs a day-ahead power flow calculation and a forecasted capacity assessment with the DLR system of the 110 kV line, based on the weather condition forecast. DSO estimates possible line congestion (bottleneck). DSO submits a sell order to the FMO with the allowable value of the production profile and corresponding prices.

The allowable production profile is calculated using OPF algorithm, and the admissible line capacities calculated using DLR calculation.

Activation/Delivery and Monitoring:

The flexibility service is activated automatically (without additional action by the DSO), in accordance with the schedule agreed in the concluded transaction. DSO monitors lines load congestion production.

Settlement:

- DSO collects the metering data and transmits it to the FMO

- FMO, DSO and producer validate the delivery based on the metering data

- FMO creates settlement information for FSP and DSO which is used for bidding settlement and payments

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***
DSO	Role		
Producer	Role		
FMO	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define “success” or “failure” conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Producer can register as a buyer on the market platform and can register his assets (wind farms) to be entitled to submit buy orders.	Producer, DSO, FMO	Producer wants to qualify wind farm(s) for flexibility market	Producer’s wind farm(s) meet market access requirements defined by DSO & FMO Meter point/connection point of asset is identified and confirmed.	If the prequalification is successful, the producer gets access to the flexibility market. The producer can now create buy orders on the flexibility market and will be visible to the DSO. If the prequalification is not successful, the producer cannot register the wind farm(s) nor create offers on the flexibility market.

2	Selection/Technical estimation	The producer applies for the temporary enhancement of the generation profile. There are a day-ahead power flow calculation and a 110 kV line forecasted capacity assessment with DLR system	DSO, FMO	Planned (forecasted) next day generation exceeds connection power agreed in “connection agreement” i.e., the contract between the relevant system operator (DSO)	DSO is permanently subscribed to the same FMO platform as the flexibility service buyer to trace the buy orders and vice-versa. DSO will proceed with an assessment of the possibility to transfer in the 110kV network additional power taking into account admissible line power flow limits calculated according to the dynamic line rating algorithm.	The buy order is evaluated based on the minimum default information defined by the FMO to enable the submission of orders. DSO sends the sell order to FMO along with the generation profile (hourly values above the connection power value) and the price. Reduced generation power profile or no sell order is also possible. In case there is less line capacity than already sold via the market, the DSO places a new sell order, asking the producer to decrease it’s generation. Similarly, if there are buy and sell orders, but there is no match in prices, it is possible to adjust the order (until the market closure 1 hour before real time) to have a successful match. We refer to it as process negotiation.
3	Delivery and Monitoring	Activation of bids and monitoring	DSO	The flexibility service is activated automatically	The delivery of flexibility is proven by power generation metering both	Possibility to record the generating power value.

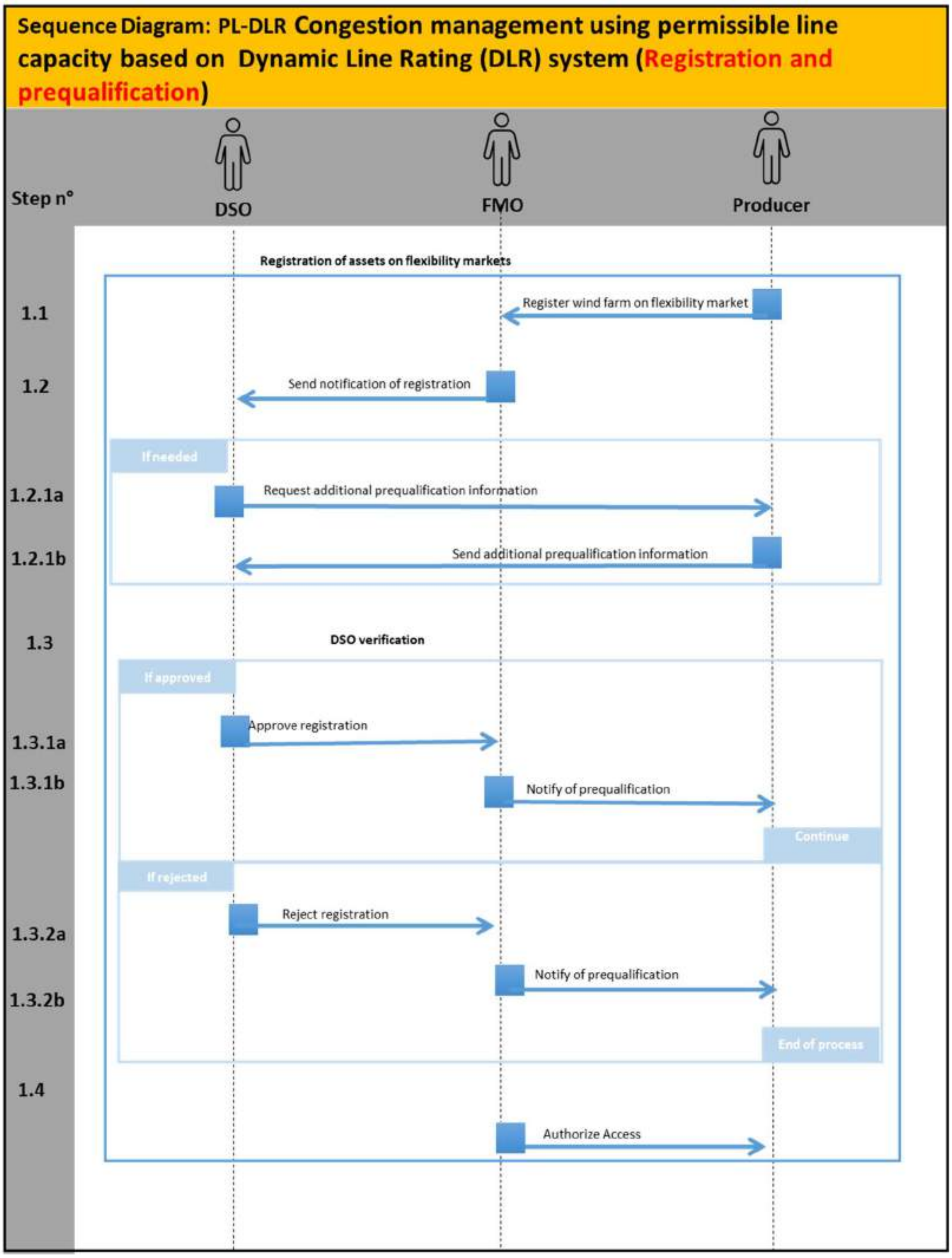
				(without additional intervention of a DSO), in accordance with the schedule agreed in the concluded transaction.	at Producer premises and DSO 110 kV network substations.	
4	Settlement (in the project as a simulation)	Invoicing and Payments	DSO	The Producer pays the DSO for the flexibility delivery according to the previously agreed method.	Delivered generating power value was recorded	Delivered flexibility products are remunerated

<u>Steps – Scenarios</u>

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
    - Input to the use case from some external source that is not described in this use case,
    - Internal to the use case (although could be between different applications and systems within the use case),
    - Output from the use case that will be used by other actors / entities not included in this use case.
    - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and prequalification

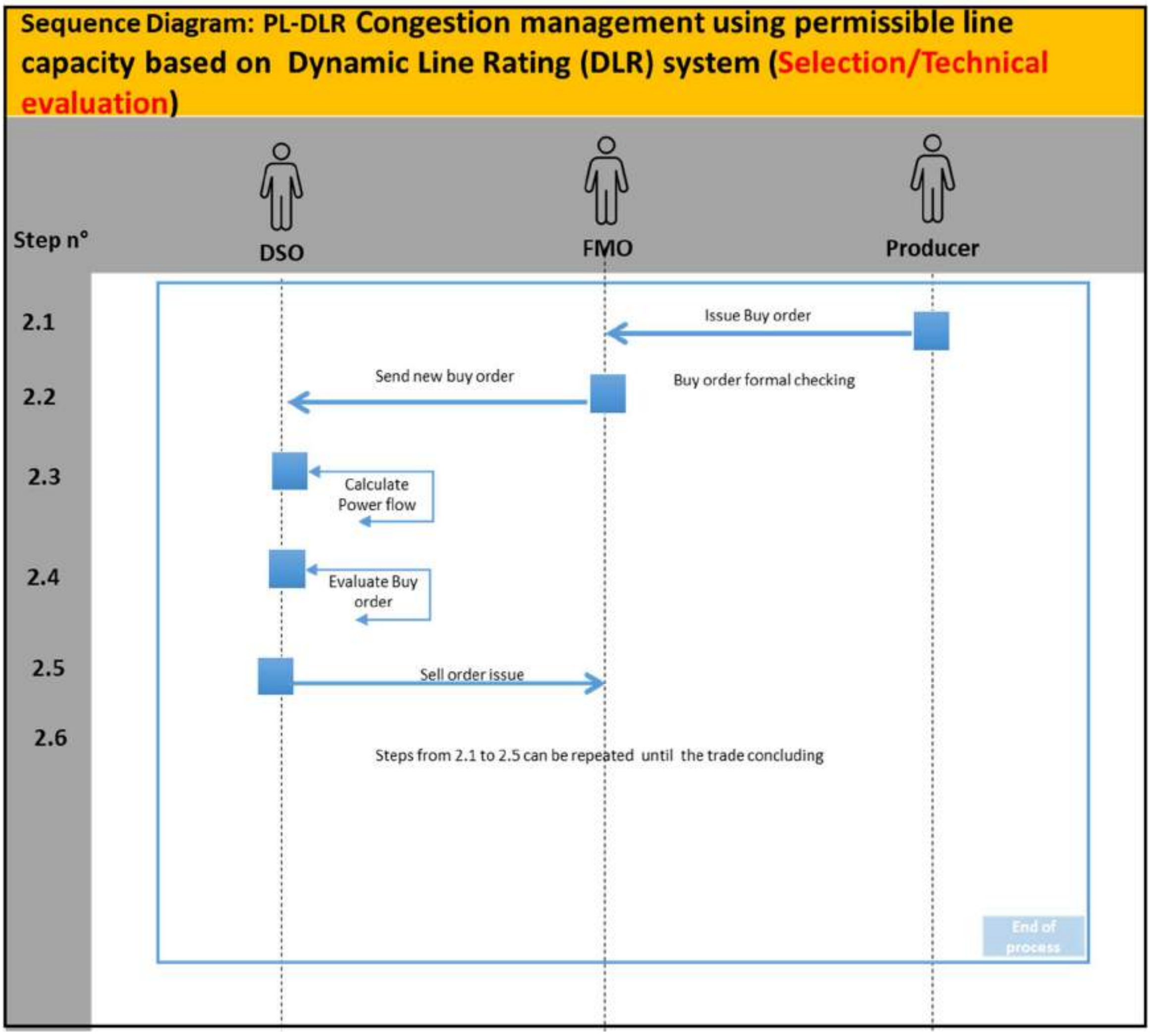


Scenario step by step analysis

Scenario								
Scenario name	Registration and Prequalification							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Registration of producer on the market	Producer registers wind farm on the market platform under the pre-qualification conditions	Registers	Producer	FMO	Info 1	
1.2		New producer notification and evaluation	FMO sends notification that a wind farm has been registered and needs to be approved. DSO can consult information for approval on the platform. DSO evaluates the wind farm by the submitted documentation on the market platform and evaluates the need for additional information.	Sends	FMO	DSO	Info1	
1.2.1a		Request of additional prequalification information	DSO can request additional information for the prequalification	Requests	DSO	Producer		
1.2.1b		Delivery of additional	Producer sends additional information for the prequalification to the DSO	Sends	Producer	DSO	Info1	

		prequalification information						
1.3		Wind farm verification	DSO verifies the new producer and assigns it to a location					
1.3.1a		Registration approval	DSO approves registration on the market platform. Corresponding wind farm can participate in the flexibility market	approves	DSO	FMO		
1.3.1b		Prequalification notification	The producer receives a notification about the outcome of the prequalification process of the new asset	sends	FMO	producer		
1.3.2a		Registration rejection	DSO rejects registration on the market platform. Respective wind farm cannot take part in the flexibility market	reject	DSO	FMO		
1.3.2b		Prequalification notification	The producer receives a notification about the outcome of the prequalification process of the new wind farm	sends	FMO	Producer		
1.4		Access authorisation	Producer gets full access to the market platform.	becomes	FMO	Producer		

Selection /Technical estimation

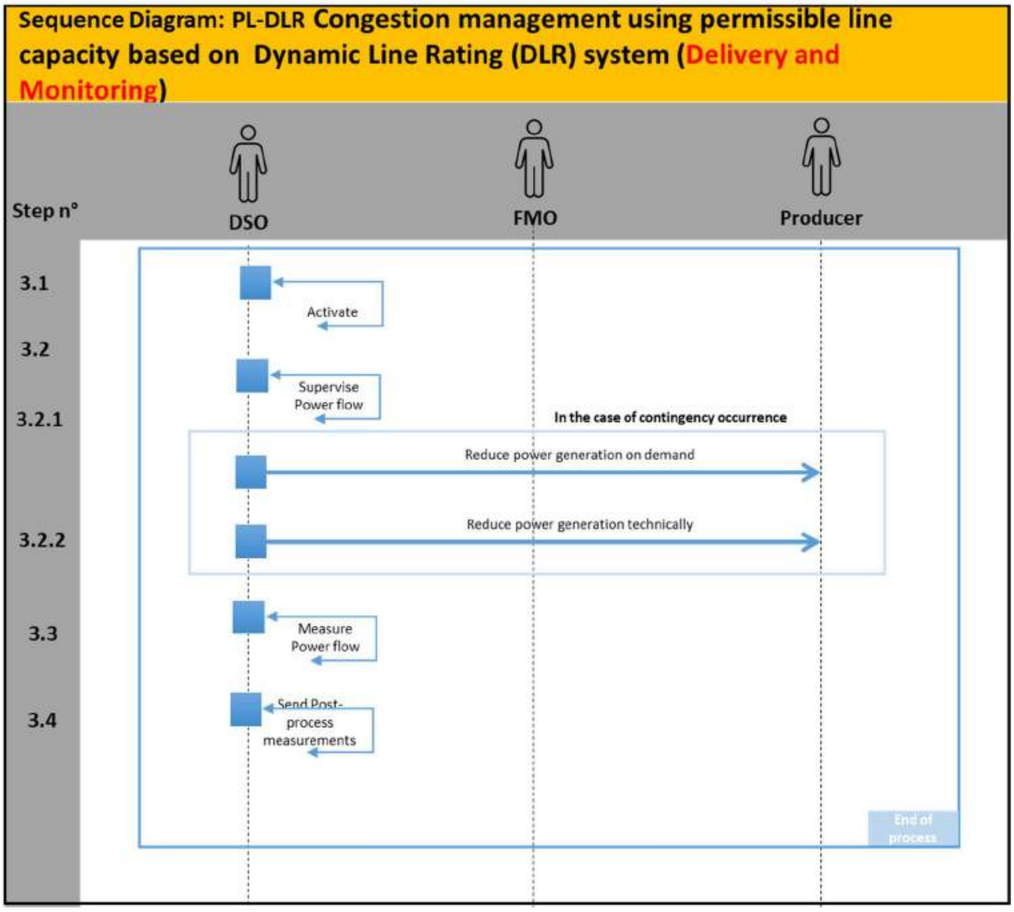


Scenario step by step analysis

Scenario								
Scenario name	Selection/ Technical estimation							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.1		Buy order issue	The producer sends to the FMO a buy order with requested generation forecasted hourly profile values (above connection power) and the price	sends	Producer	FMO	Info2	
2.2		Awareness of the buy order	DSO as the subscriber to the market platform is aware of the appearance of the new buy order with production profile volume and price.	Become aware	FMO	DSO	Info2	
2.3		Power flow calculation	A 110 kV network day-ahead power flow calculation with the Producer's forecasted generation profile and lines capacity limits based on the DLR and available weather forecast are performed.	calculation	DSO	DSO		
2.4		Buy order evaluation	The Producer (RES-WF) allowable generation resulting from power flow calculation is compared with the producer requested power profile.	calculation	DSO	DSO		

2.5		Sell order issue/	DSO submits a sell order with the production profile and the price.	sends	DSO	FMO	Info3	
2.6		Trade concluding	Once a buy and sell order is matched the DSO is bound to activate the offered flexibility or at least to do his best to keep this possibility.	sends	FMO	Producer	Info 4	

Delivery and Monitoring

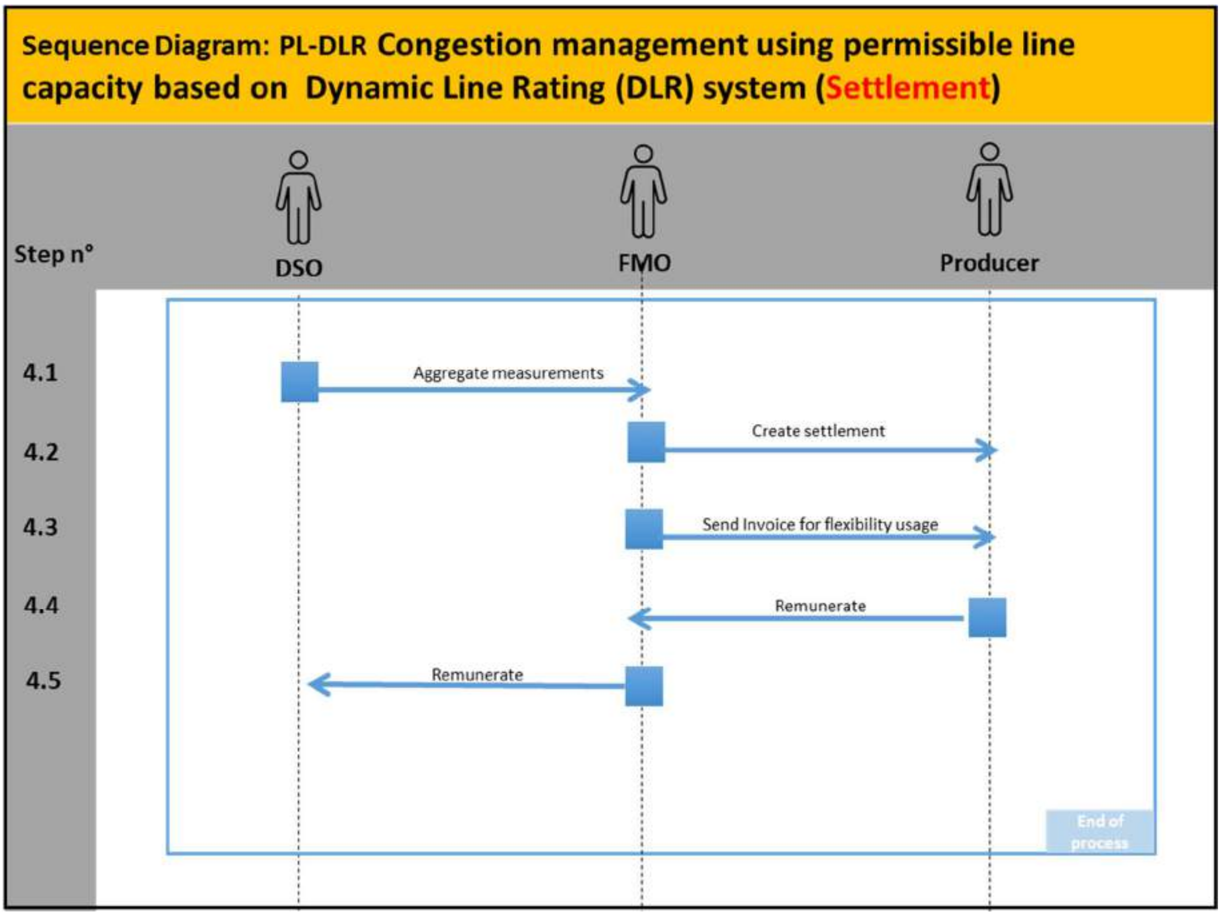


Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1	time	activation	Activation (time) according to time agreed in the bid	Activate				
3.2		Power flow supervising	DSO supervises online power flow in the lines bunded to the Producer Wind Farm generation process i.e. it compares actual power flow with the admissible power (calculated by the DLR system, preferably online based on the actual weather measurement). In the case of contingency occurrence, the action 3.2.1 or 3.2.2 are taken.	Monitor	DSO			
3.2.1		Reduce power generation on demand	Demand to reduce Producer Wind Farm generation to the requested value	Dispatch	DSO	Producer	Info5	
3.2.2		Reduce power generation technically	In case the Wind Farm does not adapt its power flow, DSO limits Producer Wind Farm generation by technical means	Control	DSO	Producer		

3.3		Power flow metering	The delivery of flexibility is proven by power generation metering both at Producer premises and DSO-owned 110 kV lines.	Metering	DSO			
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase	collects	DSO			

Settlement


Sequence Diagram: PL-DLR Congestion management using permissible line capacity based on Dynamic Line Rating (DLR) system (Settlement)
Step n°
DSO
FMO
Producer
4.1
Aggregate measurements
4.2
Create settlement
4.3
Send Invoice for flexibility usage
4.4
Remunerate
4.5
Remunerate
End of process

Scenario step by step analysis

Scenario								
Scenario name	Settlement[31]							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1		Aggregate measurements	DSO aggregates measurements of one period of the specific resource that participated.	sends	DSO	FMO		
4.2		Create settlement	FMO creates settlement information for the Producer according to the bid	sends	FMO	Producer	Info6	
4.3		Invoice for flexibility usage	The result of the settlement and the invoice for the used flexibility are sent to the producer.	Send	FMO	Producer		
4.4		FMO remuneration	The producers settle the invoice and send the payment to the FMO		Producer	FMO		
4.5		DSO remuneration	The FMO receives the producer payment and distributes the funds to the DSO.		FMO	DSO		

[31] Settlement is not implemented in the field test, this part will only be simulated.

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info 1	Registration and prequalification	Type of asset, meter point ID, installed capacity	
Info2	Buy order	Buy order indicating quantity of flexibility (additional line capacity) and price	
Info3	Sell order	Sell order indicating quantity of flexibility (additional line capacity) and price	
Info4	Confirmation of the matching of buy and sell orders	Confirmation of the matching of buy and sell orders	
Info5	Demand to reduce the generation	Demand to reduce Producer generation to the requested value	

Info6	Settlement information	Hourly energy delivered by Producer	

6.4. BUC4 Poland

Use case description

<u>Use case name, scope, objectives, hypotheses and associated smart grid functions</u>

<table>
<tr><th>ID</th><th>Name of use case

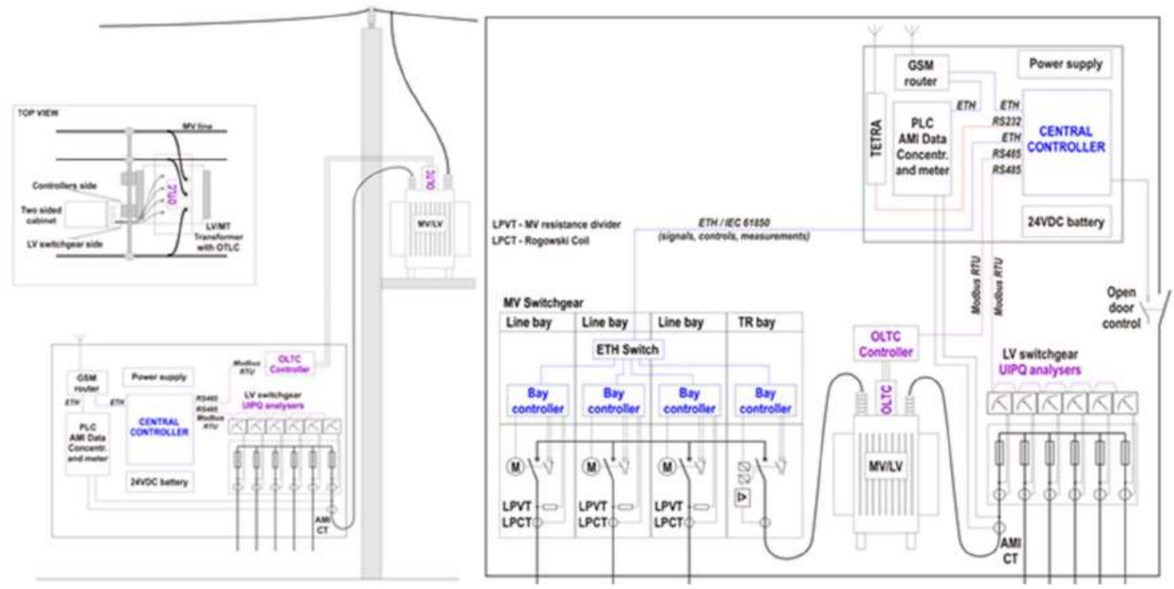
Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use “verb + description”, e.g., operate the distribution’s congestion management market or submit flexibility bid to the distribution’s congestion management market.</th></tr>
<tr><td>PL-FS</td><td>Voltage Control with the use of flexstation solutions</td></tr>
<tr><td colspan="2">What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.</td></tr>
<tr><td colspan="2">The subject of this Use Case is the use of an intelligent MV / LV substation- flexstation (FS) equipped with:

- Primary circuits: OLTC transformer, MV (optional) and LV switchgear.

- Secondary circuits: Smart Meter PLC data concentrator, MV line feeder bay controllers, and the central controller, for the autonomous management of the LV network ensuring the removal of voltage limitations.

PV inverters installed at prosumers will also be used for voltage control. The basis for this will be a bilateral contract

Smart meters will be installed at all consumers connected to the station.


</td></tr>
</table>

What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.
Reducing Physical Congestions (voltage band violations) with DSO assets
What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
General: - The DSO is responsible for ensuring a secure network operation and therefore takes the decision on the activation of flexibility - The use case is based on online voltage control

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
The Flexstation equipped in: - Primary circuits: OLTC transformer, MV (optional) and LV switchgear, - Secondary circuits: PLC data concentrator, MV line feeder bay controllers, and the central controller. Smart meters installed at all consumers connected to the station PV inverters installed at prosumers will also be used to for voltage control.

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
No interactions to other Use Cases in the Polish Demo

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Congestion management and voltage control are implemented to remedy physical congestions and voltage violations by: - means of the DSO's own assets (OLTC), - flexibility services provided by FSP (PV inverters) based on bilateral contracts.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Optional
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
• Services: ○ Voltage control • Market Mechanisms: ○ Bilateral contracts

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
Functional algorithms of the Flexible Substation will provide and manage services such as enhanced observability of the LV network, autonomous control and monitoring of PV, faster fault detection, isolation and restoration, low voltage controls (especially with the presence of high penetration of PV which is the case in the Polish demo).
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., "main success scenario") from a domain expert user's point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions. While writing the narrative, please consider the following:[32] • Use "just one sentence form": ▪ Use present tense. ▪ Use active verb in the active voice. ▪ Describe actions that move the process forward. ▪ For instance, "customer enters card and pin into ATM" • Keep it simple and to the point so that non-domain experts can understand it. Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case. We suggest including the following aspects into the narrative: ○ Type of mechanism used (Market or other – please be specific) ○ Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system") ○ Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA) ○ Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)

[32] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

○ Relevant phase (e.g., pre-qualification, procurement, activation, settlement)
The voltage control algorithm utilizes voltage data delivered to the substation from smart meters via the PLC network and accesses them through the data concentrator. The voltage control algorithm evaluates delivered values and calculates the tap position of the distribution transformer. Autonomous monitoring and control of the PV installation (without the intervention of DSO dispatching center) include limiting the generation of active power or necessity to "stop generating active power" resulting from the implementation of the NC RfG requirements. The decision is developed locally on the basis of the voltage measurement in place in which the µPV installations are connected. Voltage measurements are delivered to the station controller by PLC data concentrator in the FS which can also collect other data from PV inverters connected to the grid with the PLC adapter. *Registration and Prequalification:* - DSO sends offers to prosumers to use a PV inverter to control the voltage in the grid - Prosumer sends the DSO permission to use the inverter and install the communication router. - Installing the router and starting communication with FS. *Operational activities:* - Activation of the central controller for autonomous control of the flexstation. - Changing the position of the tap-changer. - DSO sends the control signal to the inverter limiting the generation of PV - DSO collects information about the introduced limitation of PV generation Monitoring & Settlement phase: - DSO aggregates measurements of one period of the specific resource that participated. - DSO creates settlement information for the FSP according to the bilateral contract

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

- **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***
DSO	Role		
RP	Role		
FSP	Device		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

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- **No.**: The scenarios are sequentially numbered.
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- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define “success” or “failure” conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	DSO sends the prosumer an offer to use their PV inverter to control the voltage in the network	DSO, RP	DSO wants to use PV inverters installed at the prosumers site to do voltage control	The secondary substation to which prosumers are connected has been modernized to the level of a Flexstation	PV inverter connected with FS
2	Operational activities	Autonomous control of the flexstation	DSO, FSP	Activation of the central controller for autonomous control of the flexstation	DSO monitors network parameters through the flex station at dedicated measurement points and	The voltage in the network is maintained within the acceptable limits

					compares them with the acceptable values	
3	Monitoring and Settlement (in the project as a simulation)	Invoicing and Payments	DSO, FSP,	The DSO pays the FSP for the flexibility delivery	Limitation of PV generation was recorded	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

» **Step No.**: Sequential number identifying the step
» **Event**: The event that triggers the step (might be completion of the previous step).
» **Name of process/activity**: Label that would appear in a sequence diagram.
» **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an “active” way: what is “done”?
» **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
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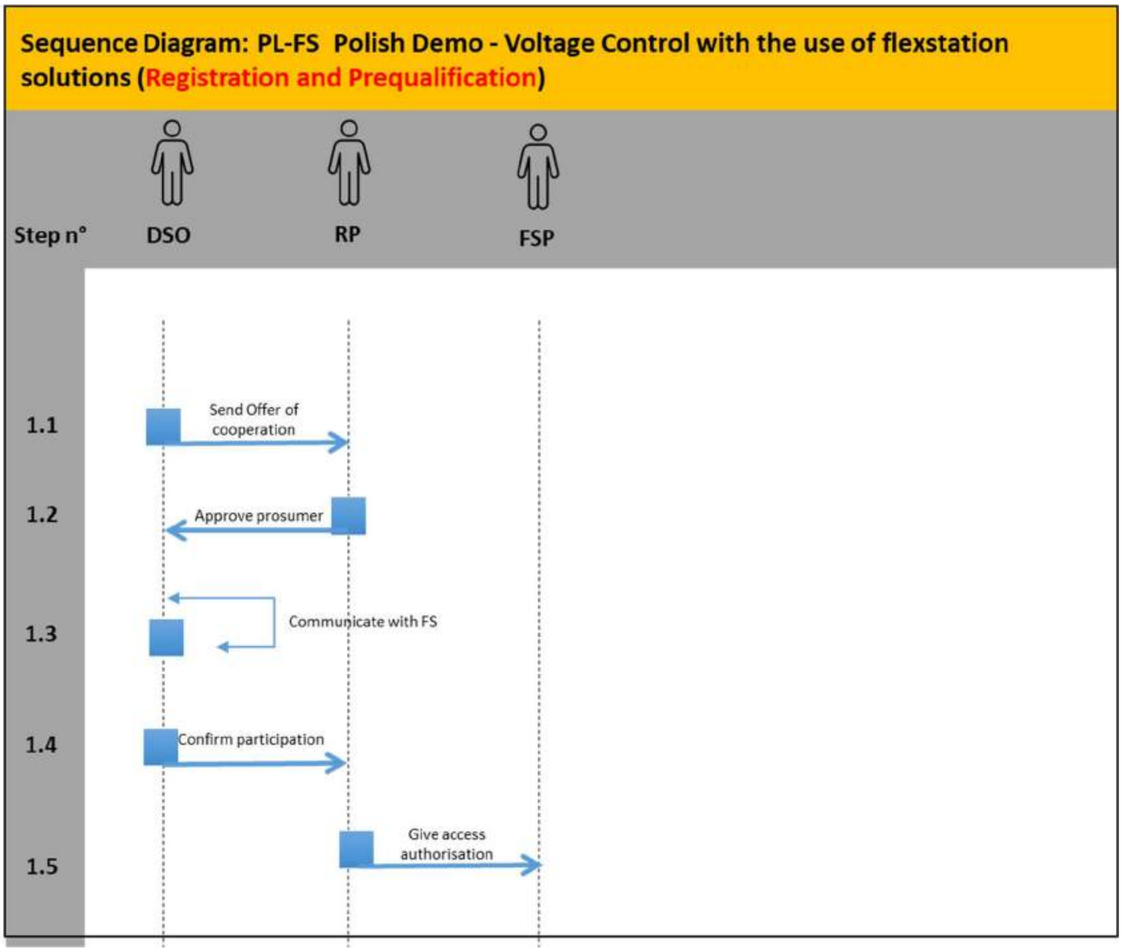
    » Input to the use case from some external source that is not described in this use case,
    » Internal to the use case (although could be between different applications and systems within the use case),
    » Output from the use case that will be used by other actors / entities not included in this use case.
    » This column should not contain technology issues/requirements.
» **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 “Definition of a list for requirements”. It is allowed to list several requirements in one step, comma separated.

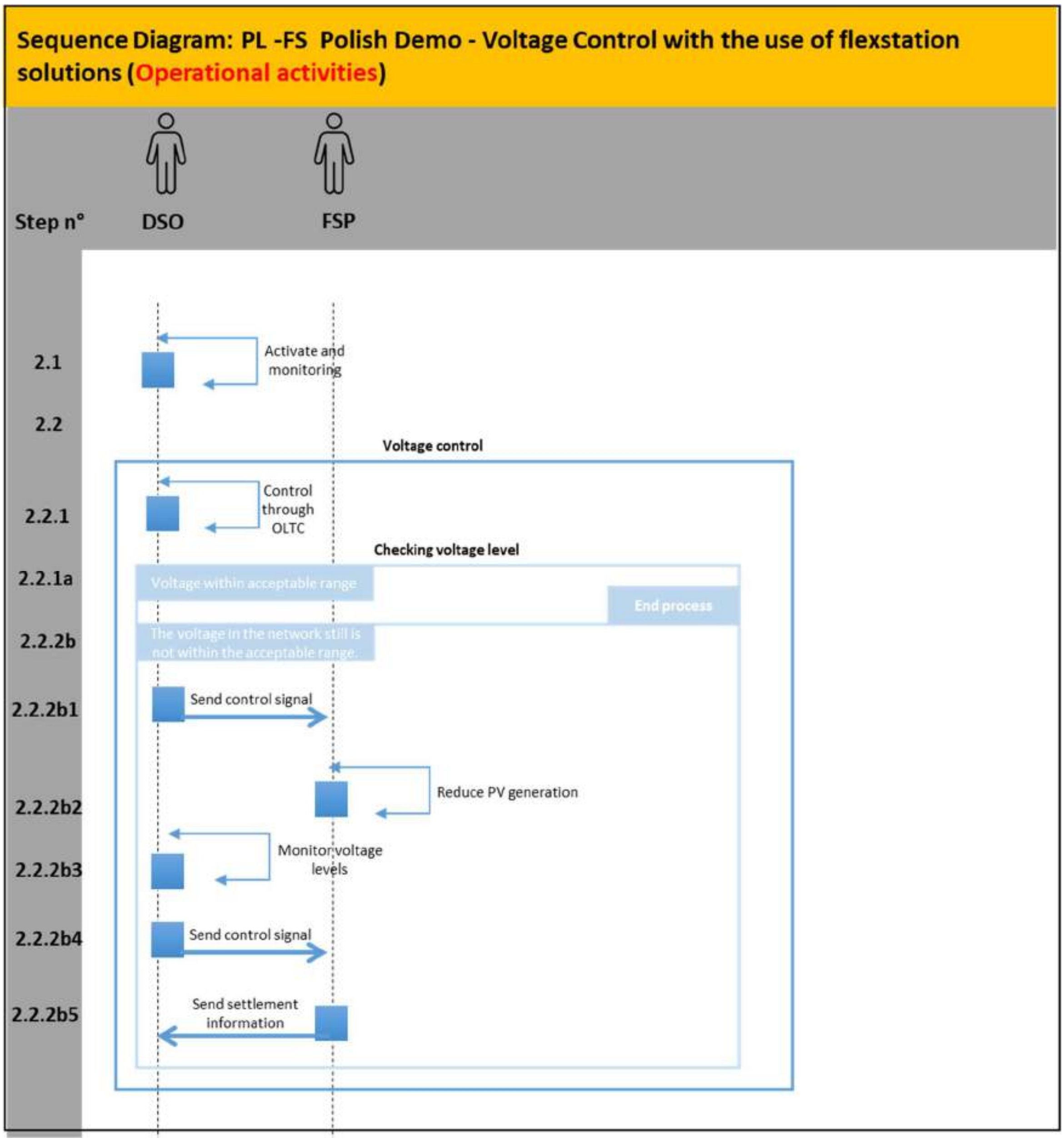
Registration and Prequalification



Scenario step by step analysis

Scenario								
Scenario name	Registration and Prequalification							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Offer of cooperation	DSO sends offers to prosumers to use a PV inverter to control the voltage in the grid	send	DSO	RP	Info1	
1.2		Prosumer permission	Prosumer sends the DSO permission to use the inverter and install the communication router	approval	RP	DSO	Info2	
1.3		Communication with FS	Installing the router and starting communication with FS	install	DSO	DSO		
1.4		DSO confirmation	Confirmation of participation in the voltage control process	send	DSO	RP	Info3	
1.5		Access authorisation	RP becomes an FSP.	becomes	RP	FSP		

Operational activities

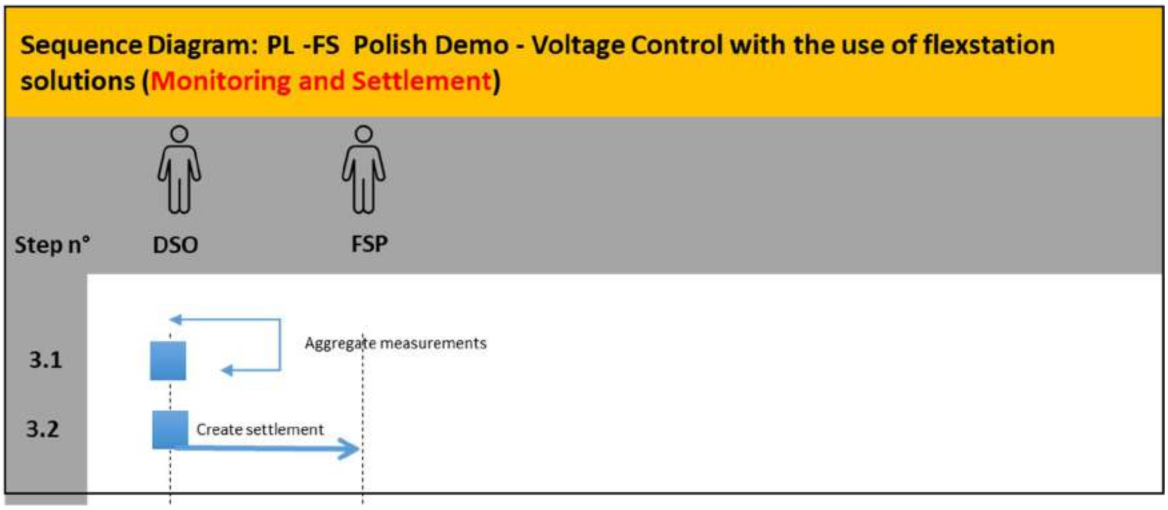


Scenario step by step analysis

Scenario								
Scenario name	Operational activities							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.1		Activation and monitoring	Activation of the central controller for autonomous control of the flexstation, monitoring network parameters at dedicated measurement points and comparing them with the acceptable values	Activation	DSO	DSO		
2.2		Voltage control	The need to adjust voltage level in the network is detected.					
2.2.1		OLTC control	Changing the position of the transformer tap-changer in the flexstation	control	DSO	DSO		
2.2.1a		Voltage within acceptable range	The voltage in the network is within the acceptable range and the process is ended.					
2.2.2b		Voltage out of acceptable range	The voltage in the network is not yet within the acceptable range. Continue with the next steps.					
2.2.2b1		PV control	DSO sends the control signal through the FS to the inverter limiting the generation of PV	sends	DSO	FSP	Info4	

2.2.2b2		Reducing PV generation	Changing the operating parameters of the inverter to reduce generating power	control	FSP	FSP		
2.2.2b3		Voltage within acceptable range	Grid parameters make it possible to remove the limitation of PV generation	monitoring	DSO	DSO		
2.2.2b4		Normal PV generation	The DSO sends the control signal through the FS to the inverter removing the limitation of PV generation	sends	DSO	FSP	Info4	
2.2.2b5		DSO settlement information	The FSP send through the FS information to DSO about the introduced limitation of PV generation	sends	FSP	DSO	Info5	

Monitoring and Settlement



Scenario step by step analysis

Scenario								
Scenario name	Settlement[33]							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1		Aggregation of measurements	DSO aggregates measurements of one period of the specific resource that participated.	collects	DSO	DSO		
3.2		Settlement creation	DSO creates settlement information for the FSP according to the agreement	sends	DSO	FSP	Info6	

[33] Settlement is not implemented in the field test, this part will only be simulated.

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

- **Name of information**: Unique ID which identifies the selected information in the context of the use case.
- **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	DSO offer	Offer to use a PV inverter to control the voltage in the grid. Incentives are included in the DSO offer. Therefore, no baseline is used.	
Info2	PR permission	Permission to use the inverter and install the communication router	
Info3	Prequalification notification	Message about the outcome of the prequalification process	
Info4	PV generation limit	PV generation limit to be implemented in real time	
Info5	DSO Settlement Information	information about the generation limit and its duration	
Info6	RP Settlement Information	Description of the measured quantity of the reduced PV generation within a specific period and price	

7. Portuguese Demo Business Use Cases

7.1. BUC1 Portugal

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

ID	Name of use case Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use “verb + description”, e.g., operate the distribution’s congestion management market or submit flexibility bid to the distribution’s congestion management market.
PT1	Congestion management in MV grids for the day-ahead market (or between 1 to 3 days in advance)
What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.	
This use case intends to address the congestion management in MV grids using the flexibility provided by the resources located at MV level as well as the possible aggregation of LV resources. Based on the generation and load forecasts for the next day, the flexibility needs are identified in order to initiate a market-procured mechanism.	
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.	
• Deal with congestion in MV distribution grids that can arise as a result of the variability of generation and load. • Demonstrate the operation of the market-based mechanisms as a cost-effective solution for congestion management in distributions grids • Optimize the grid operation through the network-integrated components (capacitor banks, tap changers, reconfiguration etc) combined with the flexibility provided by other flexible sources through markets mechanisms. • Plan the grid operation considering the forecast of the generation and load at local/regional level.	

• Promote the participation of resources connected at MV and LV grids to provide flexibility services • Ensure that the solution provided by the flexibility activation through the market mechanisms will not create additional grid problems from a technical point of view • Optimize the data exchange among the different players involved in the Portuguese demonstration. • Find a cost-effective solution, promoting the market participation of different players
What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
For this BUC, we are considering the following assumptions: - The DSO is responsible for ensuring the secure operation of the distribution inside its area of concession - Based on the operational planning, considering the generation and load forecast, the DSO will identify the flexibility needs - To deal with the congestion issues, as a first step the DSO will analyze if the use of network-integrated components (capacitor banks, tap changers, automated devices for reconfiguration) is proper to overcome the congestion in MV lines - It is assumed that in the scope of the demonstration, the flexibility can be provided by generation and/or consumption facilities. Currently, in Portugal, there is no regulatory framework for local flexibility markets. - To deal with the congestion issues in MV lines, the aggregated flexibility provided by the LV units can be considered - DSO will evaluate if the market solution does not create additional restrictions to the grid operation - Besides the market operation, the DSO can use emergency measures for ensuring grid security and stability

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
Residential DR /Shiftable loads Industrial loads (Water Treatment Plants, etc) Smart EV charging Distribution network flexible assets and control (switching equipment, MV Storage - Li-Ion Batteries) Renewable self-consumption solutions (Clients with PV Panels) Active power control of RES (Wind Farm)

Dynamic Line Rating [34] Smart Meters

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
This BUC is related to the BUC PT2 and BUC PT3.

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Congestion management to deal with the overload of MV lines. DSO will initiate a market procurement requiring specific amounts of active power to solve the physical limitations in MV lines.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Obligatory
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
Local flexibility market - Short term Local flexibility markets include a short-term pool in which offers are received from FSPs. The local market extension depends on the grid characteristics, i.e. the market area can encompass only a portion of the distribution network. The size of the local market is site-specific. The DSO will utilise flexibility based on its willingness to pay for it and the available fall-back solutions, and the type of flexibility product required. A local flexibility market seeks to promote competition among flexibility providers.

[34] To be confirmed

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
Based on the operational planning activities, the DSO will forecast possible congestion in MV lines for the next day. It is assumed that the generation and load forecast are provided by internal tools within the DSO activity. FSPs submit its flexibility offers in the market. After identifying that the internal network-integrated components are not enough to overcome the congestion, the DSO expresses its needs on the market through flexibility need bids. For this BUC, one can distinguish 4 phases: Prequalification, Selection/Bidding, Delivery and Settlement: 1. Registration and Prequalification: Product definitions and initial pre-qualification, including framework agreement with baseline delivery requirements, are determined 2. Selection/Bidding: Forecasts of congestions are made. Flexibility products are offered on a market platform by the distributed resources (distributed generators, consumers, aggregators, etc). The DSO can access the platform and express its needs to solve the congestion event. 3. Activation/Delivery and Monitoring: Flexibility resources can be activated via the market platform. The flexibility is delivered. The DSO validates the delivery. 4. Measurement & Settlement phase: The DSO transmits the measured values to the market operator. Invoices are sent, and payments are made. In this step, it is assumed that meter data is provided by the DSO.
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., "main success scenario") from a domain expert user's point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions. While writing the narrative, please consider the following:[35] • Use "just one sentence form": ▪ Use present tense. ▪ Use active verb in the active voice. ▪ Describe actions that move the process forward. ▪ For instance, "customer enters card and pin into ATM" • Keep it simple and to the point so that non-domain experts can understand it. Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.

[35] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

We suggest including the following aspects into the narrative: o Type of mechanism used (Market or other – please be specific) o Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system") o Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA) o Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data) o Relevant phase (e.g., pre-qualification, procurement, activation, settlement)
Registration and Prequalification phase: • DSO publishes pre-qualification criteria. • RA/RP registers assets on flexibility market o The information/documentation is submitted to the market platform, afterwards this information / documentation is made available to the DSO. • DSO evaluates potential FSP. o DSO checks if conditions demonstrated are compliant with pre-qualification criteria. o DSO performs a real flexibility activation test[36]. o Additional information/documentation can be required, through the market platform. o This can be an iterative process, repeated until all requirements are met. If not, the potential FSP is rejected. • RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can then create offers on the flexibility market. **Selection/Bidding phase:** • FSPs deliver a baseline per asset[37] and make sure that information is updated. • FSPs submit active power sell orders to the flexibility market. (D-3 until D-1, D =Flexibility Activation Day).

[36] How this testing will be done, will be further decided during the project.

[37] Note that even though assets will be aggregated in a portfolio, individual baselines are still required.

- DSO collects data (metering data, forecasts).
- DSO evaluates updated grid information and predicts grid congestions. This process starts in D-1.

  Two market platforms will be used.

- **Nodes Market Platform**
  - DSO selects the sell orders, to solve the predicted congestions, making sure that there is a cost-efficient solution. Two outcomes can result from this step:
    - Congestions are solved.
    - Congestions are not solved (iterative process until all constrains are solved, or until the maximum number of iterations is reached.):
      - DSO places a buy order in the market, for each congestion.
      - FSPs reply with a sell order.
      - DSO selects sell orders to solve the predicted congestions.
      - DSO validates FSP orders and provides a list of valid FSP orders for each predicted congestion to the FMO.
      - FMO clears the market for each subperiod. FMO identifies accepted bids and confirms the trade. Market closes some hours (fixed) prior to activation time, for that specific hour the next day.
- **N-Side Market Platform**
  - Based on its analysis, the DSO will submit active power buy orders on the Flexibility Market, alongside network-related constraints (Note that some of the constraints could already have been shared by the DSO a priori of this step). Both the FSPs and the DSO can continue to submit or update their bids on the Market Platform until the market closure (in day-ahead).
  - Once the market is closed, the FMO will operate the clearing of the market, matching the buy orders with the sell orders through an algorithm aiming to maximize the social welfare (i.e. the sum of the market participants surplus) while respecting the given constraint (asset parameters from FSPs and grid-related constraints from the DSO)
  - Once the clearing step is finished, the results (acceptance level of each order submitted on the market and prices) are shared with the DSO for validation. Two outcomes can result from this step:
    - The congestions are solved, and the DSO validates the outcome.

    - Congestions are not solved, or the DSO rejects the result for another operational reason. Then, an iterative process starts until all network issues are solved, or until the maximum number of iterations/a time limit is reached:

        - The DSO expresses its needs in a different way on the market, adapting either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts,

        - The FMO proceeds to a new market clearing with the updated information on the DSO side, and unchanged submitted information from FSP bids Once the final decision is taken by the DSO, the market results are shared with all market participants, informing FSPs of the acceptance and prices related to the bids they submitted.

        - Market closes some hours (fixed) prior to activation time, for that specific hour the next day.

- If no solution is found, mandatory curtailment of the need not supplied by the market is required. It is considered that FSPs can provide a partial solution to the congestion problem, minimizing the curtailed energy.

Activation/Delivery and Monitoring phase:

- Flexibility resources are activated by the FSPs following the information based on the market clearing result. This right can also be relinquished to the DSO. The FMO can then activate resources directly, by sending the activation signal to the FSPs and they will activate flexibility.

- The flexibility is delivered.

Settlement phase:

- The DSO collects the metering data and transmits it to the FMO.

- FMO validates the delivery based on the metering data and the previously given baselines.

- FMO sends an invoice to the DSO.

- Payments are made from the DSO via the market platform to the FSP, which in turn remunerates the RA and RP.

Technical details

<u>Actors</u>

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***
DSO	Role		
FMO	Role		
FSP	Role		
RA/RP	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define "success" or "failure" conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market	RA/RP	new RA/RP wants to qualify new assets for flexibility market	RA/RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market. If the prequalification is not successful, the RA/RP cannot register the assets nor create offers on the flexibility market

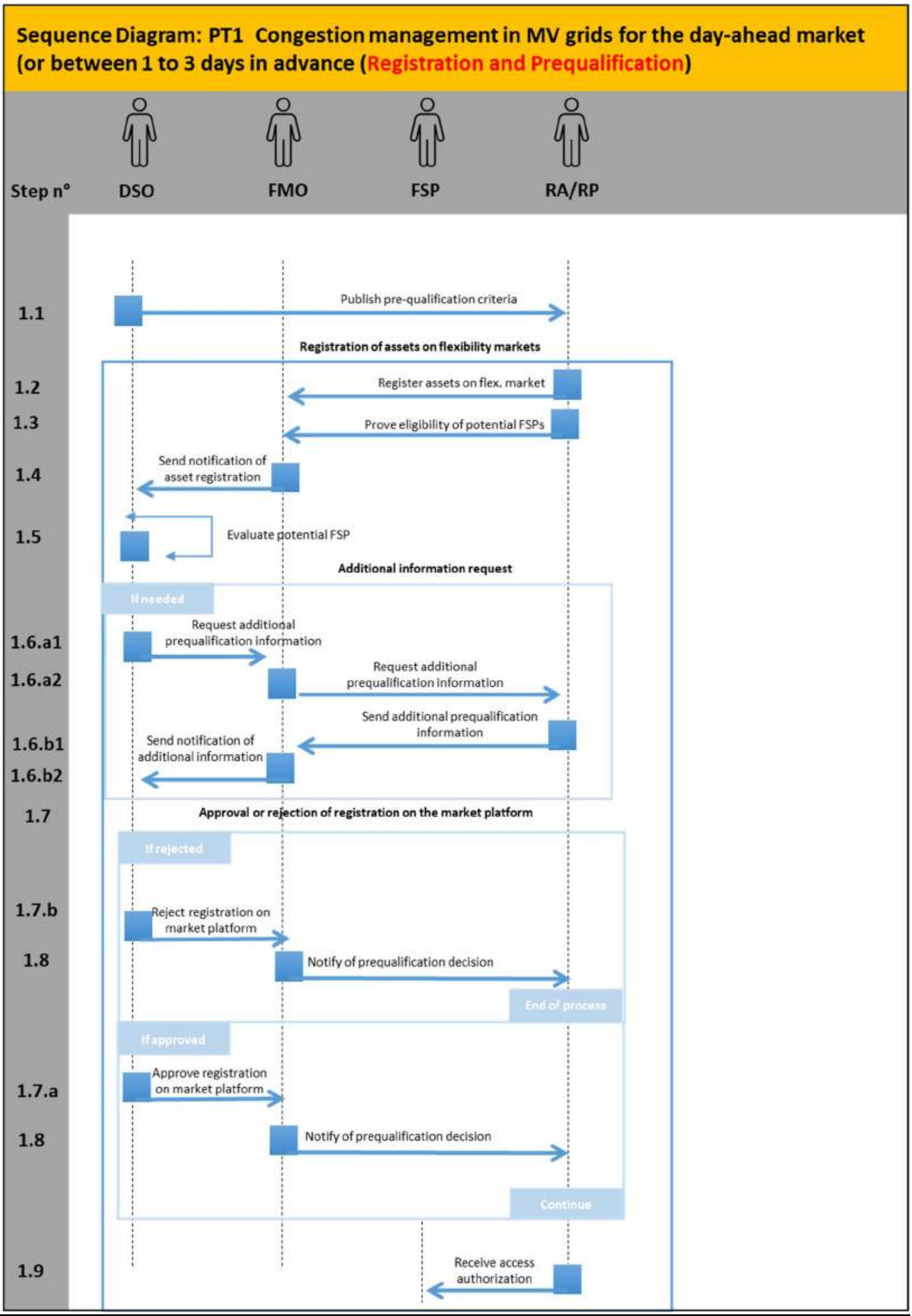
2	Selection/Bidding	Planning of grid utilisation and identifying potential congestions, followed by bid submission, evaluation, and matching	DSO, FMO, FSP	Congestion forecast, Available flexibility	Available active power flexibility connected; Prequalified FSPs	When bids are matched, the flexibility offer cleared by the local market is used for congestion management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP	Trade confirmation, proved by metering data sent from the DSO to the FMO.	Matching bids on the flexibility market	The actual provided flexibility is delivered. Congestions are eliminated.
4	Settlement	Invoicing and Payments	DSO, FMO	The DSO pays the FSP for the flexibility delivery	Delivered active Power flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
    - Input to the use case from some external source that is not described in this use case,
    - Internal to the use case (although could be between different applications and systems within the use case),
    - Output from the use case that will be used by other actors / entities not included in this use case.
    - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification



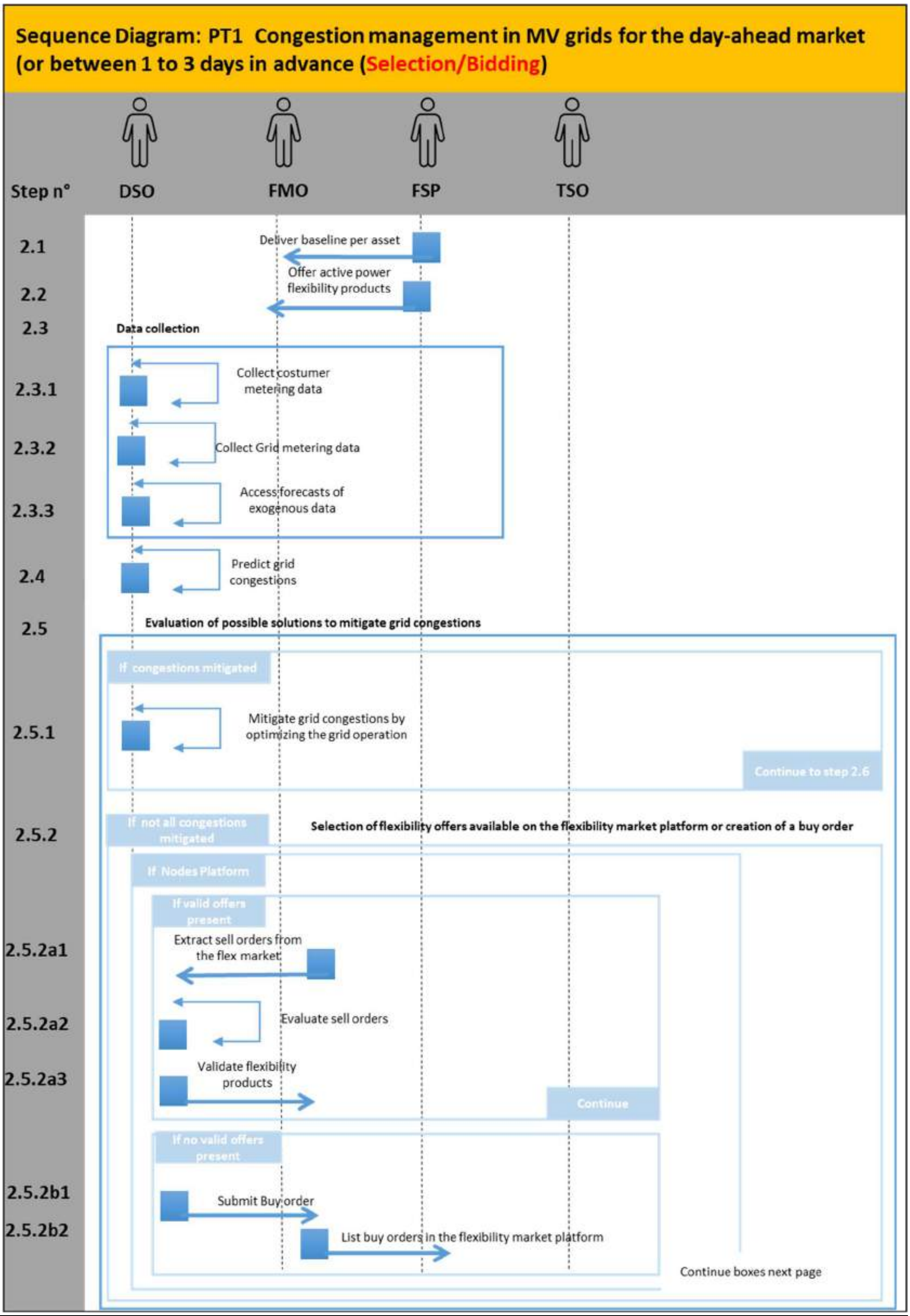
Scenario step by step analysis

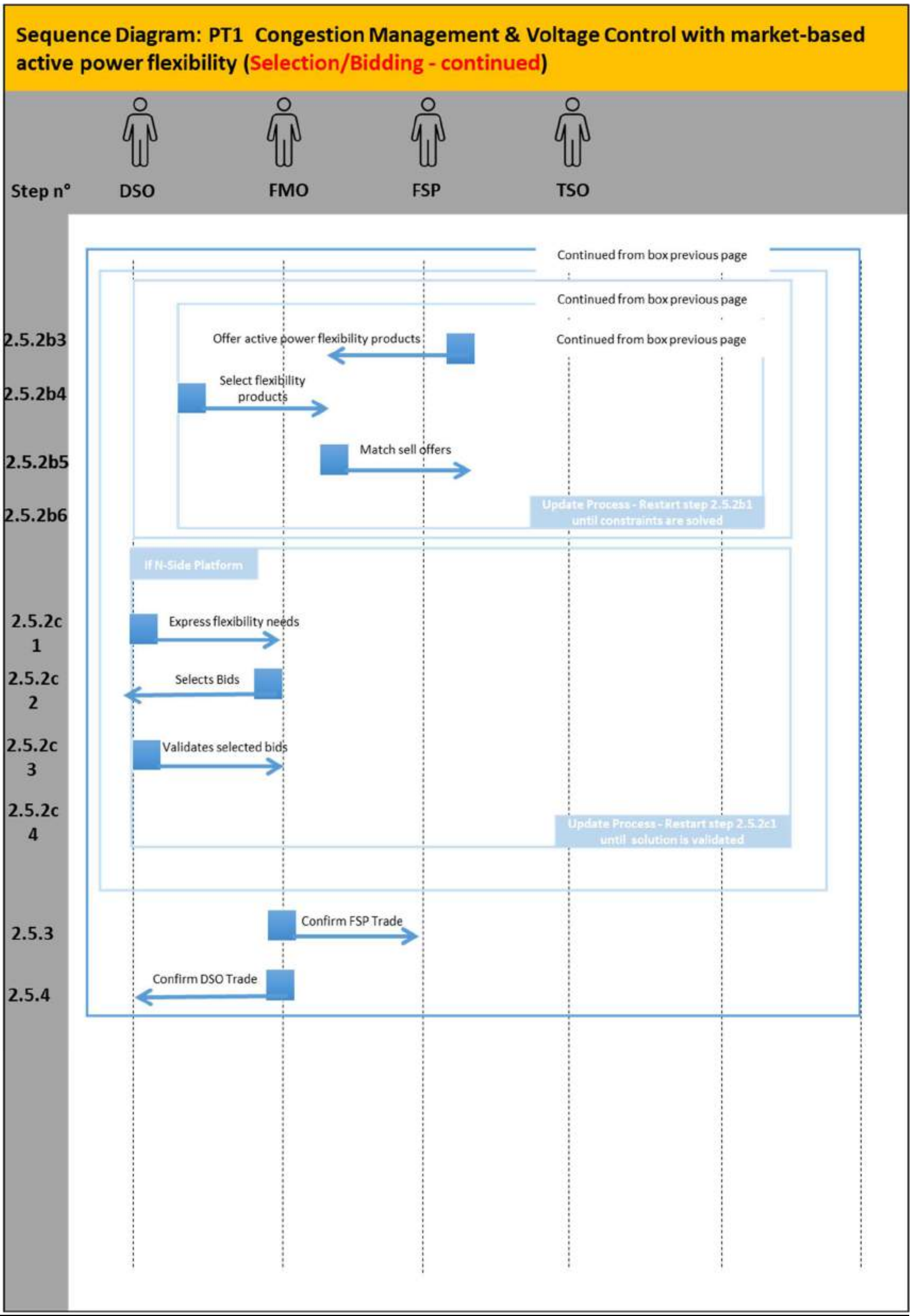
Scenario								
Scenario name		Registration and Prequalification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Publication of pre-qualification criteria	The DSO publishes regularly updated public information on pre-qualification criteria and technical requirements to be met by the FSPs.	Publishes	DSO	RA/RP	Info1	
1.2		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions.	Registers	RA/RP	FMO		
1.3		Proof of eligibility by potential FSPs	RA/RP sends proof in compliance with the prequalification criteria by submitting the required documentation.	Sends	RA/RP	FMO	Info2	
1.4		Notification of a new potential FSP registration	FMO sends a notification to the DSO stating that a potential FSP is awaiting approval and gives access to the submitted documentation. The DSO can consult the information for approval to the market on the platform.	Sends	FMO	DSO	Info3	
1.5		Evaluation of potential FSP	DSO consults the documentation submitted by the potential FSP on the market platform and	Evaluates	DSO			

			evaluates the flexibility offer and the need for additional information. A real flexibility activation test shall be performed. This can be an iterative process.					
1.6		Additional information request	DSO evaluates the need for additional information					
1.6.a1		Request of additional pre-qualification information	DSO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	DSO	FMO	Info4	
1.6.a2		Request of additional pre-qualification information	FMO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	FMO	RA/RP	Info4	
1.6b1		Provision of additional pre-qualification information/documentation	Potential FSP sends the required additional information for the pre-qualification to the DSO	Sends	RA/RP	FMO	Info2	
1.6b2		Notification of new information/documentation submitted	FMO sends a notification to the DSO stating that a potential FSP has submitted the additional required information/documentation	Sends	FMO	DSO	Info5	
1.7		Approval or rejection of registration on the market platform	The DSO needs to approve or reject the registration of the asset on the market platform.					

1.7.a		DSO approval of new FSP registration	DSO approves new FSP and registers this decision on the market platform.	Approves	DSO	FMO	Info6	
1.7.b		DSO rejection of potential FSP registration	The DSO rejects the potential FSP registration due to failure to meet pre-qualification criteria or the lack of required documentation. Potential FSP cannot take part in the flexibility market.	Rejects	DSO	FMO	Info6	
1.8		Pre-qualification result notification	FMO sends a notification to the RA/RP regarding the pre-qualification decision. Notification that additional evaluation information can be consulted in the market platform.	Sends	FMO	RA/RP	Info6	
1.9		Access authorization	The RA/RP becomes a FSP and can now access the flexibility market.	Becomes	RA/RP	FSP		

Selection/Bidding




Sequence Diagram: PT1 Congestion Management & Voltage Control with market-based active power flexibility (Selection/Bidding - continued)
Step n°
DSO
FMO
FSP
TSO
Continued from box previous page
Continued from box previous page
Continued from box previous page
2.5.2b3
Offer active power flexibility products
2.5.2b4
Select flexibility products
2.5.2b5
Match sell offers
2.5.2b6
Update Process - Restart step 2.5.2b1 until constraints are solved
If N-Side Platform
2.5.2c 1
Express flexibility needs
2.5.2c 2
Selects Bids
2.5.2c 3
Validates selected bids
2.5.2c 4
Update Process - Restart step 2.5.2c1 until solution is validated
2.5.3
Confirm FSP Trade
2.5.4
Confirm DSO Trade

Scenario step by step analysis

Scenario								
Scenario name		Selection/Bidding						
Step No	***Eve nt***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requiremen t, R-IDs***
2.1		Delivery of baseline per asset	The FSP makes available for the DSO in the market platform, the baseline for each of the assets registered in the market platform	Makes availabl e	FSP	FMO	Info8	
2.2		Offering of active power flexibility products	FSP submits a flexibility sell order of active power per asset on the flexibility market platform.[38]	Submit s	FSP	FMO	Info7	
2.3		Data collection	The DSO collects the data it needs to evaluate the grid.					
2.3.1		Costumer metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI installed infrastructure at costumer's connection points.	Collects	DSO	DSO	Info9	

[38] In the case of using N-Side platform this will be the only time when FSPs place their flexibility potential available in the market.

2.3.2		Grid metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI infrastructure installed in the grid.	Collects	DSO	DSO	Info10	
2.3.3		Access to forecasts of exogenous data	The DSO accesses the information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	Accesse s	DSO	DSO	Info11	
2.4		Evaluation of updated grid information and prediction of congestions	DSO performs grid evaluating algorithms using topology, measurement, and market related data (cf. Info 7-11). This evaluation is predictive (1 day ahead).	Predict s	DSO	DSO		
2.5		Evaluation of possible solutions to mitigate grid congestions	DSO evaluates all the available solutions to mitigate grid congestions: optimizing the grid operation through the network-integrated components, the market-based mechanisms or redispatch (out of scope).	Evaluat es	DSO	DSO		
2.5.1		Mitigation of grid congestions by optimizing the grid operation	Identified grid congestion is mitigated by optimizing grid operation through the network-integrated components (capacitor banks, tap changers, grid reconfiguration etc)	Mitigat es	DSO	DSO		

2.5.2		Selection of flexibility offers available on the flexibility market platform or creation of a buy order	If there are suitable[39] offers on the flexibility market platform (Info7), the DSO matches the offers with identified constraints or otherwise generates a buy order himself, specifying the order requirements (info4).	Selects	DSO	DSO		
If NODES platform								
2.5.2a 1		Extraction of sell orders from the flexibility market	If sell orders are available on the flexibility market platform, the DSO extracts them for evaluation purposes	Extracts	FMO	DSO	Info7	
2.5.2a 2		Evaluation of sell orders	DSO runs optimization algorithms, considering grid, costumers, and producers' constraints (location, price and volume, order time). The safe grid operation and costumer's quality supply must be ensured.	Evaluates	DSO	DSO		
2.5.2a 3		DSO validation of flexibility products	Based on the previously performed evaluations, the DSO selects which FSP's sell orders can help to solve the contingency (for each contingency) and provides this information to the FMO.	Selects	DSO	FMO		
2.5.2b 1		Buy order submission	If there are not sufficient offers on the flexibility market, the DSO motivates	Sends	DSO	FMO	Info7	

[39] Technicaly and ecnomicaly suitable.

			offers by stating a demand on the market by sending a buy order, with a price cap, to the flexibility market platform. [40]					
2.5.2b 2		Listing of buy orders in the flexibility market platform	Pre-qualified FSPs consult the listed DSO buy offers.	Provides	FMO	FSP	Info7	
2.5.2b 3		Offering of active power flexibility products	FSP submits a flexibility sell order of active power per asset on the flexibility market platform that matches a DSO stated demand on 2.5.2b1.	Offers	FSP	FMO		
2.5.2b 4		Selection of flexibility products	DSO selects which FSP can help solve the contingency (for each contingency).	Selects	DSO	FMO	Info18	
2.5.2b 5		Matching of sells offers	FMO matches FSP's asset bids with DSO buy orders if they correspond in terms of price and quantity	Selects	FMO	FMO		
2.5.2b 6		Update process	The steps from 2.5.2b1 to 2.5.2b5 shall be repeated iteratively until grid contraints are solved or until de maximum number of iterations (3 iterations)[41] is reached.					
If N-SIDE platform								

[40] Differences on the DSO buy offers from on iteration to the next , in order to boost FSP participation, is an open issue and requires further discussion.

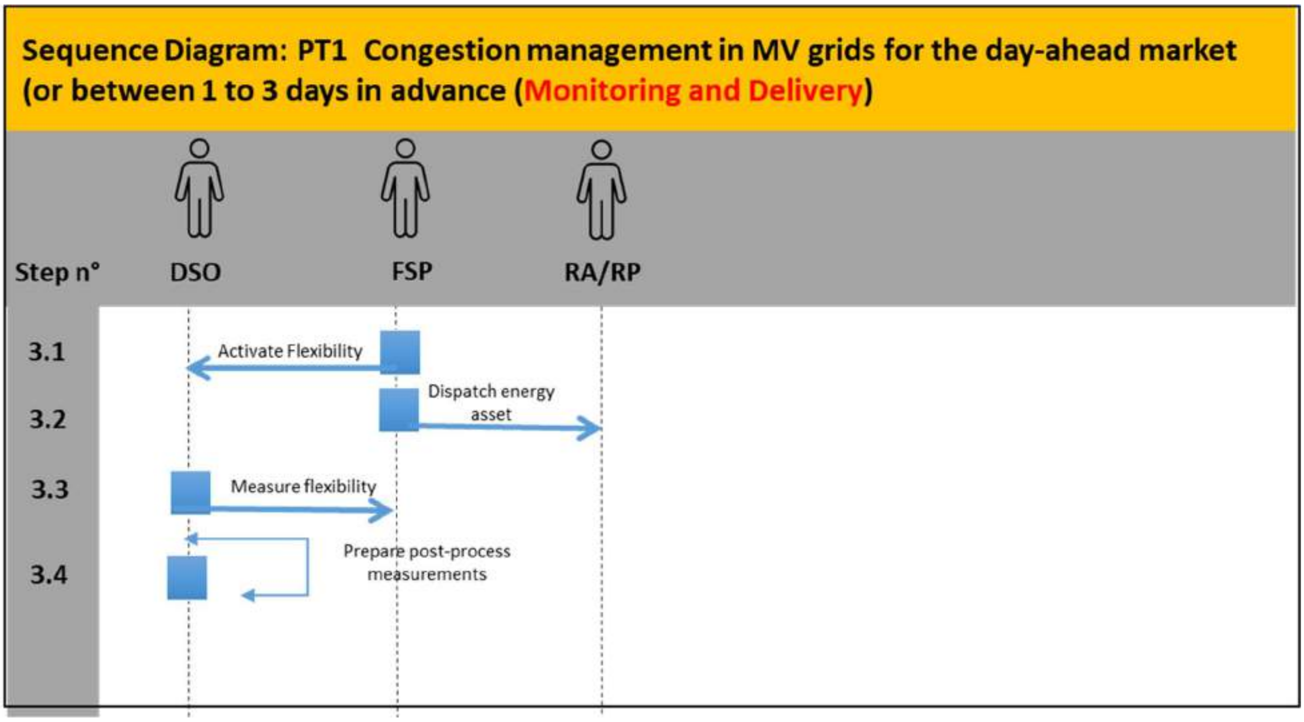
[41] The maximum number of iterations will be explored further in the next phases of the project.

2.5.2c 1		Express flexibility needs	DSO expresses its needs in the market, adapting the underlying conditions, for each congestion.	Expres ses	DSO	FMO	Info7	
2.5.2c 2		FMO selects bids	FMO selects FSP bids to solve the predicted congestions.	Selects	FMO	DSO	Info18	
2.5.2c 3		Validation of FSP offers	DSO validates selected bids	Validat es	DSO	FMO		
2.5.2c 4		Update process	The steps from 2.5.2c1 to 2.5.2c4 shall be repeated iteratively until grid constraints are solved or until de maximum number of iterations (3 iterations)[42] is reached. In each iteration, DSO should adapt either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts.					
Common to both platforms								
2.5.3		FSP Trade confirmation	The FMO sends a trade confirmation to the FSP. Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed	Sends	FMO	FSP	Info 12	

[42] The maximum number of iterations will be explored further in the next phases of the project.

2.5.4		DSO Trade confirmation	The FMO sends a trade confirmation to the DSO. Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed	Sends	FMO	DSO	Info 12	

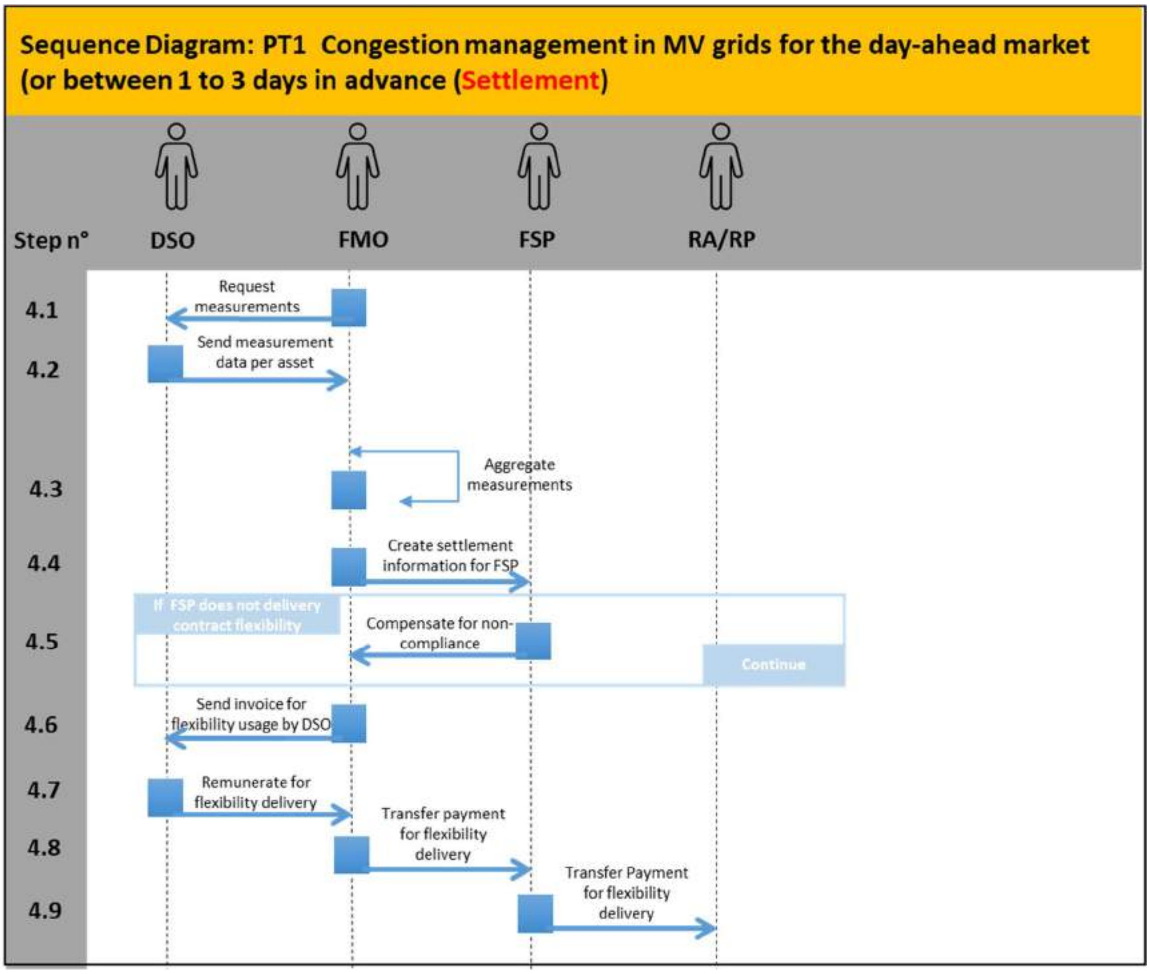
Delivery and Monitoring



Scenario step by step analysis

Scenario								
Scenario name		Delivery and Monitoring						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1.		Flexibility activation	The FSP activates the flexibility resources. Based on the matched offers and baselines.	provides	FSP	DSO		
3.2		Energy asset dispatch	The FSP dispatches energy assets	dispatches	FSP	RA/RP		
3.3		Measurement of delivered flexibility	The DSO calculates the delivered flexibility based on the measurements of the activated assets and the baselines provided by the FSPs.	collects	DSO	FSP	Info14	
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase	prepares	DSO			

Settlement



Sequence Diagram: PT1 Congestion management in MV grids for the day-ahead market (or between 1 to 3 days in advance (Settlement)
Step n°
DSO
FMO
FSP
RA/RP
4.1
Request measurements
4.2
Send measurement data per asset
4.3
Aggregate measurements
4.4
Create settlement information for FSP
If FSP does not delivery contract flexibility
4.5
Compensate for non-compliance
Continue
4.6
Send invoice for flexibility usage by DSO
4.7
Remunerate for flexibility delivery
Transfer payment for flexibility delivery
4.8
Transfer Payment for flexibility delivery
4.9

Scenario step by step analysis

Scenario								
Scenario name	Settlement							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1		Request measurements	The FMO request measurements from the DSO	requests	FMO	DSO		
4.2		Measurement data per asset	The DSO sends measurement data per asset	sends	DSO	FMO	Info14	
4.3		Aggregation of measurements	FMO aggregates meter data per asset.	aggregates	FMO	FMO	Info15	
4.4		Creation of settlement information for FSP	The FMO creates settlement information for FSP, according to market design rules. The FMO shall assess if the FSP delivered the contracted flexibility	sends	FMO	FSP	Info16	
4.5		Compensation for non-compliance	The FMO receives the compensation from the FSP	remunerates	FSP	FMO		

4.6		Invoice for flexibility usage by DSO	The FMO creates an invoice for flexibility usage by DSO, including a list of flexibilities that the DSO has activated.	sends	FMO	DSO	Info17	
4.7		Payment for flexibility delivery	The DSO prepares the payment	remunerates	DSO	FMO		
4.8		Transfer of payment for flexibility delivery	The FSP is paid by the FMO for the service	remunerates	FMO	FSP		
4.9		Payment for flexibility delivery	The RA/RP receive the remuneration for the service	remunerates	FSP	RA/RP		

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Periodic update on pre-qualification criteria	Regular updates on available pre-qualification criteria and technical requirements to be met by the FSPs	
Info2	Asset Registration Data	Information needed for the pre-qualification assessment.	
Info 3	New potential FSP registration	Information about a new potential FSP provider.	
Info4	Request for additional information/documentation	List of additional information or documentation needed by the DSO to evaluate the potential FSP.	
Info5	New information/documentation submitted notification	Notification regarding new information/documentation submitted for an in-progress pre-qualification process.	
Info6	Prequalification notification	Message about the outcome of the prequalification process	
Info7	Buy or sell flexibility order description	Information needed for the evaluation of the flexibility product. Potential order parameters are activation and availability price, quantity of power (minimum and maximum quantity), minimum and maximum duration of a delivery time interval, direction (up or down	

		regulation), mode of activation (manual or automatic), assets baseline, etc.	
Info8	Asset Baseline	Baseline determination rules are defined in the market rules	
Info9	Customer Metering Data	Existing measurements of electrical quantities at the customer connection point	
Info10	Grid Metering Data	Existing measurements of electrical quantities in the grid	
Info11	Exogenous Data	Information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	
Info12	Trade Confirmation	Information on the sell offer to be activated, like which resource are to be activated, amount of active and timeframe of activation.	
Info13	Information for mandatory processes	Data exchange for mandatory processes such as redispatch	
Info14	Metering Data of individual assets	Contains metering data for individual assets for the billing process.	
Info15	Aggregated Metering Data	Meter data per asset for the billing process	
Info16	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it	
Info17	Invoice	Address of invoice receiver, time frame of flexibility, activation, activated generation/load assets, specific flexibility costs in €/MWh per asset, total flexibility costs per asset in €, total	

		flexibility costs in €, underlying regulation scheme	
Info 18	List of Validated FSP	List of Validated FSP, selected for flexibility delivery	

7.2. BUC2 Portugal

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

ID	Name of use case Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use “verb + description”, e.g., operate the distribution’s congestion management market or submit flexibility bid to the distribution’s congestion management market.
PT2	Integrated Voltage Control in MV and LV grids for the day-ahead market (AP+RP)

What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.
This use case intends to address the voltage control in distribution grids on both voltage levels (MV and LV) considering an integrated approach. Instead of using an approach in which the voltage control is considered in a split way, this BUC will address the voltage control assuming that LV resources can support the voltage control in the upstream level. Thus, this BUC will consider network components (capacitor banks, tap changers, reconfiguration) combined with market-based procurement mechanisms to promote the participation of the resources connected to the distribution grids (MV and LV).
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.
• Dealing with voltage control in distribution grids in a coordinated manner on both voltage levels (MV and LV) • Demonstrate the operation of the market-based mechanisms as a cost-effective solution for voltage control in distributions grids • Optimizing the grid operation through the network-integrated components (capacitor banks, tap changers, reconfiguration etc) combining the flexibility provided by other facilities through markets mechanisms • Planning of the grid operation considering the forecast of the generation and load at local/regional level • Promote the participation of resources connected at MV and LV grids to provide flexibility services • Ensure that the solution provided by the flexibility activation through the market mechanisms will not create additional problems from a technical point of view and will support the grid in order to avoid voltage violations (overvoltage and undervoltage) • Optimizing the data exchange among the different players involved in the Portuguese demonstration

• Find a cost-effective solution, promoting the market participation of different players
What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
For this BUC, we are considering the following assumptions: • The DSO is responsible for ensuring the secure operation of the distribution inside its area of concession • Based on the planning operation, considering the generation and load forecast, the DSO will identify the flexibility needs for avoiding the voltage limitations • To deal with the voltage violation issues, as a first step the DSO will analyze if the use of network-integrated components (capacitor banks, tap changers, automated devices for reconfiguration) are proper to overcome the voltage violations of MV lines • It is assumed that in the scope of the demonstration, the flexibility can be provided by generation and/or consumption facilities. Currently, in Portugal, there is no regulatory framework for local flexibility markets. • To deal with the voltage problems in the distribution lines, the aggregated flexibility provided by LV units can be considered • DSO will evaluate if the market solution does not create additional restrictions to the grid operation • Besides the market operation, the DSO can use emergency measures for ensuring grid security and stability

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
Residential DR /Shiftable loads Industrial loads (Water Treatment Plants, etc) Smart EV charging Distribution network flexible assets and control (switching equipment, MV Storage - Li-Ion Batteries) Renewable self-consumption solutions (Clients with PV Panels) Active and Reactive power control of RES (Wind Farm) Dynamic Line Rating [43] Smart Meters

Further information

[43] To be confirmed

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
This BUC is related to the BUC PT1 and BUC PT3.

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Voltage control for day-ahead market considering an integrated approach for MV and LV grids.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Obligatory
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
Local flexibility market - Short term Local flexibility markets include a short-term pool in which offers are received from FSPs. The local market extension depends on the grid characteristics, i.e. the market area can encompass only a portion of the distribution network. The size of the local market is site-specific. The DSO will utilise flexibility based on its willingness to pay for it and the available fall-back solutions, and the type of flexibility product required. A local flexibility market seeks to promote competition among flexibility providers.

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
Based on the operational planning activities, the DSO will forecast possible voltage limitations in MV and LV grids for the next day. It is assumed that the generation and load forecast are provided by internal tools of the DSO. After identifying that the internal network-integrated components are not enough to avoid voltage limitations, the DSO will activate flexibility through market platforms or place an explicit buy order in the market to motivate the sellers of flexibility to submit additional bids in the case that constraints are not solved with the FMO submitted bids. The DSO will communicate the flexibility needs to the market indicating the active and reactive power requirements for the next-day (on a half hour basis). For this BUC, one can divide into the 4 phases Prequalification, Selection/Bidding, Delivery and Settlement: 1. Registration and Prequalification: Product definitions and initial pre-qualification including framework agreement with baseline delivery requirements 2. Selection/Bidding: Forecasts of voltage violations are made. Flexibility products are offered on a market platform by the distributed resources (distributed generators, consumers, aggregators, etc). The DSO can access the platform to get access to flexibility options in order to solve the voltage violation event. 3. Activation/Delivery and Monitoring: Flexibility resources can be activated via the market platform or by the DSO directly in case of an emergency case. The flexibility is delivered. 4. Settlement phase: The DSO validates the delivery and transmits the measured values to the market operator. Invoices are sent, and payments are made. In this step, it is assumed that meter data is provided by the DSO.
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., “main success scenario”) from a domain expert user’s point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions. While writing the narrative, please consider the following:[44] • Use “just one sentence form”: ▪ Use present tense. ▪ Use active verb in the active voice. ▪ Describe actions that move the process forward. ▪ For instance, “customer enters card and pin into ATM”

[44] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

- Keep it simple and to the point so that non-domain experts can understand it.

Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.

We suggest including the following aspects into the narrative:

  - Type of mechanism used (Market or other – please be specific)
  - Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system")
  - Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA)
  - Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)
  - Relevant phase (e.g., pre-qualification, procurement, activation, settlement)

Registration and Prequalification phase:

- DSO publishes pre-qualification criteria.
- RA/RP registers assets on flexibility market
  - The information/documentation is submitted to the market platform, afterwards this information / documentation is made available to the DSO.
- DSO evaluates potential FSP.
  - DSO checks if conditions demonstrated are compliant with pre-qualification criteria.
  - DSO performs a real flexibility activation test.
  - Additional information/documentation can be required, through the market platform.
  - This can be an iterative process, repeated until all requirements are met. If not, the potential FSP is rejected.
- RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can then create offers on the flexibility market.

Selection/Bidding phase:

- FSPs deliver a baseline per asset and makes sure that information is updated.
- FSPs submit active and/or reactive power sell orders, in separated markets, to the flexibility market. (D-3 until D-1, D =Flex Activation Day).

- DSO collects data (metering data, forecasts).
- DSO evaluates updated grid information and predicts grid congestions. This process starts in D-1.

Two market platforms will be used.

Nodes Market Platform

- DSO selects the sell orders, to solve the predicted voltage violations, making sure that there is a cost-efficient solution. Two outcomes can result from this step:
    - Voltage Violations are solved.
    - Voltage Violations are not solved (iterative process until all constrains are solved, or until the maximum number of iterations is reached):
        - DSO places a buy order in the market, for each voltage violation.
        - FSPs reply with a sell order.
        - DSO selects sell orders to solve the predicted voltage violations.
        - DSO validates FSP orders and provides a list of valid FSP orders for each predicted voltage violation to the FMO.
        - FMO clears the market for each subperiod. FMO identifies accepted bids and confirms the trade. Market closes some hours (fixed) prior to activation time, for that specific hour the next day.

N-Side Market Platform

- Based on its analysis, the DSO will submit active and reactive power buy orders on the Flexibility Market, alongside network-related constraints. Both the FSPs and the DSO can continue to submit or update their bids on the Market Platform until the market closure (in day-ahead).
- Once the market is closed, the FMO will operate the clearing of the market, matching the buy orders with the sell orders through an algorithm aiming to maximize the social welfare (i.e. the sum of the market participants surplus) while respecting the given constraint (asset parameters from FSPs and grid-related constraints from the DSO)
- Once the clearing step is finished, the results (acceptance level of each order submitted on the market and prices) are shared with the DSO for validation. Two outcomes can result from this step:
    - The voltage violations are solved, and the DSO validates the outcome.
    - Voltage violations are not solved, or the DSO rejects the result for another operational reason. Then, an iterative process starts until all network

issues are solved, or until the maximum number of iterations/a time limit is reached:

  - The DSO expresses its needs in a different way on the market, adapting either the pricing of flexibility needs or the underlying conditions, for each voltage violation it forecasts,
  - The FMO proceeds to a new market clearing with the updated information on the DSO side, and unchanged submitted information from FSP bids. Once the final decision is taken by the DSO, the market results are shared with all market participants, informing FSPs of the acceptance and prices related to the bids they submitted.
  - Market closes some hours (fixed) prior to activation time, for that specific hour the next day.

- If no solution is found, mandatory curtailment of the need not supplied by the market is required. It is considered that FSPs can provide a partial solution to the congestion problem, minimizing the curtailed energy.

Activation/Delivery and Monitoring phase:

- Flexibility resources are activated by the FSPs following the information received from the DSO through the flexibility market platform. This right can also be relinquished to the DSO. The DSO can then activate resources directly.
- The flexibility is delivered.

Settlement phase:

- The DSO collects the metering data and transmits it to the FMO
- FMO validates the delivery based on the metering data and the previously baselines
- FMO sends an invoice to the DSO.
- Payments are made from the DSO via the market platform to the FSP, which in turn remunerates the RA and RP

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	*Actor type*	*Description (if different from the EUniversal Role model)*	*Further information specific to this use case*
DSO	Role		
FSP	Role		
FMO	Role		
RA/RP	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

<u>Overview of scenarios</u>

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define "success" or "failure" conditions for each use case.
-

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market	RA/RP	new RA/RP wants to qualify new assets for flexibility market	RA/RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market. If the prequalification is not successful, the RA/RP cannot register the assets nor create offers on the flexibility market

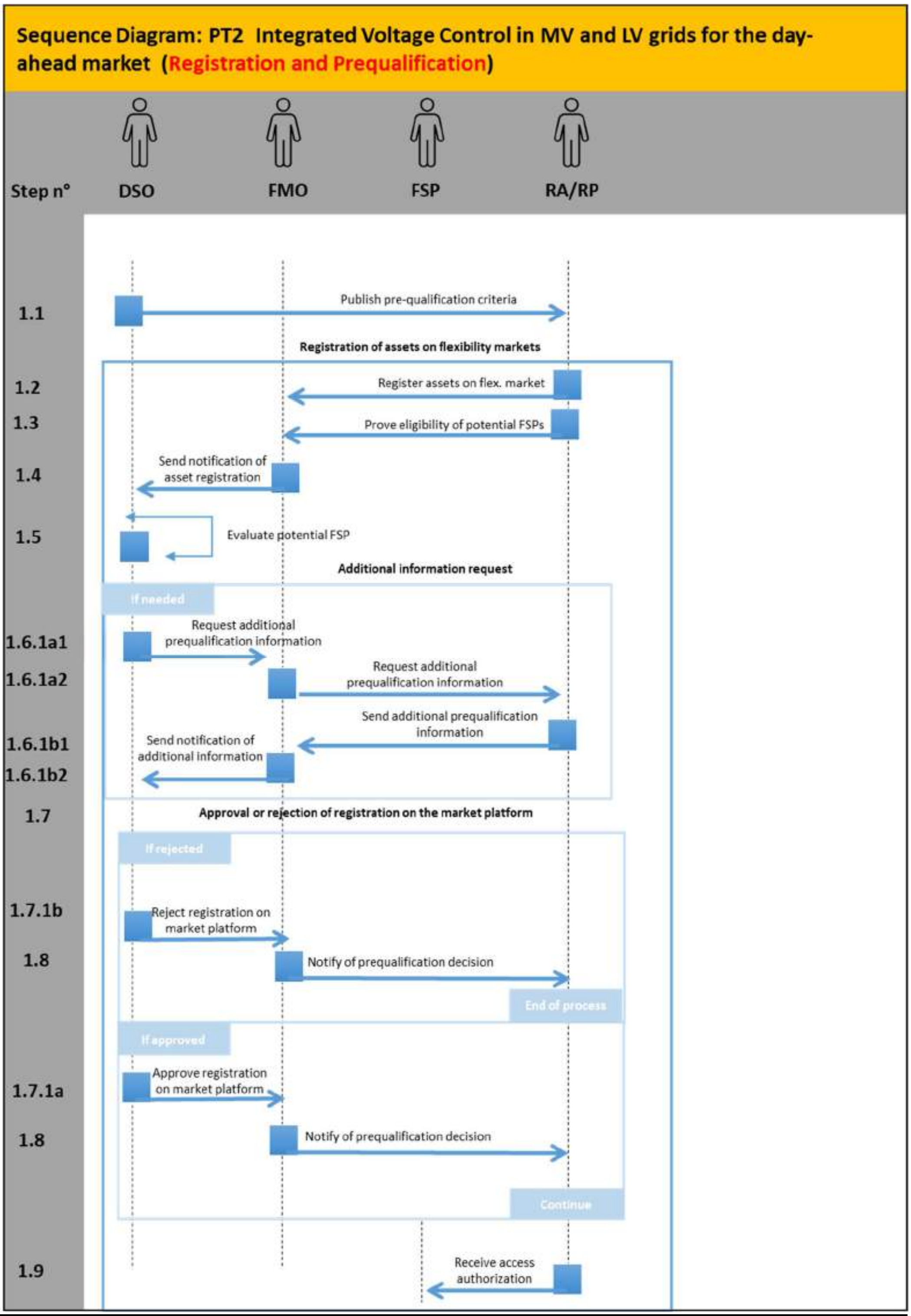
2	Selection/Bidding	Planning of grid utilisation and identifying potential voltage limit violations followed by bid submission, evaluation, and matching	DSO, FMO, FSP	Voltage limit violations forecast, Available flexibility	Available active and reactive power flexibility connected; Prequalified FSPs	When bids are matched, flexibility of the local market is used for congestion management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP, FMO, DSO	Trade confirmation, proved by metering data sent from the DSO to the FMO.	Matching bids on the flexibility market	The actual provided flexibility is delivered. Voltage limit violations are eliminated.
4	Settlement	Invoicing and Payments	DSO, FMO	The DSO pays the FSP for the flexibility delivery	Delivered active and reactive Power flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
    - Input to the use case from some external source that is not described in this use case,
    - Internal to the use case (although could be between different applications and systems within the use case),
    - Output from the use case that will be used by other actors / entities not included in this use case.
    - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification



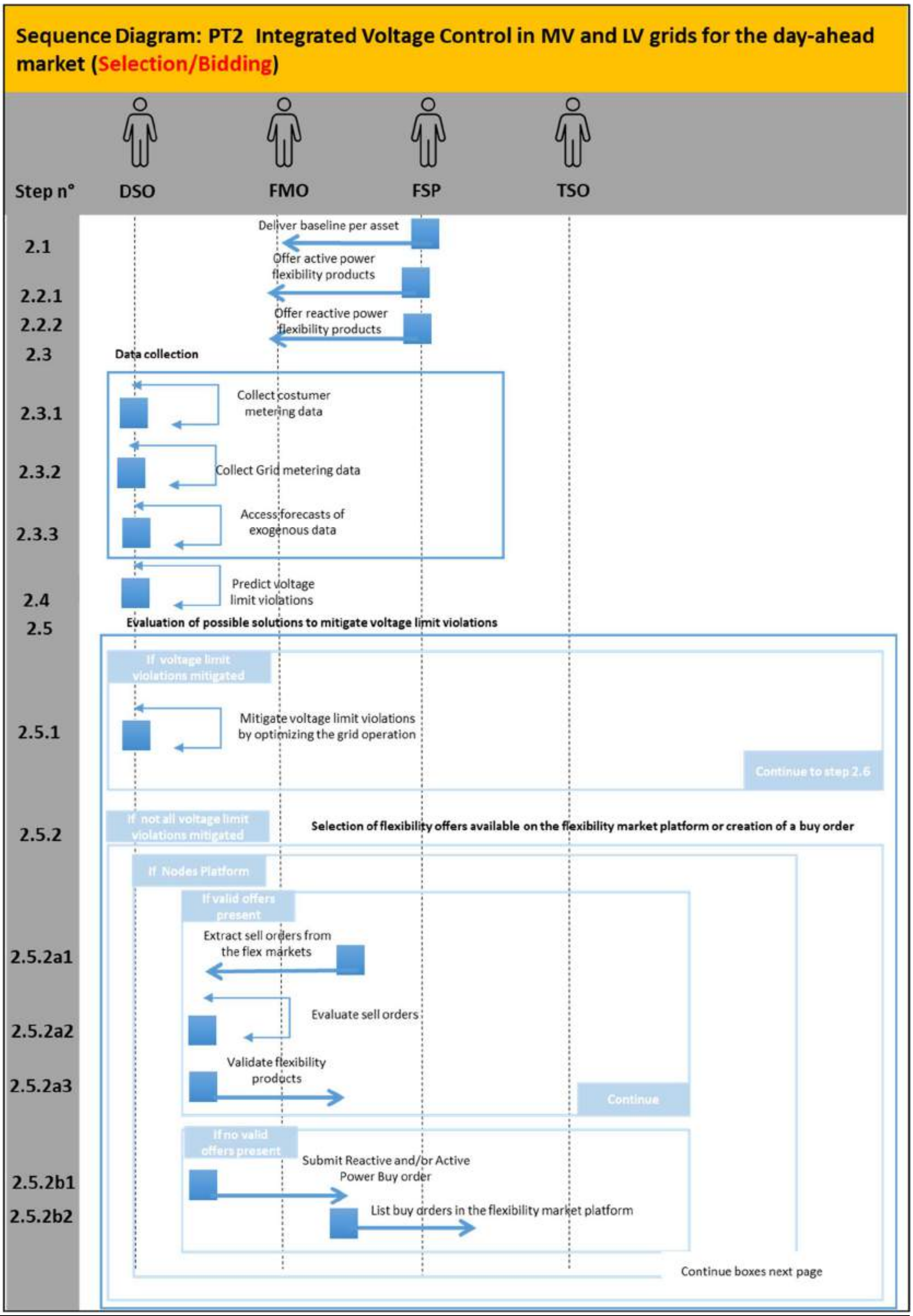
Scenario step by step analysis

Scenario								
Scenario name		Registration and Prequalification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Publication of pre-qualification criteria	The DSO publishes regularly updated public information on pre-qualification criteria and technical requirements to be met by the FSPs.	Publishes	DSO	RA/RP	Info1	
1.2		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions.	Registers	RA/RP	FMO		
1.3		Proof of eligibility by potential FSPs	RA/RP sends proof in compliance with the prequalification criteria by submitting the required documentation.	Sends	RA/RP	FMO	Info2	
1.4		Notification of a new potential FSP registration	FMO sends a notification to the DSO stating that a potential FSP is awaiting approval and gives access to the submitted documentation. The DSO can consult the information for approval to the market on the platform.	Sends	FMO	DSO	Info3	

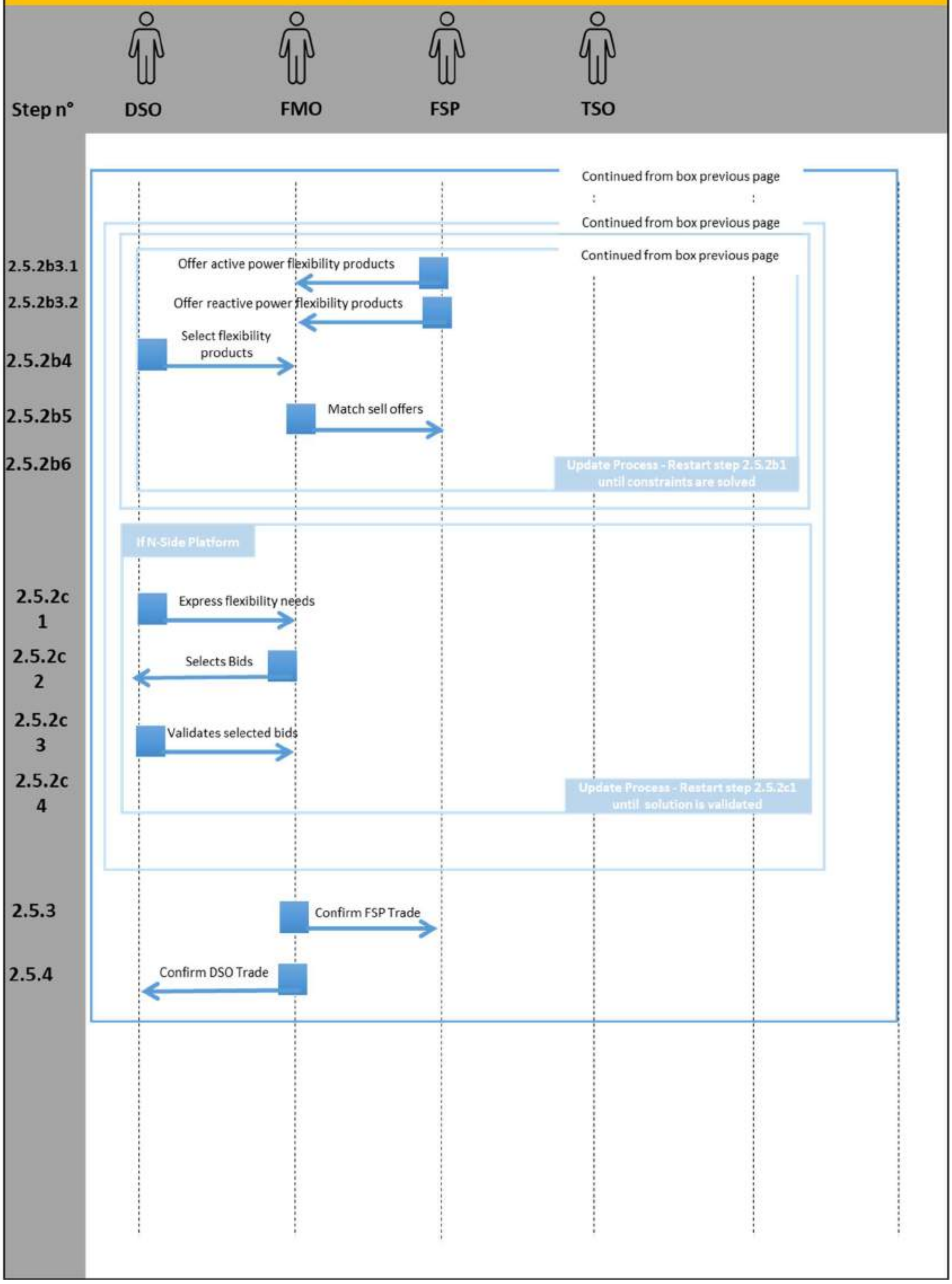
1.5		Evaluation of potential FSP	DSO consults the documentation submitted by the potential FSP on the market platform and evaluates the flexibility offer and the need for additional information. A real flexibility activation test shall be performed. This can be an iterative process.	Evaluates	DSO			
1.6		Additional information request	DSO evaluates the need for additional information					
1.6. a1		Request of additional pre-qualification information	DSO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	DSO	FMO	Info4	
1.6. a2		Request of additional pre-qualification information	FMO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	FMO	RA/RP	Info4	
1.6b 1		Provision of additional pre-qualification information/documentation	Potential FSP sends the required additional information for the pre-qualification to the DSO	Sends	RA/RP	FMO	Info2	
1.6b 2		Notification of new information/documentation submitted	FMO sends a notification to the DSO stating that a potential FSP has submitted the additional required information/documentation	Sends	FMO	DSO	Info5	
1.7		Approval or rejection of registration on the market platform	The DSO needs to approve or reject the registration of the asset on the market platform.					

1.7. 1a		DSO approval of new FSP registration	DSO approves new FSP and registers this decision on the market platform.	Approves	DSO	FMO	Info6	
1.7. 1b		DSO rejection of potential FSP registration	The DSO rejects the potential FSP registration due to failure to meet pre-qualification criteria or the lack of required documentation. Potential FSP cannot take part in the flexibility market.	Rejects	DSO	FMO	Info6	
1.8		Pre-qualification result notification	FMO sends a notification to the RA/RP regarding the pre-qualification decision. Notification that additional evaluation information can be consulted in the market platform.	Sends	FMO	RA/RP	Info6	
1.9		Access authorization	The RA/RP becomes a FSP and can now access the flexibility market.	Becomes	RA/RP	FSP		

Selection/Bidding



Sequence Diagram: PT2 Integrated Voltage Control in MV and LV grids for the day-ahead market (Selection/Bidding - continued)



Scenario step by step analysis

Scenario								
Scenario name	Selection/Bidding							
Step No	***Even t***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requiremen t, R-IDs***
2.1		Delivery of baseline per asset	The FSP makes available for the DSO in the market platform, the baseline for each of the assets[45] registered in the market platform	Makes availabl e	FSP	FMO	Info8	
2.2.1		Offering of active power flexibility products	FSP submits a flexibility sell order of active power per asset on the flexibility market platform.	Submit s	FSP	FMO	Info7	
2.2.2		Offering of reactive power flexibility products	FSP submits a flexibility sell order of reactive power per asset on the flexibility market platform.	Submit s	FSP	FMO	Info7	
2.3		Data collection	The DSO collects the data it needs to evaluate the grid.					

[45] On the NODES platform, baselines have to be submitted per portfolio. Nevertheless, even though they will be aggregated, individual baselines are still needed.

2.3.1		Costumer metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI installed infrastructure at costumer's connection points.	Collects	DSO	DSO	Info9	
2.3.2		Grid metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI infrastructure installed in the grid.	Collects	DSO	DSO	Info10	
2.3.3		Access to forecasts of exogenous data	The DSO accesses the information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	Accesse s	DSO	DSO	Info11	
2.4		Evaluation of updated grid information and prediction of voltage limit violations	DSO performs grid evaluating algorithms using topology, measurement, and market related data (cf. Info 7-11). This evaluation is predictive (1 day ahead).	Predict s	DSO	DSO		
2.5		Evaluation of possible solutions to mitigate grid voltage limit violations	DSO evaluates all the available solutions to mitigate grid voltage limit violations: optimizing the grid operation through the network-integrated components, the market-based mechanisms or redispatch (out of scope).	Evaluat es	DSO	DSO		
2.5.1		Mitigation of grid voltage limit violations by	Identified grid voltage limit violations is mitigated by optimizing grid operation	Mitigat es	DSO	DSO		

		optimizing the grid operation	through the network-integrated components (capacitor banks, tap changers, grid reconfiguration etc)					
2.5.2		Selection of flexibility offers available on the flexibility market platform or creation of a buy order	If there are suitable[46] offers on the flexibility market platform (Info7), the DSO matches the offers with identified constraints or otherwise generates a buy order himself, specifying the order requirements (info4).	Selects	DSO	DSO		
If NODES platform								
2.5.2a 1		Extraction of sell orders from the flexibility market	If sell orders are available on the flexibility market platform, the DSO extracts them for evaluation purposes	Extract s	FMO	DSO	Info7	
2.5.2a 2		Evaluation of sell orders	DSO runs optimization algorithms, considering grid, costumers, and producers' constraints (location, price and volume, order time). The safe grid operation and costumer's quality supply must be ensured.	Evaluat es	DSO	DSO		
2.5.2a 3		DSO validation of flexibility products	Based on the previously performed evaluations, the DSO indicates which FSP's sell orders can help to solve the	Selects	DSO	FMO		

[46] Technicaly and ecnomicaly suitable.

			contingency (for each contingency) and provides this information to the FMO.					
2.5.2b 1		Buy order submission	If there are not sufficient offers on the flexibility market, the DSO motivates offers by stating a demand on the market by sending a buy order (active and/or reactive), with a price cap, to the flexibility market platform. [47]	Sends	DSO	FMO	Info7	
2.5.2b 2		Listing of buy orders in the flexibility market platform	Pre-qualified FSPs consult the listed DSO buy offers.	Provide s	FMO	FSP	Info7	
2.5.2b 3.1		Offering of active power flexibility products	FSP submits a flexibility sell order of active power per asset on the flexibility market platform that matches a DSO stated demand on 2.5.2b1.	Offers	FSP	FMO		
2.5.2b 3.2		Offering of reactive power flexibility products	FSP submits a flexibility sell order of reactive power per asset on the flexibility market platform that matches a DSO stated demand on 2.5.2b1.	Offers	FSP	FMO		
2.5.2b 4		Selection of flexibility products	DSO selects which FSP can help solve the contingency (for each contingency).	Selects	DSO	FMO		
2.5.2b 5		Matching of sells offers	FMO matches FSP's asset bids with DSO buy orders if they correspond in terms of price and quantity	Selects	FMO	FMO		

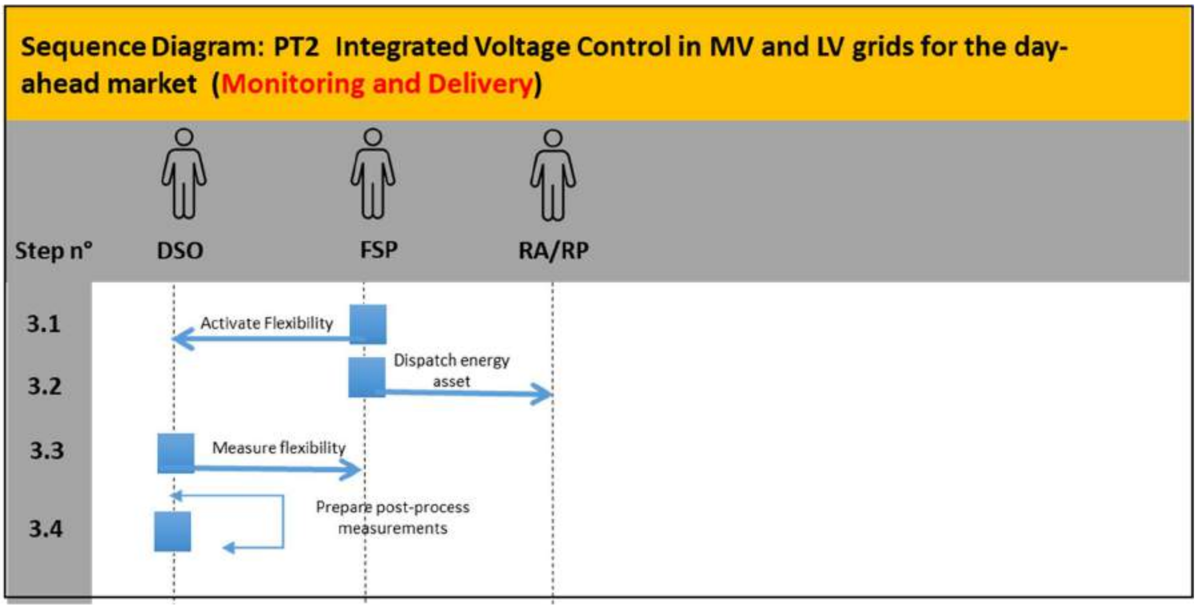
[47] Differences on the DSO buy offers from on iteration to the next , in order to boost FSP participation, is an open issue and requires further discussion.

2.5.2b 6		Update process	The steps from 2.5.2b1 to 2.5.2b5 shall be repeated iteratively until grid contains are solved or until de maximum number of iterations (3 iterations)[48] is reached.					
If N-SIDE platform								
2.5.2c 1		Express flexibility needs	DSO expresses its needs in the market, adapting the underlying conditions for each voltage violation.	Expresses	DSO	FMO	Info7	
2.5.2c 2		FMO selects bids	FMO selects FSP bids to solve the predicted voltage violation.	Selects	FMO	DSO	Info18	
2.5.2c 3		Validation of FSP offers	DSO validates selected bids	Validates	DSO	FMO		
2.5.2c 4		Update process	The steps from 2.5.2c1 to 2.5.2c4 shall be repeated iteratively until grid constraints are solved or until de maximum number of iterations (3 iterations) is reached. In each iteration, DSO should adapt either the pricing of flexibility needs or the underlying conditions, for each voltage violation it forecasts.					
Common to both platforms								

[48] The maximum number of iterations will be explored further in the next phases of the project.

2.5.3		FSP Trade confirmation	The FMO sends a trade confirmation to the FSP. Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed	Sends	FMO	FSP	Info 12	
2.5.4		DSO Trade confirmation	The FMO sends a trade confirmation to the DSO. Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed	Sends	FMO	DSO	Info 12	

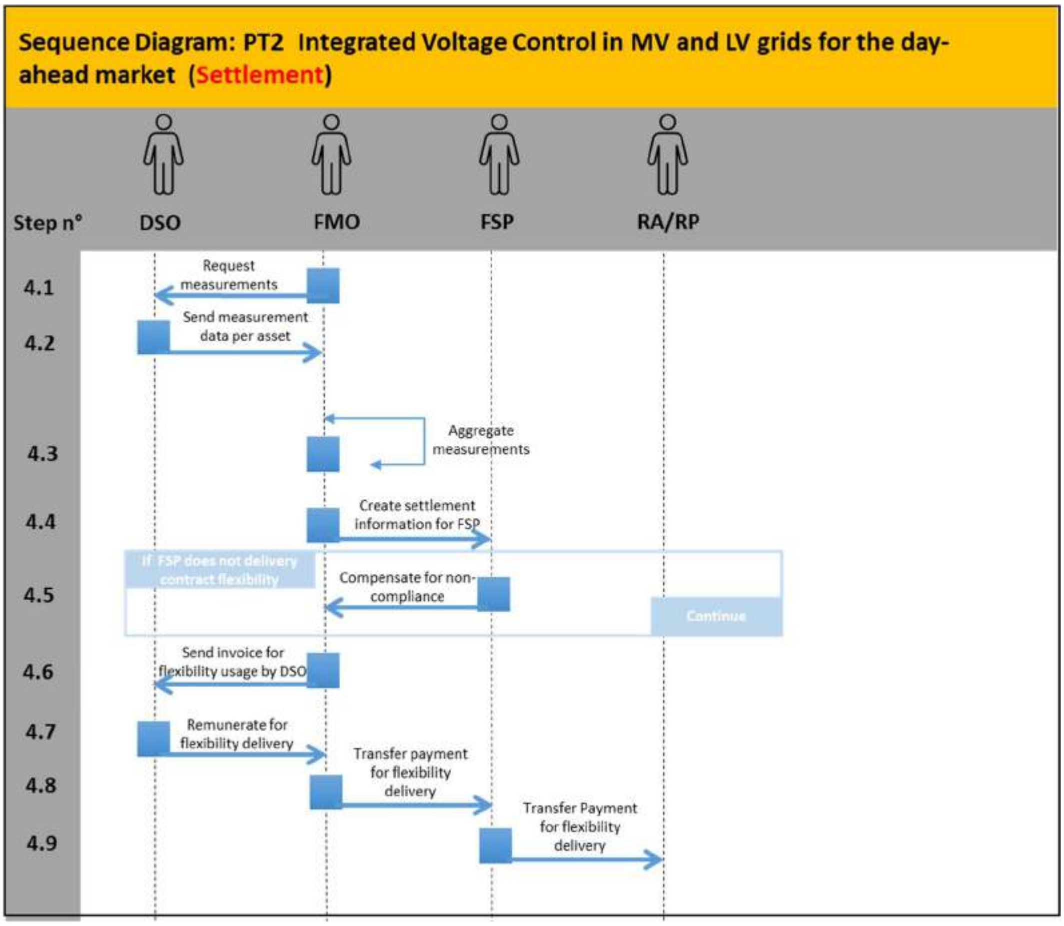
Delivery and Monitoring



Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1.		Flexibility activation	The FSP activates the flexibility resources. Based on the matched offers and baselines.	provides	FSP	DSO		
3.2		Energy asset dispatch	The FSP dispatches energy assets	dispatches	FSP	RA/RP		
3.3		Measurement of delivered flexibility	The DSO calculates the delivered flexibility based on the measurements of the activated assets and the baselines provided by the FSPs.	collects	DSO	FSP	Info14	
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase	prepares	DSO			

Settlement


Sequence Diagram: PT2 Integrated Voltage Control in MV and LV grids for the day-ahead market (Settlement)
Step n°
DSO
FMO
FSP
RA/RP
4.1
Request measurements
4.2
Send measurement data per asset
4.3
Aggregate measurements
4.4
Create settlement information for FSP
4.5
If FSP does not delivery contract flexibility
Compensate for non-compliance
Continue
4.6
Send invoice for flexibility usage by DSO
4.7
Remunerate for flexibility delivery
4.8
Transfer payment for flexibility delivery
4.9
Transfer Payment for flexibility delivery

Scenario step by step analysis

Scenario								
Scenario name	Settlement							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1		Request measurements	The FMO request measurements from the DSO	requests	FMO	DSO		
4.2		Measurement data per asset	The DSO sends measurement data per asset	sends	DSO	FMO	Info14	
4.3		Aggregation of measurements	FMO aggregates meter data per asset.	aggregates	FMO	FMO	Info15	
4.4		Creation of settlement information for FSP	The FMO creates settlement information for FSP, according to market design rules. The FMO shall assess if the FSP delivered the contracted flexibility	sends	FMO	FSP	Info16	
4.5		Compensation for non-compliance	The FMO receives the compensation from the FSP	remunerates	FSP	FMO		

4.6		Invoice for flexibility usage by DSO	The FMO creates an invoice for flexibility usage by DSO, including a list of flexibilities that the DSO has activated.	sends	FMO	DSO	Info17	
4.7		Payment for flexibility delivery	The DSO prepares the payment	remunerates	DSO	FMO		
4.8		Transfer of payment for flexibility delivery	The FSP is paid by the FMO for the service	remunerates	FMO	FSP		
4.9		Payment for flexibility delivery	The RA/RP receive the remuneration for the service	remunerates	FSP	RA/RP		

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Periodic update on pre-qualification criteria	Regular updates on available pre-qualification criteria and technical requirements to be met by the FSPs	
Info2	Asset Registration Data	Information needed for the pre-qualification assessment.	
Info 3	New potential FSP registration	Information about a new potential FSP provider.	
Info4	Request for additional information/documentation	List of additional information or documentation needed by the DSO to evaluate the potential FSP.	
Info5	New information/documentation submitted notification	Notification regarding new information/documentation submitted for an in-progress pre-qualification process.	
Info6	Prequalification notification	Message about the outcome of the prequalification process	
Info7	Buy or sell flexibility order description	Information needed for the evaluation of the flexibility product. Potential order parameters are activation and availability price, quantity of power (minimum and maximum quantity), minimum and maximum duration of a delivery time interval, direction (up or down	

		regulation), mode of activation (manual or automatic), assets baseline, etc.	
Info8	Asset Baseline	Baseline determination rules are defined in the market rules	
Info9	Customer Metering Data	Existing measurements of electrical quantities at the customer connection point	
Info10	Grid Metering Data	Existing measurements of electrical quantities in the grid	
Info11	Exogenous Data	Information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	
Info12	Trade Confirmation	Information on the sell offer to be activated, like which resource are to be activated, amount of active and timeframe of activation.	
Info13	Information for mandatory processes	Data exchange for mandatory processes such as redispatch	
Info14	Metering Data of individual assets	Contains metering data for individual assets for the billing process.	
Info15	Aggregated Metering Data	Meter data per asset for the billing process	
Info16	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it	
Info17	Invoice	Address of invoice receiver, time frame of flexibility, activation, activated generation/load assets, specific flexibility costs in €/MWh or in €/MVarh per asset, total flexibility costs	

		per asset in €, total flexibility costs in €, underlying regulation scheme	
Info18	List of Validated FSP	List of Validated FSP, selected for flexibility delivery	

7.3. BUC3 Portugal

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

ID	Name of use case
ID	***Name of use case*** Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use "verb + description", e.g., operate the distribution's congestion management market or submit flexibility bid to the distribution's congestion management market.
PT3	Voltage control and congestion management for some days/weeks in advance (until two/three weeks)

What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.
This use case intends to address the voltage control and congestion management issues which can arise due to maintenance actions on the MV lines. In the daily operation of the MV grid, dozens of maintenance activities are performed with the objective to replace aged assets, improve the performance of the components, etc. During most of those interventions, it is necessary to reconfigure the network by closing some normally open switches in order to isolate the work zone. Consequently, in some cases, it is not possible to perform the maintenance actions since the network reconfiguration will jeopardize the quality of supply to the customers, causing voltage violations or congestion in the MV lines. The typical approach to deal with these issues is to shift the activities to more favorable periods like the weekend as normally the consumption is smaller than during weekdays. This BUC aims to analyze if a market-based mechanism can be used to avoid the shift of maintenance actions to weekend periods, thereby avoiding more expenses, and in some cases, avoiding voltage control and congestion issues that would otherwise lead to the need to disconnect clients. Based on the forecast for load and generation in the distribution grid for some two/three weeks in advance as well as the planned work schedule, the DSO will predict problems that can arise as a result of those activities and take action via a market-based approach.
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.
• Anticipate technical problems that can arise as a consequence of planned action on the distribution grid for some days in advance (two/three weeks) considering the load and generation forecast as well as the schedule for planned interventions on the grid. • Identify flexibility needs to solve those problems and use the market-based mechanism as a way to solve them.

What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
For this BUC, we are considering the following assumptions: • The DSO is responsible for ensuring the secure operation of the distribution grid inside its area of concession. • Based on the schedule of the planned actions, considering the generation and load forecast, the DSO will identify the flexibility needs for avoiding the voltage limitations and congestions. • As a first step the DSO will analyze if the use of network-integrated components (capacitor banks, tap changers, automated devices for reconfiguration) are proper to overcome congestion and voltage problems. • It is assumed that in the scope of the demonstration, the flexibility can be provided by generation and/or consumption facilities. Currently, in Portugal, there is no regulatory framework for local flexibility markets. • The flexibility can be provided by flexibility providers located in MV and LV, depending on the location of the planned intervention.

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
Residential DR /Shiftable loads Industrial loads (Water Treatment Plants, etc) Smart EV charging Distribution network flexible assets and control (switching equipment, MV Storage) Renewable self-consumption solutions (Clients with PV Panels) Active power control of RES (Wind Farm) Dynamic Line Rating [49] Smart Meters

Further information

[49] To be confirmed

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).
This BUC is related to the BUC PT1 and BUC PT2. The flexibility market described in this BUC is divided in a Long Flex Market and in a Short Flex. The Short Flex Markets are the same as the ones considered in the BUC PT1(active power market) and BUC PT2 (active and reactive power market).

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Physical congestion – Corrective and predictive congestion management (three/two weeks in advance) Voltage violation - Corrective and predictive voltage control (three/two weeks in advance)
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Business need
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
Local flexibility market Local flexibility markets include long-term and short-term pools in which offers are received from FSPs. A long-term mechanism could be used in planning activities to procure flexibility by contracting long in advance the potential service providers. The local market extension depends on the grid characteristics, i.e. the market area can encompass only a portion of the distribution network. The size of the local market is site-specific. The DSO will utilise flexibility based on its willingness to pay for it and the available fall-back solutions and the type of flexibility product required. A local flexibility market seeks to promote competition among flexibility providers.

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
Based on the operational planning activities, mainly the planned maintenance actions, the DSO will forecast possible voltage limitations and congestion in MV and LV grids for some days in advance. It is assumed that the generation and load forecasts are provided by internal tools of the DSO. After identifying that the internal network-integrated components are not enough to avoid voltage limitations and congestions, the DSO will activate flexibility through market platforms or place an explicit buy order in the market to motivate the sellers of flexibility to submit additional bids in the case that constraints are not solved with the FMO submitted bids. The DSO will communicate the flexibility needs to the market indicating the active and reactive power requirements for some days in advance (on a half-hour basis). This BUC can be divided into the following 4 phases Prequalification, Selection/Bidding, Delivery and Settlement: 1. Registration and Prequalification: This phase consists of the product definitions and the initial pre-qualification including the framework agreement with baseline delivery requirements 2. Selection/Bidding: This phase can be divided into two main stages. The first one takes place during the planned maintenance planning, some days/weeks in advance. Forecasts of congestions and voltage violations are made. To mitigate the predicted constraints, the DSO places a long term flexibility request in the flexibility market (two different markets, one for active power and other for reactive power) and then the FSPs reply with long term flexibility offers (active and/or reactive). The DSO requests and FSP offers are matched continuously according to their price and quantity limits. This is the long term market. The second stage is closer to the activation period. There, new forecasts of congestions and voltage violations are made. Flexibility products are offered on a market platform by the distributed resources (distributed generators, consumers, aggregators, etc). The DSO can access the platform and selects the flexibility options to solve the congestion or voltage violation event. The FSPs are obliged to submit the sell offers previously matched/selected in the long term flexibility market along with new FSPs 3. Activation/Delivery and Monitoring: Flexibility resources are activated via the market platform according to the matched offers and the flexibility is delivered by the FSPs. The DSO validates the delivery. 4. Settlement phase: The DSO transmits the measured values to the market operator. Invoices are sent, and payments are made. In this step, it is assumed that meter data is provided by the DSO.
Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., “main success scenario”) from a domain expert user’s point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions. While writing the narrative, please consider the following:[50]

[50] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

- Use “just one sentence form”:
    - Use present tense.
    - Use active verb in the active voice.
    - Describe actions that move the process forward.
    - For instance, “customer enters card and pin into ATM”
- Keep it simple and to the point so that non-domain experts can understand it.

Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.

We suggest including the following aspects into the narrative:

- Type of mechanism used (Market or other – please be specific)
- Interaction between roles (we suggest that you focus on the roles’ intent bearing in mind that an action step reflects data circulating in one direction, e.g. “user enters name and address into the system”)
- Timeframe (e.g., local flexibility market opens at “x”. The GCT is at “y”. The clearing takes place 30 min. before the DA)
- Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)
- Relevant phase (e.g., pre-qualification, procurement, activation, settlement)

Registration and Prequalification phase:

- DSO publishes pre-qualification criteria.
- RA/RP registers assets on flexibility market
    - The information/documentation is submitted to the market platform, afterwards this information / documentation is made available to the DSO.
- DSO evaluates potential FSP.
    - DSO checks if conditions demonstrated are compliant with pre-qualification criteria.
    - DSO performs a real flexibility activation test[51].

[51] Still to be decided in the project how this would take place in practice.

- Additional information/documentation can be required, through the market platform.
- This can be an iterative process, repeated until all requirements are met. If not, the potential FSP is rejected.

- RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can then create offers on the flexibility market.

Selection/Bidding phase:

- FSPs deliver a baseline per asset and make sure that the information is updated.

First stage – Long Term Flexibility Market

- DSO plans Grid Maintenance.
- DSO collects historic data (metering data, grid metering data, forecasts).
- DSO evaluates updated grid information and predicts grid congestions and voltage violations. This process starts in W-3.

Two market platforms will be used.

Nodes Market Platform

- If constraints are identified DSO places a long term flexibility request, 3 weeks before activation.
  - DSO places a long term flexibility request in the active power market, for each congestion;
  - DSO places a long term flexibility request in the reactive power market and /or in the active power market, for each voltage violation;
- FSPs share their flexibility reserve offers in the active and/or reactive power market
- FMO closes the market, 2 weeks before activation and sends FSPs offers to the DSO.
- DSO selects and validates the offers based on quantitave criteria such as quantity, activation period, grid data or asset parameters. Both counterparties enter into a legally binding agreement upon selection
- DSO informs FMO about established agreement(s).

N-Side Market Platform

- The market opens 3 weeks before flexibility activation.
- FSPs submit active power sell orders to the flexibility market.

- FSPs submit reactive power sell orders to the flexibility market.
- Based on its analysis, the DSO will submit active power buy orders on the Flexibility Market, alongside network-related constraints. Both the FSPs and the DSO can continue to submit or update their bids on the Market Platform until the market closure (2W before activation).
- Once the market is closed, the FMO will operate the clearing of the market, matching the buy orders with the sell orders through an algorithm aiming to maximize the social welfare (i.e. the sum of the market participants surplus) while respecting the given constraint (asset parameters from FSPs and grid-related constraints from the DSO)
- Once the clearing step is finished, the results (acceptance level of each order submitted on the market and prices) are shared with the DSO for validation. Two outcomes can result from this step:
  - The grid constraints (congestions and voltage violations) are solved, and the DSO validates the outcome.
  - Grid constraints (congestions and voltage violations) are not solved, or the DSO rejects the result for another operational reason. Then, an iterative process starts until all network issues are solved, or until the maximum number of iterations/a time limit is reached:
    - The DSO expresses its needs in a different way on the market, adapting either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts,
    - The FMO proceeds to a new market clearing with the updated information on the DSO side, and unchanged submitted information from FSP bids. Once the final decision is taken by the DSO, the market results are shared with all market participants, informing FSPs of the acceptance and prices related to the bids they submitted.

- The matched sell bids, from each market, will be considered as reserved flexibility. The FSPs with matched sell bids are obliged to submit sell offers in the short-term market, with an accorded maximum price cap. FSPs with matched offers will be paid for flexibility reservation.

Second stage – Short Term Flexibility Market

- FSPs submit active and/or reactive power sell orders to the flexibility market. (D-3 until D-1, D=Flex Activation Day). These sell orders are both new sell orders and the ones that transit from the long term flexibility market.
- DSO collects data (metering data, forecasts).
- DSO re-evaluates updated grid information and predicts grid congestions and voltage violations.

Two market platforms will be used.

Nodes Market Platform

- If constraints are identified, the DSO expresses its new needs through bids on the market platform in order to solve the predicted congestions and voltage violations, making sure that there is a cost-efficient solution. The following outcomes can result from this step:
    - Congestions and Voltage violations are solved
    - Congestions are not solved, and Voltage violations are solved (iterative process until all constrains are solved, or until the maximum number of iterations is reached.):
        - DSO places a buy order in the market (active power), for each congestion.
        - FSPs reply with a sell order.
        - DSO selects sell orders to solve the predicted congestions.
    - Voltage violations are not solved, and Congestions are solved (iterative process until all voltage violations are solved, or until the maximum number of iterations is reached.):
        - DSO places a buy order in the market (active and/or reactive power), for each constraint.
        - FSPs reply with a sell order.
        - DSO selects a solution, to solve the predicted voltage violations.
    - Neither Voltage violations or Congestions are solved (iterative process until all voltage violations are solved, or until the maximum number of iterations is reached.):
        - DSO places a buy order in the market (active and reactive power), for each constraint.
        - FSPs reply with a sell order.
        - DSO selects a solution, to solve the predicted voltage violations.
- DSO validates FSP orders and provides a list of valid FSP orders for each predicted congestion to the FMO.
- FMO clears the market for each subperiod.
- FMO identifies accepted bids and confirms the trade. Market closes some hours (fixed) prior to activation time, for that specific hour the next day.

N-Side Market Platform

- The market opens 72 hours before flexibility activation.
- FSPs submit active power sell orders to the flexibility market.
- FSPs submit reactive power sell orders to the flexibility market.
- Based on its analysis, the DSO will submit active and reactive power buy orders on the Flexibility Market, alongside network-related constraints. Both the FSPs and the DSO can continue to submit or update their bids on the Market Platform until the market closure (48 hours before activation).
- Once the market is closed, the FMO will operate the clearing of the market, matching the buy orders with the sell orders through an algorithm aiming to maximize the social welfare (i.e. the sum of the market participants surplus) while respecting the given constraint (asset parameters from FSPs and grid-related constraints from the DSO)
- Once the clearing step is finished, the results (acceptance level of each order submitted on the market and prices) are shared with the DSO for validation. Two outcomes can result from this step:
    - The grid constraints (congestions and voltage violations) are solved, and the DSO validates the outcome.
    - Grid constraints (congestions and voltage violations) are not solved, or the DSO rejects the result for another operational reason. Then, an iterative process starts until all network issues are solved, or until the maximum number of iterations/a time limit is reached:
        - The DSO expresses its needs in a different way on the market, adapting either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts,
        - The FMO proceeds to a new market clearing with the updated information on the DSO side, and unchanged submitted information from FSP bids. Once the final decision is taken by the DSO, the market results are shared with all market participants, informing FSPs of the acceptance and prices related to the bids they submitted.
        - FMO selects winning bids and confirms the trade. Market closes some hours (fixed) prior to activation time, for that specific hour the next day.
- If no solution is found, mandatory curtailment of the need not supplied by the market is required. It is considered that FSPs can provide a partial solution to the congestion problem, minimizing the curtailed energy.

Activation/Delivery and Monitoring phase:

- Flexibility resources are activated by the FSPs following the information received from the DSO through the flexibility market platform. This right can also be relinquished to the DSO. The DSO can then activate resources directly, by sending the activation signal to the FSPs and they will activate flexibility.
- The flexibility is delivered.

Settlement phase:

- The DSO collects the metering data and transmits it to the FMO
- FMO validates the delivery based on the metering data and the previously given baselines
- FMO sends an invoice to the DSO
- Payments are made from the DSO via the market platform to the FSP, which in turn remunerates the RA and RP. FSPs are paid for flexibility reservation and/or delivery.

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***
DSO			
FSP			
FMO			
RA/RP			

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define “success” or “failure” conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market (long and short term)	RA/RP	new RA/RP wants to qualify new assets for flexibility market	RA/RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market and will be visible to the DSO If the prequalification is not successful, the RA/RP cannot register the assets nor create offers on the flexibility market

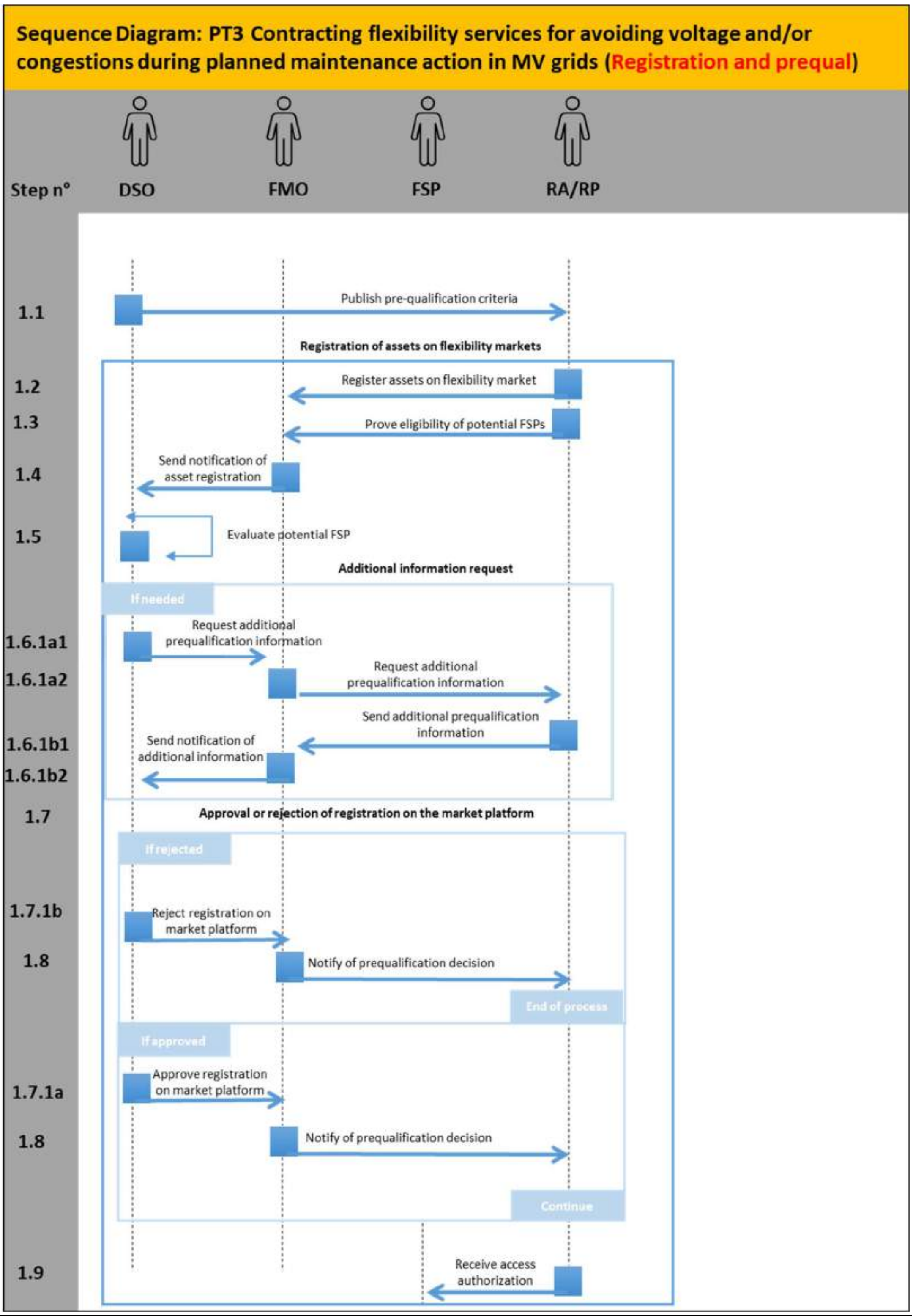
2	Selection/Bidding	Planning of grid utilisation and identifying potential congestions and/or voltage limit violations, followed by a two-stage market process of bid submission, evaluation, and matching for reserving and activating flexibility respectively	DSO, FMO, FSP	Congestion forecast, Voltage limit violations forecast Available flexibility	Available active and reactive power flexibility connected; Prequalified FSPs	When bids are matched, flexibility of the local market is used for congestion management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP	The delivery of flexibility is proven by metering data sent from the DSO to the FMO.	Matching bids on the flexibility market	The actual provided flexibility is delivered. Congestions and Voltage limit violations are eliminated.
4	Settlement	Invoicing and Payments	DSO, FMO	The DSO pays the FSP for the flexibility delivery and reservation	Delivered active Power flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products and reservations are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
    - Input to the use case from some external source that is not described in this use case,
    - Internal to the use case (although could be between different applications and systems within the use case),
    - Output from the use case that will be used by other actors / entities not included in this use case.
    - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification



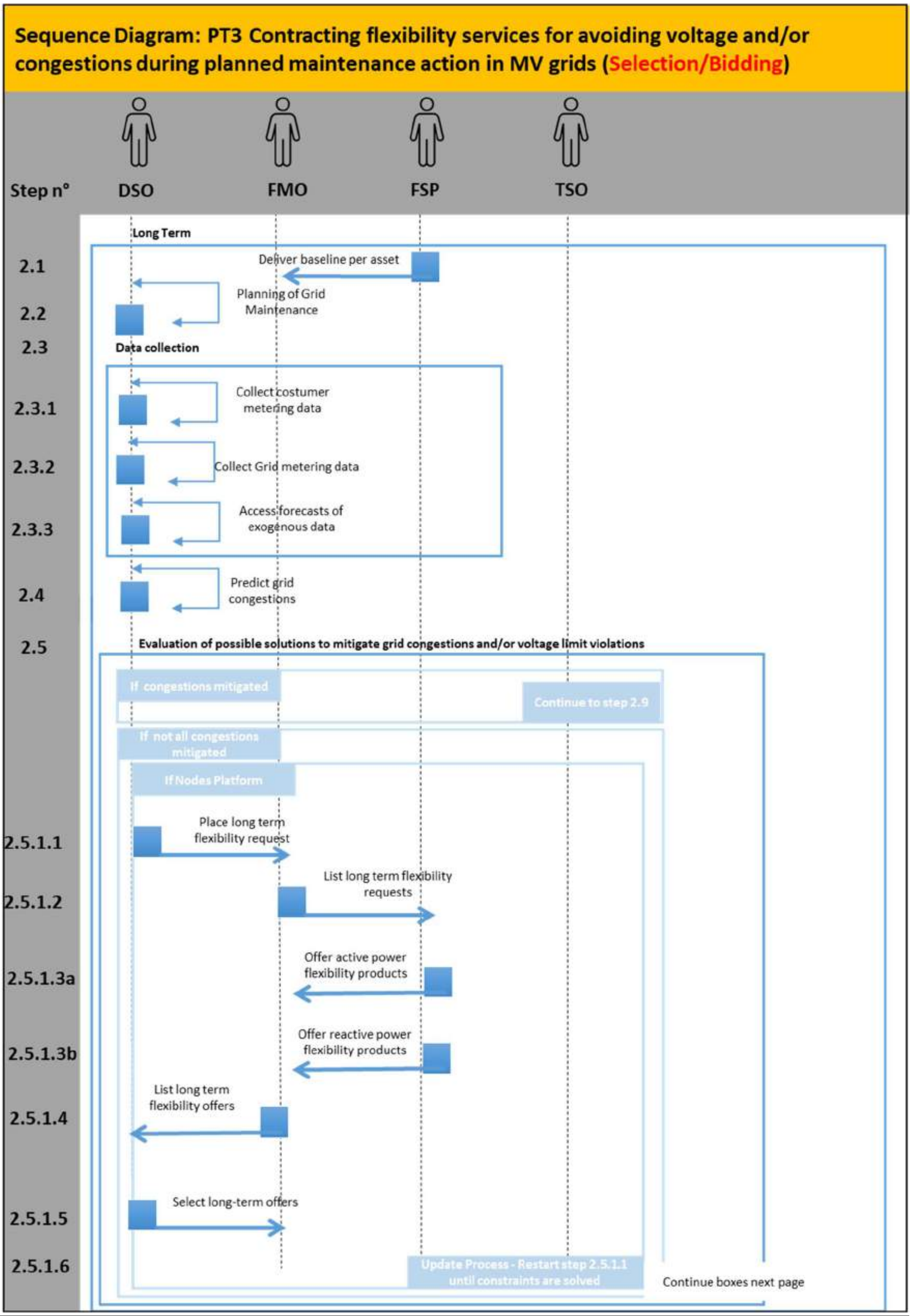
Scenario step by step analysis

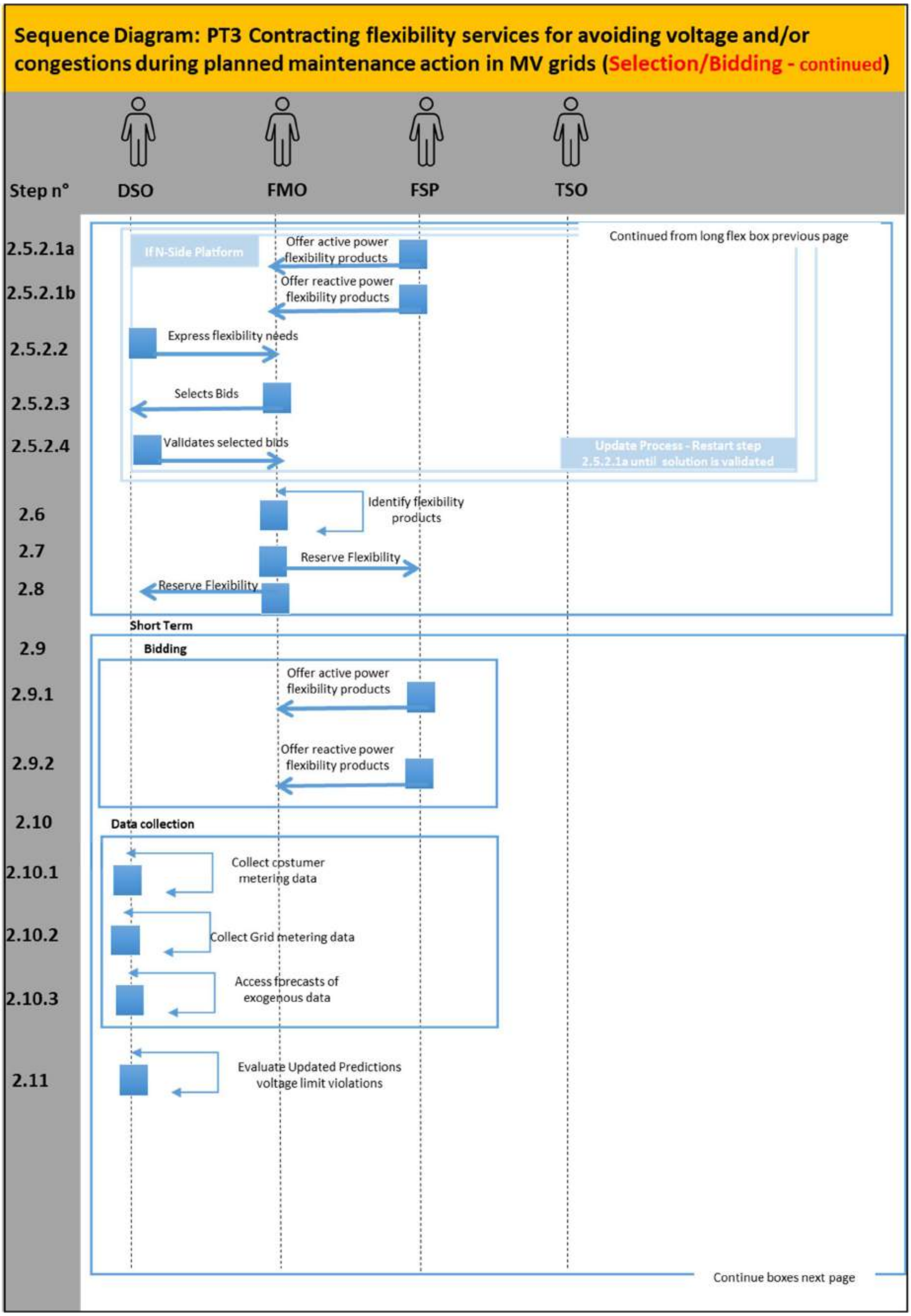
Scenario								
Scenario name	Registration and Prequalification							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Publication of pre-qualification criteria	The DSO publishes regularly updated public information on pre-qualification criteria and technical requirements to be met by the FSPs.	Publishes	DSO	RA/RP	Info1	
1.2		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions.	Registers	RA/RP	FMO		
1.3		Proof of eligibility by potential FSPs	RA/RP sends proof in compliance with the prequalification criteria by submitting the required documentation.	Sends	RA/RP	FMO	Info2	
1.4		Notification of a new potential FSP registration	FMO sends a notification to the DSO stating that a potential FSP is awaiting approval and gives access to the submitted documentation. The DSO can consult the information for approval to the market on the platform.	Sends	FMO	DSO	Info3	
1.5		Evaluation of potential FSP	DSO consults the documentation submitted by the potential FSP on the market platform and evaluates the flexibility offer and the need for	Evaluates	DSO			

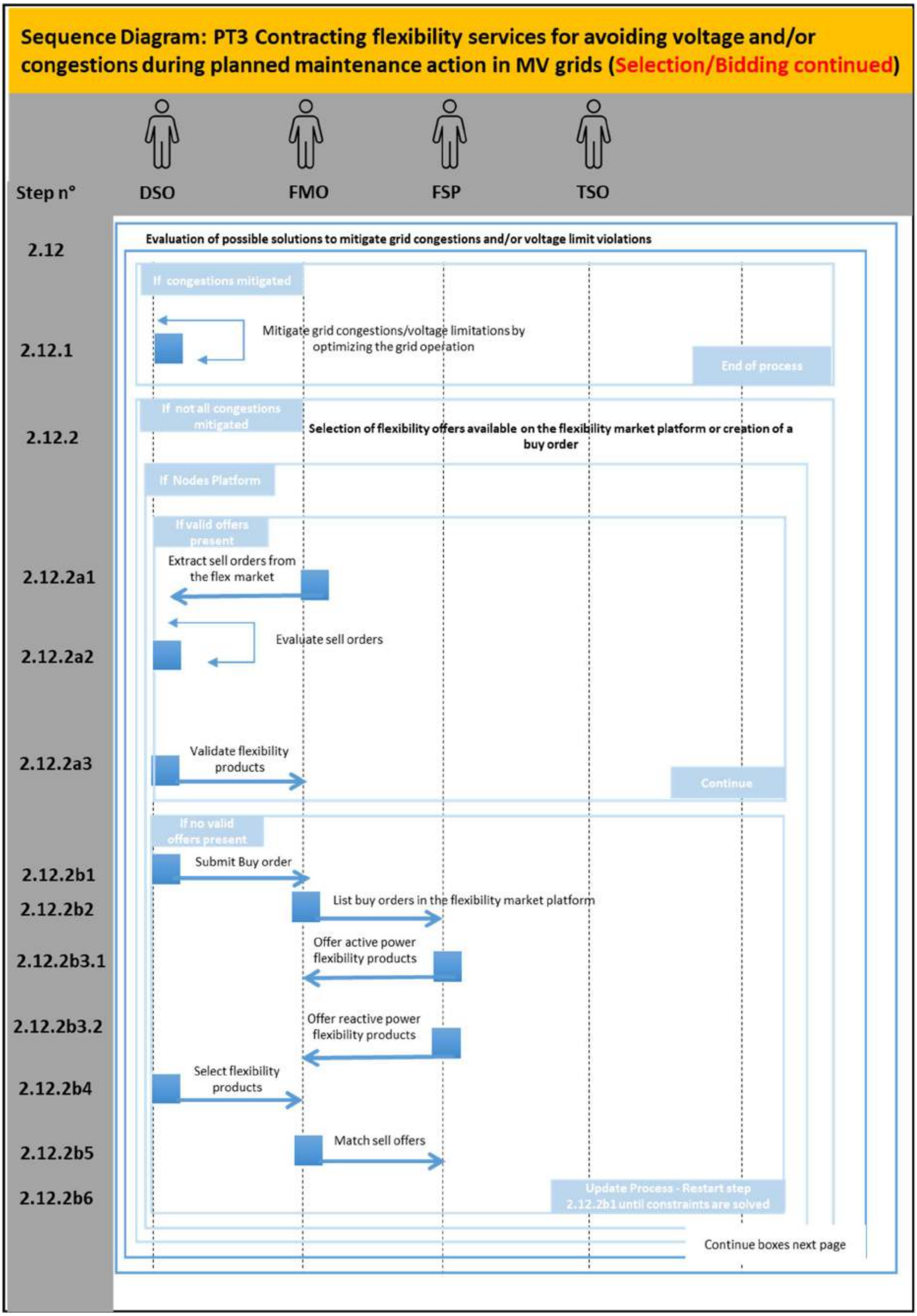
			additional information. A real flexibility activation test shall be performed. This can be an iterative process.					
1.6		Additional information request	DSO evaluates the need for additional information					
1.6. a1		Request of additional pre-qualification information	DSO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	DSO	FMO	Info4	
1.6. a2		Request of additional pre-qualification information	FMO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	FMO	RA/RP	Info4	
1.6b 1		Provision of additional pre-qualification information/documentatio n	Potential FSP sends the required additional information for the pre-qualification to the DSO	Sends	RA/RP	FMO	Info2	
1.6b 2		Notification of new information/documentatio n submitted	FMO sends a notification to the DSO stating that a potential FSP has submitted the additional required information/documentation	Sends	FMO	DSO	Info5	
1.7		Approval or rejection of registration on the market platform	The DSO needs to approve or reject the registration of the asset on the market platform.					
1.7. 1a		DSO approval of new FSP registration	DSO approves new FSP and registers this decision on the market platform.	Approves	DSO	FMO	Info6	

1.7. 1b		DSO rejection of potential FSP registration	The DSO rejects the potential FSP registration due to failure to meet pre-qualification criteria or the lack of required documentation. Potential FSP cannot take part in the flexibility market.	Rejects	DSO	FMO	Info6	
1.8		Pre-qualification result notification	FMO sends a notification to the RA/RP regarding the pre-qualification decision. Notification that additional evaluation information can be consulted in the market platform.	Sends	FMO	RA/RP	Info6	
1.9		Access authorization	The RA/RP becomes an FSP and can now access the flexibility market.	Becomes	RA/RP	FSP		

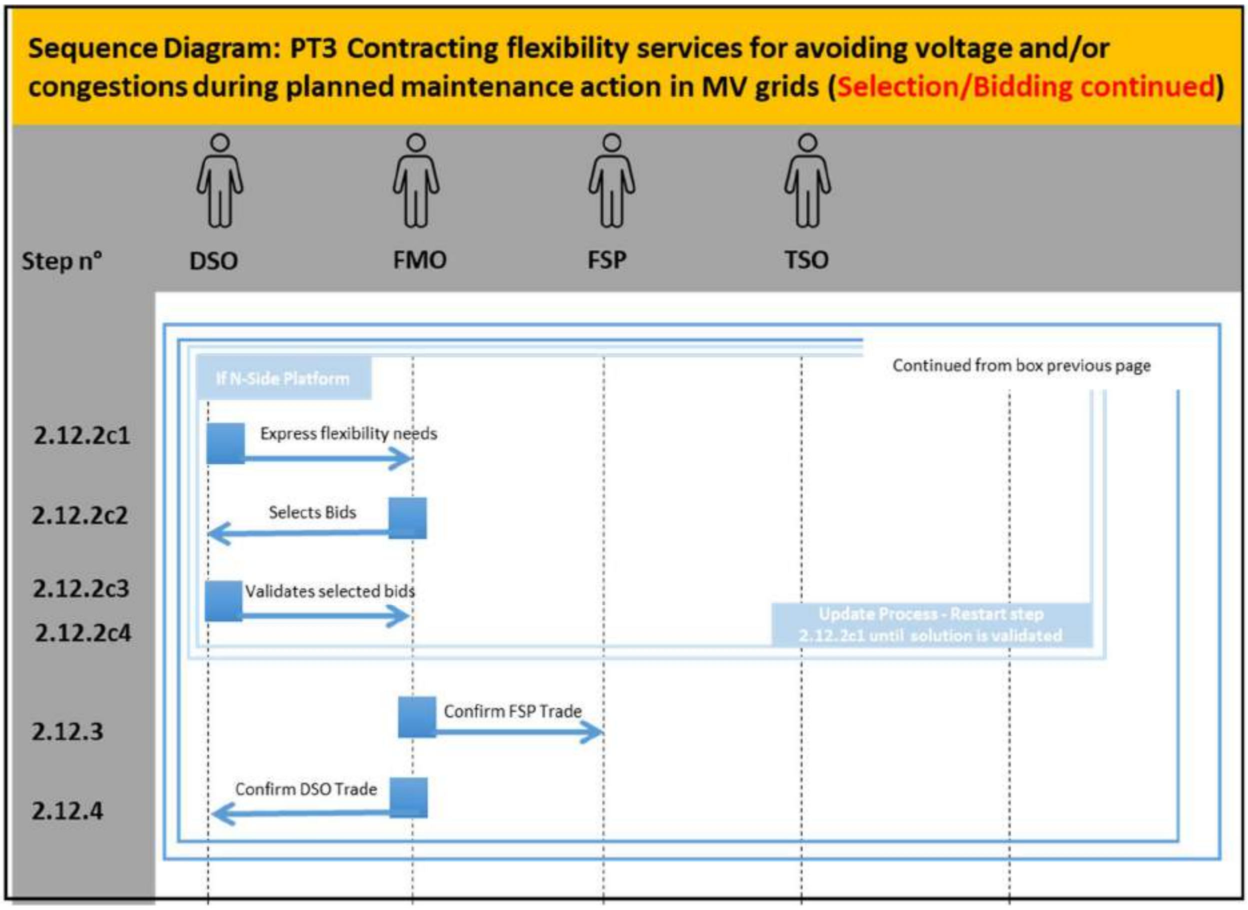
Selection/Bidding




Sequence Diagram: PT3 Contracting flexibility services for avoiding voltage and/or congestions during planned maintenance action in MV grids (Selection/Bidding - continued)
Step n°
DSO
FMO
FSP
TSO
Continued from long flex box previous page
2.5.2.1a
If N-Side Platform
Offer active power flexibility products
2.5.2.1b
Offer reactive power flexibility products
2.5.2.2
Express flexibility needs
2.5.2.3
Selects Bids
2.5.2.4
Validates selected bids
Update Process - Restart step 2.5.2.1a until solution is validated
2.6
Identify flexibility products
2.7
Reserve Flexibility
2.8
Reserve Flexibility
Short Term
2.9
Bidding
2.9.1
Offer active power flexibility products
2.9.2
Offer reactive power flexibility products
2.10
Data collection
2.10.1
Collect costumer metering data
2.10.2
Collect Grid metering data
2.10.3
Access forecasts of exogenous data
2.11
Evaluate Updated Predictions voltage limit violations
Continue boxes next page



Sequence Diagram: PT3 Contracting flexibility services for avoiding voltage and/or congestions during planned maintenance action in MV grids (Selection/Bidding continued)
Step n°
DSO
FMO
FSP
TSO
2.12
Evaluation of possible solutions to mitigate grid congestions and/or voltage limit violations
If congestions mitigated
2.12.1
Mitigate grid congestions/voltage limitations by optimizing the grid operation
End of process
If not all congestions mitigated
2.12.2
Selection of flexibility offers available on the flexibility market platform or creation of a buy order
If Nodes Platform
If valid offers present
2.12.2a1
Extract sell orders from the flex market
2.12.2a2
Evaluate sell orders
2.12.2a3
Validate flexibility products
Continue
If no valid offers present
2.12.2b1
Submit Buy order
2.12.2b2
List buy orders in the flexibility market platform
2.12.2b3.1
Offer active power flexibility products
2.12.2b3.2
Offer reactive power flexibility products
2.12.2b4
Select flexibility products
2.12.2b5
Match sell offers
2.12.2b6
Update Process - Restart step 2.12.2b1 until constraints are solved
Continue boxes next page


Sequence Diagram: PT3 Contracting flexibility services for avoiding voltage and/or congestions during planned maintenance action in MV grids (Selection/Bidding continued)
Step n°
DSO
FMO
FSP
TSO
Continued from box previous page
If N-Side Platform
2.12.2c1
Express flexibility needs
2.12.2c2
Selects Bids
2.12.2c3
Validates selected bids
2.12.2c4
Update Process - Restart step 2.12.2c1 until solution is validated
2.12.3
Confirm FSP Trade
2.12.4
Confirm DSO Trade

Scenario step by step analysis

Scenario								
Scenario name		Selection/Bidding						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
Long term flexibility ***market***								
2.1		Delivery of baseline per asset	The FSP makes the baseline for each of the assets registered in the market platform available for the DSO in the market platform	Makes available	FSP	FMO	Info8	
2.2		Planning of Grid Maintenance	DSO plans grid maintenance and identifies grid nodes affected.	Plans	DSO	DSO		
2.3		Data collection	The DSO collects the data it needs to evaluate the grid.					
2.3.1		Costumer metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI installed infrastructure at costumer's connection points.	Collects	DSO	DSO	Info9	

2.3.2		Grid metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI infrastructure installed in the grid.	Collects	DSO	DSO	Info10	
2.3.3		Access to forecasts of exogenous data	The DSO accesses the information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	Accesse s	DSO	DSO	Info11	
2.4		Evaluation of updated grid information and prediction of grid constraints (voltage limit violations and congestions)	DSO performs grid evaluating algorithms using topology, measurement and market related data (cf. Info 7-11). This evaluation is predictive and is made for the planned maintenance period.	Predicts	DSO	DSO		
2.5		Evaluation of possible solutions to mitigate congestions and/or voltage limit violations	DSO evaluates all the available solutions to mitigate grid congestions and/or voltage limit violations: optimizing the grid operation through the network-integrated components, the market-based mechanisms or mandatory redispatch (out of scope).	Evaluate s	DSO	DSO		
2.5.1	If NODES platform (tendering process)							

2.5.1.1		Placing a long term flexibility request	DSO motivates offers by stating a demand on the market (active and/or reactive market) placing long term flexibility requests in the active power market and/or in the reactive power market, with a price cap, to the flexibility market platform.	Sends	DSO	FMO	Info7	
2.5.1.2		Listing long term flexibility requests in the flexibility market platform	Pre-qualified FSPs consult the listed DSO buy offers in the two markets (reactive and active)	Provide s	FMO	FSP	Info7	
2.5.1.3a		Offering of active power flexibility products	FSP submits an offer of active power per asset on the flexibility market platform as a response to the stated demand of the DSO in 2.5.1.1, this offer includes a reservation price and a maximum activation price.	Offers	FSP	FMO		
2.5.1.3b		Offering of reactive power flexibility products	FSP submits an offer of reactive power per asset on the flexibility market platform as a response to the stated demand of the DSO in 2.5.1.1, this offer includes a reservation price and a maximum activation price.	Offers	FSP	FMO		
2.5.1.4		Listing long term flexibility offers	FSP provides a list of the FSPs long term offers	Provide s	FMO	DSO	Info 18	
2.5.1.5		Selection of long-term offers	DSO selects and validates long-term offers based on a cost-effective analysis.	Selects	DSO	FMO		

			Both counterparties enter into a legally binding agreement upon selection.					
2.5.1.6		Update process	The steps from 2.5.1.1to 2.5.1.5 shall be repeated iteratively until forecasted constraints are technically/economically solved with long term flexibility offers, according to the functioning principles of a continuous market.					
2.5.2	If N-SIDE platform (bidding)							
2.5.2.1a		Offering of active power flexibility products	FSP submits active power per portfolio on the flexibility market platform	Offers	FSP	FMO		
2.5.2.1b		Offering of reactive power flexibility products	FSP submits reactive power per portfolio on the flexibility market platform	Offers	FSP	FMO		
2.5.2.2		Express flexibility needs	DSO expresses its needs in the market, adapting the underlying conditions for each congestion.	Express	DSO	FMO	Info 7	
2.5.2.3		FMO selects bids	FMO selects FSP bids to solve the predicted congestions	Selects	FMO	DSO	Info 19	
2.5.2.4		Validation of FSP offers	DSO validates selected bids	Validate s	DSO	FMO		

2.5.2.5		Update process	The steps from 2.5.2.1 to 2.5.2.5 shall be repeated iteratively until grid constrains are solved or until the maximum number of iterations (3 iterations) is reached. In each iteration, DSO should adapt either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts.					
Common to both platforms								
2.6		Identifying flexibility products	FMO identifies validated FSP matched offers	Identifies	FMO	FMO		
2.7		FSP Flexibility Reservation	The FMO sends a Flexibility Reservation confirmation to the FSP. Once reserved, the FSP is obliged to place a flexibility bid in the short term flexibility market, with the same quantity and with a maximum activation price.	Sends	FMO	FSP	Info 18	
2.8		DSO Flexibility Reservation	The FMO sends a Flexibility Reservation confirmation to the DSO. Once reserved, the FSP is obliged to place a flexibility bid in the short term flexibility market, with the same quantity and with a maximum activation price.	Sends	FMO	DSO	Info 18	
Short Term market								

2.9		FSP Bidding	FSPs place biddings in the short term market					
2.9.1		Offering of active power flexibility products	FSPs place active power biddings in the short term market. These sell orders are both new sell orders and the ones that transit from the long term flexibility market..	Submits	FSP	FMO	Info7	
2.9.2		Offering of reactive power flexibility products	FSPs place reactive power biddings in the short flexibility market. These sell orders are both new sell orders and the ones that transit from the long term flexibility market..	Submits	FSP	FMO	Info7	
2.10		Data collection	The DSO collects the data it needs to evaluate the grid.					
2.10.1		Costumer metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI installed infrastructure at costumer's connection points.	Collects	DSO	DSO	Info9	
2.10.2		Grid metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI infrastructure installed in the grid.	Collects	DSO	DSO	Info10	
2.10.3		Access to forecasts of exogenous data	The DSO accesses the information regarding external data that can have an influence on the grid and costumer	Accesse s	DSO	DSO	Info11	

			behaviour. The forecast of the generation and load at local/regional level is also considered.					
2.11		Evaluation of updated grid information and prediction of grid congestions and/or voltage limit violations	DSO performs grid evaluating algorithms using topology, measurement and market related data (cf. Info 7-11). This evaluation is predictive and is made for the planned maintenance period.	Predicts	DSO	DSO		
2.12		Evaluation of possible solutions to mitigate grid congestions and/or voltage limit violations	DSO evaluates all the available solutions to mitigate grid congestions and/or voltage limit violations: optimizing the grid operation through the network-integrated components, the market-based mechanisms or mandatory redispatch (out of scope).	Evaluate s	DSO	DSO		
2.12.1		Mitigation of grid congestions and/or voltage limit violations by optimizing the grid operation	Identified grid congestions and/or voltage limit violations are mitigated by optimizing grid operation through the network-integrated components (capacitor banks, tap changers, grid reconfiguration etc)	Mitigate s	DSO	DSO		
2.12.2		Selection of flexibility offers available on the	If there are suitable[52] offers on the flexibility market platform (Info7), the DSO matches the offers with identified	Selects	DSO	DSO		

[52] Technically and economically suitable.

		flexibility market platform or creation of a buy order	constraints or otherwise generates a buy order himself, specifying the order requirements (info4).					
If NODES platform								
2.12.2a1		Extraction of sell orders from the flexibility market	If there are sell orders available on the flexibility market platform, the DSO extracts them for evaluation purposes	Extracts	FMO	DSO	Info7	
2.12.2a2		Evaluation of sell orders	DSO runs optimization algorithms, considering grid, costumers and producers constrains (location, price and volume, order time). The safe grid operation and costumer's quality supply must be ensured.	Evaluates	DSO	DSO		
2.12.2a3		DSO validation of flexibility products	Orders are matched with predicted grid congestions and/or voltage limit violations based on the previously performed evaluations.	Selects	DSO	FMO		
2.12.2b1		Buy order submission	If there are not sufficient offers on the flexibility market, the DSO motivates offers by stating a demand on the market by sending a buy order for active and/or	Sends	DSO	FMO	Info7	

			reactive power, with a price cap, to the flexibility market platform. [53]					
2.12.2b2		Listing of buy orders in the flexibility market platform	Pre-qualified FSPs consult the listed DSO buy offers.	Provides	FMO	FSP	Info7	
2.12.2b3.1		Offering of active power flexibility products	FSP submits a flexibility sell order of active power per asset on the flexibility market platform that matches a DSO stated demand on 2.11.2b1.	Offers	FSP	FMO		
2.12.2b3.2		Offering of reactive power flexibility products	FSP submits a flexibility sell order of reactive power per asset on the flexibility market platform that matches a DSO stated demand on 2.11.2b1.	Offers	FSP	FMO		
2.12.2b4		Selection of flexibility products	DSO selects which FSP can help solve the contingency (for each contingency).	Selects	DSO	FMO		
2.12.2b5		Matching of sell offers	FMO matches FSP's asset bids with DSO buy orders if they correspond in terms of price and quantity	Selects	FMO	FSP		
2.12.2b6		Update process	The steps from 2.11.2b1 to 2.11.2b5 shall be repeated iteratively until grid constraints are solved or until de					

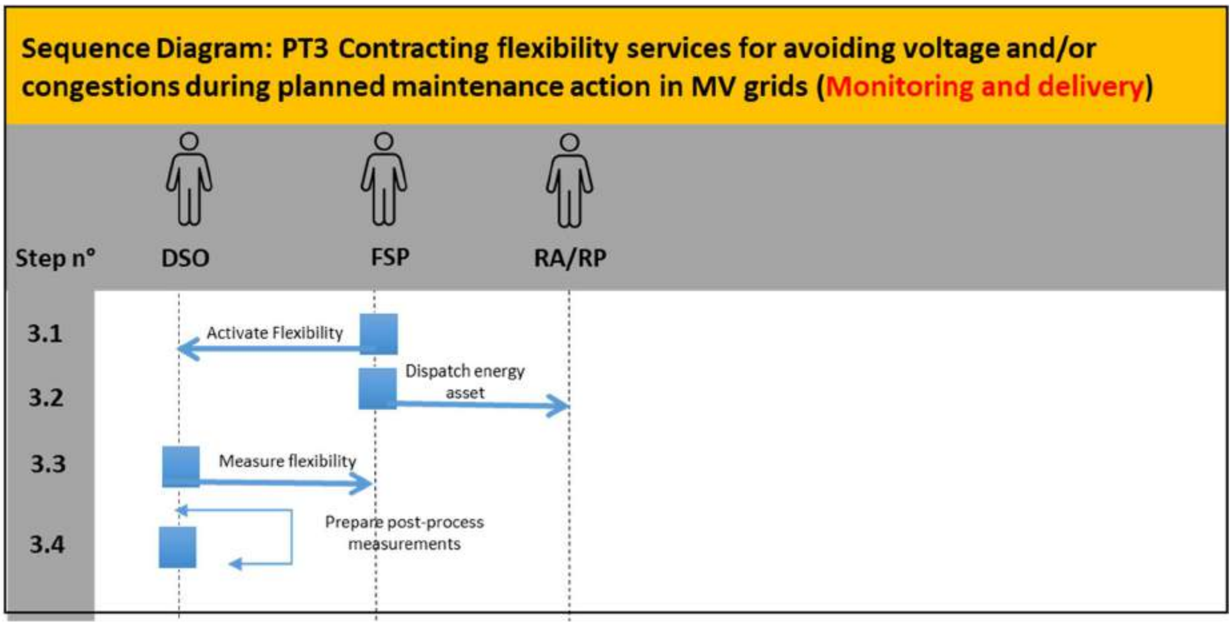
[53] Differences on the DSO buy offers from on iteration to the next , in order to boost FSP participation, is an open issue and requires further discussion.

			maximum number of iterations (3 iterations)[54] is reached.					
If N-SIDE platform								
2.12.2c1		Express flexibility needs	DSO expresses its needs in the market, adapting the underlying conditions for each congestion.	Express	DSO	FMO	Info 7	
2.12.2c2		FMO selects bids	FMO selects FSP bids to solve the predicted congestions	Selects	FMO	DSO	Info 19	
2.12.2c3		Validation of FSP offers	DSO validates selected bids	Validates	DSO	FMO		
2.12.2c3		Update process	The steps from 2.11.2c1 to 2.11.2c3 shall be repeated iteratively until grid constrains are solved or until the maximum number of iterations (3 iterations) is reached. In each iteration, DSO should adapt either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts.					
Common to both platforms								

[54] The maximum number of iterations will be explored further in the next phases of the project.

2.12.4		FSP Trade confirmation	The FMO sends a trade confirmation to the FSP. Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed.	Sends	FMO	FSP	Info 12	
2.12.5		DSO Trade confirmation	The FMO sends a trade confirmation to the DSO. Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed.	Sends	FMO	DSO	Info 12	

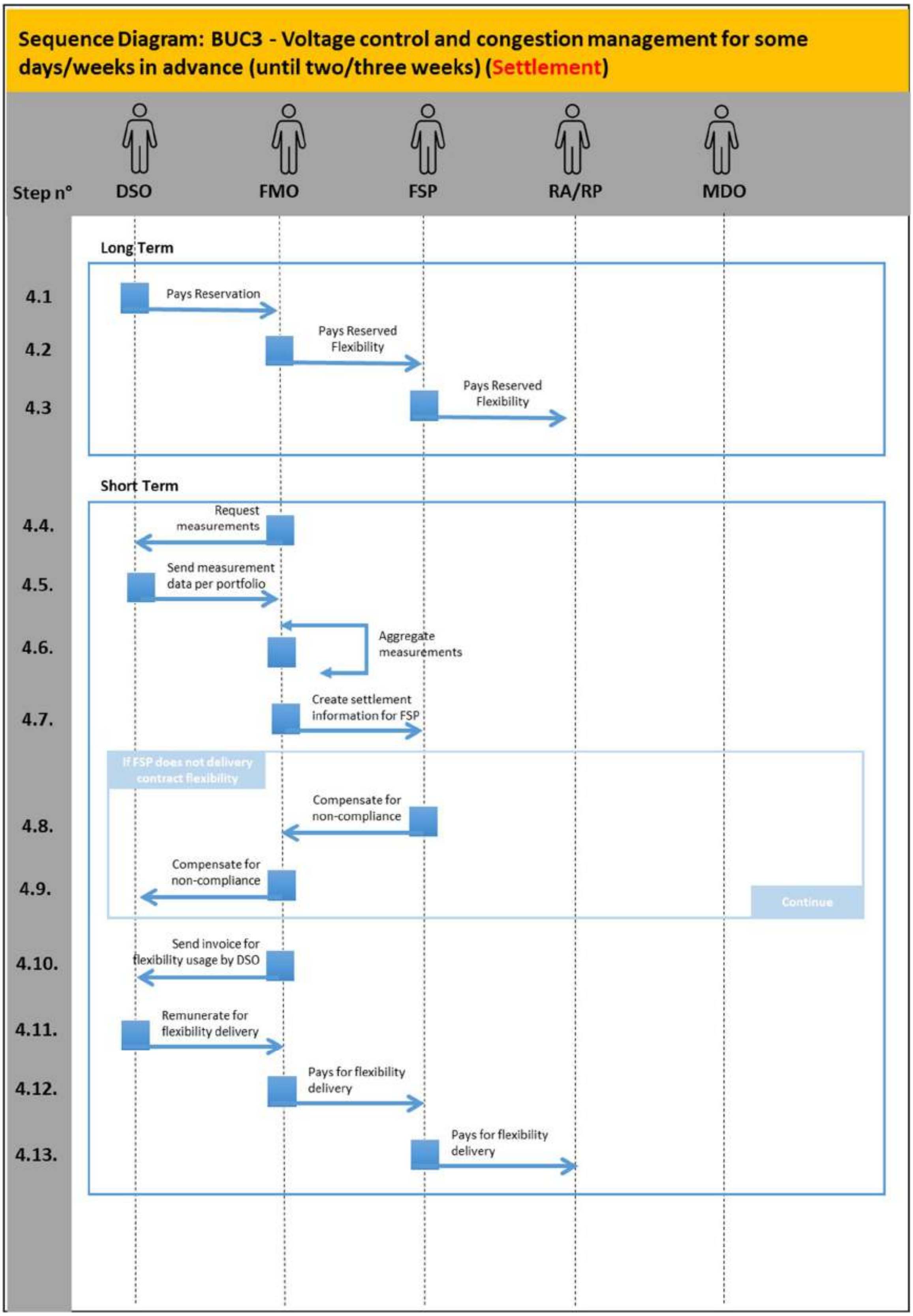
Delivery and Monitoring



Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1.		Flexibility activation	The FSP activates the flexibility resources. Based on the matched offers and baselines.	provides	FSP	DSO		
3.2		Energy asset dispatch	The FSP dispatches energy assets	dispatches	FSP	RA/RP		
3.3		Measurement of delivered flexibility	The DSO measures the delivered flexibility	collects	DSO	FSP	Info14	
3.4		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase	prepares	DSO			

Settlement



Sequence Diagram: BUC3 - Voltage control and congestion management for some days/weeks in advance (until two/three weeks) (Settlement)
Step n°
DSO
FMO
FSP
RA/RP
MDO
Long Term
4.1
Pays Reservation
4.2
Pays Reserved Flexibility
4.3
Pays Reserved Flexibility
Short Term
4.4.
Request measurements
4.5.
Send measurement data per portfolio
4.6.
Aggregate measurements
4.7.
Create settlement information for FSP
If FSP does not delivery contract flexibility
4.8.
Compensate for non-compliance
4.9.
Compensate for non-compliance
Continue
4.10.
Send invoice for flexibility usage by DSO
4.11.
Remunerate for flexibility delivery
4.12.
Pays for flexibility delivery
4.13.
Pays for flexibility delivery

Scenario step by step analysis

Scenario								
Scenario name	Settlement							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
LONG-TERM								
4.1		Payment for flexibility Reservation	DSO is bound to pay Reservation Flexibility service	Remunerates	DSO	FMO		
4.2		Transfer of Payment for Flexibility Reservation	The FSP is paid by the FMO for the Reserved service.	Remunerates	FMO	FSP		
4.3		Payment for flexibility Reservation	FSP pays Reserved service.	Remunerates	FSP	RA/RP		
SHORT-TERM								
4.4		Request measurements	The FMO request measurements from the DSO	Requests	FMO	DSO		

4.5		Measurement data per portfolio	The DSO sends measurement data per portfolio.	Sends	DSO	FMO	Info14	
4.6		Aggregation of measurements	FMO aggregates meter data per asset according to the portfolios	Aggregates	FMO	FMO	Info15	
4.7		Creation of settlement information for FSP	The FMO creates settlement information for FSP, according to market design rules. The FMO shall assess if the FSP delivered the contracted flexibility.	sends	FMO	FSP	Info16	
4.8		Compensation for non-compliance	The FMO receives the compensation from the FSP.	remunerates	FSP	FMO		
4.9		Compensation for non-compliance	FMO transfers compensation from the FSP to the DSO	remunerates	FMO	DSO		
4.10		Invoice for flexibility usage by DSO	The FMO creates invoice for flexibility usage by DSO, including a list which flexibilities the DSO has activated.	sends	FMO	DSO	Info17	
4.11		Payment for flexibility delivery	The DSO prepares the payment.	remunerates	DSO	FMO		
4.12		Transfer of payment for flexibility delivery	The FSP is paid by the FMO for the service.	remunerates	FMO	FSP		
4.13		Payment for flexibility delivery	The RA/RP receives the remuneration for the service.	remunerates	FSP	RA/RP		

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Periodic update on available capacity, allocation procedure and pre-qualification criteria	Regular updates on available electricity grid hosting capacity, connection charges, allocation procedure and pre-qualification criteria.	
Info2	Asset Registration Data	Information needed for the pre-qualification assessment.	
Info 3	New potential FSP registration	Information about a new potential FSP provider.	
Info4	Request for additional information/documentation	List of additional information or documentation needed by the DSO to evaluate the potential FSP.	
Info5	New information/documentation submitted notification	Notification regarding new information/documentation submitted for an in-progress pre-qualification process.	
Info6	Prequalification notification	Message about the outcome of the prequalification process.	
Info7	Buy or sell flexibility order description	Information needed for the evaluation of the flexibility product. Order parameters are activation and availability price, quantity of power (minimum and maximum quantity), minimum and maximum duration of a delivery time interval, direction (up or	

		down regulation), mode of activation (manual or automatic), etc.	
Info8	Portfolio Baseline	Baseline determination rules are defined in the market rules.	
Info9	Customer Metering Data	Existing measurements of electrical quantities at the customer connection point	
Info10	Grid Metering Data	Existing measurements of electrical quantities in the grid.	
Info11	Exogenous Data	Information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	
Info12	Trade Confirmation	Information on the sell offer to be activated, like which resource are to be activated, amount of active and/or reactive power and timeframe of activation.	
Info13	Information for mandatory processes	Data exchange for mandatory processes such as redispatch.	
Info14	Metering Data of individual assets	Contains metering data for individual assets for the billing process.	
Info15	Aggregated Metering Data	Meter data per portfolio for the billing process.	
Info16	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it.	
Info17	Invoice	Address of invoice receiver, time frame of flexibility, activation, activated generation/load assets, specific flexibility costs in €/MWh per asset, total flexibility	

		costs per asset in €, total flexibility costs in €, underlying regulation scheme.	
Info18	Flexibility Reserve Confirmation	Information on the sell offer to be activated in the case of a need, like which resource are to be activated, amount of active and/or reactive power and timeframe of activation.	
Info 19	List of Validated FSP	List of Validated FSP, selected for flexibility delivery.	

7.4. BUC4 Portugal

Use case description

<u>Use case name, scope, objectives, hypotheses and associated smart grid functions</u>

ID	Name of use case Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use "verb + description", e.g., operate the distribution's congestion management market or submit flexibility bid to the distribution's congestion management market.
PT4	Voltage Control and congestion management for medium and long-term grid planning through market mechanisms

What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.
This BUC will address how the contracting of flexibility in the medium and long term (1 to 5 years) can be used as an alternative to be considered in the grid planning activities. The BUC intends to analyze whether long term flexibility can be a cost-effective solution to postpone or even to avoid investments in the electric grid. Considering the expected load and generation growth for the next years, DSO will identify the investments needs in order to fulfil the quality of supply within the regulatory parameters defined by the regulator. However, sometimes, the investment is only necessary to resolve the constraints a few times a year. Then, the goal is to compare from an economic point of view, to which extend it is economically advantageous to contract flexibility services to avoid or postpone grid investments.
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.
• Cover grid investment needs through flexibility services • Demonstrate the operation of a market-based mechanism as a cost-effective solution for grid planning activities. • Demonstrate how the flexibility market can be operated for the medium or long term. • Trigger, three years in advance (Y-3 until Y-2) the emergence of flexibility offerings, (or even new FSPs,) for the network nodes where the constraint is anticipated.

• Obtain a commitment with the FSPs, two years in advance in order to guarantee the existence of flexibility service offers in the Short-term market.
What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.
For this BUC, we are considering the following assumptions: • The DSO is responsible for ensuring grid planning activities aiming to reduce the energy losses, improve quality of supply and enhance the operational efficiency. • Through the grid analysis tool, DSO will identify the technical issues for the next years. • Considering the generation and load forecast for the long term and the schedule for new connections, DSO will identify investment needs. • Compare in terms of benefit-cost ratio the long-term contracts and grid investments. • DSO will evaluate if the market solution does not create additional restrictions to the grid operation. • FSP can participate to deliver flexibility in the long-term perspective. • We further assume that all Reserve Flexibility in this BUC 4 will feed into BUC 1 and BUC 2 going forward into the short-term market.

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)
Shiftable and controllable loads (consumer/producer): LV, MV Distributed Energy Resources (DER): PV, Smart EV charging Distribution network flexible assets and control (switching equipment) Energy Meters

Batteries Residential DR /Shiftable loads Industrial loads (Water Treatment Plants, etc) Smart EV charging Distribution network flexible assets and control (switching equipment, MV Storage - Li-Ion Batteries) Renewable self-consumption solutions (Clients with PV Panels) Active power control of RES (Wind Farm) Dynamic Line Rating [55] Smart Meters

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High level use case, or it is an alternative to an existing use case).
This BUC is similar to the BUC PT1 and to the BUC PT2, in the following: • ‘prequalification’ and ‘delivery’ scenarios are identical; • the contracted services in the long-term market are activated via the short-term market (day-ahead). The steps of ‘Selection/Bidding’ and ‘Delivery’ scenarios for the Short- Term market are the same*. *The flexibility market described in this BUC PT4 is divided in a Long-term tendering Process and in a Short-term Market. The short-term market is the same as the one considered in the BUC PT1 and in the BUC PT2 (active power market).

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.
Predictive congestion management to deal with physical grid congestions. Predictive voltage control to deal with the voltage violations. DSO will initiate a market procurement requiring specific amounts of active power to solve the physical limitations on the MV grid.
Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have

[55] To be confirmed

» Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
Business need
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).
Services: • Predictive Congestion Management • Predictive Voltage Control Market Mechanisms: • Local flexibility market (long-term reserved services tendering to short term flexibility services) Local flexibility markets include long-term and short-term pools in which offers are received from FSPs. This BUC is based on long-term mechanism for planning activities to procure flexibility by contracting long in advance the potential service providers. The local market extension depends on the grid characteristics, i.e. the market area can encompass only a portion of the distribution network. The size of the local market is site-specific. The DSO will utilise flexibility based on its willingness to pay for it and the available fallback solutions and the type of flexibility product required. A local flexibility market seeks to promote competition among flexibility providers.

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.
Considering the planning activities, the DSO will forecast possible congestion and voltage problems in distribution grids for the next years, taking into account the generation and load forecast as well as the schedule of new connections. In this sense, the DSO will analyze some investment alternatives in order to overcome the foreseen problems. As some of those technical problems just arise during short periods of time a year, the DSO can consider contracting flexibility services as an alternative to avoid large investments just to cover problems that only occur sporadically. Consequently, the DSO will communicate the flexibility needs to the market indicating the active power requirements for the next years. For this BUC, the following 4 phases can be distinguished: Prequalification, Selection/Bidding, Delivery and Settlement: 1. Registration and Prequalification: Product definitions and initial pre-qualification including framework agreement with baseline delivery requirements 2. Selection/Bidding: Forecasts of congestions are made. The DSO identifies needs through data collection and grid analysis and creates Long-term requests for the FSP to answer, defining an activation maximum price cap. Flexibility products are then offered by the FSP on a market

platform by the distributed resources (distributed generators, consumers, aggregators, etc.). The DSO can access the flexibilty services provided by the market(s). This will notably include to decide between making an investment decision or reserving the flexibility needed to solve the identified congestions, transferring the orders to the Short-term market. In the Short-term market, the FSP submits active power flexibility offers (new and those coming from the Long- term market). The DSO will then collect the data from the cleared market, elaborate a new grid analysis and validate the existing offers to check if they solve the identified congestions. 3. Activation/Delivery and Monitoring: Flexibility resources can be activated via the market. The flexibility is delivered. 4. Settlement phase: The DSO validates the delivery and transmits the measured values to the market operator. Invoices are sent, and payments are made. In this step, it is assumed that meter data is provided by the DSO.

Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., "main success scenario") from a domain expert user's point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions.
 	
While writing the narrative, please consider the following:[56]
 	
• Use "just one sentence form":
    ▪ Use present tense.
    ▪ Use active verb in the active voice.
    ▪ Describe actions that move the process forward.
    ▪ For instance, "customer enters card and pin into ATM"
• Keep it simple and to the point so that non-domain experts can understand it.
 	
Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.
 	
We suggest including the following aspects into the narrative:
 	
○ Type of mechanism used (Market or other – please be specific)
○ Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system")

[56] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

- Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA)
- Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data)
- Relevant phase (e.g., pre-qualification, procurement, activation, settlement)

Registration and Prequalification phase:

- DSO publishes pre-qualification criteria.
- RA/RP registers assets on flexibility market
  - The information/documentation is submitted to the market platform, afterwards this information / documentation is made available to the DSO.
- DSO evaluates potential FSP.
  - DSO checks if conditions demonstrated are compliant with pre-qualification criteria.
  - DSO performs a real flexibility activation test.
  - Additional information/documentation can be required, through the market platform.
  - This can be an iterative process, repeated until all requirements are met. If not, the potential FSP is rejected.
- RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can then create offers on the flexibility market.

Selection/Bidding phase:

First stage – Long Term Flexibility Market

- FSP delivers a baseline per asset and makes sure that information is updated.
- DSO collects data and elaborates grid diagnosis and identifies needs.
- DSO evaluates updated grid information and predicts grid congestions and/or voltage violations. This process starts in Y-3.
- DSO evaluates the available solutions quantifying the costs of grid investment to procure alternative/complementary flexibility services, considering a maximum price cap.

Two market platforms will be used.

Nodes Market Platform

- If constraints are identified DSO places a long-term active power flexibility request, with a maximum price cap for reservation+activation (Y-3)

- FSP submits active power Long-term flexibility offers to the flexibility market that address the DSO needs. (Y-3).
- FMO closes the market according to predefined gate closure and sends FSPs offers to the DSO.
- DSO selects and validates FSP offers based on a cost-effective analysis and if the predicted congestions are solved, both counterparties enter into a legally binding agreement upon selection.
- If the predicted congestions are not solved, this process is repeated iteratively until the DSO needs are solved.
- DSO informs FMO about established agreement(s).

N-Side Market Platform

- The market opens 3 years before flexibility activation.
- FSPs submit active power sell orders per portfolio to the flexibility market.
- DSO submits active power flexibility requests, adapting the conditions of each congestion and the maximum price cap for reservation+activation.
- FMO selects FSP bids to solve the predicted congestions.
- DSO validates the bids selected by the FMO and if the predicted congestions are solved, both counterparties enter into a legally binding agreement upon selection.
- If the predicted congestions are not solved, this process is repeated iteratively until the DSO needs are solved or until the maximum number of iterations (3 iterations) is reached. In each iteration, the DSO should adapt either the pricing of the flexibility needs or the underlying conditions for each congestion it forecasts.
- Once the DSO makes a final decision, the FMO sends a flexibility reservation confirmation to the FSP and to the DSO. The FSP is then obliged to place a flexibility bid in the short term flexibility market with the agreed quantity and price cap.

Second stage – Short Term Flexibility Market

- FSPs deliver a baseline per asset and makes sure that information is updated.
- FSPs submit active power sell orders to the flexibility market. (D-3 until D-1, D=Flex Activation Day). These sell orders are both new sell orders and the ones that transit from the long term flexibility market.
- DSO collects data (metering data, forecasts).
- DSO re-evaluates updated grid information and predicts grid congestions and/or voltage violations.

Two market platforms will be used.

Nodes Market Platform

- DSO selects the sell orders, to solve the predicted congestions, making sure that there is a cost-efficient solution. Two outcomes can result from this step:
    - Congestions are solved.

- Congestions are not solved (iterative process until all constrains are solved, or until the maximum number of iterations is reached):
  - DSO places a buy order in the market, for each congestion
  - FSPs reply with a sell order
  - DSO selects sell orders to solve the predicted congestions.
  - DSO validates FSP orders and provides a list of valid FSP orders for each predicted congestion to the FMO.
  - FMO clears the market for each subperiod.
  - FMO identifies accepted bids and confirms the trade. Market closes some hours (fixed) prior to activation time, for that specific hour the next day.

N-Side Market Platform

- Based on its analysis, the DSO will submit active power buy orders on the Flexibility Market, alongside network-related constraints. Both the FSPs and the DSO can continue to submit or update their bids on the Market Platform until the market closure (in day-ahead).
- Once the market is closed, the FMO will operate the clearing of the market, matching the buy orders with the sell orders through an algorithm aiming to maximize the social welfare (i.e. the sum of the market participants surplus) while respecting the given constraint (asset parameters from FSPs and grid-related constraints from the DSO)
- Once the clearing step is finished, the results (acceptance level of each order submitted on the market and prices) are shared with the DSO for validation. Two outcomes can result from this step:
  - The Constrains (or Congestions : Voltage Control and Congestion Management) are solved, and the DSO validates the outcome.
  - Congestions are not solved, or the DSO rejects the result for another operational reason. Then, an iterative process starts until all network issues are solved, or until the maximum number of iterations/a time limit is reached:
    - The DSO expresses its needs in a different way on the market, adapting either the pricing of flexibility needs or the underlying conditions, for each voltage violation it forecasts,
    - The FMO proceeds to a new market clearing with the updated information on the DSO side, and unchanged submitted information from FSP bids. Once the final decision is taken by the DSO, the market results are shared with all market participants, informing FSPs of the acceptance and prices related to the bids they submitted.
    - Market closes some hours (fixed) prior to activation time, for that specific hour the next day.

If no solution is found, mandatory curtailment of the need not supplied by the market is required. It is considered that FSPs can provide a partial solution to the congestion problem, minimizing the curtailed energy.

Activation/Delivery and Monitoring phase:

- Flexibility resources are activated by the FSPs following the information received from the DSO through the flexibility market platform. This right can also be relinquished to the DSO. The DSO can then activate resources directly.
- The flexibility is delivered.

Measurement & Settlement phase:

LONG-TERM

- Payments for the flexibility reservation are made from the DSO via the market platform to the FSP, which in turn remunerates the RA and RP

SHORT-TERM

- DSO collects the metering data and transmits it to the FMO
- FMO validates the delivery based on the metering data and the previously given baselines
- FMO sends an invoice to the DSO.
- Payments for the flexibility service are made from the DSO via the market platform to the FSP, which in turn remunerates the RA and RP

Technical details

<u>Actors</u>

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***
DSO	Role		
FMO	Role		
RA/RP	Role		
FSP	Role		

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

» <u>Overview of scenarios</u>

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define “success” or “failure” conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Registration and Prequalification	Flexible resources can qualify for the flexibility market	RA/RP	new RA/RP wants to qualify new assets for flexibility market	RA/RP assets meet market access requirements defined by DSO & FMO	If the prequalification is successful, the RA/RP becomes an approved FSP for the respective assets on the flexibility market. The FSP can now create offers on the flexibility market and will be visible to the DSO. If the prequalification is not successful, the RA/RP cannot register the assets nor create offers on the flexibility market

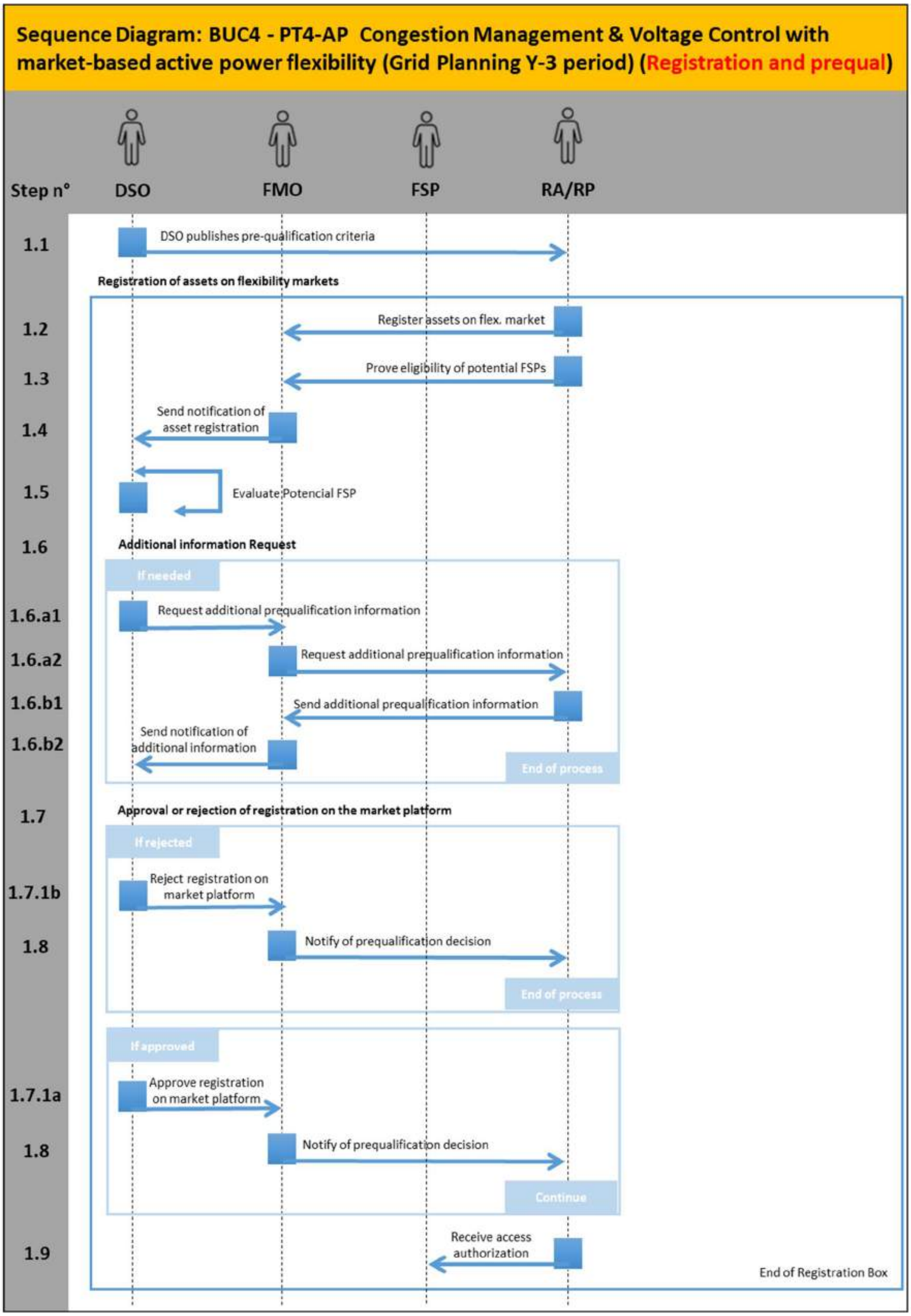
2	Selection/Bidding	Planning of grid utilisation and identifying potential congestions, followed by a two-stage market process of bid submission, evaluation, and matching for reserving and activating flexibility respectively	DSO, FMO, FSP	Congestion forecast, Available flexibility	Available active/reactive power flexibility connected; Prequalified FSPs	When bids are matched, flexibility of the local market is reserved/used for congestion management and/or voltage control by the DSO. If this does not happen, the DSO will use other (mandatory) measures for congestion management. and/or voltage control
3	Delivery and Monitoring	Activation of bids and Monitoring	FSP, DSO	Trade confirmation, proved by metering data sent from the DSO to the FMO.	Matching bids on the flexibility market	The actual provided flexibility is delivered. Congestions are eliminated.
4	Settlement	Invoicing and Payments	DSO, FMO	The DSO pays the FSP for the delivered and reserved flexibility	Delivered active flexibility; Respective Baselines for the Offers; Active Metering Systems	Delivered flexibility products are remunerated

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

- **Step No.**: Sequential number identifying the step
- **Event**: The event that triggers the step (might be completion of the previous step).
- **Name of process/activity**: Label that would appear in a sequence diagram.
- **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
- **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
- **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
- **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
  - Input to the use case from some external source that is not described in this use case,
  - Internal to the use case (although could be between different applications and systems within the use case),
  - Output from the use case that will be used by other actors / entities not included in this use case.
  - This column should not contain technology issues/requirements.
- **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Registration and Prequalification



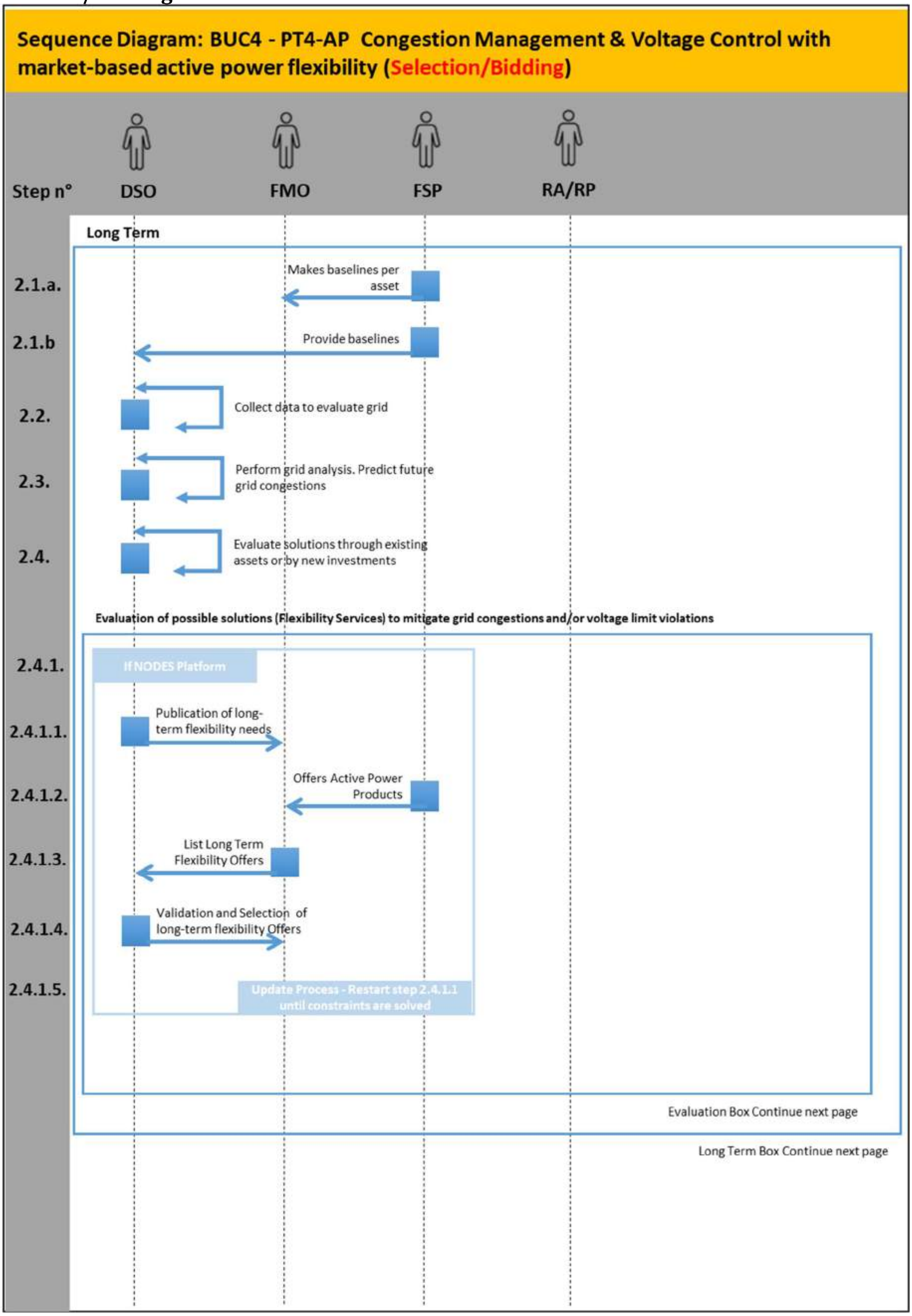
Scenario step by step analysis

Scenario								
Scenario name	Registration and Prequalification							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1		Publication of pre-qualification criteria	The DSO publishes regularly updated public information on pre-qualification criteria and technical requirements to be met by the FSPs.	Publishes	DSO	RA/RP	Info1	
1.2		Registration of assets on flexibility market	The potential FSPs register assets on the market platform under the pre-qualification conditions	Registers	RA/RP	FMO		
1.3		Proof of eligibility by potential FSPs	RA/RP sends proof in compliance with the prequalification criteria by submitting the required documentation	Sends	RA/RP	FMO	Info2	
1.4		Notification of a new potential FSP registration	FMO sends a notification to the DSO stating that a potential FSP is awaiting approval and gives access to the submitted documentation. The DSO can consult the information for approval to the market on the platform.	Sends	FMO	DSO	Info3	
1.5		Evaluation of potential FSP	DSO consults the documentation submitted by the potential FSP on the market platform and	Evaluates	DSO			

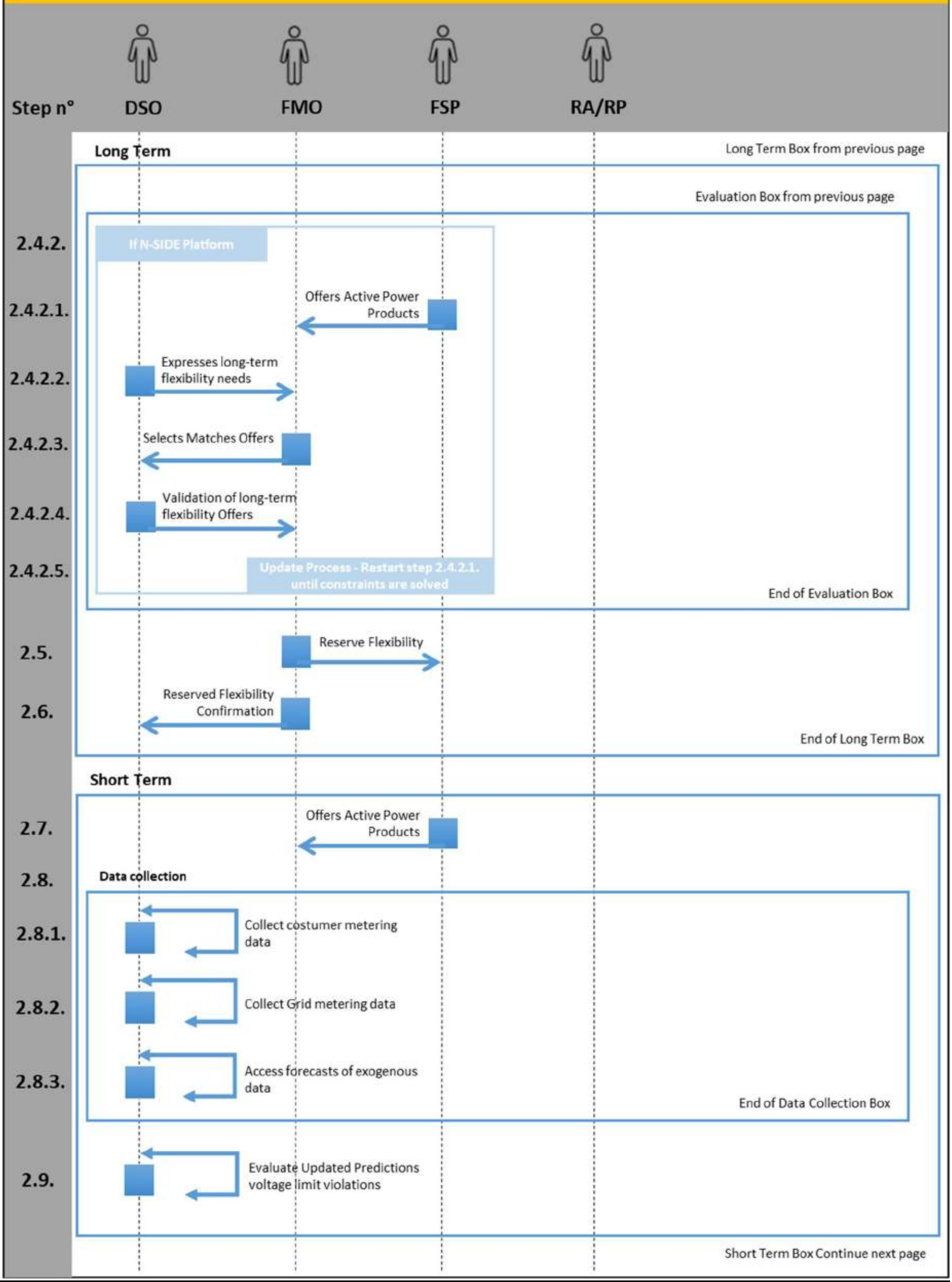
			evaluates the flexibility offer and the need for additional information. A real flexibility activation test shall be performed. This can be an iterative process.					
1.6		Additional information request	DSO evaluates the need for additional information					
1.6.a1		Request of additional pre-qualification information	DSO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	DSO	FMO	Info4	
1.6.a2		FMO requests additional pre-qualification information	FMO requests additional information/documentation for the RA/RP pre-qualification through the market platform	Requests	FMO	RA/RP	Info4	
1.6.b1		Provision of additional pre-qualification information/documentation	Potential FSP sends the required additional information for the pre-qualification to the FMO	Sends	RA/RP	FMO	Info2	
1.6.b2		Notification of new information/documentation submitted	FMO sends a notification to the DSO stating that a potential FSP has submitted the additional required information/documentation	Sends	FMO	DSO	Info5	
1.7		Approval or rejection or registration on the market platform						
1.7.1a		DSO approval of new FSO registration	DSO approves new FSP and registers this decision on the market platform.	Approves	DSO	FMO	Info6	

1.7.1b		DSO rejects potential FSP registration	The DSO rejects the potential FSP registration due to failure to meet pre-qualification criteria or to the lack of required documentation. Potential FSP cannot take part in the flexibility market.	Rejects	DSO	FMO	Info6	
1.8		Pre-qualification result notification	FMO sends a notification to the RA/RP regarding the pre-qualification decision. Notification that additional evaluation information can be consulted in the market platform.	Sends	FMO	RA/RP	Info6	
1.9		Access authorization	The RA/RP becomes a FSP and can now access the flexibility market.	Becomes	RA/RP	FSP		

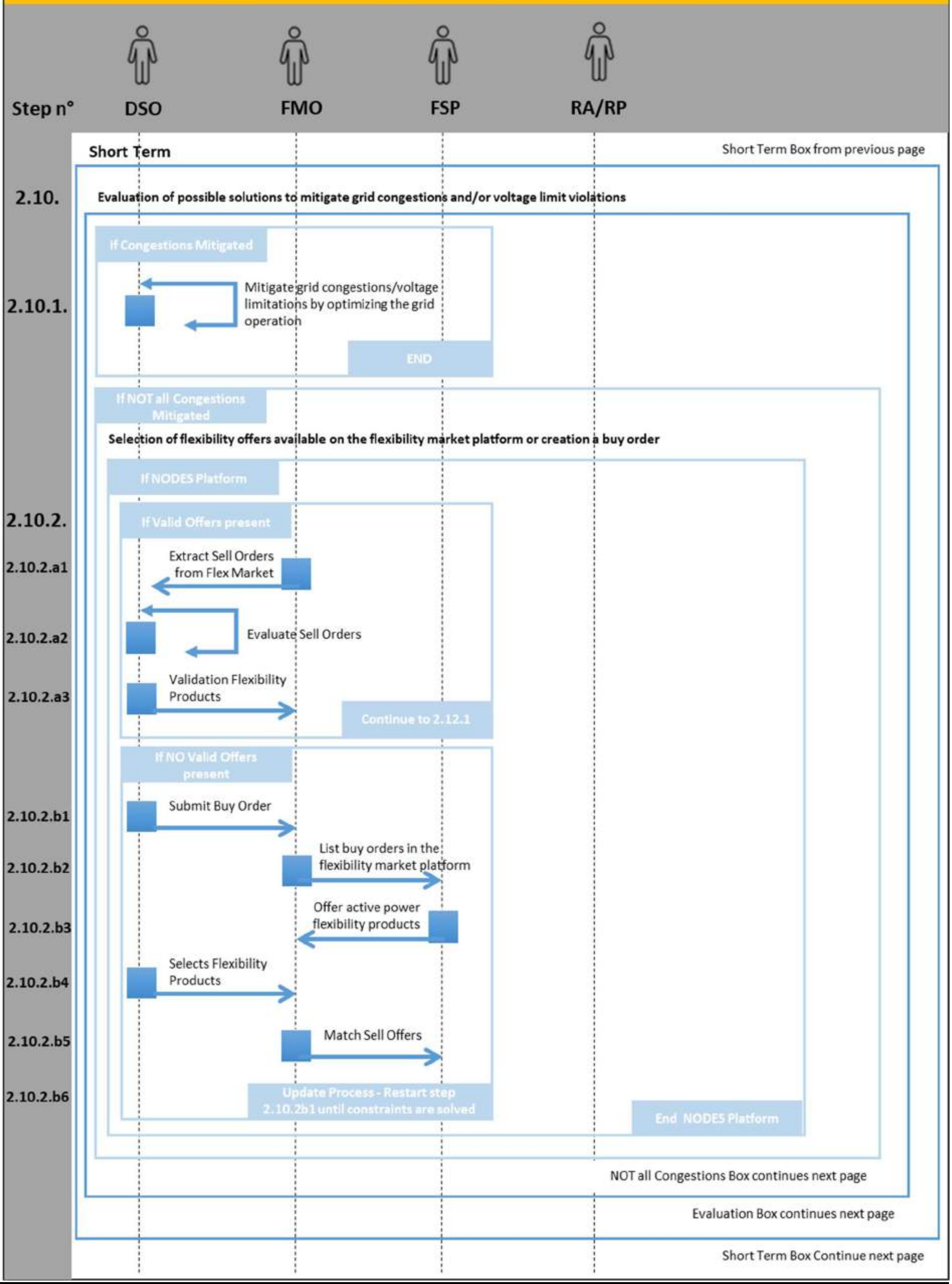
Selection/Bidding



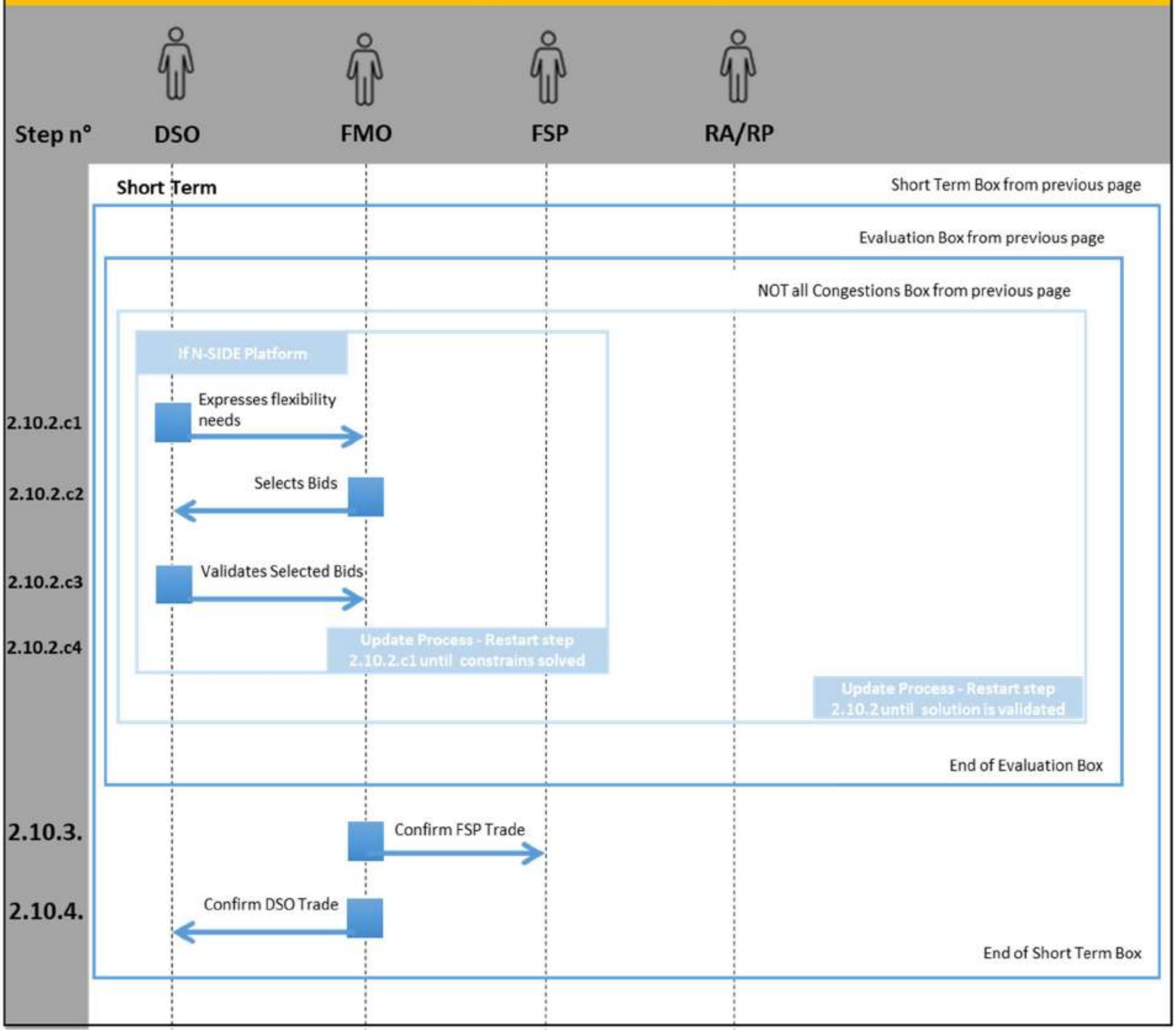
Sequence Diagram: BUC4 - PT4-AP Congestion Management & Voltage Control with market-based active power flexibility (Selection/Bidding - continued)



Sequence Diagram: BUC4 - PT4-AP Congestion Management & Voltage Control with market-based active power flexibility (Selection/Bidding - continued)



Sequence Diagram: BUC4 - PT4-AP Congestion Management & Voltage Control with market-based active power flexibility (Selection/Bidding - continued)



Scenario step by step analysis

Scenario								
Scenario name	Selection/Bidding							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
Long-term Market								
2.1.a.		Delivery of baseline per asset	The FSP makes the baseline for each of the assets registered in the market platform available for the DSO in the market platform	Makes available	FSP	FMO	Info 8	
2.1.b.		Delivery of baseline per asset	The FSP provides the baseline for each of the assets registered in the market platform available for the DSO in the market platform	Makes available	FSP	DSO		
2.2.		Data collection	DSO collects the data needed to evaluate the grid (grid topology, metering data, load growth factors, future grid expansions)	Collects	DSO	DSO	Info 9, Info 10, Info 11	
2.3.		Predict grid congestions	Based on Info above (8,9,10), DSO performs grid evaluating algorithms to	Predicts	DSO	DSO		

			predict future congestions (voltage and/or overload) for the next years					
2.4.		Evaluation of possible solutions to mitigate grid congestions	DSO evaluates the available solutions to mitigate grid congestions: optimizing the grid operation through already existent network-integrated components or quantify the costs of grid investment to procure alternative/complementary flexibility services, considering a maximum price cap	Evaluates	DSO	DSO		
2.4.1	If NODES platform (tendering process)							
2.4.1.1		Placing a long-term flexibility request	During Y-3, DSO motivates offers by submitting a long-term active power request, with a maximum price cap for reservation+activation, to the flexibility market platform	Sends	DSO	FMO	Info7	
2.4.1.2		Offering of active power flexibility products	FSP submits active power offers per portfolio on the flexibility market platform that addresses the DSO stated demand on 2.4.1. This offers includes a reservation price and a maximum activation price.	Offers	FSP	FMO		
2.4.1.3		Listing long term flexibility offers	FSP provides a list of the FSPs long term offers	Provides	FMO	DSO	Info18	

2.4.1.4		Selection of long-term offers	DSO selects and validates long-term offers based on a cost-effective analysis. Both counterparties enter into a legally binding agreement upon selection.	Selects	DSO	FMO		
2.4.1.5		Update process	The steps from 2.4.1.1 to 2.4.1.4 shall be repeated iteratively until constraints are technically/economically solved with long term flexibility offers.					
2.4.2	If N-SIDE platform (bidding)							
2.4.2.1		Offering of active power flexibility products	FSP submits active power per portfolio on the flexibility market platform.	Offers	FSP	FMO		
2.4.2.2		Express long-term flexibility needs	DSO expresses its needs in the market, adapting the underlying conditions for each congestion and the maximum price cap for reservation+activation	Offers	DSO	FMO	Info7	
2.4.2.3		FMO selects bids	FMO selects FSP bids to solve the predicted congestions	Selects	FMO	DSO	Info19	
2.4.2.4		Validation of FSP offers	DSO validates selected bids	Validates	DSO	FMO	InfoXXX	
2.4.2.5		Update process	If DSO needs not solved, the steps from 2.4.2.1 to 2.4.2.4 shall be repeated iteratively until grid constrains are					

			solved or until the maximum number of iterations (3 iterations) is reached. In each iteration, DSO should adapt either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts.					
Common to both platforms								
2.5		FSP Flexibility Reservation	The FMO sends a Flexibility Reservation confirmation to the FSP. Once reserved, the FSP is obliged to place a flexibility bid in the short term flexibility market, with the same quantity and price cap.	Sends	FMO	FSP	Info 18	
2.6		DSO Flexibility Reservation	The FMO sends a Flexibility Reservation confirmation to the DSO. Once reserved, the FSP is obliged to place a flexibility bid in the short term flexibility market, with the same quantity and price cap.	Sends	FMO	DSO	Info 18	
Short-term Market								
2.7		Offering of active power flexibility products	FSPs place active power biddings in the short flexibility market. These sell orders are both new sell orders and the ones that transit from the long term flexibility market.	Offers	FSP	FMO	Info7	

2.8		Data collection	The DSO collects the data it needs to evaluate the grid.					
2.8.1		Costumer metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI installed infrastructure at costumer's connection points.	Collects	DSO	DSO	Info9	
2.8.2		Grid metering data collection	DSO collects measurements of electrical quantities such as voltage, current, power factor from the AMI infrastructure installed in the grid.	Collects	DSO	DSO	Info10	
2.8.3		Access to forecasts of exogenous data	The DSO accesses the information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	Accesses	DSO	DSO	Info11	
2.9		Evaluation of updated grid information and prediction of grid congestions and/or voltage limit violations	DSO performs grid evaluating algorithms using topology, measurement and market related data (cf. Info 7-11). This evaluation is predictive and is made for the planned period.	Predicts	DSO	DSO		
2.10		Evaluation of possible solutions to mitigate grid congestions and/or voltage limit violations	DSO evaluates all the available solutions to mitigate grid congestions and/or voltage limit violations: optimizing the grid operation through	Evaluates	DSO	DSO		

			the network-integrated components, the market-based mechanisms or mandatory redispatch (out of scope).					
2.10.1		Mitigation of grid congestions and/or voltage limit violations by optimizing the grid operation	Identified grid congestions and/or voltage limit violations are mitigated by optimizing grid operation through the network-integrated components (capacitor banks, tap changers, grid reconfiguration etc)	Mitigate s	DSO	DSO		
If NODES platform								
2.10.2		Selection of flexibility offers available on the flexibility market platform or creation of a buy order	If there are suitable[57] offers on the flexibility market platform (Info7), the DSO matches the offers with identified constraints or otherwise generates a buy order himself, specifying the order requirements (info4).	Selects	DSO	DSO		
2.10.2a 1		Extraction of sell orders from the flexibility market	If there are sell orders available on the flexibility market platform, the DSO extracts them for evaluation purposes	Extracts	FMO	DSO	Info7	
2.10.2a 2		Evaluation of sell orders	DSO runs optimization algorithms, considering grid, costumers and producers constrains (location, price and volume, order time). The safe grid operation and costumer's quality supply must be ensured.	Evaluate s	DSO	DSO		

[57] Technically and economically suitable.

2.10.2a 3		DSO validation of flexibility products	Orders are matched with predicted grid congestions and/or voltage limit violations based on the previously performed evaluations.	Selects	DSO	FMO	InfoXXX	
2.10.2b 1		Buy order submission	If there are not sufficient offers on the flexibility market, the DSO motivates offers by stating a demand on the market by sending a buy order for active power, with a price cap, to the flexibility market platform. [58]	Sends	DSO	FMO	Info7	
2.10.2b 2		Listing of buy orders in the flexibility market platform	Pre-qualified FSPs consult the listed DSO buy offers.	Provides	FMO	FSP	Info7	
2.10.2b 3.		Offering of active power flexibility products	FSP submits a flexibility sell order of active power per asset on the flexibility market platform that matches a DSO stated demand on 2.10.2b1.	Offers	FSP	FMO		
2.10.2b 4		Selection of flexibility products	DSO selects which FSP can help solve the contingency (for each contingency).	Selects	DSO	FMO	InfoXXX	
2.10.2b 5		Matching of sell offers	FMO matches FSP's asset bids with DSO buy orders if they correspond in terms of price and quantity	Selects	FMO	FSP		

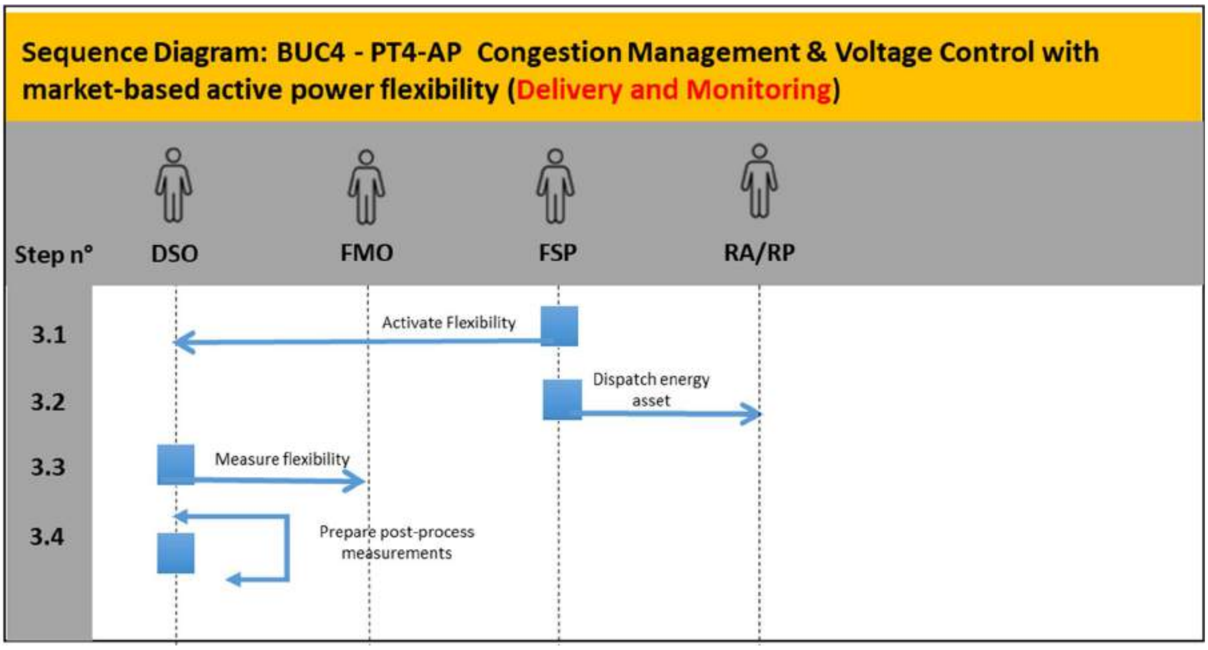
[58] Differences on the DSO buy offers from on iteration to the next , in order to boost FSP participation, is an open issue and requires further discussion.

2.10.2b 6		Update process	The steps from 2.11.2b1 to 2.11.2b5 shall be repeated iteratively until grid constraints are solved or until de maximum number of iterations (3 iterations)[59] is reached.					
If N-SIDE platform								
2.10.2c 1		Express flexibility needs	DSO expresses its needs in the market, adapting the underlying conditions for each congestion.	Express	DSO	FMO	Info 7	
2.10.2c 2		FMO selects bids	FMO selects FSP bids to solve the predicted congestions	Selects	FMO	DSO	Info 19	
2.10.c3		Validation of FSP offers	DSO validates selected bids	Validates	DSO	FMO	InfoXXX	
2.10.2c 4		Update process	The steps from 2.11.2c1 to 2.11.2c3 shall be repeated iteratively until grid constrains are solved or until the maximum number of iterations (3 iterations) is reached. In each iteration, DSO should adapt either the pricing of flexibility needs or the underlying conditions, for each congestion it forecasts.					
Common to both platforms								

[59] The maximum number of iterations will be explored further in the next phases of the project.

2.10.3		FSP Trade confirmation	The FMO sends a trade confirmation to the FSP. Once a trade confirmation is sent, the FSP is bound to activate the offered flexibility as expressed.	Sends	FMO	FSP	Info 12	
2.10.4		DSO Trade confirmation	The FMO sends a trade confirmation to the DSO. Once a trade confirmation is sent, the DSO is bound to use the offered flexibility as expressed.	Sends	FMO	DSO	Info 12	

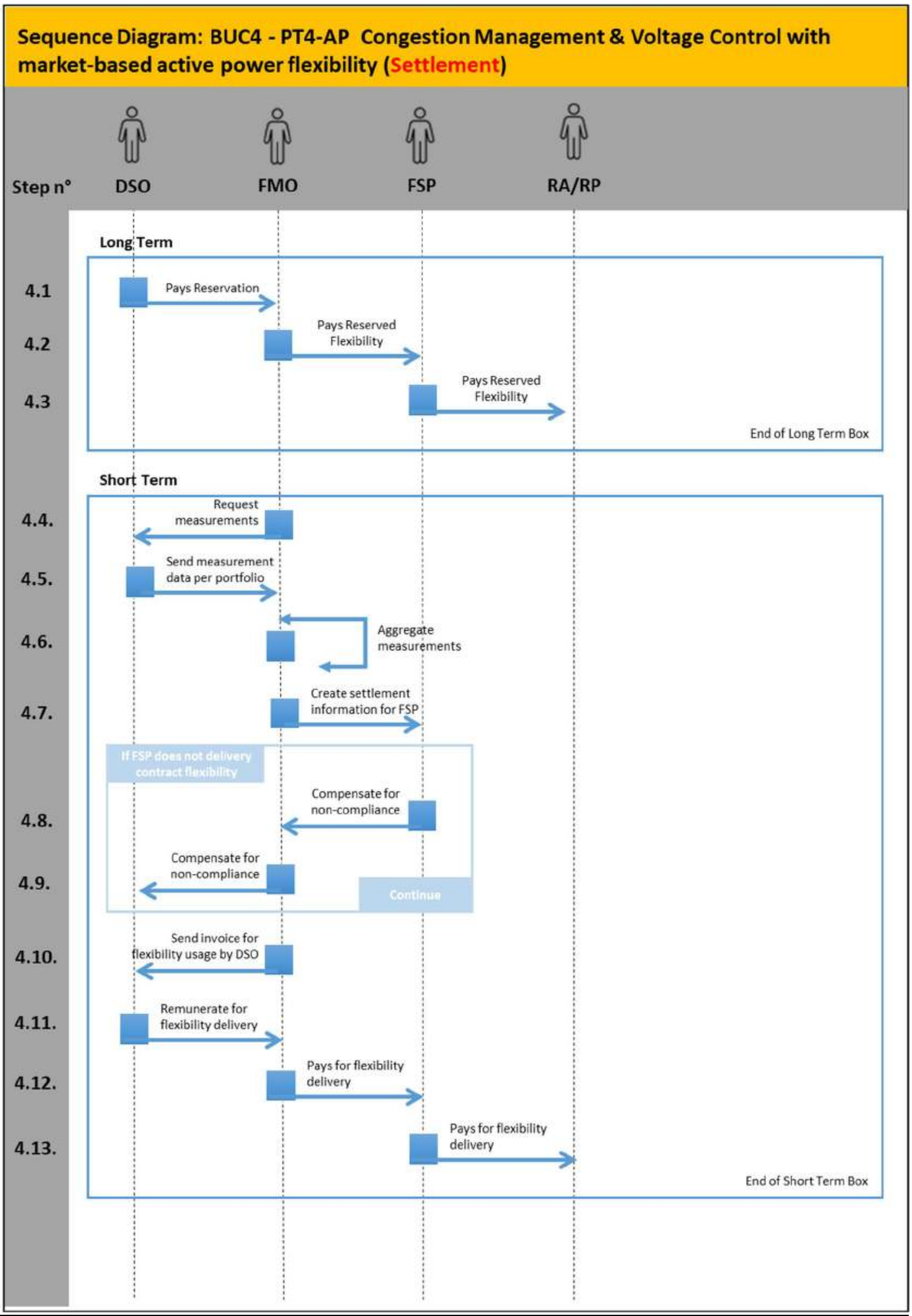
Delivery and Monitoring



Scenario step by step analysis

Scenario								
Scenario name	Delivery and Monitoring							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1		Flexibility activation	The FSP activates the flexibility resources. Based on the matched offers and baselines.	provides	FSP	DSO		
3.2.		Energy asset dispatch	The FSP dispatches energy assets	dispatches	FSP	RA/RP		
3.3.		Measurement of delivered flexibility.	The DSO measures the delivered flexibility.	collects	DSO	FSP	Info14	
3.4.		Post-process measurements	The DSO stores measurements and prepares them for the settlement phase.	prepares	DSO			

Settlement



Sequence Diagram: BUC4 - PT4-AP Congestion Management & Voltage Control with market-based active power flexibility (Settlement)
Step n°
DSO
FMO
FSP
RA/RP
Long Term
4.1
Pays Reservation
4.2
Pays Reserved Flexibility
4.3
Pays Reserved Flexibility
End of Long Term Box
Short Term
4.4.
Request measurements
4.5.
Send measurement data per portfolio
4.6.
Aggregate measurements
4.7.
Create settlement information for FSP
If FSP does not delivery contract flexibility
4.8.
Compensate for non-compliance
4.9.
Compensate for non-compliance
Continue
4.10.
Send invoice for flexibility usage by DSO
4.11.
Remunerate for flexibility delivery
4.12.
Pays for flexibility delivery
4.13.
Pays for flexibility delivery
End of Short Term Box

Scenario step by step analysis

Scenario								
Scenario name	Settlement							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
LONG-TERM								
4.1		Payment for flexibility Reservation	DSO is bound to pay Reservation Flexibility service	Remunerates	DSO	FMO		
4.2		Transfer of Payment for Flexibility Reservation	The FSP is paid by the FMO for the Reserved service.	Remunerates	FMO	FSP		
4.3		Payment for flexibility Reservation	FSP pays Reserved service.	Remunerates	FSP	RA/RP		
SHORT-TERM								
4.4		Request measurements	The FMO request measurements from the DSO	Requests	FMO	DSO		

4.5		Measurement data per portfolio	The DSO sends measurement data per portfolio.	Sends	DSO	FMO	Info14	
4.6		Aggregation of measurements	FMO aggregates meter data per asset according to the portfolios	Aggregates	FMO	FMO	Info15	
4.7		Creation of settlement information for FSP	The FMO creates settlement information for FSP, according to market design rules. The FMO shall assess if the FSP delivered the contracted flexibility.	sends	FMO	FSP	Info16	
4.8		Compensation for non-compliance	The FMO receives the compensation from the FSP.	remunerates	FSP	FMO		
4.9		Compensation for non-compliance	FMO transfers compensation from the FSP to the DSO	remunerates	FMO	DSO		
4.10		Invoice for flexibility usage by DSO	The FMO creates invoice for flexibility usage by DSO, including a list which flexibilities the DSO has activated.	sends	FMO	DSO	Info17	
4.11		Payment for flexibility delivery	The DSO prepares the payment.	remunerates	DSO	FMO		
4.12		Transfer of payment for flexibility delivery	The FSP is paid by the FMO for the service.	remunerates	FMO	FSP		
4.13		Payment for flexibility delivery	The RA/RP receives the remuneration for the service.	remunerates	FSP	RA/RP		

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

» **Name of information**: Unique ID which identifies the selected information in the context of the use case.
» **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1	Periodic update on pre-qualification criteria	Regular updates on available pre-qualification criteria and technical requirements to be met by the FSPs	
Info2	Asset Registration Data	Information needed for the pre-qualification assessment.	
Info 3	New potential FSP registration	Information about a new potential FSP provider.	
Info4	Request for additional information/documentation	List of additional information or documentation needed by the DSO to evaluate the potential FSP.	
Info5	New information/documentation submitted notification	Notification regarding new information/documentation submitted for an in-progress pre-qualification process	
Info6	Prequalification notification	Message about the outcome of the prequalification process	
Info7	Buy or sell flexibility order description	Information needed for the evaluation of the flexibility product. Order parameters are activation and availability price, quantity of power (minimum and maximum quantity), minimum and maximum duration of a delivery time interval, direction (up or down regulation), mode of activation (manual or automatic), etc.	

Info8	Asset Baseline	Baseline determination rules are defined in the market rules	
Info9	Customer Metering Data	Existing measurements of electrical quantities at the customer connection point	
Info10	Grid Data	Grid topology (actual and future) and electrical measurements	
Info11	Exogenous Data	Information regarding external data that can have an influence on the grid and costumer behaviour. The forecast of the generation and load at local/regional level is also considered.	
Info12	Trade Confirmation	Information on the sell offer to be activated, like which resource are to be activated, amount of active power and timeframe of activation.	
Info13	Information for mandatory processes	Data exchange for mandatory processes such as redispatch.	
Info14	Metering Data of individual assets	Contains metering data for individual assets for the billing process.	
Info15	Aggregated Metering Data	Meter data per portfolio for the billing process	
Info16	Settlement Information	Description of the measured quality and quantity of the delivery and the amount of value generated from it	
Info17	Invoice	Address of invoice receiver, time frame of flexibility, activation, activated generation/load assets, specific flexibility costs in €/MWh per asset, total flexibility costs per asset in €, total flexibility costs in €, underlying regulation scheme	
Info18	Flexibility Reserve Confirmation	Information on the sell offer to be activated in the case of a need, like which resource are to be activated, amount of	

		active power and timeframe of activation.	
Info 19	List of Validated FSP	List of Validated FSP, selected for flexibility delivery.	

8. Conclusion

This report summarizes the information collected for the different BUCs per demonstrator to provide input for the development of the UMEI concept. Specifically, the report reveals

- the relevant roles involved in the demonstrators, focusing strictly on roles relevant for flexibility services delivery within the project.
- an overview of the different demonstrators (their assets and flexibility resources, the geographical area where they are located, the grids they focus on, the problems they face…).
- a description of the market design per BUC, and an overview of the market platforms that are being used to implement these market designs per BUC.
- a detailed description of the different BUCs, containing individual objectives of the BUCs, summary narratives and step-by-step process descriptions for all the market phases within the BUC.

The information has been described extensively per BUC and is, were relevant, also presented visually in sequence diagrams or time scales. The different BUCs will all be implemented and tested in the project. Furthermore, the work is also a starting point for the development of the system use cases.

Note that all BUC descriptions are made based on current knowledge, discussions and decisions in the demonstrators. This implies that for some aspects (for instance of the market design) descriptions are still general as they will be further clarified in the rest of the project.

Although the BUC are diverse, the three demos will prove the Universal Market Enabling Interface (UMEI) concept with different market models, allowing for a future uptake by any stakeholder.

9. References

CEDEC, EDSO, Eurelectric, & GEODE. (2018). *Flexibility in the energy transition—A toolbox for electricity DSOs*. https://www.edsoforsmartgrids.eu/wp-content/uploads/Flexibility-in-the-energy-transition-A-tool-for-electricity-DSOs-2018-HD.pdf

CEN-CENELEC-ETSI Smart Grid Coordination Group. (2014). *SG-CG/ M490/F_ Overview of SG-CG Methodologies, ver. 3.0*.

Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (Text with EEA relevance.), 32019L0944, EP, CONSIL, OJ L 158 (2019). http://data.europa.eu/eli/dir/2019/944/oj/eng

IEC. (2013). *IEC 62559-2 Ed.1: Use case methodology – Part 2: Definition of use case template, actor list and requirement list*.

Marino, C., Takala, S., Heine, P., Albers, W., Calpe, C., Staudt, M., & Clerici, D. (2019). *Demonstrators' system use cases description* (EU-SysFlex Project Report D6.1; p. 245). http://eu-sysflex.com/wp-content/uploads/2019/03/EU-SysFlex_D6.1_Demonstrators-system-use-cases-description_v1.0_final.pdf

Annex I – First questionnaire template

MARKET ENABLING INTERFACE TO UNLOCK FLEXIBILITY SOLUTIONS
FOR COST-EFFECTIVE MANAGEMENT OF SMARTER DISTRIBUTION GRIDS

Survey T2.2: Demo & problem description

Demo name:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864334

H2020 – LC-ES-1-2019

Purpose questionnaire

This survey is set up in the framework of T2.2 of the H2020 EUniversal project. The objective of the survey is to get a **first picture of the demo site** and does not require details on the business use cases themselves yet. The aim is to get insights into specific characteristics of the demo (such as geography, smart grid infrastructure, the grid considered…), to better understand the problem/challenges of the demo and to get an overview in terms of specific requirements regarding the considered time horizon, regulation, market mechanisms…

We aim to get insights in the different demos in a timely manner, however, we understand if not all aspects are currently already clearly defined. As such, we ask you to be as complete as possible, yet to indicated incompletions or potential weakness in your answers when you give partial information. These answers can still be updated in a later phase. Please, always try to clarify and/or nuance all your answers, as this information will be used to set up the deliverable afterwards.

This survey is to be filled in by each demo and returned to VITO by the **31th of August 2020**. VITO will then review the filled in template and ask additional information in case of unclarities. The aim is to have a reviewed and completed template by the 11^{th} of September 2020.

As described in the presentation of the kick off-meeting, after this questionnaire, 2 additional questionnaires will follow: one to gain insights in the narrative of the use case, and one to describe the use cases in more detail. Parallel to these 2 activities, the role model will be set up.

Feedback/Questions

For feedback/questions about this survey, please contact:

Janka Vanschoenwinkel Janka.vanschoenwinkel@vito.be

Enrique Rivero enrique.riveropuente@vito.be

Kris Kessels kris.kessels@vito.be

Version management & author

Version Management			
Versio n No.	***Date***	***Name of Author(s)***	***Changes***
V.0.1	15/07/2020	Janka Vanschoenwinkel, Kris Kessels, Enrique Puente	First draft
V.1.0	23/07/2020	Janka Vanschoenwinkel, Gesa Milzer	Review + final draft

Demo description (If applicable, split up per demo-site)

Geographical location:

Where is the demo situated (provide country + region)?
Give a brief description of the area and highlight relevant aspects for the demo (urban/rural area, mountains, …).

Network under study:

Which is the relevant grid for the demo? (LV, MV, HV)
How does the grid topology look like (radial, meshed)?
What are the voltage levels?
Which type of grid users are connected (residential, SME, industrial, type of generation)?
With regard to specific grid conditions, what are critical periods for the grid? Please explain

Flexibility providers:

Who are the grid users (residential, industrial…) that provide flexibility? Please explain.
Provide a list of flexibility technologies to be tested and used in the demo.
Is aggregation foreseen in your demo? If yes, which grid users / flexibility technologies will be aggregated?
Will FSPs be contacted to participate within the DEMO or are the participating FSPs already registered from previous projects and business activities?

Main roles involved:

Who will be the main roles involved in your demo (TSO, DSO, market operator, BRP, producer, aggregator, supplier, flexibility service provider (FSP), prosumer, esco, other…)? Which actors take up this role?

Available Smart Grid infrastructure and solutions:

Provide a list of Smart Grid infrastructure and solutions present or planned to be installed in the pilot (smart meters, smart transformers, sensors…).

Demo problem situation

Problem situation and needs

What are current and future challenges and problems for the DSO in the grid area under study

Objectives

Which of these problems does the pilot want to address within EUniversal?

Requirements & scoping: What are important requirements and needs to achieve these objectives?

Time horizon ○ Which time frames are considered for the service delivery (i.e. what is the timing of the flexibility needs)? (real time operation, short term planning, long term planning, operational planning, other) Please provide the time range specifics.
Regulatory requirements ○ If the pilot wants to tackle the above problems, are modifications of the national regulatory framework needed or would it be possible in the current national regulatory framework? Which changes would be recommended?
Market mechanisms

○ Which market mechanisms for the procurement of flexibility needs and grid services is the pilot envisioning? (Flexibility market, Connection agreements, dynamic distribution grid tariffs…) Please explain.
Project experiences ○ Do you want to build further on an existing pilot? If yes, from which project is the original pilot and what did the pilot do? Please provide references to relevant documents.

Annex II – Second questionnaire template

MARKET ENABLING INTERFACE TO UNLOCK FLEXIBILITY SOLUTIONS FOR COST-EFFECTIVE MANAGEMENT OF SMARTER DISTRIBUTION GRIDS

Survey T2.2: Narrative business use cases

Demo name & use case: (Fill in a questionnaire per business use case)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864334

Purpose of the questionnaire

This second survey is set up in the framework of T2.2 of the H2020 EUniversal project. The objective of the survey is to get a **first picture of the business use cases per demo**. For each business use case, a separate survey has to be filled in and posted in the demo folder on the Sharepoint. Note that the responder to this questionnaire should be directly involved in the DEMO to provide the correct level of information.

We aim to get insights in the different business use cases in a timely manner, however, we understand if not all aspects are currently already clearly defined as part of the work is still work-in-progress. As such, we ask you to be as complete as possible, yet to indicate incompletions or potential gaps in your answers when you give partial information. These answers can still be updated in a later phase. Please, always try to clarify and/or provide details that ease the identification of relevant nuances in your answers, as this information will be used to set up the deliverable afterwards.

Keep in mind the following timeline:

Second questionnaire	13/11/2020	Draft Filled in for one BUC
	21/12/2020	Filled in for all BUCs
Third questionnaire	21/12/2020	Draft Filled in for one BUC
	19/02/2021	Filled in for all BUCs

After each step, VITO will then review the filled in templates and work together with the contact person(s) to clarify any open points.

As described in the presentation of the kick off-meeting, after this questionnaire, a follow up questionnaire will target a more detailed description of the use cases. The questionnaire is currently already available for review and inspiration.

Feedback/Questions

For feedback/questions about this survey, please contact:

Janka Vanschoenwinkel Janka.vanschoenwinkel@vito.be

Kris Kessels kris.kessels@vito.be

Version management & author

Version Management			
Version No.	***Date***	***Name of Author(s)***	***Changes***
V.0.1	31/08/2020	Janka Vanschoenwinkel, Kris Kessels, Enrique Puente	First draft
V.01	17/09/2020	Staudt Maik	Comments / Feedback
V.10	17/09/2020	Janka Vanschoenwinkel, Kris Kessels, Enrique Puente	Final template
V.1.0	27/10/2020	Janka Vanschoenwinkel	Move diagrams to third questionnaire

Use case description

Use case name, scope, objectives, hypotheses and associated smart grid functions

Name of the use case: add a short name, which refers to the activity of the use case itself. We suggest you use "verb + description", e.g., operate the distribution's congestion management market or submit flexibility bid to the distribution's congestion management market.
What is the scope of the use case? The scope defines the boundaries of the use case, i.e. what is in and what is out of the scope of the use case. This section may refer to the domain being considered (network, market…), the associated sub-domains (network level, type of market, e.g., balancing market, …), and time horizons (planning, real-time operations, …) for instance. E.g., scope: short-term network operation at MV level. UC includes flexibility activation. Out-of-scope: settlement process.
What are the objectives of the use case? List of objectives/goals the use case is expected to achieve (not for the writer or reader of the use case, but for the actor(s) using the system). For instance, objective: ensure that flexibility activation of market bids (local market) will not create grid constraints.

What are the limitations and assumptions of the use case (for instance related to the time dimension, type of population, geography…). For instance, the SO relies on emergency action only when no market is available.

Grid services selection

Based on the discussion in T2.1, which needs and related grid services will be implemented in this use case? Provide a detailed description and service definition based on the demo characteristics.

Use case narrative

Give a short description of the use case. The goal is to provide a short text summarizing the UC. Please reflect on the main steps of the UC and provide an overview in no more than 10 lines.

Give a complete description of the use case. The objective is to provide a narrative of a concrete scenario (e.g., "main success scenario") from a domain expert user's point of view. This description should cover motivations and intentions from various actors. It should guide the reader from beginning (stating triggers) to end (explaining how the service is completed). That is, the narrative should describe what occurs when, why, with what expectation, and under what conditions.
 	
While writing the narrative, please consider the following:[60]
 	
• Use "just one sentence form":
  ▪ Use present tense.
  ▪ Use active verb in the active voice.
  ▪ Describe actions that move the process forward.
  ▪ For instance, "customer enters card and pin into ATM"
• Keep it simple and to the point so that non-domain experts can understand it.
 	
Bear in mind that the length of this section can range from a few sentences to a few pages, depending on the complexity and / or novelty of the use case. Good narratives support the domain expert to reflect about the requirements for the use case.
 	
We suggest including the following aspects into the narrative:
 	
○ Type of mechanism used (Market or other – please be specific)

[60] Suggestions extracted from Cockburn, A. (2001). *Writing Effective Use Cases*. Addison-Wesley.

○ Interaction between roles (we suggest that you focus on the roles' intent bearing in mind that an action step reflects data circulating in one direction, e.g. "user enters name and address into the system") ○ Timeframe (e.g., local flexibility market opens at "x". The GCT is at "y". The clearing takes place 30 min. before the DA) ○ Data exchanges (please provide an indication of the data that is being exchanged, e.g., metered consumption data, contract data, generation forecast data) ○ Relevant phase (e.g., pre-qualification, procurement, activation, settlement)

Annex III – Third questionnaire template

MARKET ENABLING INTERFACE TO UNLOCK FLEXIBILITY SOLUTIONS
FOR COST-EFFECTIVE MANAGEMENT OF SMARTER DISTRIBUTION GRIDS

Survey T2.2: detailed template Business Use Cases

Demo + BUC name

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864334

Purpose of the questionnaire

This final survey is set up in the framework of T2.2 of the H2020 EUniversal project. The objective of the survey is to get a **final and full picture of the business use cases per demo**. It is important to note that this questionnaire follows the previous questionnaires. Although the previous questionnaires were there to make sure that the demos had time to shape the BUCS step by step, the information is still necessary and needed for the final BUC description.

Therefore, we ask the following:

- For each business use case, fill in a separate survey and post it in the demo folder on the Sharepoint. Note that the responder to this questionnaire should be directly involved in the DEMO to provide the correct level of information.
- Update previous questionnaires in line with the information that you fill in in this questionnaire in case that changes to previous ideas are made. All questionnaires need to be in line and complete.
- Unlike previous questionnaires: this is the final process in coming to a complete BUC description. So, make sure you are as complete and clear as possible.

Keep in mind the following timeline:

Second questionnaire	13/11/2020	Draft Filled in for one BUC
	21/12/2020	Filled in for all BUCs
Third questionnaire	21/12/2020	Draft Filled in for one BUC
	19/02/2020	Filled in for all BUCs

After each step, VITO will then review the filled in templates and work together with the contact person(s) to clarify any open points.

Feedback/Questions

For feedback/questions about this survey, please contact:

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Kris Kessels kris.kessels@vito.be

Version management & author

Version Management			
Version No.	***Date***	***Name of Author(s)***	***Changes***
V0.1	27/10/2020	Janka Vanschoenwinkel, Kris Kessels	First draft questionnaire

Description of the use case

Name of the use case

Please provide in the table below the following information:

» **ID**: The identifier (ID) is unique within a repository / or project and serves for organization / administration of use cases. Use as an ID your country code (PT, PL, DE) + a sequential number per use case.

» **Name of the use case**: identical to previous questionnaire

ID	***Name of use case***

Assets of the Use case

Please provide a list of assets which are needed specifically for this use case. (e.g. smart meters, CHPs…)

Further information

Please provide relations to Other Use Cases if they exist (i.e. the use case is a more detailed one related to a High Level use case, or it is an alternative to an existing use case).

Please provide a **priorisation of the use case**. Considering a larger number of Use Cases it might be interesting to cluster them according to priority (mandatory or optional). » **Examples**: » Obligatory / mandatory, optional, nice to have » Political target / business need / prioritization from standardization point of view » Time scale to deployment / timing, benefit, answer to new challenges
For the services (T2.1) that are used in this use case, please define the used market mechanisms (as described in T5.1).

Note: You already filled in scope, objectives, need and services in the second questionnaire. Please update this questionnaire in case updates regarding the description of the use case are needed / available.

Technical details

Actors

Please fill in the table below. Use the roles agreed upon in the role model workshop. The aim of the list is to limit the number of actors which are doubled using similar names.

» **Actor Type**: Can be a **Role** (a DSO, a Balance Responsible Party, an Aggregator…), a **Person** (a Distribution Management System Operator), a **System** (a Weather Forecast System, a Demand Response Management System, a Building Management System…), a **Device** (a charging spot), or an **Application**.

Name	***Actor type***	***Description (if different from the EUniversal Role model)***	***Further information specific to this use case***

For the remaining of the questionnaire, the authors must ensure that the names of the actors as listed in this table are consistently used throughout the document (specifically in the scenario conditions, preconditions and assumptions and scenarios). Writers shall check also for common capitalization, small differences in usage, abbreviations vs. whole words (i.e. ESP and elsewhere Energy Service Provider).

Step by step analysis of use case

Overview of scenarios

- **No.**: The scenarios are sequentially numbered.
- **Scenario Name and description**: is used to identify and describe the scenario.
- **Primary Actor**: Describes which actor(s) trigger(s) this scenario.
- **Triggering Event**: describes which event(s) trigger(s) this scenario.
- **Pre-Condition**: describes which condition(s) should have been met before this scenario happens.
- **Post-Condition**: describe which condition(s) should prevail after this scenario happens. The post conditions may also define “success” or “failure” conditions for each use case.

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Prequalification					
2	Selection/Bidding					
3	Delivery					
4	Settlement					

Steps – Scenarios

Please fill in the tables and diagrams on the next pages for each of the scenarios. The goal is to get a clear overview of all the steps that are needed to come to the desired outcome. For each step, fill in the following information:

» **Step No.**: Sequential number identifying the step
» **Event**: The event that triggers the step (might be completion of the previous step).
» **Name of process/activity**: Label that would appear in a sequence diagram.
» **Description of process / activity**: Describes what action takes place in this step. Make sure to phrase it in an "active" way: what is "done"?
» **Information producer**: Identifies the producer or source of the information. This should be one of the actors defined above.
» **Information receiver**: Identifies the receiver of the information. This should be one of the actors defined above.
» **Information exchanged**: Describes briefly the information to be exchanged between actors. Detailed information exchange should be identified using an ID. In this case the column only contains the ID of the exchanged information which link to more details about the information in a separate table in the following template section 4 which is used for all steps of the use case. It is allowed to list several requirements in one step, comma separated. This describes briefly the information to be exchanged between different actors:
    » Input to the use case from some external source that is not described in this use case,
    » Internal to the use case (although could be between different applications and systems within the use case),
    » Output from the use case that will be used by other actors / entities not included in this use case.
    » This column should not contain technology issues/requirements.
» **Requirements**: Detailed requirements such as data formatting, metering… are not needed for the business layer. However, general requirements regarding data, regulation, assumptions… are needed. If desired, more information on such requirements/assumptions are to be given in section 5. Please use in these tables only the IDs. Refer to the same IDs as you indicate in section 5 "Definition of a list for requirements". It is allowed to list several requirements in one step, comma separated.

Prequalification

Sequence diagram

Scenario step by step analysis

Scenario								
Scenario name		Prequalification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.1								
1.2								
1.3								
1.4								
1.5								
1.6								
1.7								

Selection/Bidding

Sequence diagram

Scenario step by step analysis

Scenario								
Scenario name	Selection/Bidding							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.1								
2.2								
2.3								
2.4								
2.5								
2.6								

Delivery

Sequence diagram

Scenario step by step analysis

Scenario								
Scenario name	Delivery							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.1								
3.2								
3.3								
3.4								
3.5								

Settlement

Sequence diagram

<u>Scenario step by step analysis</u>

Scenario								
Scenario name		Settlement						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
4.1								
4.2								
4.3								
4.4								
4.5								

Information exchanged

Please fill in the table below. Note that no detailed information on formatting and quantities are needed. The goal is to gain insights in the content of the information needed. E.g. for forecasting, some of the following information could be needed: production data, consumption profiles of households…

- **Name of information**: Unique ID which identifies the selected information in the context of the use case.
- **Description of Information Exchanged**: Brief description, in case a reference to existing data models / information classes should be added. Using existing canonical data models is recommended.

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
Info1			
Info2			
Info3			