Validation and results of concept test - Spain

D9.3

Authors:

Beatriz Alonso Santos (i-DE)

David Martín Utrilla (i-DE)

Santiago Falcón de Andrés (UFD)

Teresa Hormigo González (UFD)

Celia Vidal Silvestre (OMIE)

María Hernández Martínez (OMIE)

Sergio Muñoz Delgado (OMIE)

Jose Pablo Chaves (Comillas)

Matteo Troncia (Comillas)

Carmen Gutierrez Moles (IDAE)

Responsible Partner	i-DE
Checked by WP leader	Madalena Lacerda (E-REDES), 05/05/2023
Verified by the appointed Reviewers	Marjan Ilkovski (ULJ), 12/05/2023 Lenos Hadjidemetriou (UCY), 17/05/2023 Markos Asprou (UCY), 17/05/2023
Approved by Project Coordinator	Padraic McKeever (Fraunhofer), 31/05/2023

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About OneNet

The project OneNet (One Network for Europe) will provide a seamless integration of all the actors in the electricity network across Europe to create the conditions for a synergistic operation that optimizes the overall energy system while creating an open and fair market structure.

OneNet is funded through the EU's eighth Framework Programme Horizon 2020, "TSO – DSO Consumer: Large-scale demonstrations of innovative grid services through demand response, storage and small-scale (RES) generation" and responds to the call "Building a low-carbon, climate resilient future (LC)".

As the electrical grid moves from being a fully centralized to a highly decentralized system, grid operators have to adapt to this changing environment and adjust their current business model to accommodate faster reactions and adaptive flexibility. This is an unprecedented challenge requiring an unprecedented solution. The project brings together a consortium of over seventy partners, including key IT players, leading research institutions and the two most relevant associations for grid operators.

The key elements of the project are:

1. Definition of a common market design for Europe: this means standardized products and key parameters for grid services which aim at the coordination of all actors, from grid operators to customers;
2. Definition of a Common IT Architecture and Common IT Interfaces: this means not trying to create a single IT platform for all the products but enabling an open architecture of interactions among several platforms so that anybody can join any market across Europe; and
3. Large-scale demonstrators to implement and showcase the scalable solutions developed throughout the project. These demonstrators are organized in four clusters coming to include countries in every region of Europe and testing innovative use cases never validated before.

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Table of Contents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

List of Figures

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

List of Tables

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

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List of Abbreviations and Acronyms

Acronym	Meaning
A	Availability
ASM	Active System Management
BUC	Business Use Case
DER	Distributed Energy Resource
DSO	Distribution System Operation
E	Energy
ES	Spain
FSP	Flexibility Service Providers
HV	High Voltage
i-DE	i-DE Redes Eléctricas Inteligentes, S.A.U. (Spanish DSO)
IMO	Independent Market Operator
KPI	Key Performance Indicator
kW	Kilowatt
kWh	Kilowatt-hour
LMP	Local Market Platform
LT	Long-term
LV	Low Voltage
MV	Medium Voltage
NEMO	Nominated Electricity Market Operator
OMIE	Iberian Electricity Market Operator
P	Power
RT	Real Time
RUC	Regional Use Case
SO	System Operators (referring to both DSOs and TSOs)
ST	Short-Term
SUC	System Use Case
TSO	Transmission System Operator
UFD	Union Fenosa Distribución (Spanish DSO)
UOL	Unidad de Oferta Local (Local unit offer)
UMU	Murcia University
WECL	WECL Western Cluster
WP	Work Package

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Executive Summary

This document contains the definition, evaluation and results of the use case scenarios tested in the Spanish demonstrator, whose objective is unlocking the flexibility of the resources connected to the distribution system to contribute to congestion management at the distribution level.

The Spanish demonstrator involves two Distribution System Operators (DSOs) namely i-DE and UFD, OMIE, the nominated electricity market operator (NEMO) for managing the Iberian peninsula's Day-ahead and intraday electricity markets, IDAE, which is the Spanish Government's Institute for the Diversification and saving of Energy, Comillas Pontifical University and seven Flexibility Service Providers (FSPs).

The FSPs connected to the medium voltage system, with flexibility capacity between 10 to 1.000 kW, participated in the provision of flexibility services, located in areas where DSOs operate: i-DE in Murcia and Cantoblanco, Madrid and UFD in Alcalá de Henares, Madrid.

To enable the trading of flexibility products, two local market platforms (LMP), long-term and short-term, have been developed by OMIE in which the DSOs can buy flexibility services from FSPs in two main submarkets:

- Long-term market: long term procurement of flexibility services through a market mechanism to avoid congestions at the distribution medium or low voltage networks, from years to days ahead of delivery.
- Short-term market: short term procurement of flexibility services through a market mechanism to avoid congestion management at the distribution medium or low voltage network, for the Day ahead or intraday.

The Long-Term Market Platform has been designed as an online platform where the participants are identified under a username and a password provided by the Independent Market Operator (IMO), represented by OMIE, while the Short-Term Market Platform has been developed following the current design of the platforms (see Ch. 4.1. Short Term Platform) used in the Iberian Electricity Market to facilitate the usability for those participants that already negotiate with OMIE's platforms, and it is also prepared to be integrated with the Global Electricity Markets, such as, the Intraday Continuous Market (XBID).

Ten field tests were performed where local congestion problems have been resolved by acquiring flexibility in the local market platform: 3 long term market agreements (1 in Murcia and 2 in Alcalá de Henares), 6 short term day ahead agreements (1 in Murcia, 3 in Cantoblanco and 2 in Alcalá de Henares) and 1 short term intraday market agreement in Murcia.

The FSPs could be efficiently connected to the OMIE market platforms and go through all market phases: from prequalification, forecasts, market clearing, monitoring and activation until settlement.

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The results showed that flexibility providers were able to deliver the contracted amount on time and for the duration set for almost all cases. The KPIs are computed and reported for each demo site test showing in general positive results in terms of cost efficiency, accuracy of load forecast and asset load impact.

However, some barriers were identified during the development of the demos, including customer engagement challenges, maintaining customer comfort, baseline calculation, adjusting market production needs for industrial providers and lack of regulatory rules for incentives/penalties.

Lack of customer participation was identified as the biggest challenge, for that reason, demo site selection was motivated more by the feasibility to engage potential flexibility providers in a trial framework than by the network need to be solved, which was simulated accordingly.

To overcome the rest of the barriers, demo site dates (days and activation flexibility schedule) were selected in agreement with the engaged FSPs to avoid possible inconvenience to building users or production development in the case of industrial participants.

Some of the features in the platform are still to be further developed, such as the absence of notifications to FSPs about the opening of an intraday market and the need for certain labels to provide complete information. Additionally, it is currently necessary to log onto the long-term platform to consult information about which FSP has been awarded as it is not available in the short-term platform.

Overall, the demonstrator highlights the potential of local flexibility markets to address network constraints in a cost-effective manner. Nonetheless, further efforts are required to overcome the identified barriers and make these markets a reality. The demonstrator provides valuable insights into the challenges and opportunities of local flexibility markets and can inform future research and policy decisions in this area. The successful implementation of these objectives could pave the way for more widespread adoption of flexibility services in the Spanish electricity system, leading to more resilient and cost-effective solutions providing relevant inputs for the European development.

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1 Introduction

This deliverable reports on Task 9.3.2 “Demonstration and test Spain” of the OneNet project, which aims at providing the definition and the conditions of the use case scenarios to be tested in the Spanish demonstrator, including the evaluation and results of those scenarios.

The OneNet Spanish demonstrator aims at unlocking the flexibility of the resources connected to the distribution system to contribute to congestion management at the distribution level.

It involves two Distribution System Operators (DSOs) namely i-DE and UFD, OMIE, the nominated electricity market operator (NEMO) for managing the Iberian Peninsula’s Day-ahead and intraday electricity markets, IDAE, which is the Spanish Government’s Institute for the Diversification and saving of Energy and Comillas Pontifical University.

Different Flexibility Service providers (FSPs) participate in the provision of flexibility services. Although the Spanish Transmission System Operator (TSO) doesn’t participate in the project, the TSO-DSO coordination has also been considered through OMIE, who coordinates energy market results and responsibilities with the System Operators (SOs) and includes the local markets being developed in OneNet.

To enable the trading of flexibility products, a local market platform (LMP) has been developed by OMIE in which the DSOs can buy flexibility services from FSPs in two main submarkets:

- Long-term market: long term procurement of flexibility services through a market mechanism to avoid congestions at the distribution medium or low voltage networks.
- Short-term market: short term procurement of flexibility services through a market mechanism to avoid congestion management at the distribution medium or low voltage network, the Day ahead or intraday.

The Spanish demonstration is part of the Work Package 9, which addresses the work of the three Western Cluster demonstration countries: Portugal, France and Spain.

1.1 Task 9.3 Objectives and interaction with other WP9 Tasks and other OneNet WPs

This task is focused on the demonstration activities at the two Spanish DSOs selected locations to solve local constraints covering long-term and short-term local markets with the following objectives:

- Test market procedures to obtain flexibility services attending DSO requirements.
- Demonstrate that long term agreements are suitable amongst different available Distributed Energy Resources (DERs).

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- Implement flexibility provision/usage through a market platform.
- Use consumers' demand-response in efficient flexibility services.

Task 9.3 has interactions with other tasks and work packages in which definitions affecting the Spanish demonstration were taking place. The main interactions are summarized in the Figure 1-1:

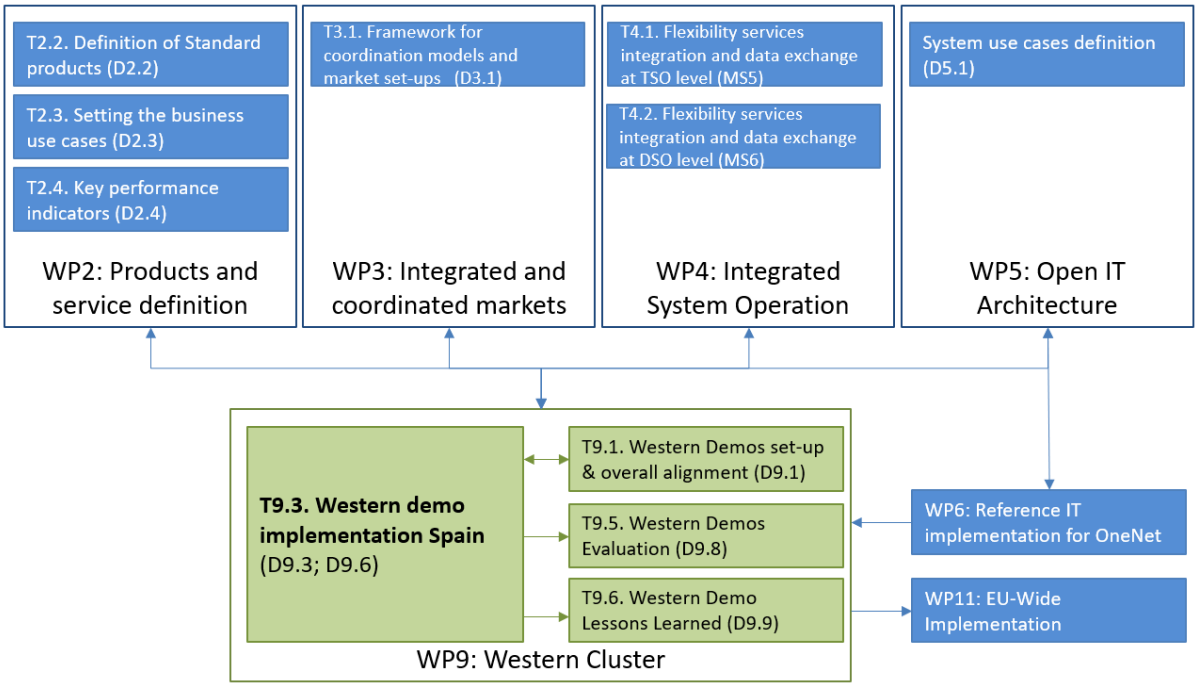

Figure 1-1: Interaction within WP9 and other WPs

- WP2 provided standardized understanding of products and services [1][2], Business Use Cases (BUCs) definition [3] and Key Performance Indicators (KPIs) definition and overall alignment [4].
- WP3 provided definition of coordinated and scalable markets for the procurement of system services by DSOs and TSOs [5].
- WP5 [6] provided System Use Cases (SUC) definition and technical requirements for platform development and OneNet system description based on the information of WP4.
- WP6 [7] defined the Reference Architecture and OneNet Connector implementation.

The output of this task is an input for task 9.5, which will endorse the integration of the results coming from the three different Member States involved in WP9, and for task 9.6, which will provide a vision and strategy in the form of main findings and lessons learned and perform the scalability and replicability analysis of the demo solutions. Additionally, the data obtained in this task will be collected from the demo site and aggregated for further analysis of the different cluster demonstrations to extract general conclusions in WP11 and linked to direct collaboration with different projects in WP12.

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This document is the first of the two deliverables of Task 9.3, which includes also D9.6 for data gathering following cost benefit analysis and business model framework from the tests. It will also include the results of OneNet connector implementation and common demo KPIs, which are the ones which have one unique value for the whole Spanish demonstrator versus the KPIs included in this deliverable, which are related to a specific location and are calculated for each demo site.

1.2 Outline of the Deliverable

This document is divided into 10 sections:

- Section 1 consists of the introduction to Task 9.3, Spanish demonstrator, including objectives and interactions with work packages.
- Section 2 introduces the methodology already adopted to develop the task and to achieve the results needed for further analysis in WP9.
- Section 3 includes the overall description of the Spanish demonstrator: service and products, BUC and SUC definitions and markets design to be tested in the demonstrator sites.
- Section 4 describes the platforms developed for the demonstrators.
- Section 5 details the flexibility service providers participating in the demo, describing and characterizing their resources.
- Section 6 describes the individual demo sites, including definition of the congestion problem to be solved and the distributed resources requirements to be acquired in the local markets for each such problem.
- Section 7 includes the results and evaluation for each demo site.
- Section 8 has the conclusion of this task.

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2 Methodology

The identification and description of the demonstration to be done in Spain followed a methodology that consisted of several steps as indicated in Figure 2-1:

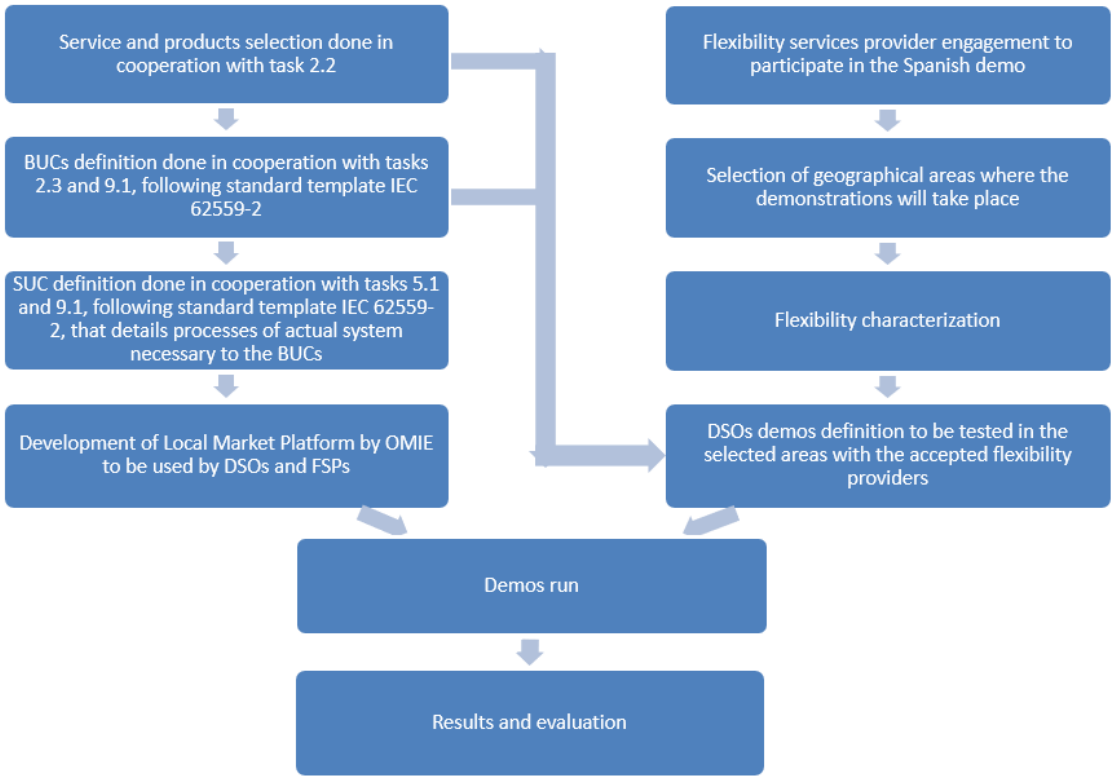

Figure 2-1: Methodology steps

While BUC and SUC definitions were developed, flexibility providers were approached to engage them to participate in the demo. Therefore, the demo sites selected have been motivated more by the feasibility to engage potential flexibility providers in a non-regulated incentivized framework than by the network needs, which have been simulated in the areas where customers were engaged to participate.

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3 Overview of the Spanish demonstration

The OneNet Spanish demonstrator aims at unlocking the flexibility of the resources connected to the distribution system to contribute to congestion management at the distribution level acquiring flexibility in short-term or long-term local markets.

Table 3-1 shows a summary of the Spanish demonstration definition. The description of each concept is included in the following subsections as indicated between brackets in the first row. Where:

- P=Power
- A=Availability
- E= Energy (activation)

Table 3-1 - Overview of Spanish demonstration

Service (sub.3.1)	**Product** (sub.3.1)	**BUC** (sub.3.2)	**SUC** (sub.3.3)	**Submarket design** (sub.3.4)
Corrective active power for Congestion management	Corrective local active	WECL-ES-02: Short-term congestion management	SUC-ES-01: Local Market Platform	DSO coordination Short-term Intraday market: -Power Activation, P-E
Predictive active power for congestion management	Predictive short-term local active	WECL-ES-02: Short-term congestion management	SUC-ES-01: Local Market Platform	DSO coordination Short-term Day Ahead market: -Power Activation, P-E; -P Availability and Activation, P-A-E
	Predictive long-term local active	WECL-ES-01: Long-term congestion management	SUC-ES-01: Local Market Platform	DSO coordination Long term market: -Power Availability, P-A; -P Availability and activation, P-A-E

3.1 Services and products

SOs have the responsibility of operating their networks securely and reliably. When operating their networks, they will face several system needs which can be defined as requirements of a high-level strategical action or set of actions for the better operation and/or planning of the grid (in terms of security and quality of supply) related to a specific grid aspect.

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To address their system needs, SOs require several services with the associated products, that as discussed in D2.1 [1], have been defined as follows for the OneNet project:

- Service: the action (generally undertaken by the network operator) which is needed to mitigate a technical scarcity or scarcities that otherwise would undermine network operation and may create stability risks.
- Product: tradable unit that the network operator acquires from flexibility providers and that entails the option to deliver a service in case of activation (this activation can be automatic). The characteristics of the technical scarcity mitigated by the relevant service will determine the attributes of the tradable unit.

The Spanish demonstrator tested congestion management need, which arises when the power flows exceed the thermal limits of at least one network asset. According to the standardized services and products provided in WP2, D2.2 [2], the following services have been defined to address this need:

Table 3-2 - Services for Congestion Management needs

Service	Definition
Corrective active power for Congestion management	For targeting congestion management needs caused by network failures and subsequent corrective actions (e.g. switching state changes, ad-hoc active power intervention), through the activation of active power generation and demand side sources. Given that these services are caused by unexpected situation, they could only arise in our operational time frame. This service needs products with fast activation and their duration should be aligned with the thermal limits of the congested assets.
Predictive active power for congestion management	Predictive active power management is a service meant to solve congestions that are forecastable (e.g. congestion arising due to forecast maintenance activities or long-term planning process). These needs could arise in all three times frames considered in our framework. However, the reasons behind these needs could be different which could result in different products to address them. For example, at the operational level, the SO could forecast congestion as a result of a change in the weather forecasts affecting the availability of some FSPs while in the long-term timeframe, this service can be considered either as a complement or even an alternative to traditional grid investments.

The products to be used for congestion management, as provided in WP2, D2.2 [2], are shown in Table 3-3, with the corresponding markets where have been tested in the Spanish demo:

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Table 3-3 – Products for Congestion Management needs

Service	Product	Definition	Market
Corrective active power for Congestion management	Corrective local active	To react with active power to an unexpected incident that requires correction in less than one hour	Short-term Intraday market, ST -Power Activation, P-E
Predictive active power for congestion management	Predictive short-term local active	To react using active power to a forecasted system need within the operational planning timeframe	Short-term Day Ahead market, ST: -Power Activation, P-E; -P Availability and Activation, P-A-E
	Predictive long-term local active	To mitigate and/or delay the need for traditional grid reinforcements using active energy	Long term market, LT -Power Availability, P-A; or -P Availability and activation, P-A-E

The attributes that characterize the products are shown in Table 3-4:

Table 3-4 – Attributes for congestion management products

Attributes	Corrective local active	Predictive short-term local active	Predictive long-term local active
Capacity/energy	Energy	Energy and optional capacity	Capacity and optional energy
Location required (Y/N)	Yes	Yes	Yes
Maximum full activation time	<60 min	<60 min	24h
Minimum required duration of delivery period	A multiple of 15 minutes up to 1 hour	A multiple of 15 minutes up to 1 hour	A multiple of 15 minutes up to 1 hour
Maximum deactivation period	Defined in terms and conditions for FSPs	Defined in terms and conditions for FSPs	Defined in terms and conditions for FSPs
Maximum recovery period	Defined in terms and conditions for FSPs	Defined in terms and conditions for FSPs	Defined in terms and conditions for FSPs
Required mode of activation	Automatic or manual (if compliant with FAT)	Automatic/ Manual	Automatic/ Manual
Minimum quantity	1 MW for TSOs 0.01 MW for DSOs	1 MW for TSOs 0.01 MW for DSOs	1 MW for TSOs 0.01 MW for DSOs
Divisibility (Y accepted / Y required /N)	Divisible and indivisible bids are allowed	Divisible and indivisible bids are allowed	Divisible and indivisible bids are allowed
Granularity	1 MW for TSOs 0.01 MW for DSOs	1 MW for TSOs 0.01 MW for DSOs	1 MW for TSOs 0.01 MW for DSOs
Availability price (Y/N)	No	If required, in €/MW	Yes, in €/MWh

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Attributes	Corrective local active	Predictive short-term local active	Predictive long-term local active
Activation price (Y/N)	Yes, in €/MWh	Yes, in €/MWh	If required, in €/MWh
Symmetric/asymmetric product (Y/N)	No symmetry required	No symmetry required	No symmetry required
Aggregation allowed (Y/N)	Allowed	Allowed	Allowed

3.2 Business Use Cases

According to the Business Use Cases (BUCs) provided in WP2, D2.3 [3], the Spanish demonstration sites tested the following BUCs:

- WECL-ES-01: Long-term congestion management
- WECL-ES-02: Short-term congestion management

Consumer engagement has been a barrier since the beginning of the Project. Therefore, the areas selected have been motivated more by the feasibility to engage potential flexibility providers in a non-regulated incentivized framework than by the network needs.

Network needs have been simulated appropriately, as discussed later in chapter 6 n the selected demo sites where flexibility providers were engaged.

Apart from these, a Regional Use Case, RUC, has been developed, called "WECL-REGIONAL-01: Cross-SO grid prequalification", which foresees prequalification across borders, involving partners from the different countries within the Western Cluster. It will be addressed jointly in D9.8.

3.2.1 BUC WECL-ES-01: Long-term congestion management

This BUC is focused on the long-term procurement of congestion management products by the DSO. The main objective of the BUC is to ensure that the DSO can procure flexibility in advance to solve specific local system loading issues on the distribution system, thus deferring/eliminating the need for traditional system upgrades.

This BUC describes the exchanges of information and the processes that should be established between DSO, IMO and FSP to solve distribution network local congestions. The objective is to procure products to ensure the network remains secure and does not go beyond its firm capacity at times of peak demand. The products can be procured from weeks to years ahead of delivery and are aimed towards medium voltage or low voltage (MV/LV) flexibility providers.

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The DSO procures the product in the long term (years to weeks ahead of delivery) indicating a band of flexibility that will be activated when needed or as scheduled, one or more times during the life of the contract. The flexibility providers receive a payment for the availability during the life of the contract, and if activation is needed, the flexibility provider may receive an additional utilisation payment or not (to be defined in the contract). If the activation is not delivered, penalties may be applied to the flexibility provider. If the flexibility is delivered as contracted, the DSO proceeds with the settlement as agreed in the contract.

Five scenarios are defined for this BUC:

1. Prepare/Pre-qualification: to ensure that a particular FSP can participate in a particular market and can provide a particular service considering market and product design aspects.

   It starts once the flexibility service provider expresses interest in entering the flexibility market. It consists in two steps: grid prequalification, to ensure that the resource meets the technical requirements and product prequalification, to ensure that the FSP can participate in a particular market and can provide a particular service considering market and product design aspects.

2. Plan/Forecast: to detect congestions in the grid.

   The DSO carries out an internal analysis (e.g. forecasts, power flows) to detect congestions in the grid, which could be solved by the long-term procurement of flexibility. This service phase happens years to weeks ahead.

3. Market Phase: to select FSP in terms of quality and cost by auction type of market.

   Based on the flexibility needs identified, the DSO is able to call a market through the market platform. This market, operated by the independent market operator, will procure either availability (MW) only or availability (MW) and activation (MWh).

4. Monitoring and activation: to monitor network conditions in real time and send activation signals

   This service phase takes place close to real-time and in real-time. The DSO will monitor the conditions of the grid in real time and send the activation signals to the FSPs committed in the market phase, in accordance with the type of product procured.

5. Measurement phase: to verify and measure FSP delivery.

   In this final service phase, the MO and/or DSO will verify if the flexibility was provided in accordance to the product procured in the market phase. This service phase can take place in the real-time and/or after the real-time. For the measurement of flexibility, a baseline has to be previously defined, to which the actual metered data of the FSP can be compared too. If the FSP is not able to deliver the flexibility in accordance with the predefined market conditions and agreed baseline, penalties may apply, which would decrease the remuneration received by FSP.

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Figure 3-1 presents the overview diagram for this BUC, WECL-ES-01, and Appendix A.1 has the complete description, based on IEC 62559-2, including diagrams and step by step scenario analysis.

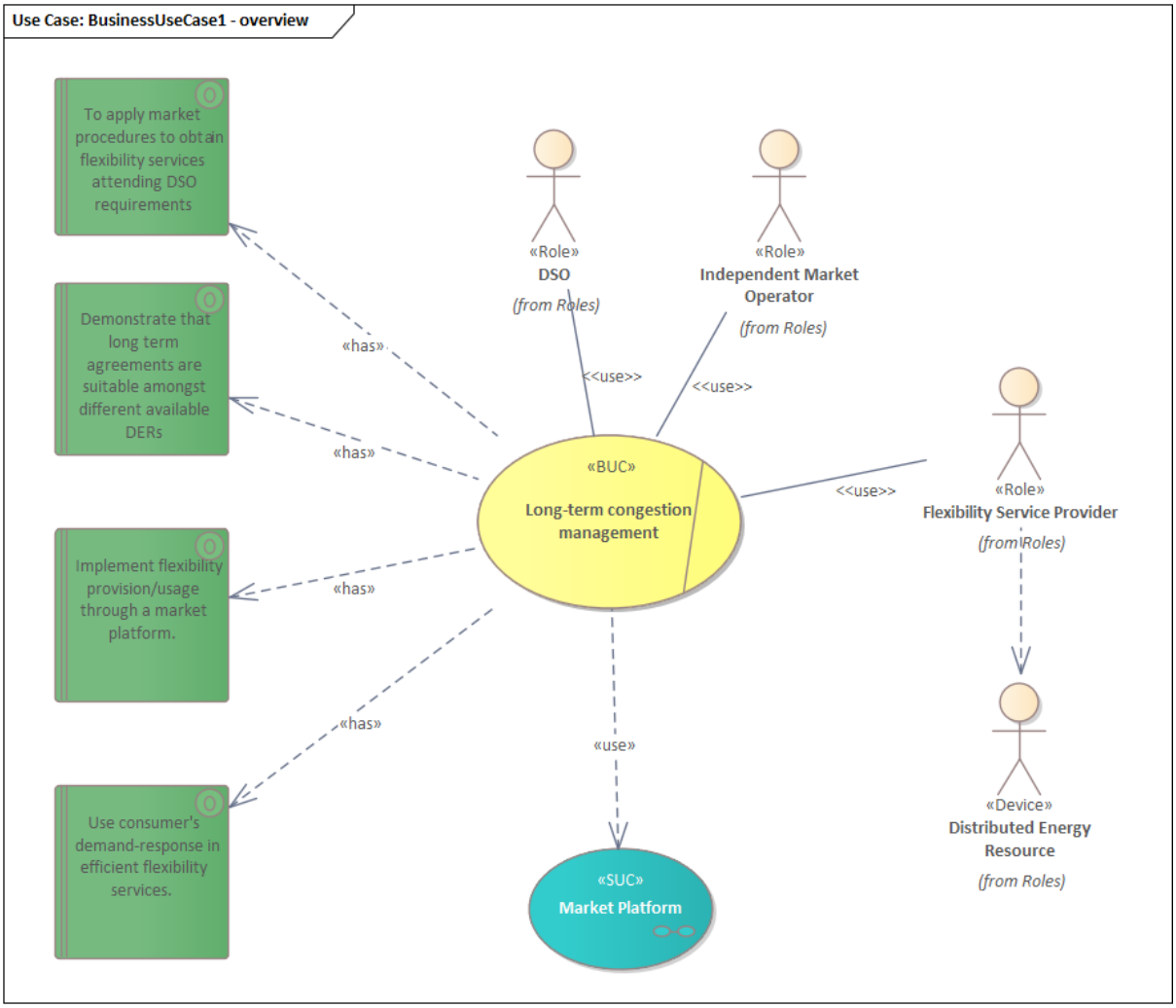

Figure 3-1: WECL-ES-01 Overview Diagram

3.2.2 BUC WECL-ES-02: Short-term congestion management

This BUC will demonstrate the short-term congestion management procurement of local flexibility products by the DSO. It describes the exchanges of information and the processes that should be established between DSO, IMO and FSP to solve distribution network local congestions. Two timeframe markets are considered: Day-ahead and intraday.

The “day-ahead” market will be used for short-term procurement of flexibility availability to support the network in the event of an expected/programmed work conditions as maintenance work. The DSO will procure a band of flexibility that could be activated one or more times (to be defined in the product specifications) during

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the life of the contract. The flexibility providers will receive a payment for the availability during the life of the contract. If activation is needed, the flexibility provider may receive an additional utilisation payment or not (to be defined in the product specifications). If activation is needed and the flexibility provider is not able to deliver it as contracted, a penalty may apply.

The “intraday” market will be used for short-term procurement of flexibility availability to help restoration or reduce the stress on the network following an unexpected fault of equipment. The product will be contracted close to real-time (up to one hour before delivery) when constraints in the network may arise. The product will be set as an activation product. In this product, the DSO procures flexibility with predefined activation characteristics (e.g. time of activation, duration, ramping periods etc.). At activation time, the DSO monitors the delivery of the service. If the flexibility provider delivers the service, the DSO proceeds with the settlement. If the flexibility provider does not deliver the service as contracted, a penalty may apply.

Five scenarios are defined for this BUC:

1. Prepare/Pre-qualification: to ensure that a particular FSP can participate in a particular market.
   It starts once the flexibility service provider expresses interest in entering the flexibility market. It consists in two steps: grid prequalification, to ensure that the resource meets the technical requirements and product prequalification, to ensure that the FSP can participate in a particular market and can provide a particular service considering market and product design aspects.
2. Plan/Forecast: to detect structural congestions in the grid.
   The DSO carries out an internal analysis (e.g. forecasts, power flows) to detect congestions in the grid, which could be solved by the long-term procurement of flexibility. This service phase happens years to weeks ahead.
3. Market Phase: to select FSP in terms of quality and cost by auction type of market.
   Based on the flexibility needs, the DSO is able to call a market through the market platform. This market will procure either availability or availability and activation. Availability means a capacity band (product defined in kW) with a start and finish times defined, in which the FSP is expected to provide the flexibility upon the DSO’s call. Activation is predefined in terms of day, time, capacity and duration of activations (product defined in kWh). In principle, the day-ahead market will be open for availability and activation procurement, while the intraday will be used for activation procurement.
   During this phase there is a qualification process to check if the flexibility provider is able to provide the demand service in terms of quality and cost.
4. Monitoring and activation: to monitor network conditions in real time and send activation signals.

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This service phase takes place close to real-time and in real-time. The DSO will monitor the conditions of the grid in real time and send the activation signals to the FSPs committed in the market phase, in accordance with the type of product procured.

5. Measurement phase: to verify and measure FSP delivery.
   In this final service phase, the MO and/or DSO will verify if the flexibility was provided in accordance to the product procured in the market phase. This service phase can take place in real-time and/or after the real-time. For the measurement of flexibility, a baseline has to be previously defined, to which the actual metered data of the FSP can be compared too. If the FSP is not able to deliver the flexibility in accordance with the predefined market conditions and agreed baseline, penalties may apply, which would decrease the remuneration received by FSP.

Figure 3-2 presents the overview diagram for this BUC, WECL-ES-02, and Appendix A.2 has the complete description, based on IEC 62559-2, including diagrams and step by step scenario analysis.

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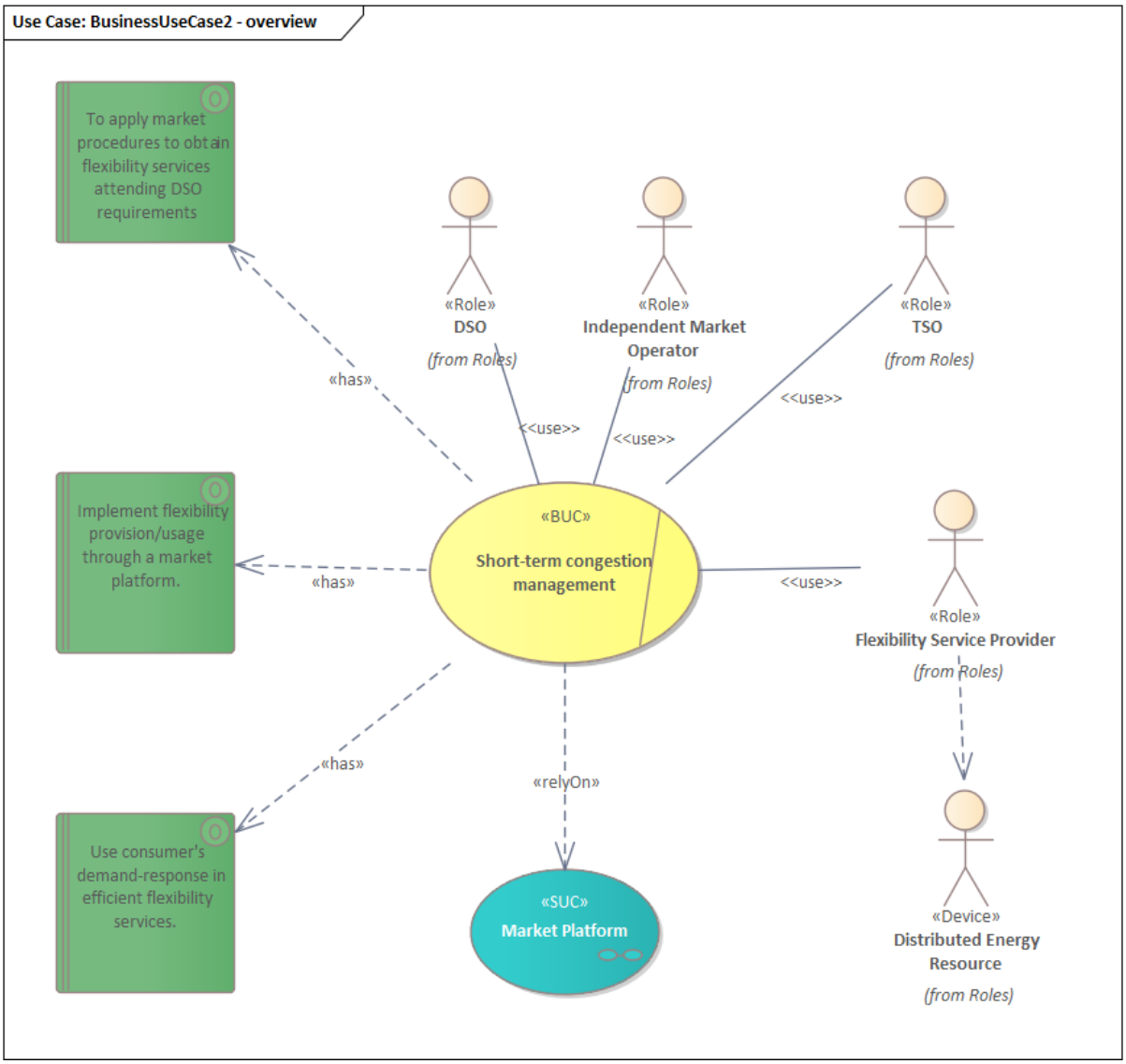

Figure 3-2: WECL-ES-02 Overview Diagram

3.3 System Use Case

According to the System Use Cases (SUCs) provided in WP5, D5.1 [6], the Spanish demonstration site tested one System Use Case, SUC-ES-01, Local Market Platform. This SUC serves both WECL-ES-01 and WECL-ES-02 BUCs.

This SUC describes the Local Market Platform, a system responsible for receiving the DSO needs on market sessions for flexibility procurement, the bids from FSPs, for the market clearing and for the communication of market results to different stakeholders.

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The Local Market Platform will be operated by the Independent Market Operator and will serve as the interface for the different market participants as well as for clearing the different markets. This system use case starts with the request from the DSO for a market session.

Three scenarios are defined for this SUC:

1. Flexibility resource register: to register flexibility resources,
2. Market request: to enable and handle a market session request by DSO,
3. Market session: to enable and handle market activities.

The last scenario, market session, also includes the interactions with the OneNet System by publishing the market results on a certain periodicity, every hour or daily. The objective of this interaction is to make other SOs aware of activations in case those activations can impact their operations (e.g. activations of units near the border between two SOs).

Appendix A.3 includes the complete description, based on IEC 62559-2, including diagrams and step by step scenario analysis.

3.4 Submarkets design

According to submarket design in WP3, D3.1 [5], the Spanish demonstration use the market-based DSO coordination, which describes the procurement mechanisms in which the flexibility from FSPs solves local needs of the relevant system operator without affecting other areas.

To enable the trading of flexibility products, a local market platform (LMP) has been developed by OMIE and used by DSOs and FSPs to test two main submarkets.

- Long term (LT) submarket (P availability and activation submarket and a P availability submarket)
- Short term (ST) submarket (day ahead and real time P activation submarket)

The existing submarkets that are relevant for the scope of the demonstrator are:

- Day-ahead energy market: As an integral part of the electrical energy production market, the day-ahead market, also called single day-ahead coupling (SDAC), aims to carry out electrical energy transactions by submitting selling and takeover bids for electrical energy on behalf of the market agents for the twenty-four hours of the following day. This market is coupled with Europe since 2014.
- Intraday energy markets: The intraday markets are an important tool that allows market agents to adjust the day-ahead market's resulting schedule by submitting selling and takeover bids for energy, according to expected needs in real-time. The intraday markets are currently structured into six bidding sessions in MIBEL's scope (Iberian Peninsula) and a continuous cross-border European market, and they

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are carried out once the system operator has made the necessary adjustments after the day-ahead market so that the resulting schedule may be technically viable.

- Common congestion management market: TSO market to acquire products to solve network congestion management needs.
- Balancing energy market: TSO market to maintain the stability of the electric system

Figure 3-3 provides an overview of the market architecture of the OneNet Spain demonstrator. All the new submarkets are decentralized markets and event based. In the case of a need for system services, the DSO asks the IMO to open a call in a specific grid area to procure flexibility. The system service procured is active power flexibility. It is procured active power availability, activation, or both depending on the submarket considered.

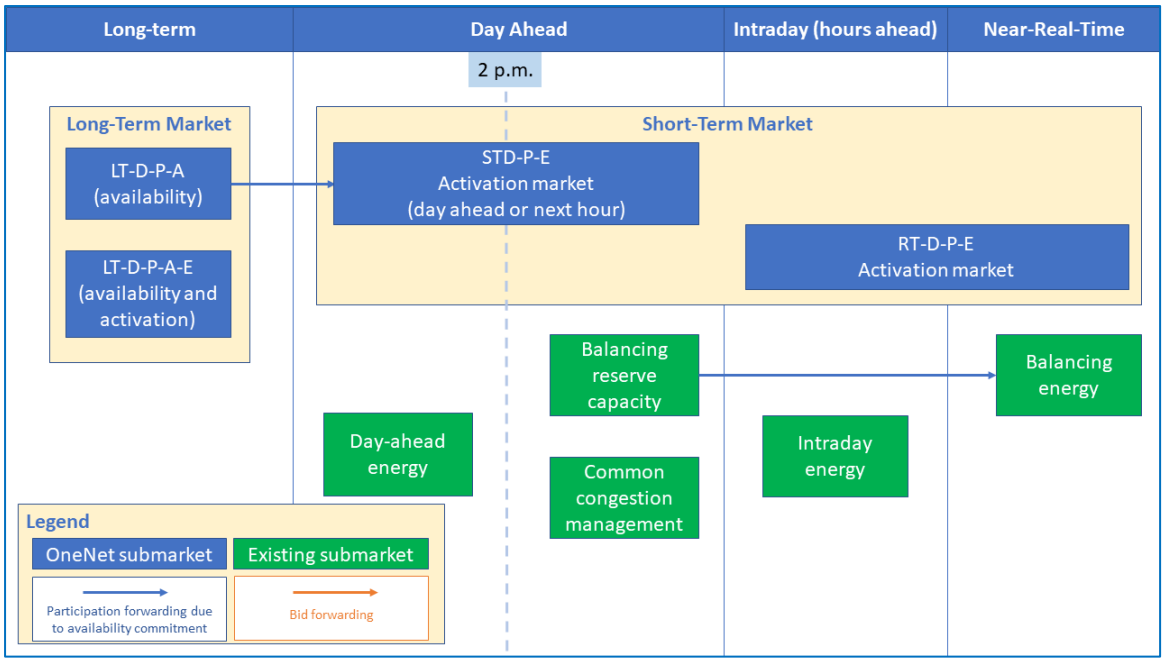

Figure 3-3: Overview of the Market Architecture

3.4.1 Long-term submarket

In the long-term submarket developed by the OneNet Spanish demonstrator, are included:

a. Long-Term active Power Availability submarket (LT-P-A);
b. Long-Term active Power Availability and Energy activation submarket (LT-P-A-E).

The Long-Term active power availability (LT-P-A) submarket is part of the long-term submarkets for flexibility procurement. It represents a local mechanism in which the DSO procures active power flexibility in terms of

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availability from FSPs connected at the distribution system level. The FSPs belonging to the procurement area compete by submitting availability bids to the local auction marketplace. In this case, the FSPs get the compromise to be available, but the activation is not granted (it could be renegotiated closer to Delivery Time).

On the other hand, the Long-Term active power availability and activation submarket (LT-P-A-E) has a similar structure; however, the bids submitted by the FSPs include both the availability and the activation offer. In this market, the DSO procure both availability and activation and will not be renegotiated anymore. This market is designed for procuring flexibility services in all those cases in which the need for flexibility can be forecasted long in advance.

3.4.2 Short-term submarket

In the short-term submarket developed by the OneNet Spanish demonstrator, two are included:

a. Short-Term- Power Energy activation submarket (ST-P-E) optional Availability, A;
b. Real-Time Power Energy activation submarket (RT-P-E).

The Short-Term Power activation submarket (ST-P-E) is part of the short-term submarkets for flexibility procurement. It represents a day-ahead local mechanism in which the DSO can procure active power flexibility from the FSPs connected at the distribution system level. In this market, active power activation is procured and remunerated; however, the submarket structure leaves open the possibility to remunerate also availability in some cases. The peculiarity of this submarket relies on the fact that it is composed of two different time procedures. If the market operator receives the request for flexibility before 3 p.m., the auction opens at 3 pm; otherwise, the auction opens at the next hour. Although all the FSPs in the relevant procurement area can participate in the related auction, the participation of the FSPs that have been cleared in the Long-Term active power availability submarket (LT-P-A) is mandatory. These FSPs can bid a different amount and price in the short-term submarket. However, the ST-P-E auction is characterised by a reserve price established by DSO (maximum price accepted by the algorithm in the auction process) that cannot be exceeded and is related to the long-term matching price.

The Real-Time Power activation submarket (RT-P-E) is part of the short-term submarkets for flexibility procurement. It represents a local mechanism that occurs on the same day of the delivery in which the DSO procures active power flexibility from FSPs connected at the distribution system level. In this market, active power activation is procured and remunerated. Participation in the RT-P-E submarket is open to all qualified FSPs, and there is no link with the long-term submarkets (LT-P-A and LT-P-A-E).

In the Spanish demonstrator, only the Long-Term Power availability submarket (LT-P-A) and Short-Term Power activation submarket (ST-P-E) directly interact. This interaction is based on the fact that the FSPs cleared

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in the long-term availability market are obliged to participate in the short-term market. In any case, the FSPs can submit new bids and update the implicit activation bid.

3.4.3 Market comparison

Table 3-5 shows the characteristic and the differences between long term and short-term markets tested in the Spanish demo:

Table 3-5 – Market design summary

Feature	Attribute	Submarket		
		a. **LT-P-A** b. **LT-P-A-E**	a. **ST-P-(A)-E**	b. **RT-P-E**
Submarket dimension	Gate Opening Time (GOT)	From more than one year-ahead to weeks ahead	Day-ahead or the next hour after the DSO request (limit 3 pm)	The day of delivery
	Timing of the submarket clearing (GCT)	Week ahead	Day-ahead	Real time
	Sub-market type	Auction market	Auction market	Auction market
Location	Level of spatial granularity	Distribution system	Distribution system	Distribution system
	Voltage Level	MV, LV	MV, LV	MV, LV
Roles and actors	Who is the buyer(s)	DSO	DSO	DSO
	Who is the seller(s)	FSP	FSP	FSP
	Who is the MO	IMO	IMO	IMO
	Participation in submarket	Optional	Hybrid	Optional
Remuneration		Uniform pay-as-clear	Uniform pay-as-clear	Uniform pay-as-clear
Procurement frequency		Event-based on DSO call	Event-based on DSO call	Event-based on DSO call
Remunerated product attribute		a. Active power Availability b. Active power availability and activation	Active Power Availability Active Power Activation	Active Power Activation
Market clearing type	Discrete; Continuous	Discrete	Discrete	Discrete
Clearing objective		Minimisation of cost*	Minimisation of cost*	Minimisation of cost*

*The Minimisation of cost is done using a prioritization algorithm to sort bids considering price

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3.5 Key Performance Indicators

According to the KPIs provided in WP2, D2.4 [4], the Spanish demonstration site has evaluated the following KPIs for BUCs, Table 3-6, and for SUC, Table 3-7, which is a subset of the KPIs for BUCs:

Table 3-6 – List of KPIs for BUCs

ID	Name	Description	Formula	Unit
1	Cost effectiveness	Compare cost for flexibility with avoided traditional grid cost (Cost of the flexibility solution against traditional solution).	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$ $Cost_{Sub}$: Avoided traditional solution cost (€/MWh) $Cost_{flex}$: Cost of flexibility (€/MWh)	%
2	ICT costs	The term ICT cost comprises the information and communication technologies necessaries for DSO-IMO-FSP coordination through platforms to develop new local markets.	$ICT_{cost} = \sum_{i=1}^{N_c} c_i$ c_i: generic ith cost directly related new local market implementation (€) Nc: overall number of cost items	€
3	Available Flexibility	Flexible power that can be used for congestion management at a specific grid segment, i.e., the available power flexibility in a defined period (e.g. per day) that can be allocated by the DSO at a specific grid segment, measured in MW. This is in relation with the total amount of power in the specific grid segment in the same period.	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$ $\sum P_{Available_{Flexibility}}$: Power in MW of available flexibility at a specific grid segment in reporting period (MW). $\sum P_{Total_{in_{Area}}}$: Total power demand in MW at DEMO grid segment (MW)	%
4	Error of load forecast	Error of load forecast calculated T hours in advance	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right).100$ FC_{load} : Load estimated T hours in advance (MW) RL_{load} : Real load (MW) N: Number of available data points	%
5	Power exchange deviation	Tracking error between a set-point requested by the SO and the measure.	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$ $P_{accepted}$: accepted (contracted) power (kW) $P_{activacted}$: activated flexibility power (kW)	%
6	Asset load profile variation	This indicator measures the percentage decrease of load demand in the requested asset by a flexibility provider resource.	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$ $AL_{initial}$: asset load before delivering flexibility (initial asset load (kW)) AL_{final}: asset load a during delivery of flexibility (final asset load (kW))	%
7	Volume of transactions (Power)	This indicator measures the volume of transactions in kW. This indicator will be used to measure the volume of transactions (cleared bids) during the examined period T for each product.	$VT_P = \sum_T \sum_I P_{i,t}$ $P_{i,t}$: Volume offered or cleared capacity by the i-th flexible resource at time t (kW) I: Set of flexible resources. T: Examined period.	kW

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ID	Name	Description	Formula	Unit
8	Number of transactions	This indicator measures the number of transactions. This indicator will be used to measure the number of offered and cleared bids for each product	$N_T = \sum_T n_{Bids,t}$ $n_{Bids,t}$: number of offered or cleared bids at time t T: examined period	#
9	Number of products per demo	This indicator measures the percentage of products tested in the demos with respect to the number of products initially targeted by the demos.	$NPD = \frac{nP_{tested}}{nP_{targeted}} \cdot 100\%$ nP_{tested}: number of products tested in the BUC. $nP_{targeted}$: number of products initially targeted for the BUC	%
10	Active participation	This indicator measures the percentage of customers actively participating in the demo with respect to the total customers that accepted the participation. This indicator will be used to evaluate customer engagement plan.	$R = \frac{N_{active}}{N_{accept}} \cdot 100$ N_{active}: Customers actively participating in the demo N_{accept}: Customers accepted to participate in the demo.	%
11	Number of FSPs	Number of FSPs joining the platform.	N_{FSP}	#
12	Ease of access	Ease of access to the flexibility market for flexibility service providers, including accessibility, no redundant barriers to entry, user-friendliness.	Survey	N/A
13	Number of avoided technical restrictions	Avoided congestions thanks to the measures implemented in the demo	$ATR\% = \frac{N_{TRFlex}}{N_{TR}} \cdot 100$ N_{TR}: Total number of expected technical restrictions N_{TRFlex}: Total number of technical restrictions solved through activation of flexibility services	%

Table 3-7 – List of KPIs for SUC

ID	Name	Description	Formula	Unit
1	Cost effectiveness	Compare cost for flexibility with avoided traditional grid cost (Cost of the flexibility solution against traditional solution).	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$ $Cost_{Sub}$: Avoided traditional solution cost (€/MWh) $Cost_{flex}$: Cost of flexibility (€/MWh)	%
2	ICT costs	The term ICT cost comprises the information and communication technologies necessaries for DSO-IMO-FSP coordination through platforms to develop new local markets.	$ICT_{cost} = \sum_{i=1}^{N_c} c_i$ c_i: generic ith cost directly related new local market implementation (€) Nc: overall number of cost items	€
3	Available Flexibility	Flexible power that can be used for congestion management at a specific grid segment, i.e., the available power flexibility in a defined period (e.g. per day) that can be allocated by the DSO	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	%

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ID	Name	Description	Formula	Unit
		at a specific grid segment, measured in MW. This is in relation with the total amount of power in the specific grid segment in the same period.	$\sum P_{Available_{Flexibility}}$: Power in MW of available flexibility at a specific grid segment in reporting period (MW). $\sum P_{Total_{in_{Area}}}$: Total power demand in MW at DEMO grid segment (MW)	
5	Power exchange deviation	Tracking error between a set-point requested by the SO and the measure.	$P_{Deviation} = \frac{\lvert P_{accepted} - P_{activacted} \rvert}{P_{accepted}} \cdot 100$ $P_{accepted}$: accepted (contracted) power (kW) $P_{activacted}$: activated flexibility power (kW)	%
7	Volume of transactions (Power)	This indicator measures the volume of transactions in kW. This indicator will be used to measure the volume of transactions (cleared bids) during the examined period T for each product.	$VT_P = \sum_T \sum_I P_{i,t}$ $P_{i,t}$: Volume offered or cleared capacity by the i-th flexible resource at time t (kW) I: Set of flexible resources. T: Examined period.	kW
8	Number of transactions	This indicator measures the number of transactions. This indicator will be used to measure the number of offered and cleared bids for each product	$N_T = \sum_T n_{Bids,t}$ $n_{Bids,t}$: number of offered or cleared bids at time t T: examined period	#
12	Ease of access	Ease of access to the flexibility market for flexibility service providers, including accessibility, no redundant barriers to entry, user-friendliness.	Survey	N/A

Additional information about variables and KPIs calculation is included in annex **Error! Reference source not found.**.

This deliverable includes the results of the KPIs that are specific for each demo site test:

- 1. Cost effectiveness,
- 3. Available flexibility,
- 4. Error of load forecast,
- 5. Power exchange deviation,
- 6. Asset load profile variation.

Common Spanish demonstration KPIs, which have one unique value for the whole Spanish demonstrator, will be addressed in D9.6:

- 2. ICT Costs,
- 7. Volume of transactions (Power),
- 8. Number of transactions,
- 9. Number of products per demo,

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- 10. Active participation,
- 11. Number of FSPs,
- 12. Ease of access,
- 13. Number of avoided technical restrictions.

KPIs concerning the Regional Use Case, RUC, are also out of the scope of this deliverable and will be presented in D9.8.

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4 Components and platforms

This section details the platforms that have been developed by the IMO in order to negotiate flexibility in the distribution network under the request of a determined DSO.

OMIE, as the Spanish Market Operator, decided to develop two different but interrelated local market platforms to negotiate long-term and short-term flexibility products. The aim is to test different solutions and try to find the option that best suits to the services and the needs of all parties (DSOs, FSPs, IMO).

The local market platform is the system responsible for receiving the DSO needs on market sessions for flexibility procurement, the bids from FSPs, the market clearing and the communication of market results to different stakeholders.

The platforms allow to test the 3 scenarios, described in SUC-ES-01 (Appendix A.3) and shown in Figure 4-1:

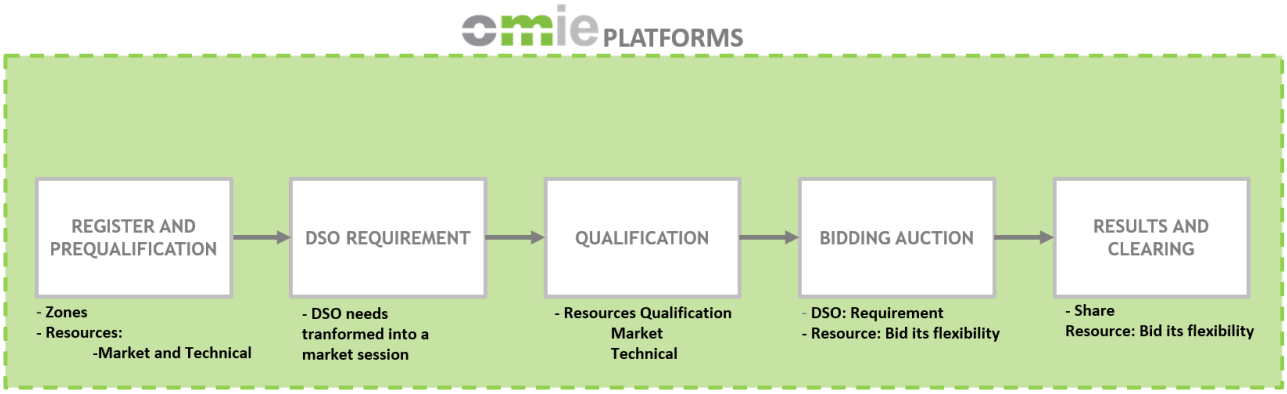

Figure 4-1: Local Market Processes

1. **Flexibility resource register**

   As proposed by the Active System Management (ASM) report, it is necessary to create a standardized Flexibility Resource Register. The platform will take this role and allows the DSOs and the IMO to know how many resources are available, which type of technology are, location, and other relevant information about them.

2. **Market request**

   The platforms allow DSOs to request a flexibility market in an area where they operate as distribution system operators.

3. **Market session**

   Involves three different macro processes that achieve the effective negotiation of local flexibility markets, starting with the qualification of the resources capable of delivering the service requested in the market, going on with the bidding auction and finally the clearing and results sharing.

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The local market platforms will be the main information exchange enabler between parties, as shown in Figure 4-2, centralizing the communications to simplify the processes and to avoid becoming an entry barrier for small FSPs or DSOs.

Figure 4-2: Local Market Communications

4.1 Long-Term Market Platform

The Long-Term Market Platform has been designed as an online website, Figure 4-3, where the participants are identified under a username and a password provided by the IMO. It has been developed to negotiate Long-Term products from days to years in advance of the service and with a long period between processes (qualification – bidding- clearing).

Figure 4-3: General design of the Long-Term Market platform

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The platform has an open section, Figure 4-4, where public information is provided such as *How to participate on Local Flexibility Markets? How Local Flexibility Market works?* And non-confidential information about resources and auctions.

Figure 4-4: How to participate? Online web section.

Besides the public section, a private area is available too where participants have to register themselves as Agents (Resources, Aggregators, Consumers, Prosumers) or as System Operators (DSOs). Those profiles have different functionalities described below.

4.1.1 DSO profile

- **Zone registration**

  Before being able to request a flexibility service, the DSOs has to register the areas where they need a service, Figure 4-5. Those areas can be created by postal code and then can be limited further, for which the prequalification and qualification of the resources take place. Furthermore, zones registered in the Long-Term Local Platform would be automatically available on the Short-Term Local Platform too, after some internal validations.

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Figure 4-5: Screenshot of a zone registration process

- **Market Request**

  Once a future grid congestion or issue is detected or foreseen by the corresponding DSO, a market request can be sent to the system.

  The information that needs to be provided to create a market session encompasses the market session date, the area where the need is predicted, the technical characteristics and the product that needs to be negotiated. The system receives the request and after some validations from the Market Operator side the Negotiation Session is created, Figure 4-6.

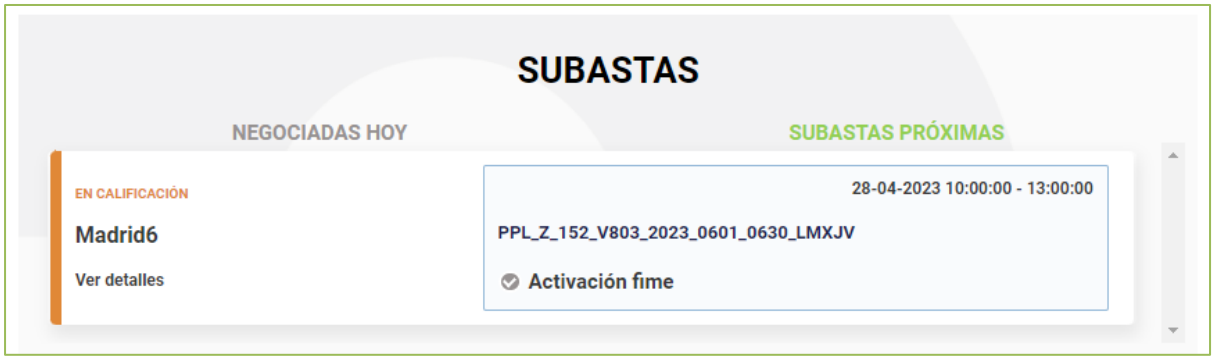

Figure 4-6: Screenshot of future sessions

- **Technical qualification**

  To achieve a successful flexibility market, it is essential to verify that a resource is capable of solving the problem in the grid. That is why a technical qualification must be done before negotiating a long-term flexibility product.

  The qualification is a process through which the DSO validates capacities, response times and maximum service delivery time among other aspects, to determine whether or not a resource is valid for the negotiated product.

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- **Results consultation**

  After the negotiation, the results of the clearing are published to inform the DSO if the requirement has been fulfilled or not and which resources are the ones who will provide the service.

4.1.2 FSP profile

- **Resources registration**

  The registration or prequalification of the resources is the first step to participate in these markets. As soon as a resource is registered in the Long-Term flexibility platform it would be available on the Long-Term and Short-Term Platform too. This section of the platform allows the FSPs to provide information about their installations and furthermore, it allows DSOs and IMO to validate that information.

  Once a resource is successfully registered it appears on the platform's map, Figure 4.7, and it is available on the Flexibility Resource Register.

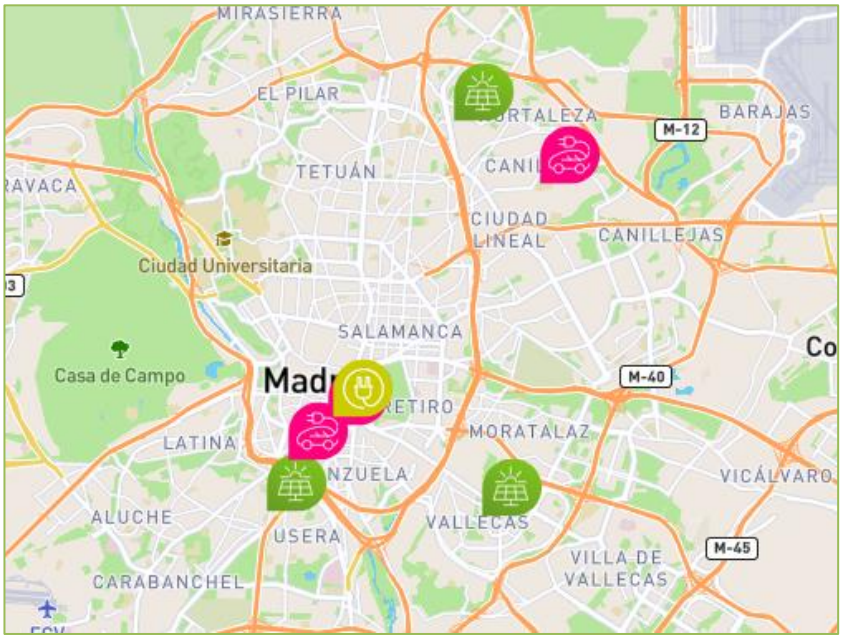

Figure 4-7: Resources representation on the platform's map.

- **Resource qualification**

  It is a request that a FSP should make in order to participate in a Long-Term Local Market. The qualification is based on several market and technical validations to ensure that the installation is capable of providing the service. It should be done for every single or aggregated resource.

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- **Bidding**

  When the market session time arrives, the platform allows the qualified resources to introduce a bid in the system.

- **Results consultation**

  After the negotiation, the results of the clearing are published on the platform to inform the FSP if its resources have been or not selected as service providers.

4.2 Short-Term Market Platform

The Short-Term Market Platform has been developed following the current design of the platforms used in the Iberian Electricity Market to facilitate the usability for that participants that already negotiate with OMIE's platforms and it is also prepared to be integrated with the Global Electricity Markets, such as, the Intraday Continuous Market (XBID), Figure 4-8:

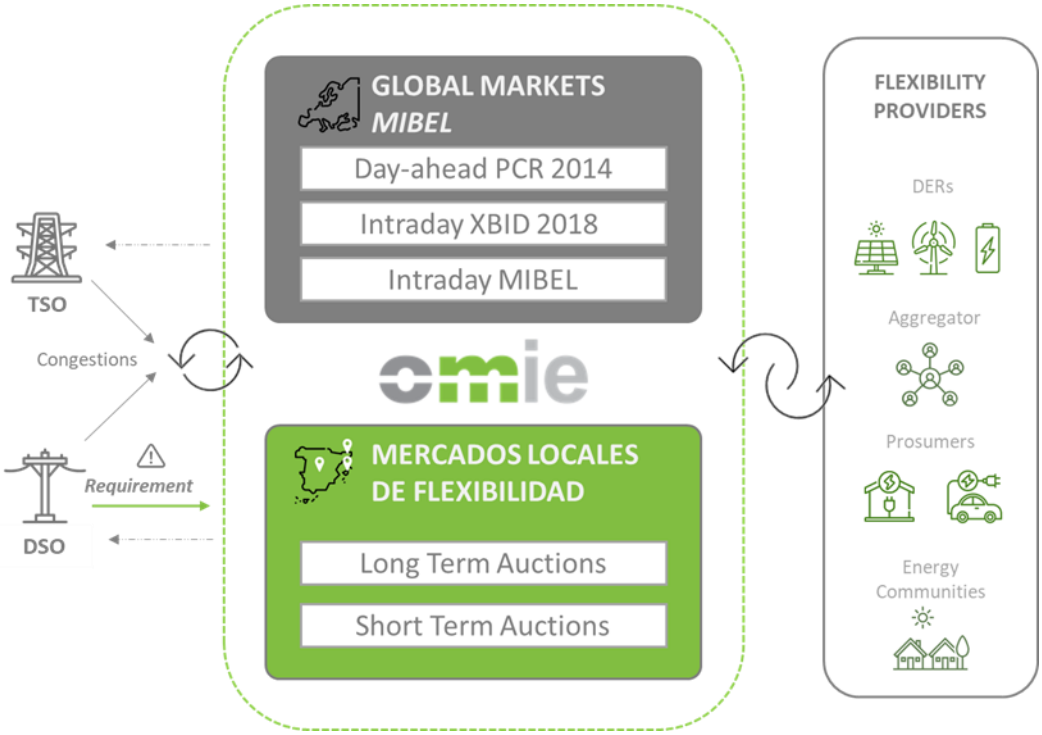

Figure 4-8: All parties integrated in Global and Local Electricity Markets.

This platform is prepared to negotiate day-ahead or intraday products, those with less time for preparation, qualification, negotiation, etc. That is why it is an operational and faster system.

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It is composed of an online website and a local trading application (.exe). To access both systems it is required a personal software certificate provided by the IMO (same procedure followed by OMIE in production global markets).

4.2.1 Short-Term Market Platform

The access to the website is determined by the software certificate provided by the IMO, Figure 4-9. The certificate permissions are different depending on the role: FSP or DSO. Following the same ideas explained in the Long-Term Market Platform description above, the DSO would be able to request a market whereas the FSPs would be able to insert a bid, for example.

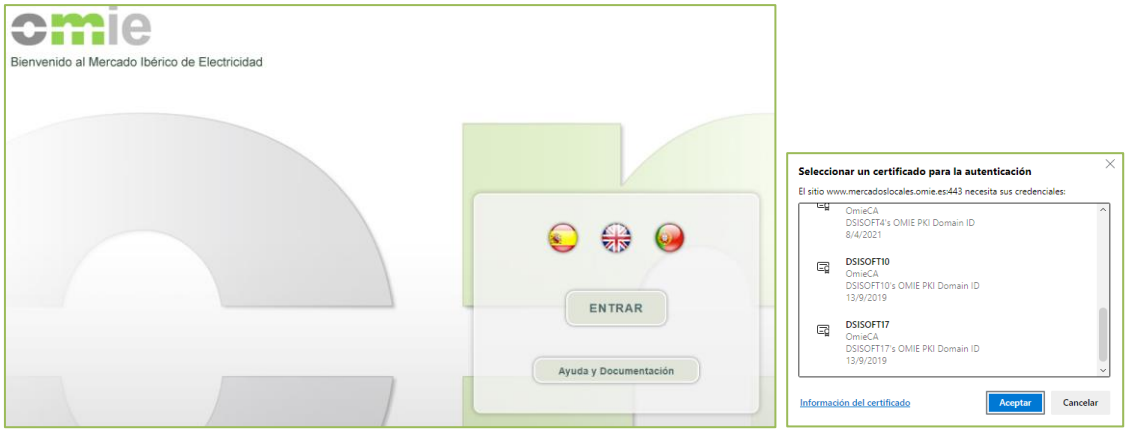

Figure 4-9: Online web Short Term Local Platform access.

4.2.2 Short-Term Local Trading Application

The negotiation in this platform will always take place in the trading application, Figure 4-10. This app can be downloaded from the short-term local website and will only need a valid software certificate installed on the windows pc that is intended to use.

The application shows the products that are going to be negotiated soon (UPC: upcoming state), that are being negotiated at the moment (TRADE: trading state), that are being cleared (MAT: matching) and the ones that closed during the day (FIN: finalized).

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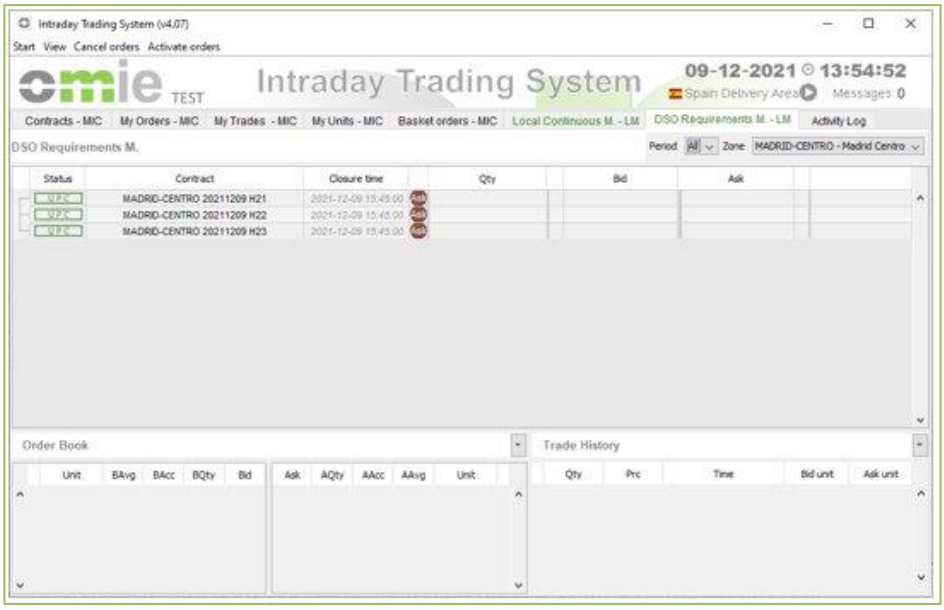

Figure 4-10: Local Trading Application

4.3 Markets schedule

Long-term and Short-term markets share processes such as prequalification, qualification, bidding, clearing and settlement. The differences between them are mainly two: first the kind of contingency they are intended to solve and second the time they have to carry out the processes mentioned above.

4.3.1 Long-term schedule

Long-term Local Markets are negotiated years, months or weeks in advance, Figure 4-11. That means that between the moment the DSO sends the requirement to the IMO and the DERs activations are time to all the processes to take place.

First, the DSO sends a flexibility requirement to the IMO, who must check and verify the requirement before publishing the market session to the resources. Once published, DERs have enough time to prequalify new resources (if needed) and qualify them to participate in the market.

Each Friday, a long-term market session is celebrated, and all the requirements sent by the DSO can be negotiated. On the same day as the auction the results are published to the corresponding DSO and to the resources that have participated.

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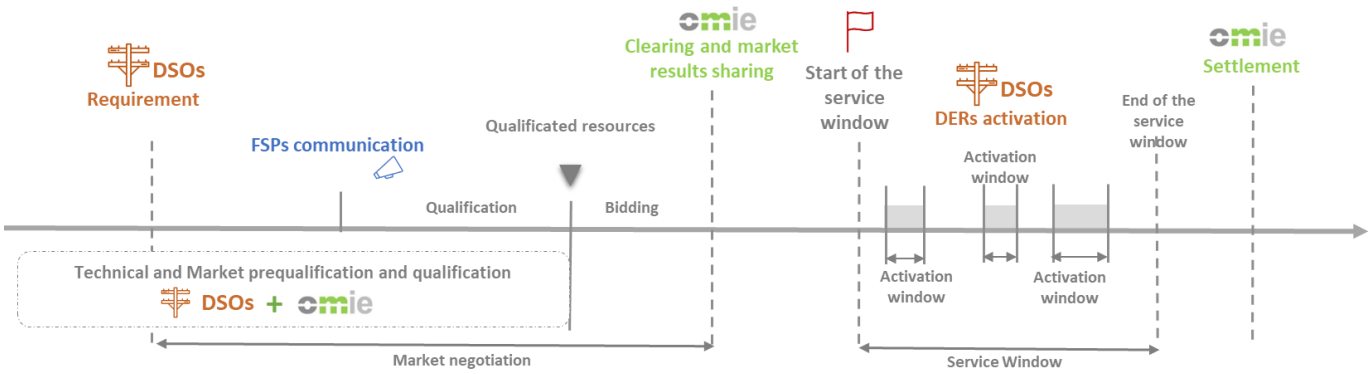

Figure 4-11: Long-term schedule

4.3.2 Short-Term schedule

Short-term Local Markets are negotiated the day before or the same day of the delivery, Figure 4-12. That means that all the processes take place in a short period.

These markets respond to imminent needs of the DSO that is why some of the processes like the IMO validations to the requirements are automatic.

To simplify the bidding action to the resources, all the requirements that have enough time to be negotiated at the session time (GOT 3 pm) wait until that hour. Those, that on the contrary cannot wait because they need to be delivered sooner are negotiated at the next hour (e.g. Requirement sent at 6.30 pm are negotiated at 7pm).

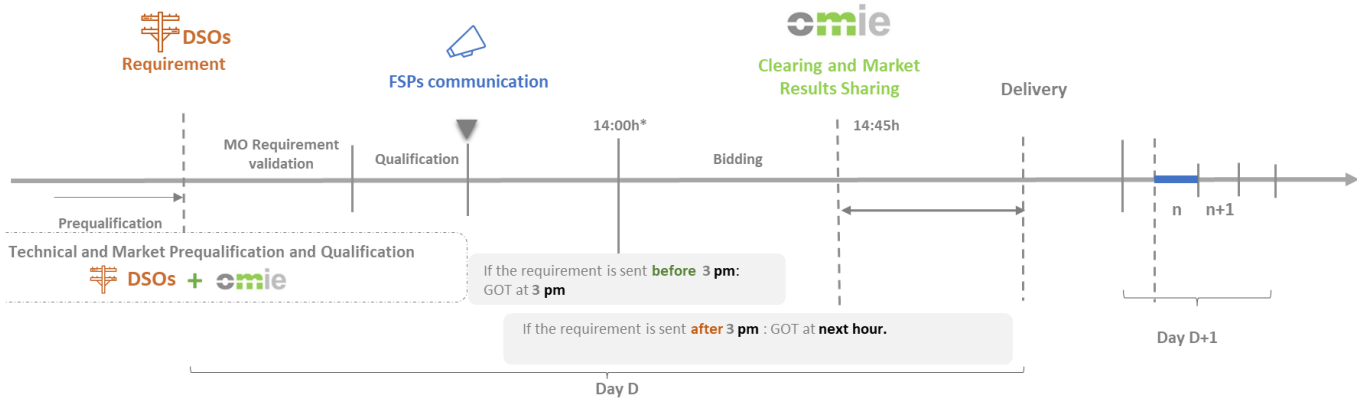

Figure 4-12: Short-term schedule.

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Once the activation is done and the energy has been delivered, the IMO with the metering done by the DSO proceeds with the settlement of the acquired commitments. The settlement process will be described in more detail in deliverable D9.6.

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5 Flexibility service providers

This section details the flexibility providers that participated in the demos, flexibility from the distributed resources considered and specific characteristics.

Table 5-1 shows a summary of them and the subsections include a detail description:

Table 5-1 – Flexibility service providers

ID	FSP/Aggregator	Resources	DSO Network	Location	Voltage Level (kV)	Flexibility capacity (kW)
FSP-iDE-01	ODINS (FLEXUM project)	UMU	i-DE	Murcia	20	600-1.000
FSP-iDE-02	Stemy Energy (FLAGS project)	Comillas, Cantoblanco	i-DE	Cantoblanco, Madrid	20	100
FSP-UFD-01	Alcalá de Henares City council	Renewable Energy demonstration centre	UFD	Alcalá de Henares, Madrid	15	21
FSP-UFD-02	Alcalá de Henares City council	El Juncal Sport Centre	UFD	Alcalá de Henares, Madrid	15	11
FSP-UFD-03	Metalúrgica Madrileña	Metalúrgica Madrileña	UFD	Alcalá de Henares, Madrid	15	312
FSP-UFD-04	Fiesta Colombina	Fiesta Colombina	UFD	Alcalá de Henares, Madrid	15	770
FSP-UFD-05	HERA biogas	HERA biogas	UFD	Alcalá de Henares, Madrid	15	1.000

In the case of the UFD Demo, FSPs have been selected to be located at the same medium voltage distribution network area in Alcalá de Henares. In this way, FSPs can participate by providing flexibility in the resolution of simulated situations in the same network.

Alcalá de Henares is a city belonging to the Community of Madrid, Spain. Its municipal area covers an area of 87.99 km² and has 200,000 inhabitants. It is famous for its university, built in 1499. It was declared a World Heritage City by UNESCO in 1998. In addition to its historical and cultural facet, it houses a very varied industry, with high energy consumption. This has been one of the main reasons for the choice for this demo.

Figure 5-1 shows the arrangement of the FSPs within the scope of Alcalá de Henares.

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Figure 5-1: UFD FSPs location in Alcalá de Henares

5.1 FSP-iDE-01 Murcia University

The University of Murcia (UMU) is one of the biggest Universities in Spain. UMU has a population of 40,000 people: students, services personnel, etc. UMU has five campuses and several facilities deployed throughout different cities in the Region of Murcia. Among them, the Espinardo Campus, which has shown interest, is the biggest one with more than 30 buildings.

Murcia is a city located in the south-east of Spain, the capital and most populous city of the Region of Murcia and the seventh-largest city in the country.

5.1.1 Resources description

Seven buildings were selected to participate in the demo through demand response, using the flexibility of their air conditioning and heat pumps systems. The building location is shown in Figure 5-2.

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Figure 5-2: Espinardo Campus Buildings

These buildings have a significant power peak and general consumption throughout the year in the entire campus in both summer and winter as shown in Table 5-2

Table 5-2 – Maximum power peaks of the preselected building

ID	Winter peak (MW)	Summer peak (MW)
1	417	375
2	122	137
3	421	618
4	230	228
5	179	523
6	223	312
7	251	277

5.1.2 Flexibility characterization

To carry out the remote actions and to monitor the air conditioning and heat pumps machines to reduce power peaks in these building, and evaluation of the original situation of these installation in each building was carried out by ODINs company, which acted as UMU aggregator. Different tests were executed to evaluate the capacity of selected faculties for flexibility services. Each test was divided into three parts: methodology, baseline and results [8].

The results showed that during peak time, the resources have a flexibility capacity between 0.6 and 1 MW, during at least 30 minutes, without affecting people working comfort at the selected building.

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5.2 FSP-iDE-02 Universidad Pontificia Comillas

The Universidad Pontificia Comillas is located in Cantoblanco, in the north of Madrid, Alcobendas. Madrid is a city located in the centre of Spain. It is the capital and most populous city of Spain.

The University has three buildings, A, B and C with a maximum consumption of 500 kW. They count with an installed power of 2,7 MW of heating and cooling systems.

5.2.1 Resources description

The University Campus consists of 3 buildings, A, B and C for various uses, Figure 5-3: Building A and B are used for classrooms, teachers' offices, admin office, cafeteria, conference halls, while building C is used as a student's residence and admin offices. Only building A and B, heating and cooling systems, are part of the demo. The following figure shows the whole campus and the three buildings:

Figure 5-3: Comillas Campus Buildings

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5.2.2 Flexibility characterization

Flexible resources presented in the selected buildings were identified and discussed with the facility managers, to analyze the actuations to be done to monitor their energy consumption to characterize their flexibility potential and analyze the impact of flexibility actions.

The main equipment installed for monitoring and controlling was amperes, chronos and carriers developed by Stemy company, which acted as Universidad Pontificia Comillas aggregator.

The results showed that during peak time, the resources have a flexibility capacity up to 100 kW.

5.3 FSP-UFD-01 Renewable Energy Demonstration Center

One of the two resources that the City Council of Alcalá de Henares has made available to UFD to participate in the OneNet demo has been the Renewable Energy Demonstration Center Figure 5-4, located in the old GAL factory, current a multifunctional center that is used for various social, cultural and educational functions. It currently houses the Motorcycle Museum.

Figure 5-4: 'Garden of Energies'

5.3.1 Resources description

The Renewable Energy Demonstration Center, called 'Garden of Energies', is a reference space for schoolchildren, tourist groups, associations and for all citizens, in which they will know the different ways of obtaining sustainable energy and respectful with the environment.

For the generation of wind energy, a 2 kW wind turbine has been installed on a structure 10 meters high; in the case of photovoltaic energy, a total of 16 panels have been located with a power generation capacity of approximately 5 kW, and for the generation of kinetic energy a swing has been installed that will generate energy

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when the visitor uses it and will allow charging up to four devices (tablets or cell phones) at the same time. Likewise, 3 electric Vehicles charging points, of 7,2 kW each, have been installed on the outside. Some of the resources are shown in Figure 5-5:

Figure 5-5: 'Garden of Energies' map and some resources

5.3.2 Flexibility characterization

There are apparently many resources available at the location. However, most of them are not applicable for the Demo. It is necessary to consider that the installed equipment are elements designed for dissemination, so they are of small installed power. For this reason, in collaboration with the technicians responsible for the city council, it was decided that the resources that could be used to provide flexibility to the distribution network were the electric vehicle charging points.

These charging points are used intensively during certain periods of the day, so if necessary, a lower consumption of them can be controlled, so that this decrease in demand could contribute to a network congestion reduction. The maximum flexible capacity shall be 21 kW of a maximum demand of 110 kW.

5.4 FSP-UFD-02 El Juncal Sport Center

The City Council of Alcalá de Henares has multiple sports facilities in the municipality. For the OneNet project, Ciudad Deportiva Municipal El Juncal, Figure 5-6, has been chosen, due to its electrical location dependent on the same substation and in the same medium voltage circuits of the rest of FSPs.

The Centre has a Sports Area, in which there are: 3 sports courts, 2 paddle tennis courts (x2), 4 tennis courts, 2 pediments, 6 7-soccer artificial grass fields, 1 11-soccer artificial grass field and 1 11-soccer sand field, as well as other multipurpose spaces. It also has an Aquatic Area with 2 heated swimming pools and 3 summer

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swimming pools. Finally, it has a Sports Pavilion with a sports court for different uses (basketball, minibasketball, handball, futsal, volleyball and minivolleyball).

Figure 5-6: Sport Center 'El Juncal'

5.4.1 Resources description

The electricity consumption of the sports city can be grouped into three groups: heating, lighting and purification of swimming pools.

The first two cannot be used as a flexible resource. Heating is mainly based on natural gas. Only some facilities have electric air conditioning systems. But the consumption of these is not relevant in the whole consumption of the sports center and less in the MV circuit in which it is connected. On the other hand, lighting is not a flexible vector. It is necessary when there are sporting events and cannot be modified for external reasons. Only the consumption of the water treatment plant has a small flexible component.

5.4.2 Flexibility characterization

Within the total of purification pumps available, only the summer pumps (summer-autumn) are usable since they will be the ones that are working during the demo. On the other hand, for legal reasons of hygiene the levels of purification are very demanding. That is why it is only possible to make part of the pump sets more flexible.

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Table 5-3 – Juncal Sport Centre flexibility

Swimming pool	Season	Pump	Power (kW)	Provides flexibility (kW) In summer test
External pool	Summer	Nª 1 Big	7,5 kW	NO
External pool	Summer	Nº 2 Big	7,5 kW	NO
External pool	Summer	Nº 3 Big	7,5 kW	7,5 kW
External pool	Summer	Nº 4 Medium	4 kW	NO
External pool	Summer	Nº 5 Medium	4 kW	4 kW
External pool	Summer	Nº 6 Medium	0,82 kW	NO
Internal pool	Winter	Nº 1 Small	3 kW	NO
Internal pool	Winter	Nº 2 Small	3 kW	NO
Internal pool	Winter	Nº 3 Big	5,5 kW	NO
Internal pool	Winter	Nº 4 Big	7,5 kW	NO
		Total	**50,32 kW**	**11,5 kW**

5.5 FSP-UFD-03 Metalúrgica Madrileña

Founded in 1953, Metalúrgica Madrileña, SA, Figure 5-7, is a steel foundry with the capacity to manufacture, import and supply its clients with cast steel parts of different compositions, with great flexibility, since it has a weight range from 100 gr to 2.500 kg, allowing both the production of large series, with very competitive costs, as well as small series or even the manufacture of single pieces, always with a high level of quality.

With a clear international vocation, Metalúrgica Madrileña allocates 75% of its production for export, mainly to countries of the European Union, the United States, Eastern Europe and India, serving numerous industrial sectors.

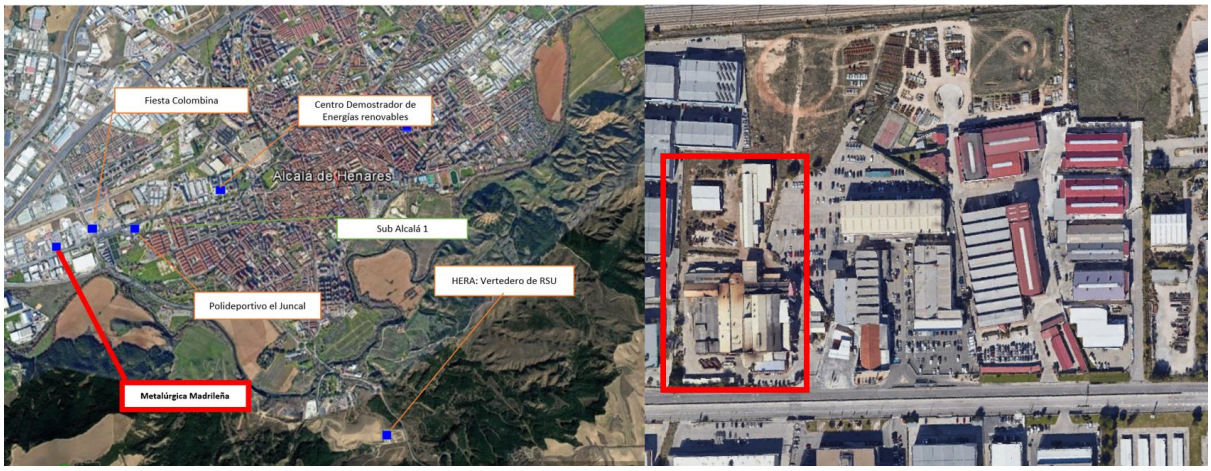

Figure 5-7: Metalúrgica Madrileña

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In addition to cast iron parts of low, medium and high alloy, of different compositions, Metalúrgica Madrileña SA can also supply gray cast iron, nodular cast iron and white cast iron parts, and added services on cast parts such as machining, painting, galvanizing and special heat treatments, with a clear vocation to meet the needs of customers.

5.5.1 Resources description

The contracted power in the installation is 2.400 kW. The main electrical equipment of the installation are furnaces of different types. The main induction furnace is induction melting one of a power of 1.500 kW. There is also a tempering furnace of 110 kW. The rest of the installations are transport machinery (cranes and conveyor belts), air purification (filters) and subsequent processing of products (deburring, shot blasting machines).

5.5.2 Flexibility characterization

To provide flexibility to the distribution network, it was initially thought of using the main furnace by reducing the power of the operating tip. But due to the dates on which the demo tests were carried out this was not possible. For this reason, three processes were used that could be moved to different times depending on the needs of the test. These were the tempering furnace and two of the shot blast machines along with their air filtration systems.

Table 5-4 – Metalúrgica Madrileña flexibility characterization

Resource	Individual Power (kW)	Group Power (kW)
Cometa shot blast machine	62,5	
Cometa shot blast machine filter	18,4	**80,9**
Alju shot blast machine	102,7	
Alju shot blast machine filter	19,0	**121,7**
Tempering furnace	110,0	**110,0**
Total FSP		**312,6**

5.6 FSP-UFD-04 Fiesta Colombina

Fiesta, Figure 5-8, was founded in Alcalá de Henares (Madrid) in 1965. Its origins date back to the 40s in Puerto Rico, setting up the first factory in Venezuela, from where the leap to Spain is made. It is a food industry dedicated to the candy sector. Among its products are some of the most emblematic in Spain, such as Kojak.

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Figure 5-8: Fiesta Colombina

5.6.1 Resources description

The main electrical consumption is related to industrial cooking, cooling and automatic weighing systems. As well as the transport and packaging systems of the products in their different phases. Additionally, Fiesta Colombina has refrigeration and air conditioning systems. The contracted power is 1.100 kW.

The possibilities of flexibility will depend on the productive moment of the factory and the processing lines that are operating at any given time. Some of the products that are less in demand can be moved at different times or days. Obviously, for quality reasons, refrigeration systems cannot be used for flexible. However, the air conditioning associated with some product lines may not be essential, so it can also be considered to bring flexibility to the network.

5.6.2 Flexibility characterization

It was decided to use the licorice product line and its associated air conditioning. The advantage of this line is that it is separated from other production lines. It shares electrical output with hard candy but allows the measurement of the associated flexible power separately.

Tabla 5-5 – Fiesta Colombina flexibility characterization

Product Line	Power (kW)
Licorice	250
Licorice depurator	120
Air Conditioning + Storage	400
Total FSP	**770**

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5.7 FSP-UFD-05 HERA biogas

HERA Holding is a leading company in the integral management of waste and environmental resources, Figure 5-9. Founded more than 30 years ago, the HERA Group has considered waste as a resource with great potential for reuse and recovery, which allows obtaining new materials, energy, regenerated raw material, space and hydrofuels. The company is engaged in decontamination activities and other waste management services. It has controlled deposits for municipal and non-hazardous industrial waste, treatment plants and hazardous waste management. HERA offers elaborate solutions, giving each waste the appropriate fractionation, selection and recovery process.

Hera is the manager of the municipal solid waste landfill in Alcalá de Henares. This is a medium density controlled landfill that serves the municipalities of the eastern part of Madrid. In the landfill there is a biogas plant that is responsible for the production of electricity from the biogas generated by the anaerobic decomposition of organic waste.

Figure 5-9: Hera Biogas

5.7.1 Resources description

Currently Hera is already a production unit that regularly participates in the electricity production market in Spain. It has two generator sets, one of 1.300 kW and another of 1.000 kW. Its general operation is almost permanently at maximum production since the deposit of municipal solid waste has hardly any storage capacity and therefore, as the objective is not to emit methane, it must be consumed either by generating or burning the gas in a burner.

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5.7.2 Flexibility characterization

Apparently in the previous section it is not possible to think of providing flexibility by increasing its production. The only possibility is to reduce production by relying on the small storage capacity of the landfill to generate in the hours immediately after the contribution of the Flexibility service.

The medium-term interest could be to participate in long-term markets that allow the need to lower generation to coincide with a scheduled maintenance shutdown of one of the groups.

Its flexible reduction power will be 1.000 kW.

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6 Demo sites definition, problem assessment

This section details the problem assessment for the demos to be done in the different areas.

Table 6-1 - shows a summary of them and subsections include a detail description of the congestion problems to be solved by procurement of local flexibility products:

Table 6-1 - Spanish demos

ID	BUC	Service	Product	Site	Voltage Level	Problem MW	Timeline	Flexibility resources
ES-iDE-01	ST: WECL-ES-02 Day ahead	Predictive congestion	E	Murcia/ Espinardo	20kV	0,4	28/07/2022 9:30-10:30	Murcia University
ES-iDE-02	ST: WECL-ES-02 Intraday	Corrective congestion	E	Murcia/ Espinardo	20kV	0,5	28/07/2022 12:00-12:30	Murcia University
ES-iDE-03	LT: WECL-ES-01	Predictive congestion	A+E	Murcia/ Espinardo	20kV	1,1	September Monday to Friday	Murcia University
ES-iDE-04	ST: WECL-ES-02 Day ahead (2 tests)	Predictive congestion	E	Madrid/ Cantoblanco	20kV	0,1	14/01/2023 21/01/2023 12:30-13:00	Comillas University
ES-iDE-05	ST: WECL-ES-02 Day ahead	Predictive congestion	E	Madrid/ Cantoblanco	20kV	0,1	04/02/2023 11:00-12:00	Comillas University
ES-UFD-01	LT: WECL-ES-01	Predictive congestion	A+E	Madrid/ Alcalá de Henares	15kV	1,1	From 19/09/2022 To 08/12/2022 L M X J V 6:00-19:00	All FSP in Alcalá de Henares
ES-UFD-02	LT: WECL-ES-01	Predictive congestion	A+E	Madrid/ Alcalá de Henares	15kV	1,1	From 03/10/2022 To 22/12/2022 L M X J V 6:00-19:00	All FSP in Alcalá de Henares
ES-UFD-03	ST: WECL-ES-02 Day ahead	Predictive congestion	E	Madrid/ Alcalá de Henares	15kV	0,63	4/10/2023 17:00-18:00	All FSP in Alcalá de Henares
ES-UFD-04	ST: WECL-ES-02 Day ahead	Predictive congestion	E	Madrid/ Alcalá de Henares	15kV	1,0	6/10/2023 17:00-18:00	All FSP in Alcalá de Henares

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6.1 ES-iDE-01: Short-term day ahead Murcia

The objective of ES-iDE-01 is to test the short-term congestion management procurement of local flexibility products by the DSO, to support the network in the event of a programmed work conditions, 28/07/2022, from 9:30 to 10:00, which could create a congestion problem.

The programmed work was simulated to have a problem that requires procurement of flexibility in a day ahead market. Capacity of the limiting asset was considered less than the real one to generate a problem. Assets and measures are real and helped us to evaluate market procurement and flexibility solutions efficiency.

6.1.1 Congestion problem

a) Location: Murcia, Espinardo area

Figure 6-1: Location – ST Day ahead Murcia

b) Description: Because of a maintenance work in a 20 kV line, day 28/07/2022, from 9:30 to 10:00, Murcia University 20 kV feeder line could increase its load up to 1 MW, which could mean to exceed its 5,6 MW of capacity. It is necessary to keep the line below 4,6MW to support the maintenance work.
c) Limiting assets: Murcia University 20 kV feeder line
d) Critical load (when the problem happens): 4.6 MW (feeder line)
e) Forecast Load curve: The forecasted temperature for 28/07 is expected to be between the temperatures of 25/07 and 26/07, and as the bigger percentage of load is because of air conditioning it is not expected to reach the 5 MW.

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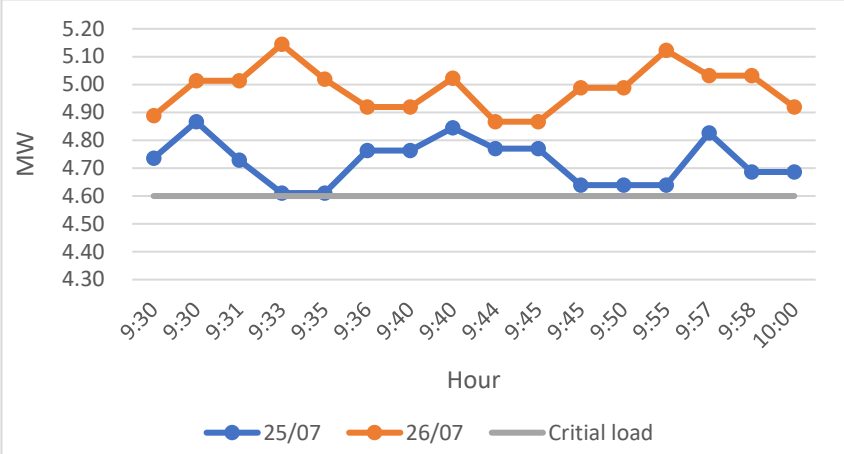

Figure 6-2: Load feeder 20kV Murcia – ST Day ahead Murcia

f) Magnitude of issue (maximum difference between load forecast and critical load): 5-4.6=0.4 MW

6.1.2 Traditional solution description

a) Project name: Diesel generator group
b) Scope: 30 min 400 kVA diesel generator group
c) Cost: 1.165€

6.1.3 Distributed resource requirements

a) Location: Murcia University 20 kV feeder line
b) Timeline & requirement: 0.4 MW, 28/07/2022 from 9:30am to 10:00am
c) Ceiling cost: 5.825€/MWh (1.165€/(0.4 MW*0.5h))

Table 6-2 – Demo ES-iDE-01 summary – problem assessment

Problem	MW Requirement	Grid Location	Day	Hour
Congestion: programmed maintenance work 28/07	0.4	Murcia University 20kV feeder line	28/07/2022	9:30-10:00

6.2 ES-iDE-02: Short-term intraday Murcia

The objective of ES-iDE-02 is to test the short-term congestion management procurement of local flexibility products by the DSO, to help restoration or reduce stress on the network following an unexpected failure equipment 28/07/2022 at 9:30, which could create a congestion problem at peak time at 12:00.

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The unexpected failure was simulated to have a problem that requires procurement of flexibility in an intraday market. Capacity of the limiting asset was considered less than the real one to generate a problem. Assets and measures are real and helped us to evaluate market procurement and flexibility solutions efficiency.

6.2.1 Congestion problem

a) Location: Murcia, Espinardo area

Figure 6-3: Location – ST Day ahead Murcia

b) Description: Because of an unexpected failure in a 20 kV line (simulated failure), day 28/07/2022 at 9:00am, Murcia University 20 kV feeder line could increase its load up to 500 kW, which could mean to exceed its 6 MW of capacity at peak time, between 12:00pm to 12:30pm. It is necessary then to keep the line below 5,5 MW, between 12:00pm to 12:30pm to reduce stress on the network at peak time.
c) Limiting assets: Murcia University 20 kV feeder line
d) Critical load (when the problem happens): 5.5 MW (feeder line)
e) Forecast Load curve: According to prior days information, it is expected to reach up to 6 MW between 12:00pm and 12:30pm

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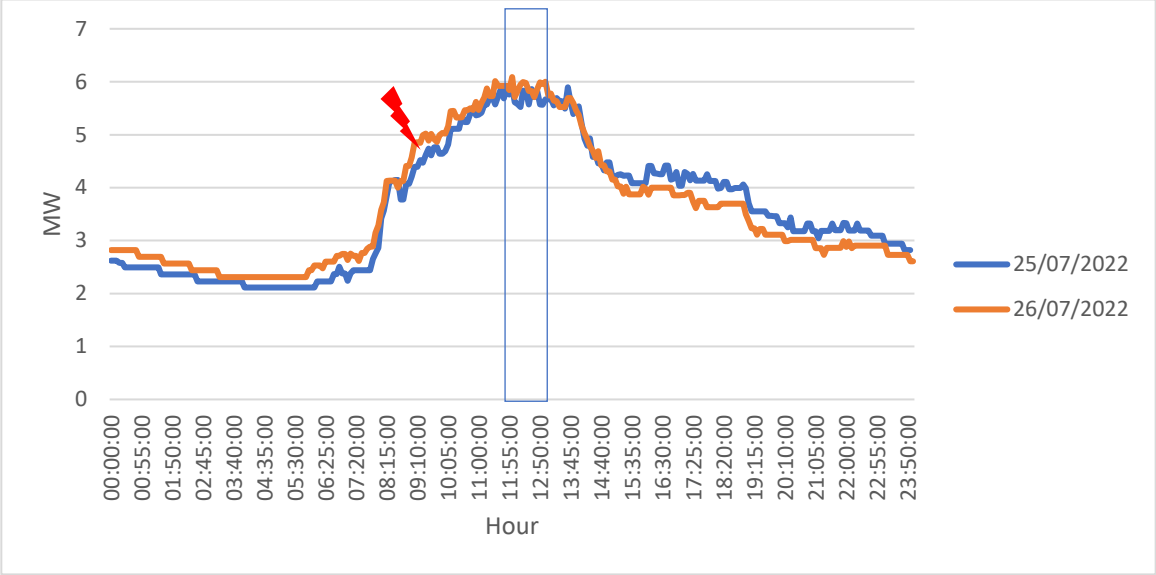

Figure 6-4: Load feeder 20kV Murcia – ST Intraday Murcia

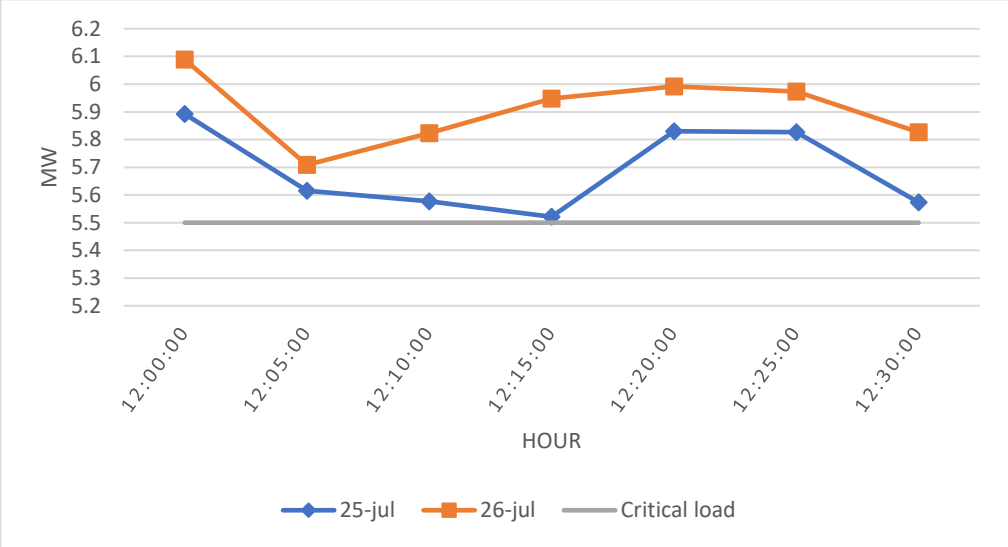

Figure 6-5: Load feeder 20 kV Murcia 12-12:30 – ST Intraday Murcia

f) Magnitude of issue (maximum difference between load forecast and critical load): 6-5.5=0.5 MW

6.2.2 Traditional solution description

a) Project name: Diesel generator group
b) Scope: 30min 600kVA diesel generator group
c) Cost: 1.165€

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6.2.3 Distributed resource requirements

a) Location: Murcia University 20 kV feeder line
b) Timeline & requirement: 0,5 MW, 28/07/2022 from 12:00 to 12:30
c) Ceiling cost: 4.660 €/MWh (1.165 €/(0,5 MW*0,5 h))

Table 6-3 – Demo ES-iDE-02 summary – problem assessment

Problem	MW Requirement	Grid Location	Day	Hour
Congestion: unexpected fault 28/07/2022 at 9am	0,5	Murcia University 20 kV feeder line	28/07/2022	12:00-12:30

6.3 ES-iDE-03: Long term Murcia

The objective of ES-iDE-03 is to test the long-term congestion management procurement of local flexibility products by the DSO in advance, to solve specific local system loading issues on the distribution system thus deferring/eliminating the need for traditional system upgrades.

The capacity of the limiting asset was considered less than the real one to generate a future congestion problem to solve in advance. Assets and measures are real and helped us to evaluate long term market procurement and flexibility solutions efficiency.

6.3.1 Congestion problem

a) Location: Murcia, Espinardo area

Figure 6-6: Location – ST Day ahead Murcia

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b) Description: Over the past years, as shown in Figure 6-7, Murcia University feeder line has been near or above its capacity during summer and winter peak hours. An upgrade of the most critical part of the line is scheduled to solve the problem.

c) Limiting assets: Murcia University 20 kV feeder line

d) Critical load (when the problem happens): 5,7 MW (feeder line)

e) Forecast Load curve: According to prior years information, Figure 6-7, it could be expected to reach 6.8MW peak load in summer and 6.3 MW peak load in winter during the next years. The critical months are July and September in summer and January in winter weekdays, as it is shown in

f) Figure 6-8. The exposure hours are calculated from historical daily load curves escalated to the projected load, Figure 6-9.

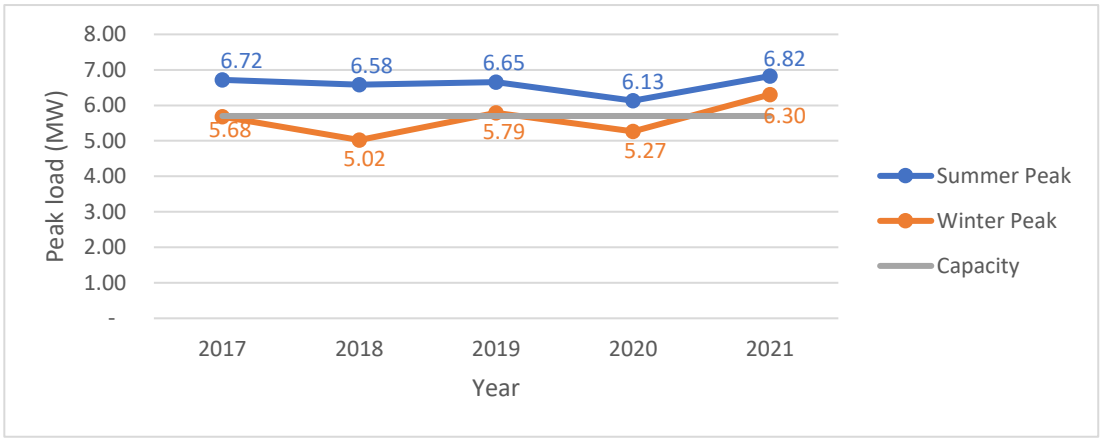

Figure 6-7: Historical peak Load feeder 20 kV Murcia

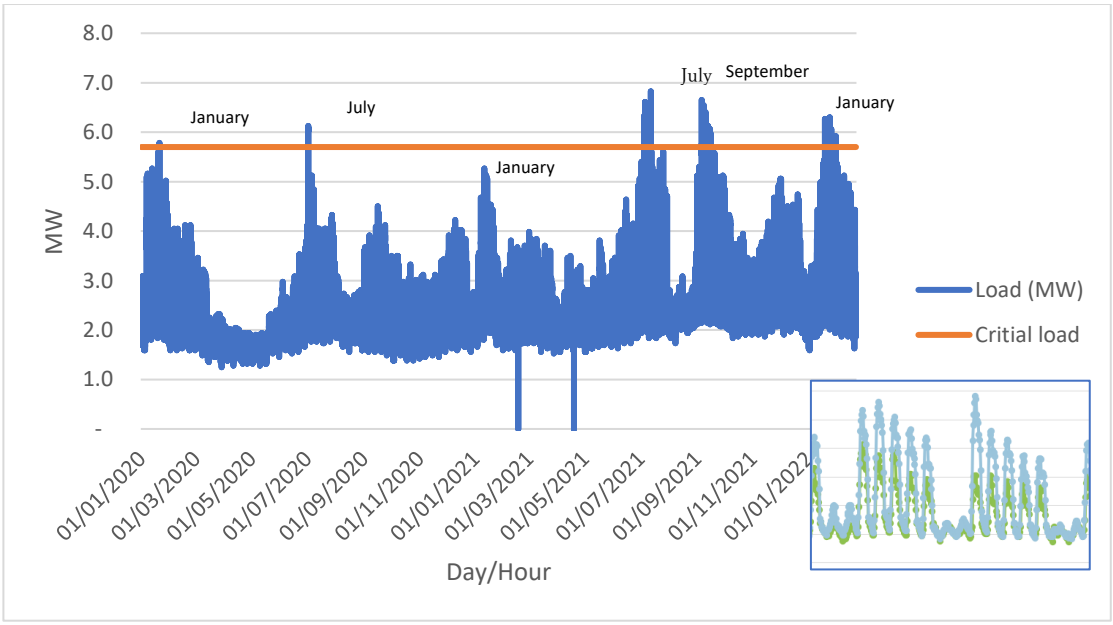

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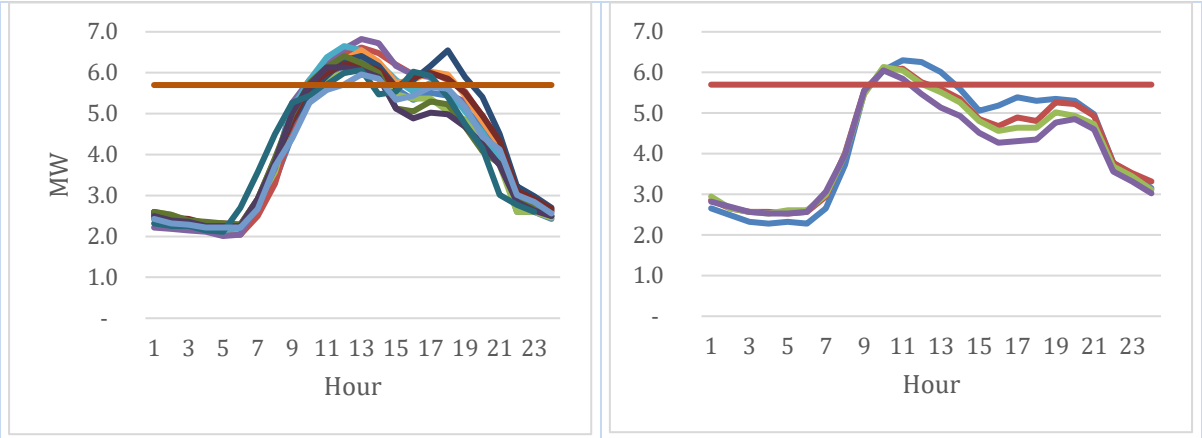
Figure 6-8: Historical Load feeder 20 kV Murcia (2020-2022)



a) b)

Figure 6-9: Daily peak load curve: a) summer; b) winter

g) Magnitude of issue (maximum difference between load forecast and critical load):
   a. Summer: 6,8-5.7=1,1 MW
   b. Winter: 6,3-5.7=0,6 MW

6.3.2 Traditional solution description

a) Project name: Increase capacity 20 kV UMU feeder line
b) Scope: Change 1.179 m of Al150 cable between point A to point B for Al240
c) Cost: 170.814 €
d) In service date: Summer 2022

6.3.3 Distributed resource requirements

a) Location: Murcia University 20 kV feeder line
b) Timeline & requirement: To delay the project 3 years, until summer 2025

Table 6-4 – Demo ES-iDE-3 – Timeline & requirement

Year	Amount (MW)	Period	Service window	Days	Duration	%
2022/23	1,1	July & September	10:00-19:00	L-V	3 hours	19%
	0,6	January	10:00-13:00	L-V		21%
2023/24	1,1	July & September	10:00-19:00	L-V	3 hours	19%

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Year	Amount (MW)	Period	Service window	Days	Duration	%
	0,6	January	10:00-13:00	L-V		21%
2024/25	1,1	July & September	10:00-19:00	L-V	3 hours	19%
	0,6	January	10:00-13:00	L-V		21%

The percentage of use for the indicated period and service window, have been calculated using 2021 information escalated to the projected load.

If the whole period summer and winter is considered, using 2020-2021 information escalated to the projected load, only 1,7% of total summer hours and 0,3% winter hours, the line will be over its capacity,

Figure 6-10:

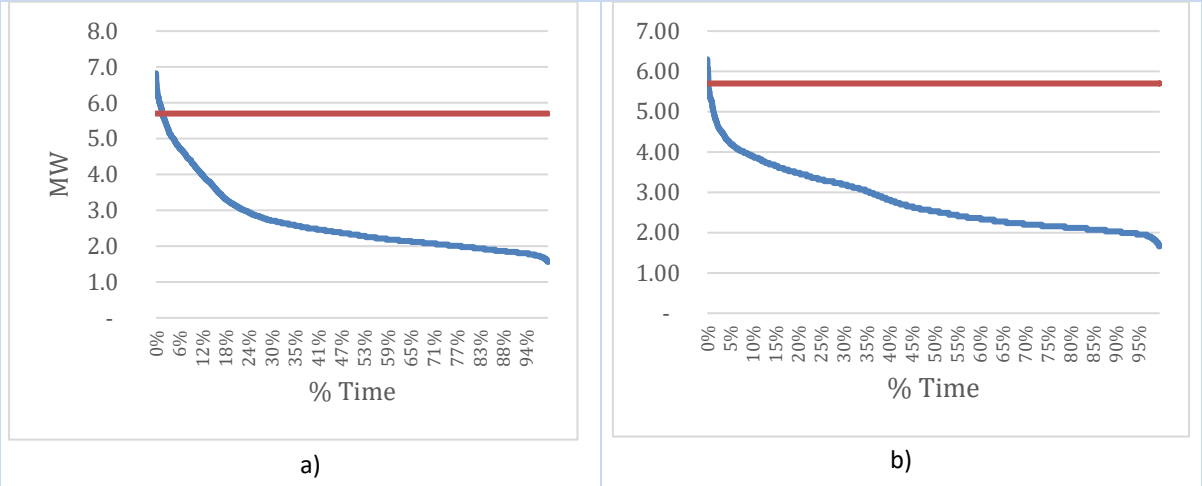

Figure 6-10: Load curve: a) summer; b) winter

c) Ceiling cost: 8.955,67 €/Year
   - System savings: 8.794,7 €/Year
   - Maintenance cost saving: 160,3 €/Year

Table 6-5 – Demo ES-iDE-03 summary – problem assessment

Problem	MW Requirement	Grid Location	Day	Hour
Congestion: delay traditional investment from 2022 to 2025	1,1 summer 0,6 winter	Murcia University 20kV feeder line	July September January	Service window

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6.4 ES-iDE-04: Short-term day ahead Madrid (30 min)

The objective of ES-iDE-04 is to test the short-term congestion management procurement of local flexibility products by the DSO, to support the network in the event of a programmed fault conditions, days 14/01/2023 and 21/01/23, from 12:30 to 13:00, which could create a congestion problem.

The programmed fault was simulated to have a problem that requires procurement of flexibility in a day ahead market. Capacity of the limiting asset was considered less than the real one to generate a problem. Assets and measures are real and helped us to evaluate market procurement and flexibility solutions efficiency.

6.4.1 Congestion problem

a) Location: Cantoblanco, Madrid

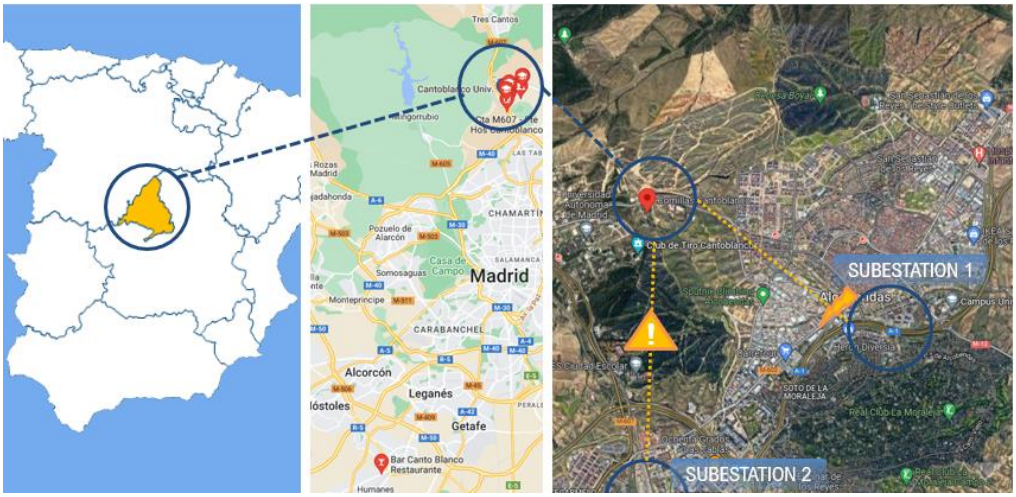

Figure 6-11: Location – ST Day ahead Cantoblanco

b) Description: Because of a maintenance work in a 20 kV line breaker close to substation 1, days 14/01/2023 and 21/01/2023, from 12:30 to 13:00, the loads from that line, where Comillas Pontifical University is located, have to be fed from a Substation 2 line, which could exceed its 3 MW of capacity. It is necessary then to keep the line below 3 MW to support the maintenance work.
c) Limiting assets: 20 kV line from Substation 2
d) Critical load (when the problem happens): 3MW (feeder line from Substation 2)
e) Forecast Load curve: It is used as reference January 15th 2022, when the sum of feeder from Substation 1 and feeder from Substation 2 could reach a load up to 3,1MW, from 12:30 to 13:00, that will have to be assumed by line from substation 2 during the maintenance work.

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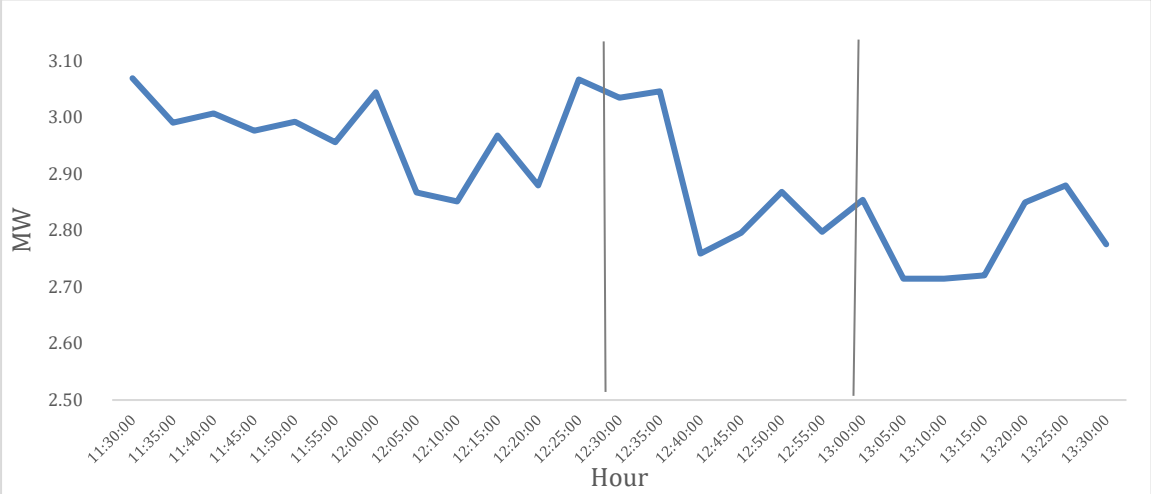

Figure 6-12: Load feeder 1 (from substation 1) +feeder 2 (from substation 2)

f) Magnitude of issue (maximum difference between load forecast and critical load): 3.1-3.0=0.1 MW

6.4.2 Traditional solution description

a) Project name: Diesel generator group
b) Scope: 30min 100 kVA diesel generator group
c) Cost: 1.165 €

6.4.3 Distributed resource requirements

a) Location: Line 20kV feeders from substation 1 or from substation 2
b) Timeline & requirement: 0,1 MW, 14/01/2023 and 22/01/2023 from 12:30pm to 1:00pm
c) Ceiling cost: 23.300 €/MWh (1.165 €/(0,1 MW*0,5 h))

Table 6-6 – Demo ES-iDE-04 summary – problem assessment

Problem (2 tests)	MW Requirement	Grid Location	Day	Hour
Congestion: programmed maintenance work 14/01	0,1	Line 20 kV feeder from substation 1 or substation 2	01/14/2023	12:30-13:00
21/01	0,1	Line 20 kV feeder from substation 1 or substation 2	01/21/2023	12:30-13:00

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6.5 ES-iDE-05: Short-term day ahead Madrid (1h)

The objective of ES-iDE-05 is to test the short-term congestion management procurement of local flexibility products by the DSO, to support the network in the event of a programmed fault conditions, day 04/02/23, from 11:00 to 12:00, which could create a congestion problem.

The programmed fault was simulated to have a problem that requires procurement of flexibility in a day ahead market. Capacity of the limiting asset was considered less than the real one to generate a problem. Assets and measures are real and helped us to evaluate market procurement and flexibility solutions efficiency.

6.5.1 Congestion problem

a) Location: Cantoblanco, Madrid

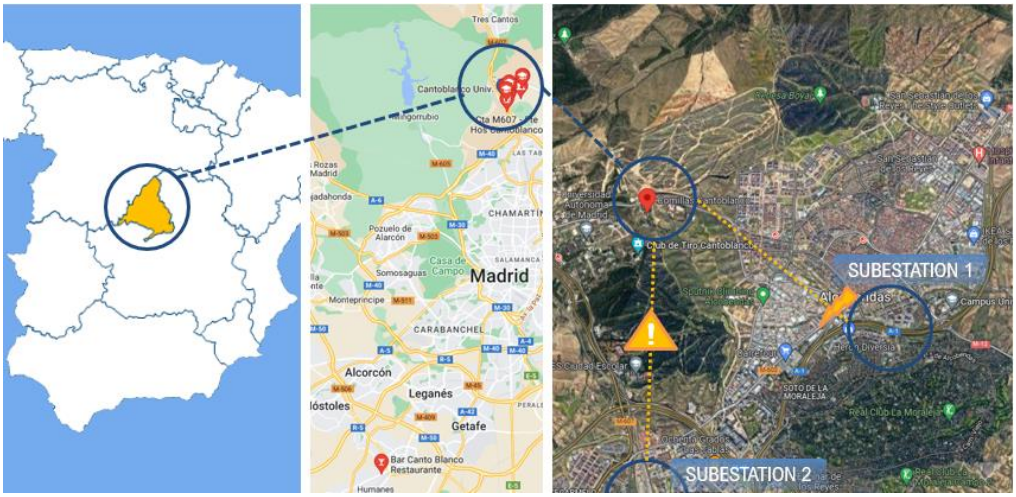

Figure 6-13: Location – ST Day ahead Cantoblanco

b) Description: Because of a maintenance work in a 20 kV line breaker close to substation 1, day 04/02/2023, from 11:00 to 12:00, the loads from that line, where Comillas Pontifical University is located, have to be fed from a Substation 2 line, which could exceed its 3MW of capacity. It is necessary then to keep the line below 3MW to support the maintenance work.
c) Limiting assets: 20kV line from Substation 2
d) Critical load (when the problem happens): 3 MW (feeder line from substation 2)
e) Forecast Load curve: It is used as reference January 15th, 2022, when the sum of feeder from Substation 1 and feeder from Substation 2 could reach up to 3,1 MW, from 11:00 to 12:00, that will have to be assumed by line from substation 2 during the maintenance work.

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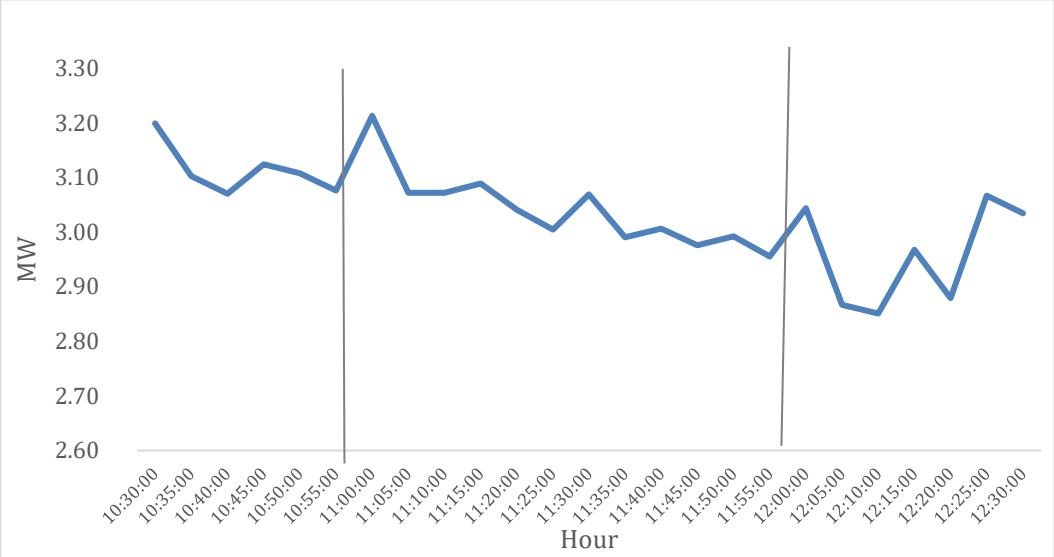

Figure 6-14: Load feeder 1 (from substation 1) +feeder 2 (from substation 2)

f) Magnitude of issue (maximum difference between load forecast and critical load): 3,1-3,0=0,1 MW

6.5.2 Traditional solution description

a) Project name: Diesel generator group
b) Scope: 1 h 100 kVA diesel generator group
c) Cost: 1.165 €

6.5.3 Distributed resource requirements

a) Location: Line 20 kV feeders from substation 1 or from substation 2
b) Timeline & requirement: 0,1 MW, 02/04/23 from 11:00 to 12:00
c) Ceiling cost: 11.650 €/MWh (1.165 €/(0,1 MW*1 h))

Table 6-7 – Demo ES-iDE-05 summary – problem assessment

Problem	MW Requirement	Grid Location	Day	Hour
Congestion: programmed maintenance work 04/02	0,1	Line 20 kV feeder from substation 1 or substation 2	04/0**2**/2023	11:00-12:00

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6.6 ES-UFD-01: Long term Alcalá de Henares I

The objective of ES-UFD-01 is to test the long-term congestion management procurement of local flexibility products by the DSO in advance, to solve specific local system loading issues on the distribution system thus deferring/eliminating the need for traditional system upgrades.

The capacity of the limiting asset was considered less than the real one to generate a future congestion problem to solve in advance. Assets and measures are real and helped us to evaluate long term market procurement and flexibility solutions efficiency.

6.6.1 Congestion problem

a) Location: Alcalá de Henares, Madrid
b) Description: The demand for the circuit under study has been experiencing a slight growth in recent years. It is necessary to point out that the 2020 data is a simulation to undo the effect caused by COVID19. Therefore, similar increases were expected for 2022. Figure 6-15 shows the evolution of the peak values of the load of the circuit in which the FSPs are located. By 2022 and the following years growth was expected to exceed the capacity of the line. The graphs in Figures 6-16 and 6-17 show the whole of the year 2021 and the hourly curves of the winter working days. In them the limit capacity is already close to being reached in 2021.
c) Limiting assets: Common FSPs 15 kV feeder line in Alcalá de Henares
d) Critical load (when the problem happens): 3,4 MW (feeder line). The value of the capacity is 65 % lower than the real one to find a valid case for the demo.
e) Forecast Load curve: A Winter Case: According to prior years information, Figure 6-15, it could be expected to reach 3.4 MW peak load in winter during the next years. The critical months are October to December during the working days. The exposure hours are calculated from historical daily load curves escalated to the projected load , Figure 6-17.
At first it was planned to do the demo during the peak of summer. This had advantages both for the actual participation of the FSPs and for the adjustment to the values of maximum utilization of the circuit under study. However, various technical and operational problems with the monitoring equipment installed in the customers' facilities made it necessary to take the Demo to autumn/winter. That is why the values used are those of the winter peak.
On the other hand, the hours chosen for the Demo will coincide with the needs of the FSPs rather than with the true peak hours.

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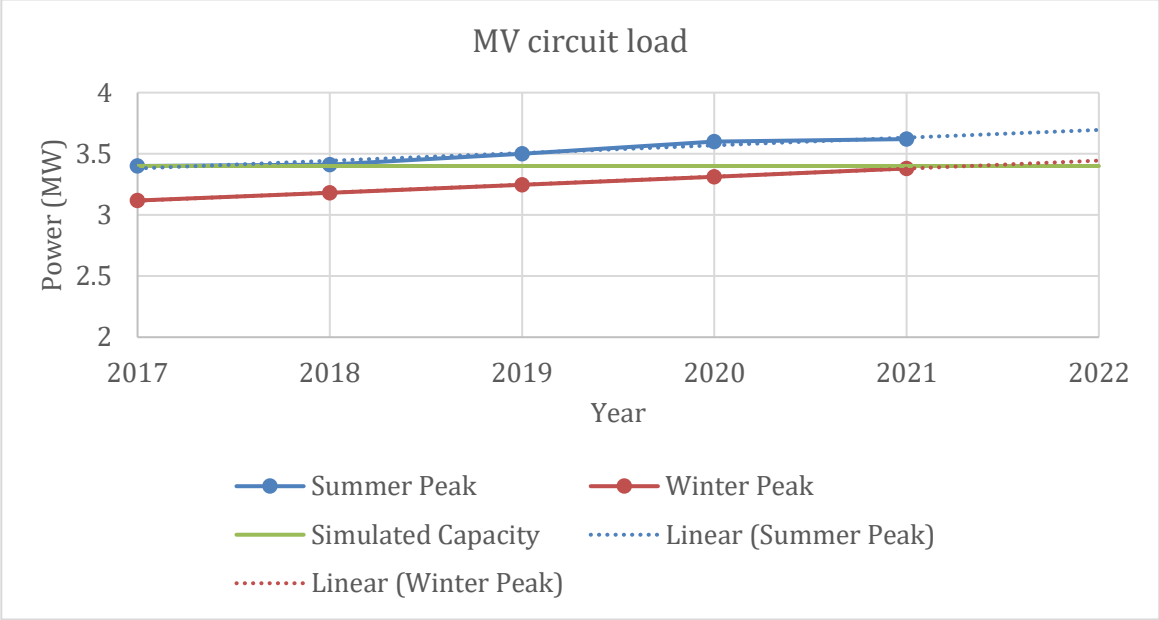

Figure 6-15: Historical peak Load Alcalá de Henares circuit

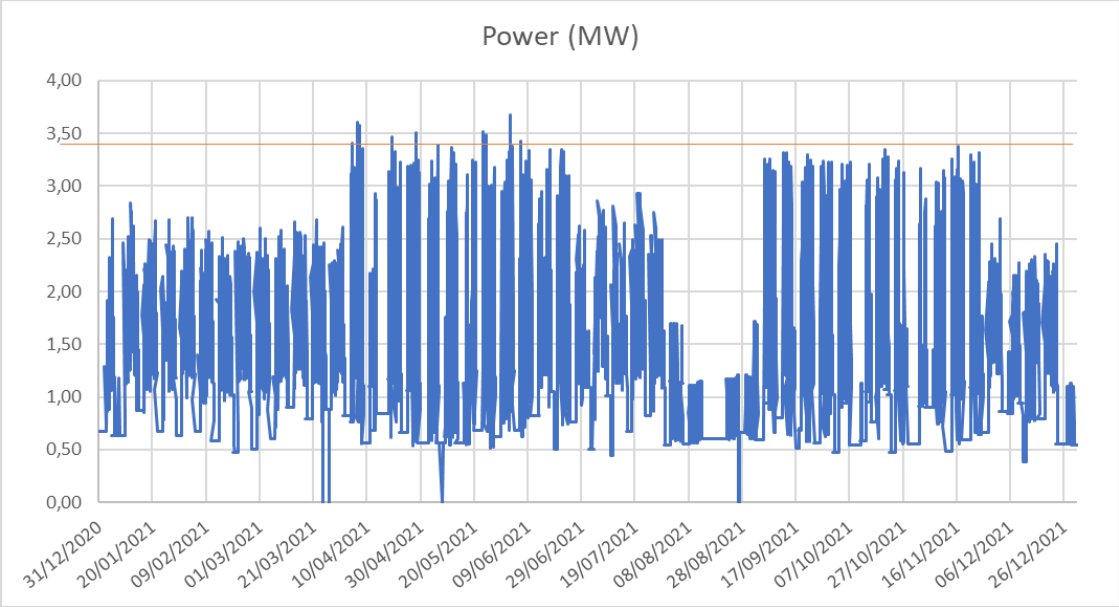

Figure 6-16: Load feeder 15kV Alcalá de Henares (2021)

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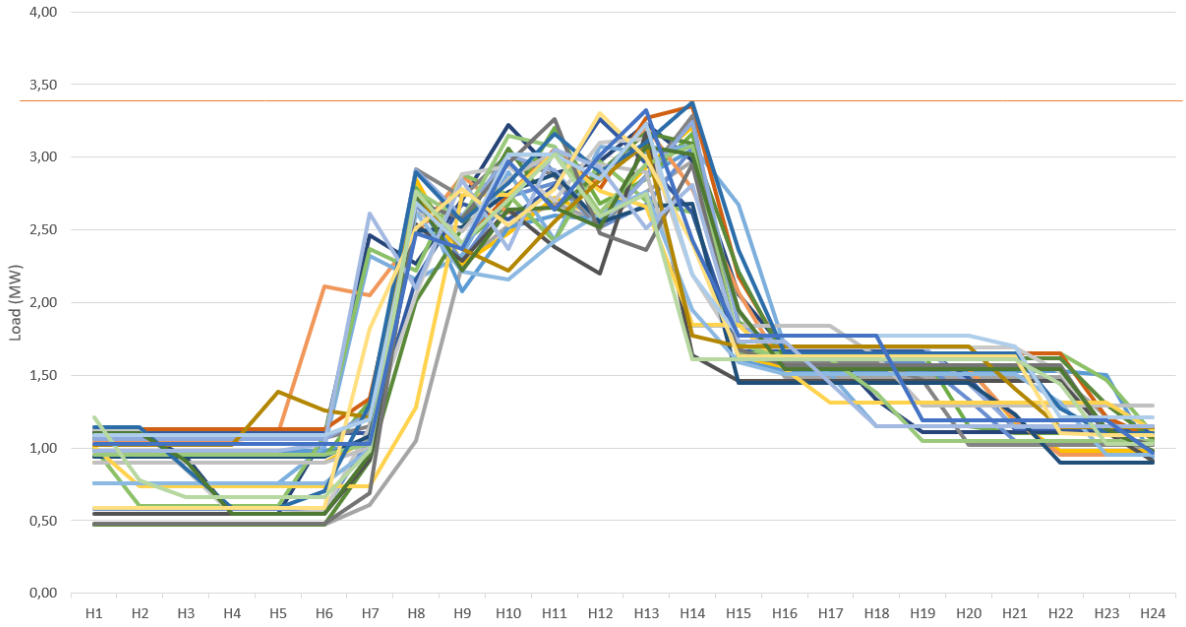

Figure 6-17: Hourly load curve winter 2021

f) Magnitude of issue (maximum difference between load forecast and critical load): 4,6-3,4 = 1,1 MW

6.6.2 Traditional solution description

a) Project name: reinforcement of the existing 15 kV feeder line (development of new network feed in tariff)
b) Scope: Construction of a new 15 kV (790 m) support circuit to link with the Alcalá AL2 substation, to have another support with other substations in case of contingency
c) Cost: 146.648,40 €
Flexibility should not cover the full cost of the investment, but only the avoided cost of the number of years that the investment is delayed. As the demo is going to be done only for one year, we will assume the cost of remuneration of the investment of the first year is delayed to the second. Therefore, the cost avoided by flexibility will be 17.218,84€.
d) In service date: Summer 2023

6.6.3 Distributed resource requirements

a) Location: Alcalá de Henares 15 kV feeder line
b) Timeline & requirement: To delay the project 1 year, until summer 2023. The simulation has been carried out with a market only for the following year.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

Table 6-8 – Demo ES-UFD-1 – Timeline & requirement

Year	Amount (MW)	Period	Service window	Days	Duration	%
2023	1,1	From 09/19/2022 to 12/08/2022	06:00-19:00	L-V	3 hours	17%

The percentage of use for the indicated period and service window, have been calculated using 2021 information escalated to the projected load. An average use of 2-3 hours a day is estimated, within the service window.

c) Ceiling cost: Although in a real case a ceiling cost would be set, in the demo it has been preferred not to use it to maximize the participation of the FSPs in solving the problemES-UFD-01: Long term Alcalá de Henares.

6.7 ES-UFD-02: Long term Alcalá de Henares II

The objective of ES-UFD-02 is to test the long-term congestion management procurement of local flexibility products by the DSO in advance, to solve specific local system loading issues on the distribution system thus deferring/eliminating the need for traditional system upgrades.

The interest of the UFD Long Term Demo is not so much to test different use cases but to learn from the various situations that can occur with a diverse set of FSPs. For this reason, the parameters of ES-UFD-02 are the same as those previously described in ES-UFD-01. The only thing that changes are the market and activation dates. In this way, multiple aspects related to customer engagement could be verified. One of them is the impact of the flexibility market with its own productive and organizational processes, both in participation and in compliance capacity. It is important to note that only one of the 5 resources has previous experience in participating in markets.

6.7.1 Congestion problem

a) Location: Alcalá de Henares, Madrid
b) Description: The demand for the circuit under study has been experiencing a slight growth in recent years. It is necessary to point out that the 2020 data is a simulation to undo the effect caused by COVID19. Therefore, similar increases were expected for 2022. Figure 6-15 shows the evolution of the peak values of the load of the circuit in which the FSPs are located. By 2022 and the following years growth was expected to exceed the capacity of the line. The graphs in Figures 6-16 and 6-17 show the whole of the year 2021 and the hourly curves of the winter working days. In them the limit capacity is already close to being reached already in 2021.
c) Limiting assets: Common FSPs 15 kV feeder line in Alcalá de Henares

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d) Critical load (when the problem happens): 3.4 MW (feeder line). The value of the capacity is 65% lower than the real one to find a valid case for the demo.

e) Forecast Load curve: A Winter Case: According to prior years information, Figure 6-15, it could be expected to reach 3.4 MW peak load in winter during the next years. The critical months are October to December during the working days. The exposure hours are calculated from historical daily load curves escalated to the projected load, Figure 6-17..

At first it was planned to do the demo during the peak of summer. This had advantages both for the actual participation of the FSPs and for the adjustment to the values of maximum utilization of the circuit under study. However, various technical and operational problems with the monitoring equipment installed in the customers' facilities made it necessary to take the Demo to autumn/winter. That is why the values used are those of the winter peak.

On the other hand, the hours chosen for the Demo will coincide with the needs of the FSPs rather than with the true peak hours.

f) Magnitude of issue (maximum difference between load forecast and critical load): 4,6-3,4 = 1,1 MW

6.7.2 Traditional solution description

a) Project name: reinforcement of the existing 15 kV feeder line (development of new network feed in tariff)

b) Scope: Construction of a new 15 kV (790 m) support circuit to link with the Alcalá AL2 substation, to have another support with other substations in case of contingency

c) Cost: 146.648,40 €

Flexibility should not cover the full cost of the investment, but only the avoided cost of the number of years that the investment is delayed. As the demo is going to be done only for one year, we will assume the cost of remuneration of the investment of the first year is delayed to the second. Therefore, the cost avoided by flexibility will be € 17,218.84.

d) In service date: Summer 2023

6.7.3 Distributed resource requirements

a) Location: Alcalá de Henares 15 kV feeder line

b) Timeline & requirement: To delay the project 1 year, until summer 2023. The simulation has been carried out with a market only for the following year.

Tabla 6-9 – Demo ES-UFD-2 – Timeline & requirement

Year	Amount (MW)	Period	Service window	Days	Duration	%
2023	1,1	From 10/03/2022 to 12/22/2022	06:00-19:00	L-V	3 hours	17%

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The percentage of use for the indicated period and service window, have been calculated using 2021 information escalated to the projected load. An average use of 2-3 hours a day is estimated, within the service window.

c) Ceiling cost: Although in a real case a ceiling cost would be set, in the demo it has been preferred not to use it to maximize the participation of the FSPs in solving the problem.

6.8 ES-UFD-03: Short term Alcalá de Henares I

The objective of ES-UFD-03 is to test the short-term congestion management procurement of local flexibility products by the DSO, to support the network in the event of a programmed maintenance conditions. The case raised is that in the event of a network failure, service is restored as soon as possible. However, a part remains in service "provisionally". To repair it, you need to schedule a demand download. During the time that the repair lasts, the service to the clients will be carried out using generator sets.

The programed work was simulated to have a problem that requires procurement of flexibility in a day ahead market. Capacity of the limiting asset was considered less than the real one to generate a problem. Assets and measures are real and helped us to evaluate market procurement and flexibility solutions efficiency.

6.8.1 Congestion problem

a) Location: Alcalá de Henares, Madrid
b) Description: Maintenance work on a 15 kV line close to Alcalá substation during a day (8 working hours). To put part of the line out of service and keep all customers in service, the capacity of the line would be exceeded from the end from where it is fed.
g) Limiting assets: Common FSPs 15 kV feeder line in Alcalá de Henares
c) Critical load (when the problem happens): 3,4 MW (feeder line). The value of the capacity is 65% lower than the real one to find a valid case for the demo.
g) Forecast Load curve: The load forecast from 10:00 to 14:00 will be higher than the capacity of the line (3,4MW). In particular, in the last hour it will be 0,63 MW higher than said capacity.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

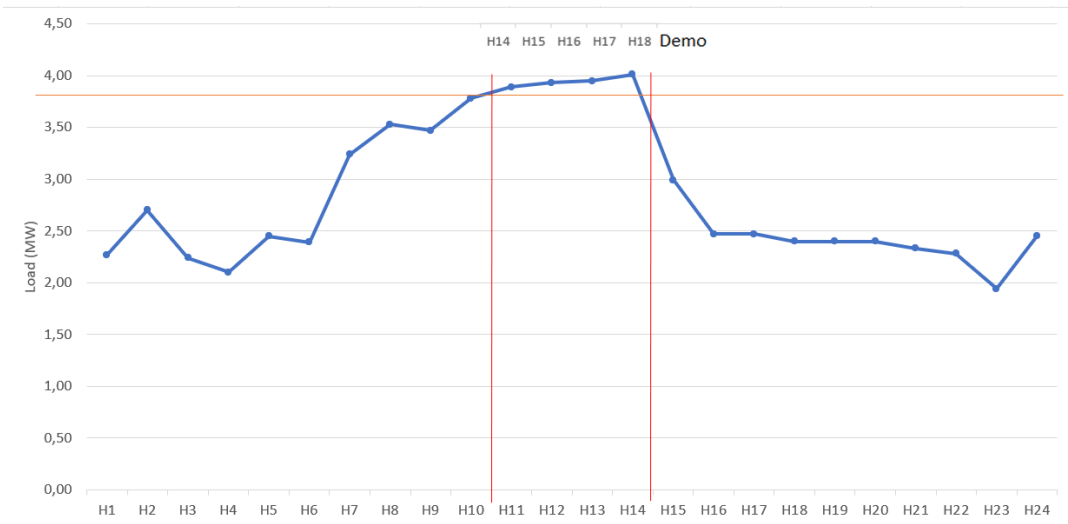

Figure 6-18: Forecast common feeder from substation Alcalá load

d) Magnitude of issue (maximum difference between load forecast and critical load): 4.03 - 3.4= 0,63 MW

UFD Demo Note: As mentioned before, one of the main interests of the UFD Demo is the concurrence of different FSPs in the same location. For this reason, the development of the same in the H18 period (5:00 p.m. to 6:00 p.m.) was agreed with the FSPs. It is simulated that the period H18 corresponds to the demands of H14.

6.8.2 Traditional solution description

a) Project name: One 400 kVA Diesel generator set group (8 hour hired)
b) Scope: 1 hour in operation
c) Cost: 977 €

6.8.3 Distributed resource requirements

a) Location: Common 15 kV feeder line from Alcalá substation
b) Timeline & requirement: 0,63 MW, 04/10/2022 from 5:00 pm to 6:00 pm
c) Ceiling cost: Although in a real case a ceiling cost would be set, in the demo it has been preferred not to use it to maximize the participation of the FSPs in solving the problem.

Table 6-10 – Demo ES-UFD-03 summary – problem assessment

Problem	MW Requirement	Grid Location	Day	Hour
Congestion: programmed maintenance work	0,63	Common 15 kV feeder line from Alcalá substation	04/10/2022	17:00-18:00

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6.9 ES-UFD-04: Short term Alcalá de Henares II

The parameters and description of ES-UFD-04 are mainly the same as those previously described in ES-UFD-03. As it is said for long term demos, the interest of the UFD short term demos is not so much to test different use cases but to learn from the various situations that can occur with a diverse set of FSPs. In this case two things have changed: the market and activation dates and the demanded power.

6.9.1 Congestion problem

a) Location: Alcalá de Henares, Madrid
b) Description: Maintenance work on a 15 kV line close to Alcalá substation during a day (8 working hours). To put part of the line out of service and keep all customers in service, the capacity of the line would be exceeded from the end from where it is fed.
c) Limiting assets: Common FSPs 15 kV feeder line in Alcalá de Henares
d) Critical load (when the problem happens): 3,4 MW (feeder line). The value of the capacity is 65% lower than the real one to find a valid case for the demo.
e) Forecast Load curve: The load forecast from 12:00 to 14:00 will be higher than the capacity of the line (3,4MW). In particular, in the last 2 hours it will be 1 MW higher than said capacity. See Figure 6-19.

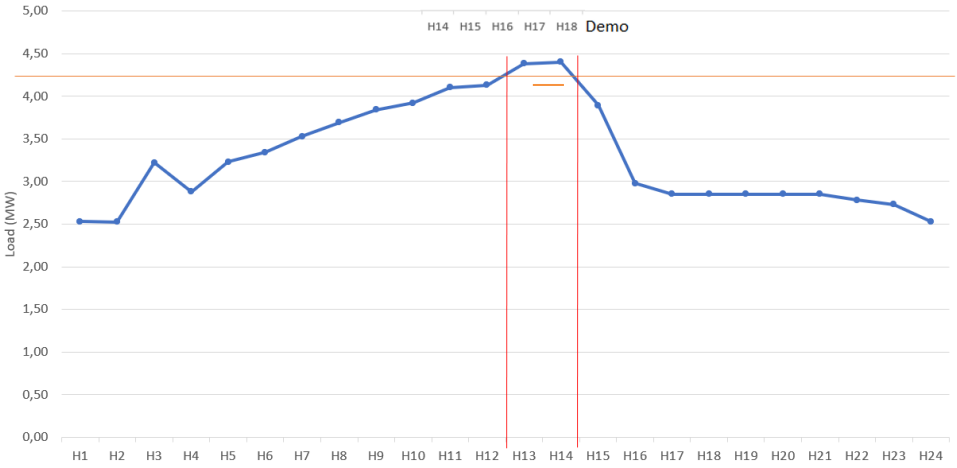

Figure 6-19: Forecast common feeder from substation Alcalá load

f) Magnitude of issue (maximum difference between load forecast and critical load): 4,4 – 3,4= 1 MW

UFD Demo Note: As mentioned before, one of the main interests of the UFD Demo is the concurrence of different FSPs in the same situation. For this reason, the development of the same in the H18 period (5:00 p.m. to 6:00 p.m.) was agreed with the FSPs. It is simulated that the period H18 corresponds to the demands of H14.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

6.9.2 Traditional solution description

a) Project name: One 400 kVA Diesel generator set group (8 hour hired)
b) Scope: 1 hour in operation
c) Cost: 977 €

6.9.3 Distributed resource requirements

a) Location: Common 15 kV feeder line from Alcalá substation
b) Timeline & requirement: 1 MW, 06/10/2022 from 17:00 pm to 18:00 pm
c) Ceiling cost: Although in a real case a ceiling cost would be set, in the demo it has been preferred not to use it to maximize the participation of the FSPs in solving the problem.

Table 6-11 – Demo ES-UFD-04 summary – problem assessment

Problem	MW Requirement	Grid Location	Day	Hour
Congestion: programmed maintenance work	1	Common 15 kV feeder line from Alcalá substation	06/10/2022	17:00-18:00

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7 Evaluation and results

This section shows the results and steps, that have been followed for procurement of local flexibility products by the DSO, for each of the problem assessment defined in section 6.

Table 7-1 shows a summary of the developed markets and results:

Table 7-1 – Spanish demo markets

ID	Request date	Market session	Market clearing	Activation	Quantity (MW)	Price
ES-iDE-01 Short-term day ahead Murcia	27/07/22	27/07/22 3-3:45pm	07/27/2022 3:45pm	28/07/2022 9:30-10:100	0.4	1.000€/MWh
ES-iDE-02 Short-term intraday Murcia	28/07/22	28/07/22 10-10:45am	07/28/2022 11:00am	28/07/2022 12-12:30pm	0.6	1.300€/MWh
ES-iDE-03 Long-term Murcia	29/07/22	05/08/22 10am-1pm	08/05/2022 1pm	02/09/2022 12:15-12:45	1.1	600€/MW 20€/MWh
ES-iDE-04 Short-term day ahead Madrid (2 30min tests)	13/01/23 20/01/23	13/01/23 1:40-2pm 01/20/23 1:35-2pm	01/13/23 2:11pm 01/20/23 2:03pm	14/01/23 12:30-1pm 01/21/23 12:30-1pm	0.1	6.000€/MWh 300€/MWh
ES-iDE-05 Short-term day ahead Madrid (1h test)	03/02/2023	03/02/2023 11:30-11-50am	02/03/2023 11:53	04/02/2023 11am-12pm	0.1	250€/MWh
ES-UFD-01 Long-term	15/09/2022	16/09/2022 10:00-11:30	09/16/2022 11:50	03/10/2022 to 06/10/2022 17:00-18:00	1.2	N/A
ES-UFD-02 Long-term	15/09/2022	30/09/2022 10:00-11:30	09/30/2022 11:50	03/10/2022 to 06/10/2022 17:00-18:00	1.2	N/A
ES-UFD-03 Short-term day ahead	03/10/2022	03/10/2022 13:00-13:30	10/03/2022 13:40	04/10/2022 17:00-18:00	0.63	N/A
ES-UFD-04 Short-term day ahead	05/10/2022	05/10/2022 13:00-13:30	10/05/2022 13:40	06/10/2022 17:00-18:00	1.00	N/A

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7.1 ES-iDE-01 Short-term day ahead Murcia: scenario results

The steps followed as indicated in the BUC WECL-ES-02, Short term congestion management were:

1. Prepare/Pre-qualification
2. Plan/Forecast
3. Market Phase
4. Monitoring and activation
5. Measurement phase

7.1.1 Prepare/Pre-qualification

- FSP units: UMU_Campus de Espinardo
- Prequalification date: 26/07/2022

Table 7-2 – Pre-qualification timeline

FSP	Date of Initial Prequalification Data Reception	Final Date of approval by MO	Final Date of approval by DSO	Was initial data submitted complete?
FSP-iDE-01: UMU	26/07/22	26/07/22	27/07/22	Yes

- Results:

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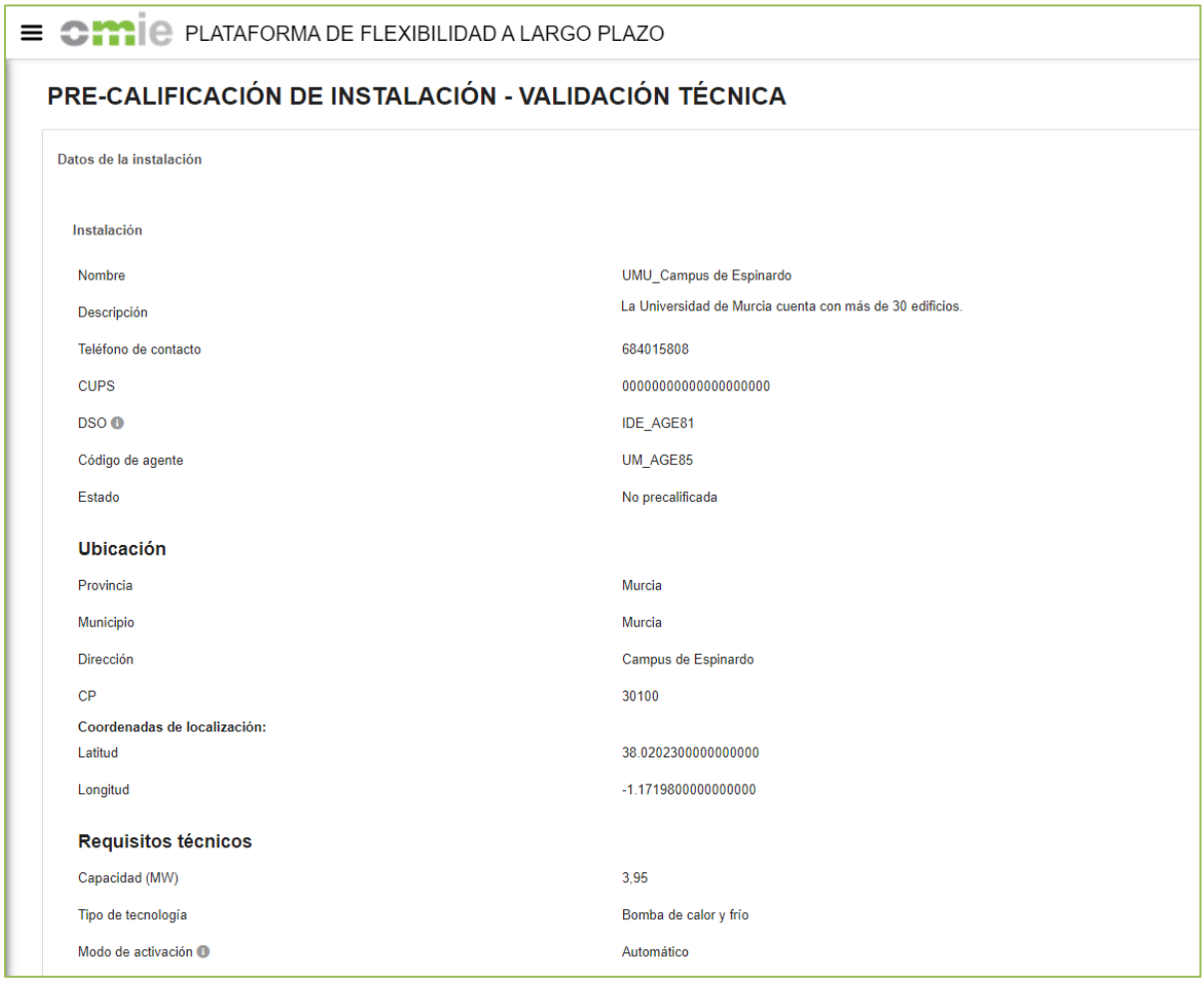

Figure 7-1: Prequalification scenario for Murcia University

7.1.2 Plan/Forecast

The complete problem assessment is included in section 6.1, ES-iDE-01, Short-term day ahead Murcia:

- Timeline: 9:30-10:00, 28/07/2022
- Limiting assets: Murcia University 20kV feeder line
- Critical load (when the problem happens): 4,6 MW (feeder line)
- Forecast Load: 5 MW
- Requirement: 0,4 MW
- DSO requirement date: 27/07/2022, day ahead, energy (activation)

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7.1.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Market opening,
3. Qualification,
4. Bid collection,
5. Market clearing.

1. **DSO request**: Introduce DSO Day ahead request in OMIE short term platform, 27/07/2022 before 3pm:
   1.1. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside: i-DE_Espinardo

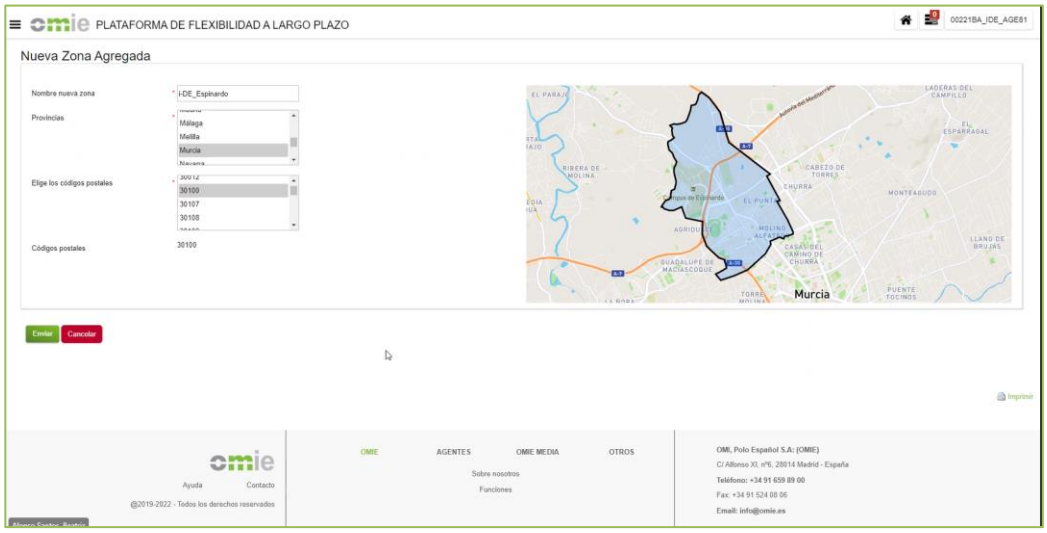

Figure 7-2: ST Murcia day ahead – Area creation in LT market platform

   1.2. Log on in Short-term OMIE Platform
   1.3. Introduce request:

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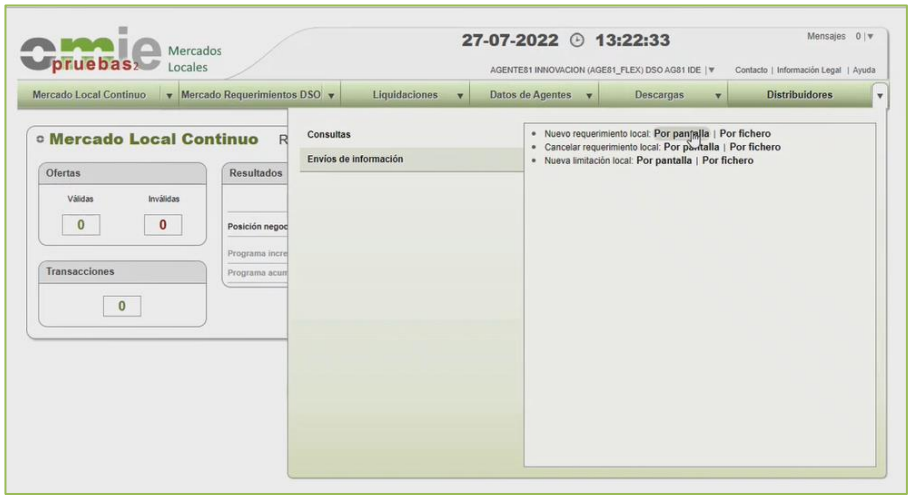

Figure 7-3: ST Murcia day ahead – DSO introduce request selection

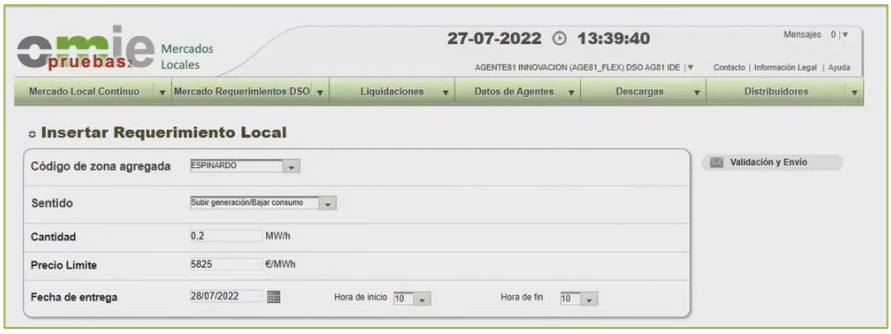

Figure 7-4: ST Murcia day ahead – DSO request

DSO request is introduced in the screen shows in Figure 7-4 with the following information, as presented in the plan forecast:

- Area, “Código de zona agregada”: i-DE Espinardo
- Activation direction, “Sentido”: Downward consumption (“Subir generación/Bajar consumo”)
- Quantity (MW/h), “Cantidad”: 0,2*
- Limit Price (€/MWh), “Precio límite”: 5.825
- Delivery time, “Fecha de entrega”:
    - Day: 28/07/2022
    - Initial time, “Hora de inicio”: 10**
    - Final time, “Hora de fin”: 10**

Notes: * The value was introduced as energy (0,4 MW*0,5 h=0,2 MWh), but it was power to keep for 1 hour. It was a misinterpretation that was corrected later ** Initial time and final time selection are in 1 hour period; The

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number represents the final time. If the delivery is equal or less than 1 hour, initial and final period have to be the same. There is no possibility of including duration less than 1 hour in the platform.

2. **Market opening**: The market is opened from 3pm to 3:45 pm

FSPs located in the selected area can bid from 3pm to 3:45. Figure 7-5 shows the bid which was introduced by Murcia University:

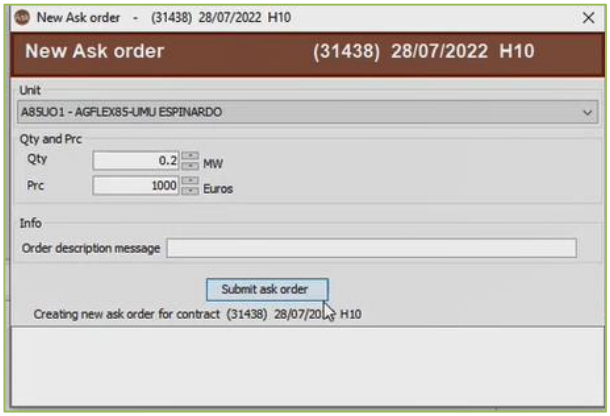

Figure 7-5: ST Murcia day ahead – FSP bid

NOTE: For this test, the quantity value was introduced in MWh to agree with the request. That is the reason it appears 0,2 instead of 0,4 MW. The price is in €/MWh. The label showing "Euros" instead of "€/MWh" for the price box, was corrected later.

3. **Qualification**: only the bid of prequalified resources located in the area, participating with a quantity below its total recognized capacity is accepted.

4. **Bids received:**

Table 7-3 – ST Murcia day ahead - Bids

BID ID	FSP ID	Volume Offered (kW)	Price (€/MWh)
1	FSP-iDE-01: UMU	400	1.000

5. **Market clearing:**

Table 7-4 – ST Murcia day ahead – Market clearing

BID ID	Cleared (YES/NO)	Quantity Cleared (kW)	Price (€/MWh)
1	YES	400	1,000

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Table 7-5 shows a summary of the market phase:

Table 7-5 – ST Murcia day ahead – market phase summary

Market Session ID	ES-iDE-01 Short-term day ahead Murcia
Request date	07/27/2022 before 3pm
Market session	07/27/2022 3pm-3:45pm
Market clearing date/time	07/27/2022 3:45pm
Number of bids received	1
Volume of bids received - in kW or kWh	400 kW/200 kWh
Number of bids cleared	1
Volume of bids cleared - in kW or kWh	400 kW/200 kWh
Total cost of capacity/energy cleared (in €/MWh)	1.000
Average cost of capacity/energy cleared (in €/MWh)	1.000

7.1.4 Monitoring and Activation

Resources were activated by FSP on 07/28/2022 from 9:00 to 9:30. Monitoring is done by FSP in its installation and by DSO in its monitored assets.

7.1.5 Measurement phase

Two elements are measured as it is shown in Figure 7-6:

- Limiting asset load: 20 kV UMU feeder line (identified with blue color)
- Resource load/delivery: FSP, UMU (identified with orange color)

NOTE: a previous test was done on 27/07/2022 before market session to test the delivery, that is the reason the curves look similar both days.

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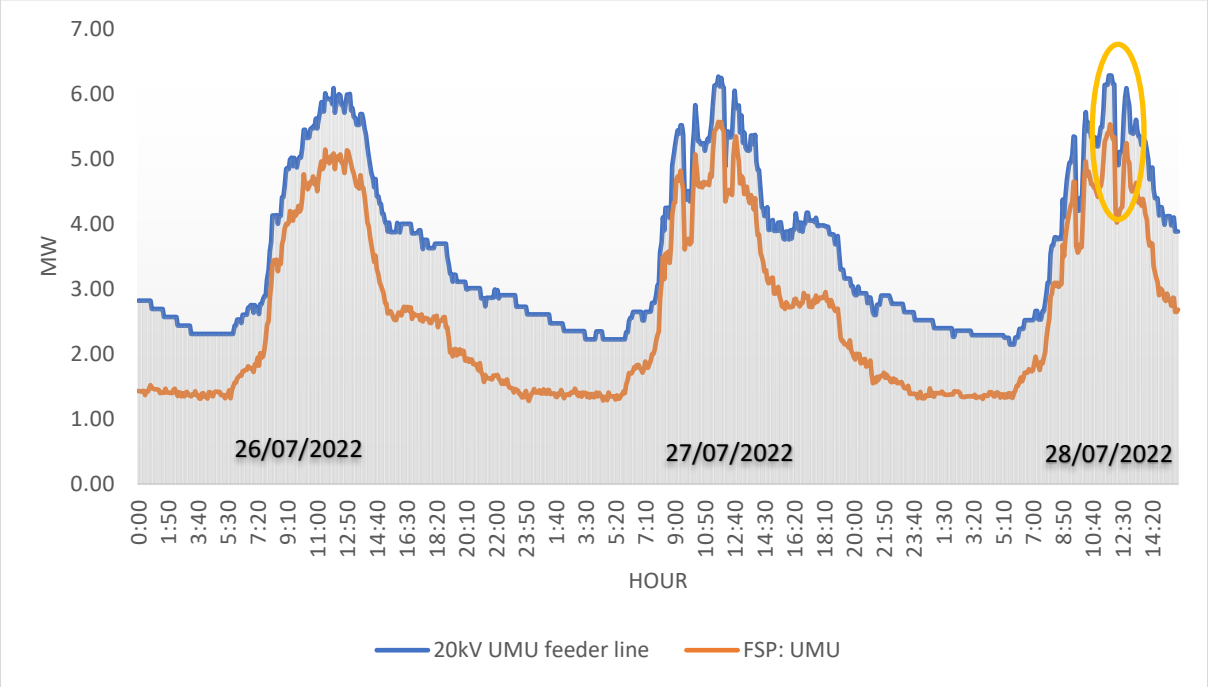

Figure 7-6: ST Murcia day ahead – Load evolution

1. Limiting asset load: 20 kV UMU feeder line

Figure 7-7 shows the evolution of 20 kV UMU feeder during the activation time (9:30-10:00). The line has been below the critical load, 4,6 MW, except at the beginning of the period (9:30-9:35) because the activation was late:

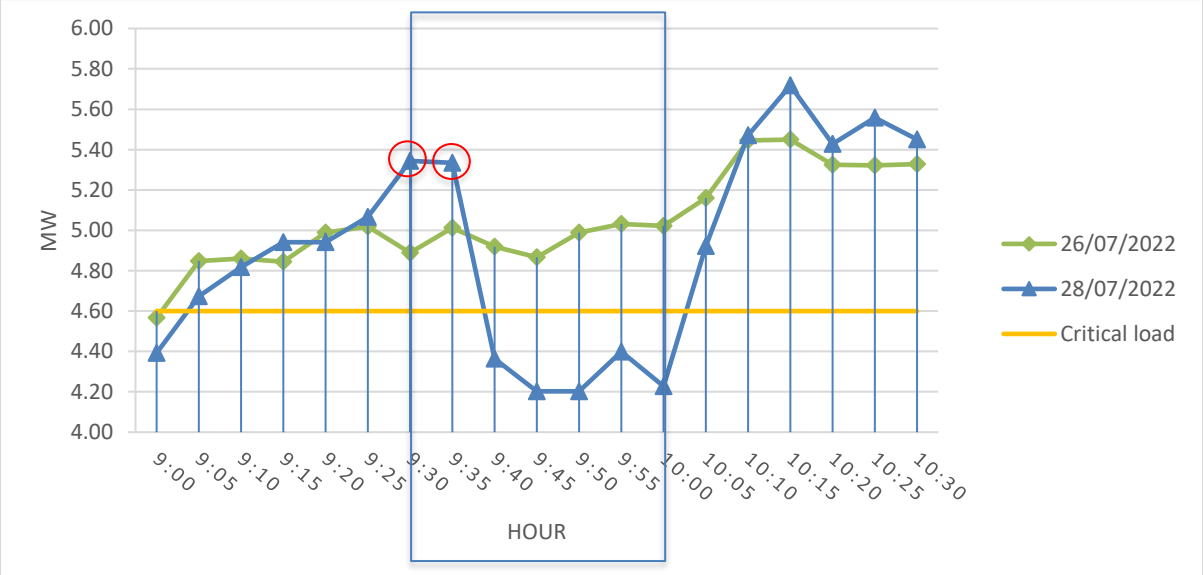

Figure 7-7: 20 kV UMU feeder line load, 9:30-10:00

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2. **Resource load/delivery**: FSP, UMU

Figure 7-8 shows the evolution of UMU load during the activation time (9:30-10:00) and Figure 7-9 shows the delivered quantity for two different cases:

- Considering the initial load: load at 9:25
- Considering as base line the load on 26/07/2022

As the activation was late on time, the delivery didn't reach the objective (400 kW) at the beginning of the period (9:00-9:35) being above for the rest of the period for both cases (considering load before activation or 26/07/2022 as baseline load).

If the two references used as baselines (load before activation or load on 26/07/2022) are compared, it looks a better approximation to compare with a reference base line, as 07/26/2022, to avoid comparing with a high value if an increased in load is done before the activation to have mayor margin, as it is shown in Figure 7-8 (red arrow).

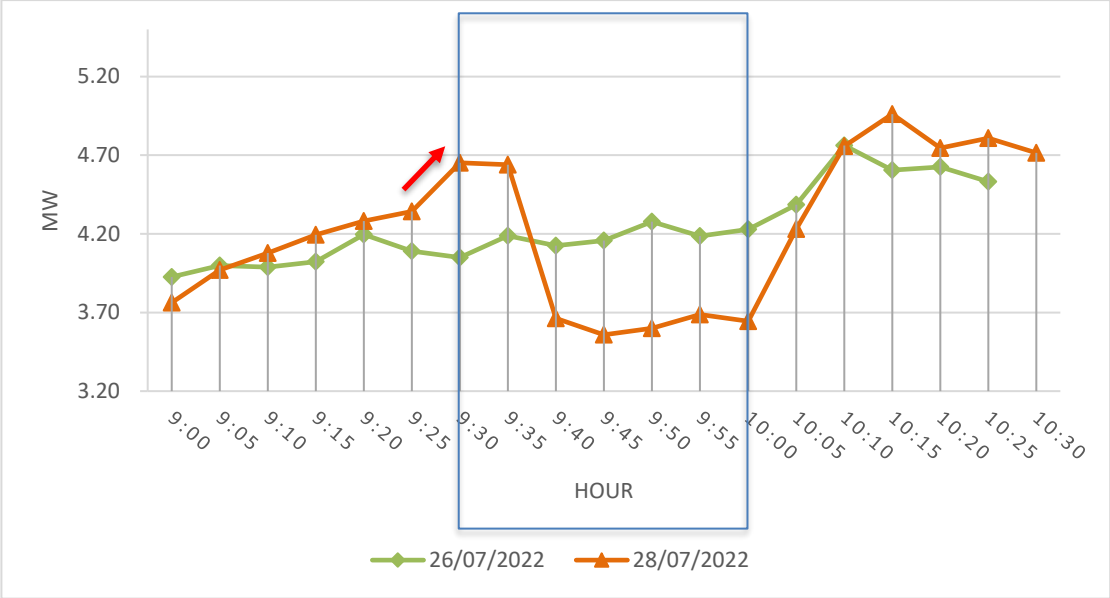

Figure 7-8: 20 kV UMU load, 9:30-10:00

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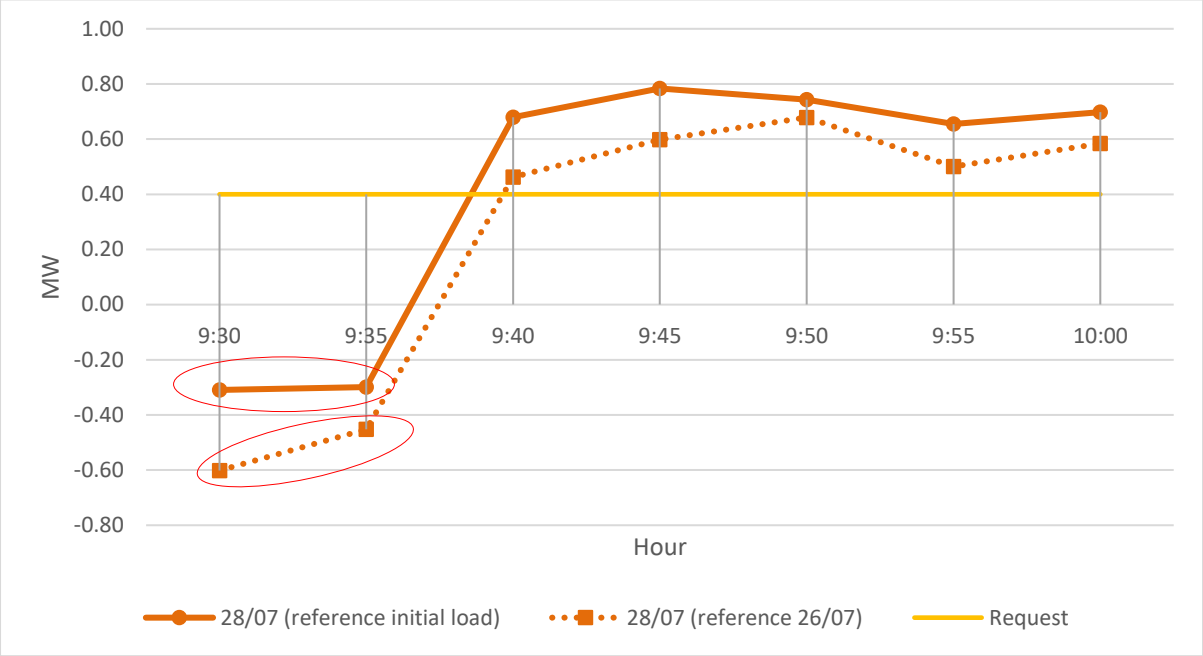

Figure 7-9: ST Murcia day ahead – Delivery quantity evolution

Table 7-6 – ST Murcia day ahead – Measurement information

Maximum load in MW at DEMO limiting asset:	4,40 (no considering late activation)
Forecasted load 24 hours in advanced (MW):	5,00
Initial limiting asset load (before activation)	4,94 (before increasing load)
Activation date:	28/07/2022
Minimum activated flexibility power (MW)*	0,46 (no considering late activation)
Maximum activated flexibility power (MW)*	0,68
Energy delivery (MWh)*	0,19

*Using as reference 07/26

7.1.6 Settlement phase

- Compliance (Y/N/Partially): Partially, 83% of the time
- Penalties amount: No
- Total cost: 1.000 €/MWh*0.19 MWh=190 €

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7.1.7 Demo KPI results

Table 7-7 – ST Murcia day ahead – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 5,825€/MWh $Cost_{flex}$: 1,000€/MWh	83%
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,4MW $\sum P_{Total_{in_{Area}}}$: 4,4MW	9%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\lvert\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\rvert\right).100$	FC_{load} : 5MW RL_{load} : 4,94MW N=1	1,2%
5	Power exchange deviation	$P_{Deviation} = \frac{\lvert P_{accepted} - P_{activacted}\rvert}{P_{accepted}} \cdot 100$	$P_{accepted}$: 400kW $P_{activacted}$: 460kW (minimum)	15% (above)
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 4,94MW AL_{final}: 4,4MW	11%

In general, KPI values show positive results in term of cost effectiveness, error of load forecast, power exchange deviation and asset load profile variation, meaning the following:

- In economic terms, for this case, it is most efficient to use flexibility than the traditional solution (diesel generation) as flexibility cost is 17% of the traditional solution cost.
- Load forecast was very accurate, close to 98% of the real demand
- Requested power was delivered being up to 15% above the requested one (not considering late activation for the calculation of this KPI)
- The asset was impacted by flexibility activation decreasing its load 11%

On the other side, available flexibility in the area is only 9% of total area load, as only one customer participated with its flexibility in the demo site test.

7.1.8 Challenges

<u>The following objectives were reached in this demo:</u>

- DSO has been able to procure local flexibility day ahead using OMIE short term platform.
- FSP resources were activated during the contracted period although the activation was late on time.
- The FSP load reduction impacted the limiting asset load as expected.

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- The goal was reach 83% of the requested time.

Challenges:

- Some platform labels need to be changed to clarify the information that needs to be completed.
- There is no possibility to include duration less than 1 hour in the platform request window.
- To know which FSP has been cleared, it is necessary to log on in the long-term platform to get the information as it was not available at the short-term platform, only the FSP code is shown.
- Activation needs to start before the contracted time to avoid violations at the beginning of the period.
- It is not recommended to use prior load as reference to calculate the delivery as it could be an increase just before it. A baseline needs to be established to avoid this and evaluate FSP delivery compliance.
- It is necessary to have tools for forecasting estimation ahead of time.
- Some penalties may apply if there isn´t compliance for the whole period.

7.2 ES-iDE-02 Short-term intraday Murcia: scenario results

The steps followed as indicated in the BUC WECL-ES-02, Short term congestion management were:

1. Prepare/Pre-qualification
2. Plan/Forecast
3. Market Phase
4. Monitoring and activation
5. Measurement phase

7.2.1 Prepare/Pre-qualification

- FSP units: UMU_Campus de Espinardo
- Prequalification date: 26/07/2022

Table 7-8 – Pre-qualification timeline

FSP	Date of Initial Prequalification Data Reception	Final Date of approval by MO	Final Date of approval by DSO	Was initial data submitted complete?
FSP-iDE-01: UMU	26/07/22	26/07/22	26/07/22	Yes

- Results:

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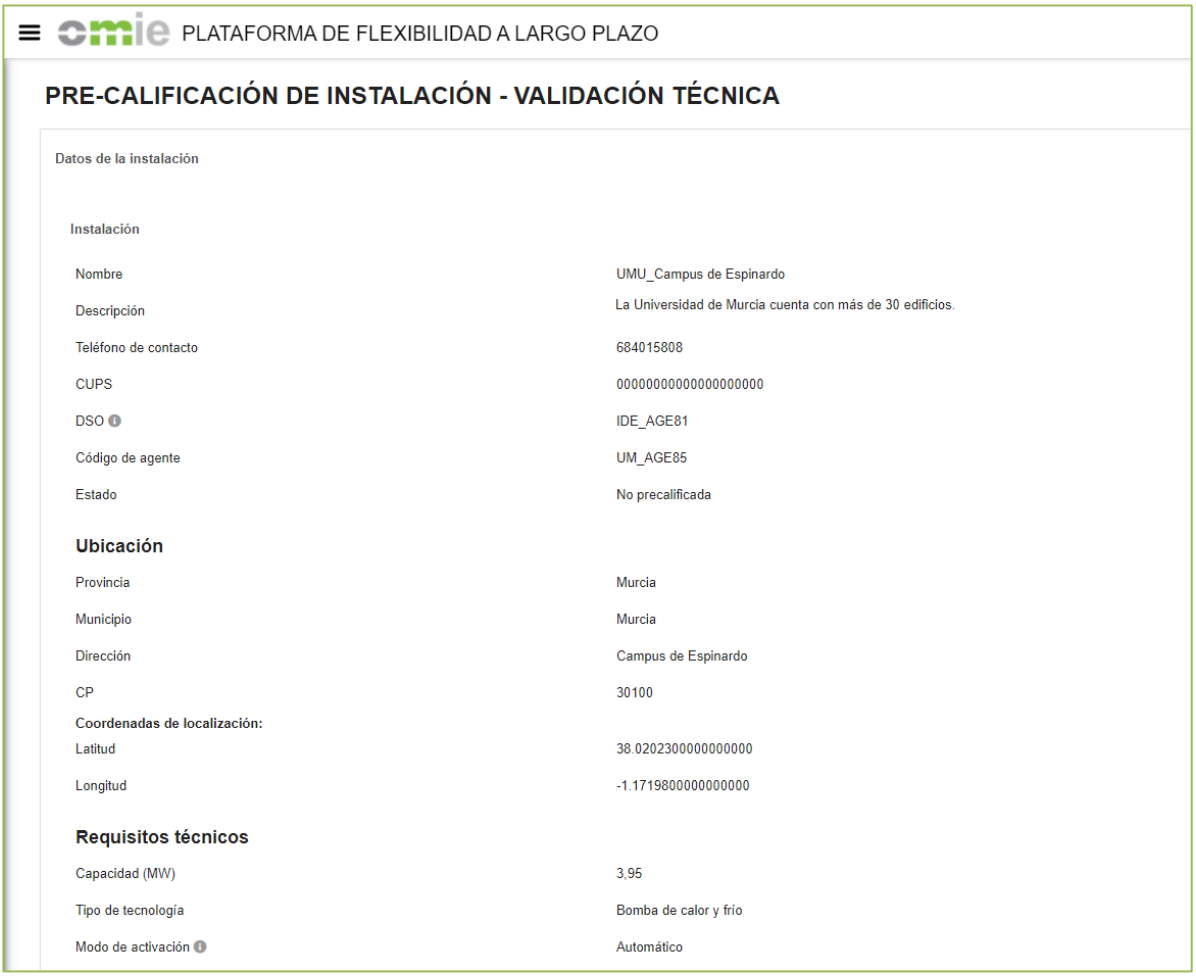

Figure 7-10: Prequalification scenario for Murcia University

7.2.2 Plan/Forecast

The complete problem assessment is included in section 6.2, ES-iDE-02, Short-term intraday Murcia:

- Timeline: 12:00pm-12:30pm, 28/07/2022
- Limiting assets: Murcia University 20kV feeder line
- Critical load (when the problem happens): 5,5 MW (feeder line)
- Forecast Load: 6 MW
- Requirement: 0,5 MW
- DSO requirement date: 28/07/2022, intraday (before 10 am), energy (activation)

7.2.3 Market Phase

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Market phase includes the following steps:

1. DSO request,
2. Market opening,
3. Qualification,
4. Bid collection,
5. Market clearing.

1. **DSO request**: Introduce DSO intraday request in OMIE short term platform, 28/07/2022 before 10am, to be able to schedule the delivery at 12pm.

   Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside. In this case, the area was created for prior demo, **Error! Reference source not found.**.

   1.1. Log on in Short-term OMIE Platform

   1.2. Introduce request:

Figure 7-11: ST Murcia intraday – DSO introduce request selection

Figure 7-12: ST Murcia intraday – DSO request

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DSO request is introduced in the screen shows in Figure 7-12 with the following information, as presented in the plan forecast:

- Area, “Código de zona agregada”: i-DE Espinardo
- Activation direction, “Sentido”: Downward consumption (“Subir generación/Bajar consumo”)
- Quantity (MW/h), “Cantidad”: 0,25*
- Limit Price (€/MWh), “Precio límite”: 4.660
- Delivery time, “Fecha de entrega”:
  - Day: 07/28/2022
  - Initial time, “Hora de inicio”: 13**
  - Final time, “Hora de fin”: 13**

Notes: * The value has been introduced as energy (0.5 MW*0,5 h=0.25 MWh), but it was power to keep for 1 hour. It was a misinterpretation that was corrected later** Initial time and final time selection are in 1 hour period; The number represents the final time. If the delivery is equal or less than 1 hour, initial and final period has to be the same. There is no possibility of including duration less than 1 hour in the platform.

2. Market opening: The market is open from 10am to 10:45 pm

FSPs located in the selected area can bid from 10pm to 10:45. Figure 7-5 shows the bid which was introduced by Murcia University:

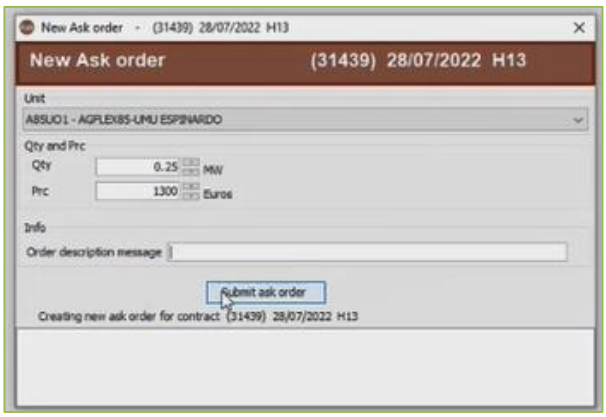

Figure 7-13: ST Murcia day ahead – FSP bid

NOTE: For this test, the quantity value was introduced in MWh to agree with the request. That is the reason it appears 0,25 instead of 0,5 MW. The price is in €/MWh. The label showing “Euros” instead of “€/MWh” for the price box, was corrected later.

Another FSP has been simulated in this test to have a second bid:

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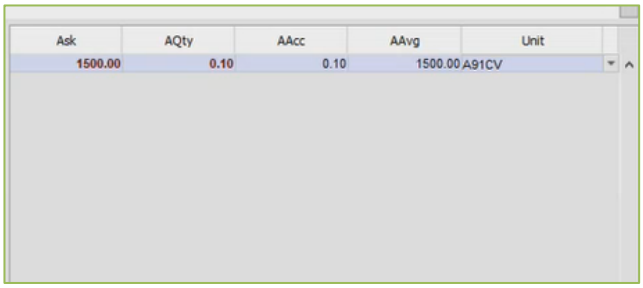

Figure 7-14: ST Murcia day ahead – Simulated FSP bid

3. **Qualification**: only the bids of prequalified resources located in the area, participating with a quantity below its total recognized capacity are accepted.

4. **Bids received:**

Table 7-9 – ST Murcia intraday - Bids

BID ID	FSP ID	Volume Offered (kW)	Price (€/MWh)
1	FSP-iDE-01: UMU	500	1.300
2	FSP: Simulated 1	20	1.500

5. **Market clearing:**

Table 7-10 – ST Murcia intraday – Market clearing

BID ID	Cleared (YES/NO)	Quantity Cleared (kW)	Price (€/MWh)
1	YES	500	1.300

Table 7-11 shows a summary of the market phase:

Table 7-11 – ST Murcia intraday – market phase summary

Market Session ID	ES-iDE-02 Short-term intraday Murcia
Request date	28/07/2022 at 9:50am
Market session	28/07/2022 10am-10:45am
Market clearing date/time	28/07/2022 11am
Number of bids received	2
Volume of bids received - in kW or kWh	520 kW/260 kWh
Number of bids cleared	1
Volume of bids cleared - in kW or kWh	500 kW/250 kWh
Total cost of capacity/energy cleared (in €/MWh)	1.300
Average cost of capacity/energy cleared (in €/MWh)	1.300

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7.2.4 Monitoring and Activation

Resources were activated by FSP on 28/07/2022 from 12:00 to 12:30 as contracted in the short-term local market. Monitoring is done by FSP in its installation and by DSO in its monitored assets to verify and measure resources delivery.

7.2.5 Measurement phase

Two elements are measured as it is shown in Figure 7-15:

- Limiting asset load: 20 kV UMU feeder line (identified with blue color)
- Resource load/delivery: FSP, UMU (identified with orange color)

NOTE: a test was done 27/07/2022 before market session to test the delivery, that is the reason the curves look similar both days.

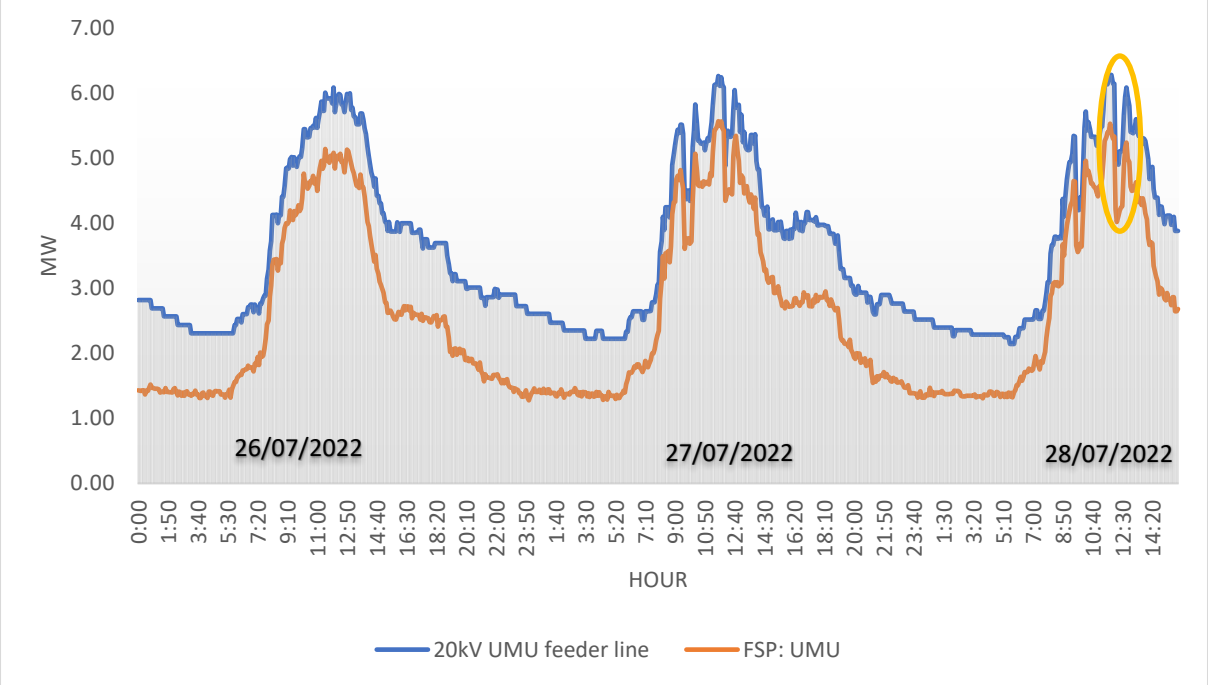

Figure 7-15: ST Murcia intraday – Load evolution

1. **Limiting asset load:** 20 kV UMU feeder line

Figure 7-16 shows the evolution of 20 kV UMU feeder during the activation time (12:00pm-12:30pm). The line has been below the critical load, 5,5 MW, except at the beginning of the period (12:00pm) because the activation was started at that moment.

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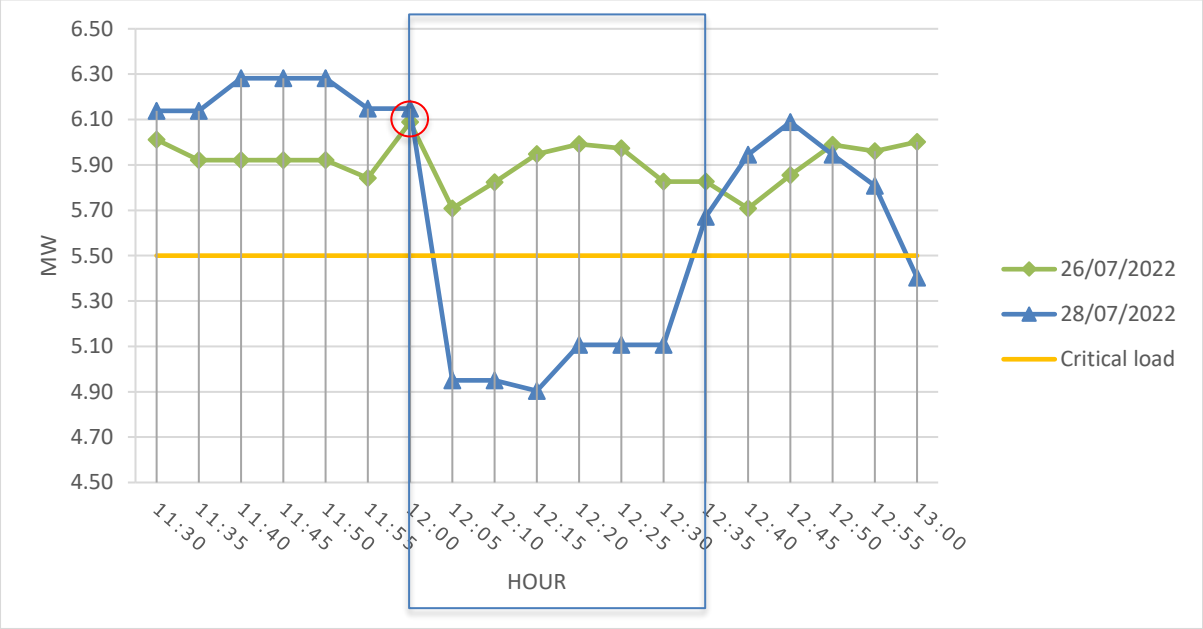

Figure 7-16: 20 kV UMU feeder line load, 12:00-12:30

2. Resource load/delivery: FSP, UMU

Figure 7-17 shows the evolution of UMU load during the activation time (12:00pm-12:30pm) and

Figure 7-18 shows the delivered quantity for two different cases:

- Considering the initial load: load at 11:55am
- Considering as base line the load on 26/07/2022

As the activation was late on time, the delivery didn't reach the objective (400 kW) at the beginning of the period (12:00pm) being above for the rest of the period for both cases (considering initial load or 26/07/2022 as baseline load).

If the two references are compared, it looks a better approximation to compare with a reference base line, as 26/07/2022, to avoid comparing with a high value if an increased in load is done before the activation to have mayor margin, as it is shown in Figure 7-17 (red arrow), although small than in the prior case, Figure 7-8**,** because 12pm is peak time and it was already a high load value.

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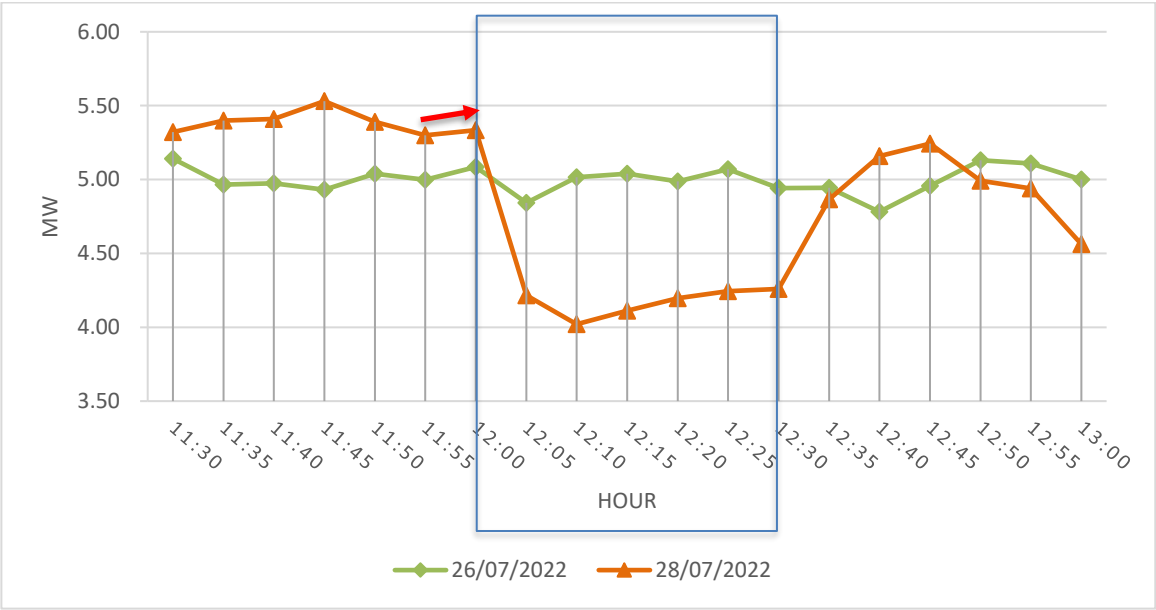

Figure 7-17: 20 kV UMU load, 12:00-12:30

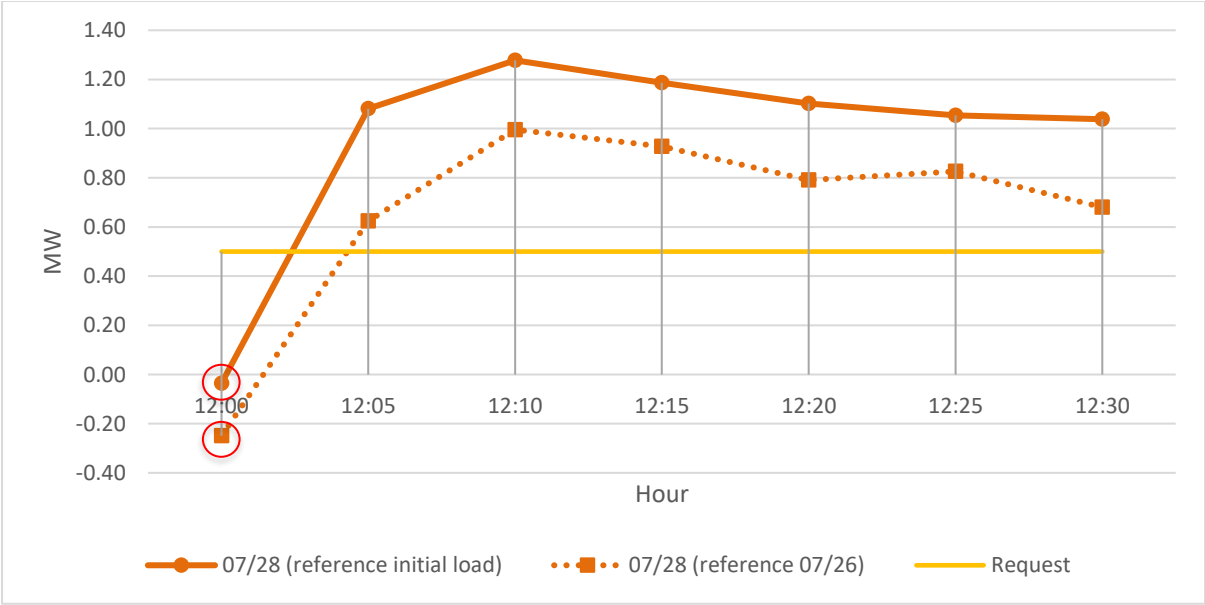

Figure 7-18: ST Murcia intraday –Delivery quantity evolution

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Table 7-12 – ST Murcia intraday – Measurement information

Maximum load in MW at DEMO limiting asset:	5,11 (no considering 12pm point)
Forecasted load 3 hours in advanced (MW):	6,00
Initial limiting asset load (before activation)	6,15
Activation date:	28/07/2022
Minimum activated flexibility power (MW)*	0,62 (no considering late activation)
Maximum activated flexibility power (MW)*	1
Energy delivery (MWh)*	0,37

*Using as reference 07/26

7.2.6 Settlement phase

- Compliance (Y/N): Partially, 91% of the time
- Penalties amount: No
- Total cost: 1.300 €MWh*0,25 MWh=325 €

NOTE: No additional payment over the agreed energy. That is the reason the calculation is done with 0,25 MWh instead of the delivered one, 0,37 MWh.

7.2.7 Demo KPI results

Table 7-13 – ST Murcia day intraday – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 4.660€/MWh $Cost_{flex}$: 1.300€/MWh	72%
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,52MW $\sum P_{Total_{in_{Area}}}$: 5,1MW	10%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right) . 100$	FC_{load} : 6MW RL_{load} : 6,15MW N=1	2,4%
5	Power exchange deviation	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 500kW $P_{activacted}$: 620kW (minimum)	24% (above)
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 6,15MW AL_{final}: 5,11MW	20%

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In general, KPI values show positive results in term of cost effectiveness, error of load forecast, power exchange deviation and asset load profile variation meaning the following:

- In economic terms, for this case, it is most efficient to use flexibility than the traditional solution, diesel generation as flexibility cost is 28% of the traditional solution cost.
- Load forecast was very accurate, close to 98% of the real demand
- Requested power was delivered being up to 24% above the requested one (no considering late activation)
- The asset was impacted by flexibility activation decreasing its load 20%

On the other side, available flexibility in the area is very low, only 9% of the total area load, as only one customer participated with its flexibility in the demo site test.

7.2.8 Challenges

The following objectives were reached in this demo:

- DSO has been able to procure local flexibility intraday using OMIE short term platform.
- FSP resources were activated during the contracted period.
- The FSP load reduction impacted the limiting asset load as expected.
- The goal was reach 91% of the requested time.

Challenges:

- There aren't notifications from the platform to FSPs to advise them about the coming of an intraday market and opening auction time. They must log on in the short term platform to know about it.
- Some platform labels need to be changed to clarify the information that needs to be completed.
- There is no possibility to include duration less than 1 hour in the platform.
- To know which FSP has been cleared, it is necessary to log on in the long-term platform to get the information as it was not available at the short-term platform, only the FSP code is shown.
- Activation needs to start before the contracted time to avoid violations at the beginning of the period.
- It is not recommended to use prior load as reference to calculate the delivery as it could be an increase just before it. A baseline needs to be established to avoid this and evaluate FSP delivery compliance.
- It is necessary to have tools for forecasting estimation ahead of time.
- Some penalties may apply if there isn´t compliance for the whole period.

7.3 ES-iDE-03 Long-term Murcia

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

The steps followed as indicated in the BUC WECL-ES-01, long term congestion management were:

1. Prepare/Pre-qualification,
2. Plan/Forecast,
3. Market Phase,
4. Monitoring and activation,
5. Measurement phase.

7.3.1 Prepare/Pre-qualification

- FSP units: UMU_Campus de Espinardo
- Prequalification date: 26/07/2022

Table 7-14 – Pre-qualification timeline

FSP	Date of Initial Prequalification Data Reception	Final Date of approval by MO	Final Date of approval by DSO	Was initial data submitted complete?
FSP-iDE-01: UMU	26/07/22	26/07/22	26/07/22	Yes

- Results:

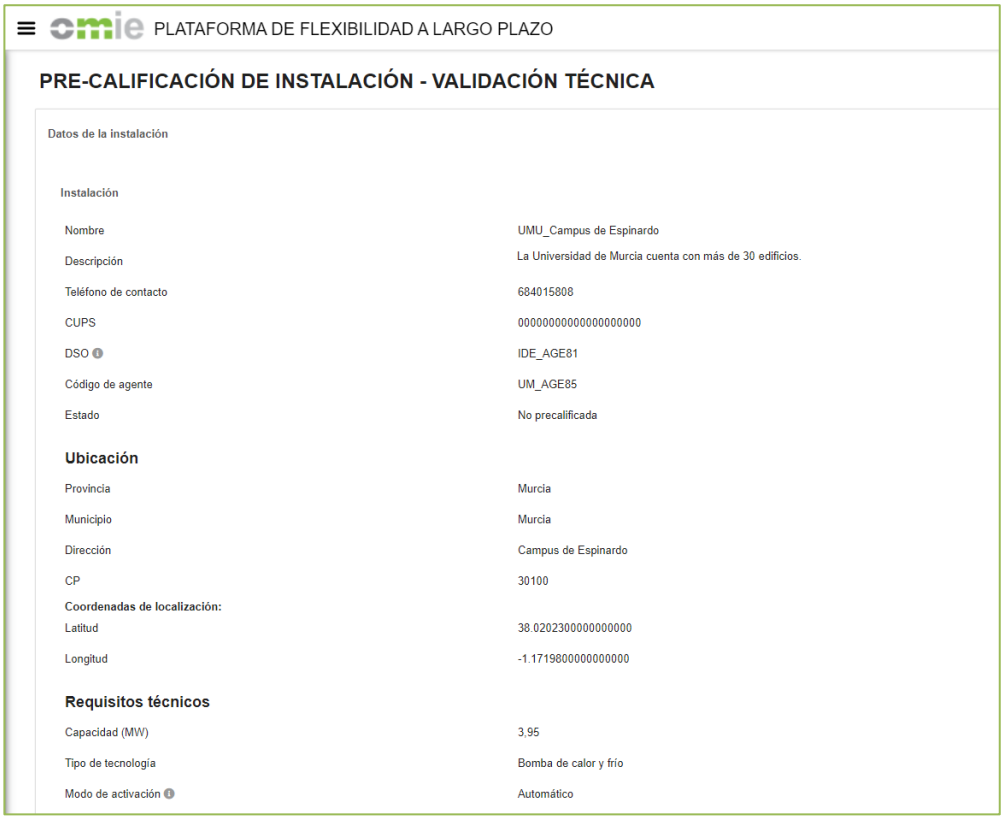

Figure 7-19: Prequalification scenario for Murcia University

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7.3.2 Plan/Forecast

The complete problem assessment is included in section 6.3, ES-iDE-03, long-term Murcia:

- Timeline: 3 years 2022-2025 summer (July-September) and winter (January) peak time

Table 7-15 – ES-iDE-03 Long-term Murcia – Timeline request

	Period	Service window	Days	Duration	%
2022/23	July & September	10:00-19:00	L-V	3 hours	19%
	January	10:00-13:00	L-V		21%
2023/24	July & September	10:00-19:00	L-V	3 hours	19%
	January	10:00-13:00	L-V		21%
2024/25	July & September	10:00-19:00	L-V	3 hours	19%
	January	10:00-13:00	L-V		21%

- Limiting assets: Murcia University 20 kV feeder line
- Critical load (when the problem happens): 5,7 MW (feeder line)
- Forecast Load/Requirement:

Table 7-16 – ES-iDE-03 Long-term Murcia – Forecast/requirement

Year	Summer Peak	Summer requirement	Winter Peak	Winter requirement
2022/23	6,8 MW	1,1 MW	6,3 MW	0,6 MW
2023/24	6,8 MW	1,1 MW	6,3 MW	0,6 MW
2024/25	6,8 MW	1,1 MW	6,3 MW	0,6 MW

- DSO requirement date: Years/Weeks/days before need **(**Availability + Energy). For demo requirement was done 29/07/2022.

7.3.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Qualification,

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3. Market opening,
4. Bid collection,
5. Market clearing.

1. **DSO request**: Introduce DSO long term request in OMIE long term platform. It can be done years/weeks/days ahead of time. In this case, it was done 29/07/2022 for open negotiation 05/08/2022.
   1.1. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside. In this case, the area was created previously, **Error! Reference source not found.**.
   1.2. Introduce request:
      1.2.1. Negotiation date: 05/08/2022, Figure 7-20
      1.2.2. Area: i-DE Espinardo, Figure 7-21
      1.2.3. Data information, Figure 7-22
      1.2.4. Service window, Figure 7-23
      1.2.5. Additional information

Figure 7-20: LT Platform – Negotiation date selection

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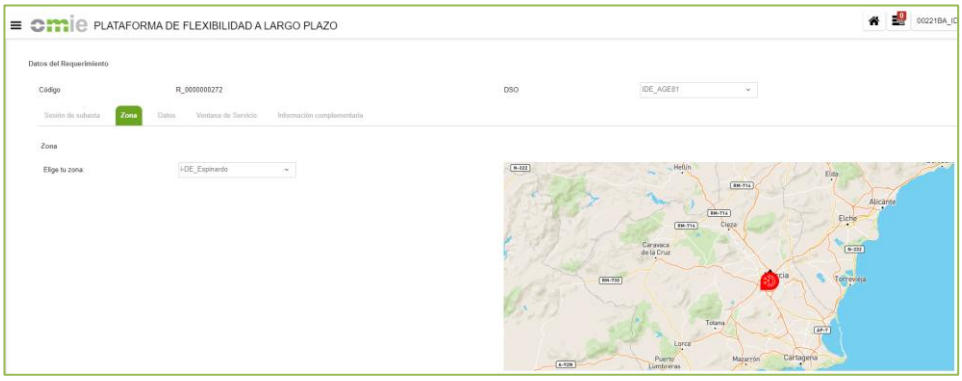

Figure 7-21: LT Platform – Area selection

Flexibility request information is introduced in the screen shows in Figure 7-22. It is noted that it wasn´t possible to include the whole request, from 2022-2025, to delay the traditional project 3 years, as the long-term platform doesn´t allow to include more than one period in each request. To solve it, for this demo, we have included only a request for September 2022, dividing the annual cost between 3 periods (January, July and September) to calculate the price: 2.985 €=8.955,01/3

The following information has been included:

- Product type, "Categoria de producto": A+E, "Activación firme"
- Quantity (MW), "Capacidad Requerida (MW)": 1,1
- Activation direction, "Sentido": Downward consumption ("Subir generación/Bajar consumo")
- Minimum required offer to participate, "Potencia minima requerida a los DER cualificados para ofertar (MW)": 0.1
- Price:
    - Availability fee (€/MW), "Término de disponibilidad (€/MW)": 814,10*
    - Utilization fee (€/MWh), "Término de utilización (€/MWh)": 44,17*

Notes: * The values have been estimated considering the probability of activation for the service window during September using prior year information, with is equal to 24 % (~43 hours) of the service window.

Check: 814.10 €/MW*1.1 MW+44.17 €/MWh*1.1 MW*43 h=2,985 € (maximum September price)

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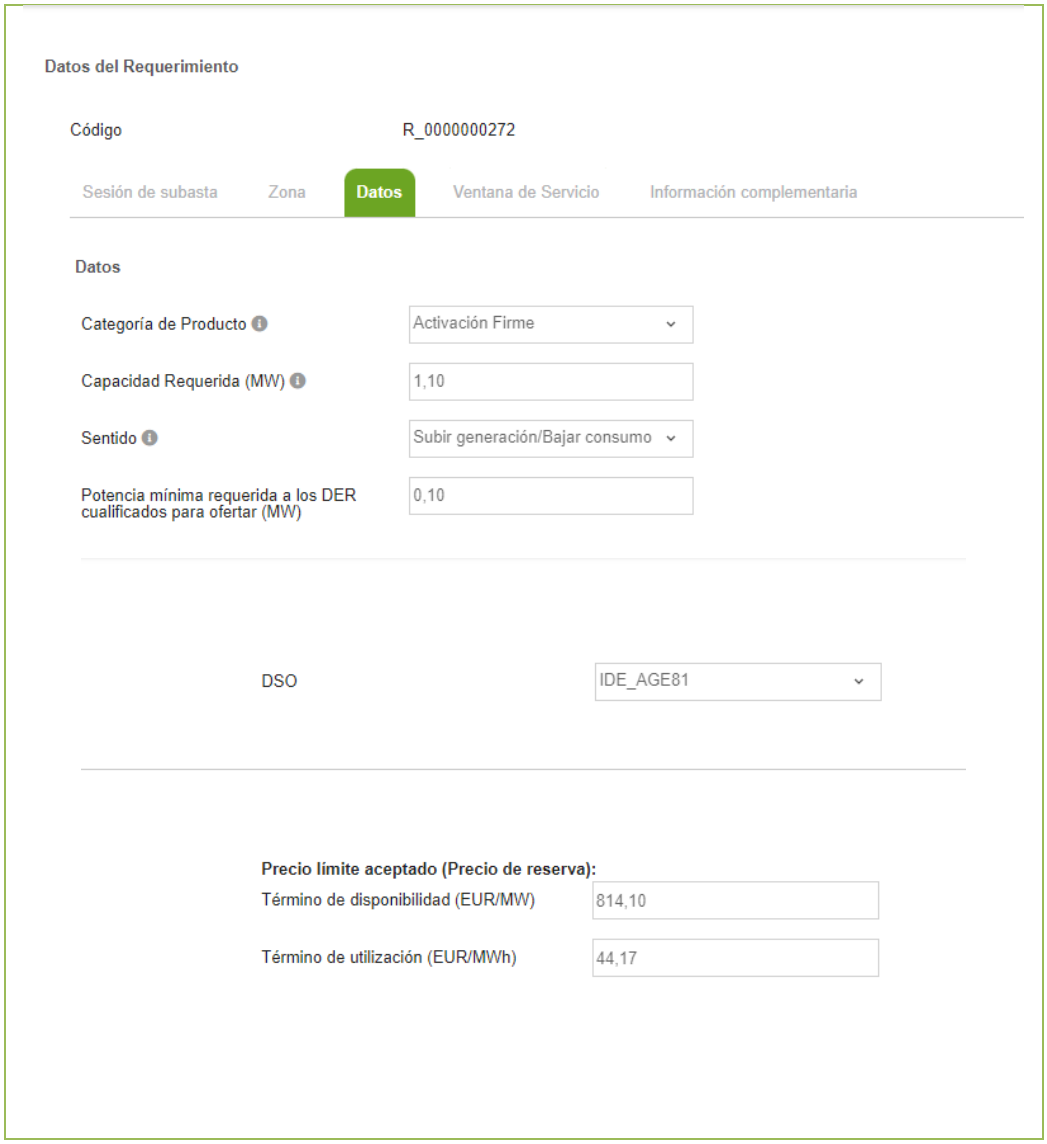

Figure 7-22: LT Platform – Data

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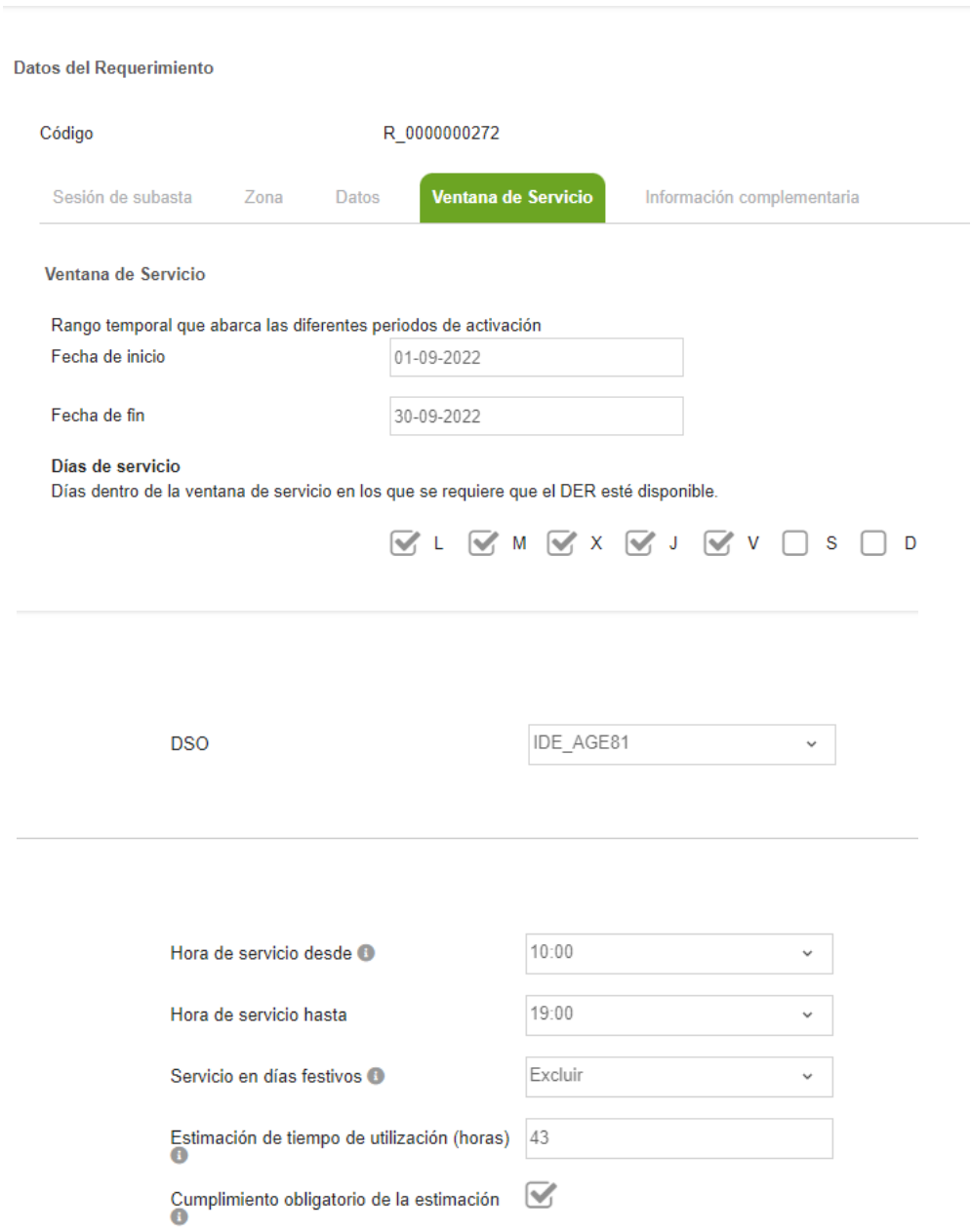

Figure 7-23: LT Platform – Service window

The service window is introduced in Figure 7-23 with the following information:

- Time period, "Rango temporal que abarca los diferentes periodos de activación":
  - Initial date, "Fecha de inicio": 01/09/2022
  - Final date, "Fecha de fin": 30/09/2022
- Service days, "Días de servicio": Monday "L", Tuesday "M", Wednesday "X" and Friday "V"
- Service hours, "Horas de servicio":

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- From, “Hora de servicio desde”: 10am
- To, “Hora de servicio hasta”: 7pm

- Include holiday days, “Servicio en días festivos”: Exclude, “Excluir”
- Approximated numbers of utilization hours: 43

1.3. Create request: The request is sent to the Market Operator (OMIE) who has to approve it. Once approved it, it is shown in the long-term platform screen, Figure 7-24, to allow FSPs to apply for a qualification to be able to participate in the future market.

Figure 7-24: LT Platform – Long term request information

2. **Qualification**: FSP introduces its information in order to be qualified by the DSO to participate in that market. The DSO has to approve (“Confirmar”) or decline (“Cancelar”), after checking the technical conditions, Figure 7-25 and verify the quantity they are asking for qualification. In this case, it is equal to the request amount: 1.1 MW.

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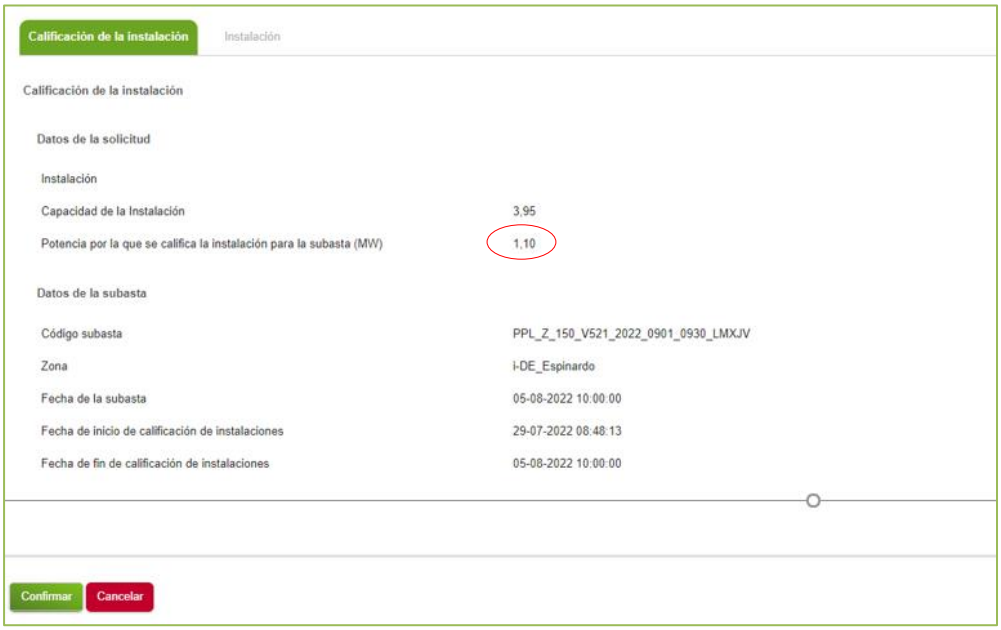

Figure 7-25: LT Platform – DSO Qualification validation screen

3. **Market opening**: The market is open from 10am to 1pm on August 5th

Qualified FSPs located in the selected area can bid from 10pm to 1pm. Figure 7-26 shows the bid which was introduced by Murcia University:

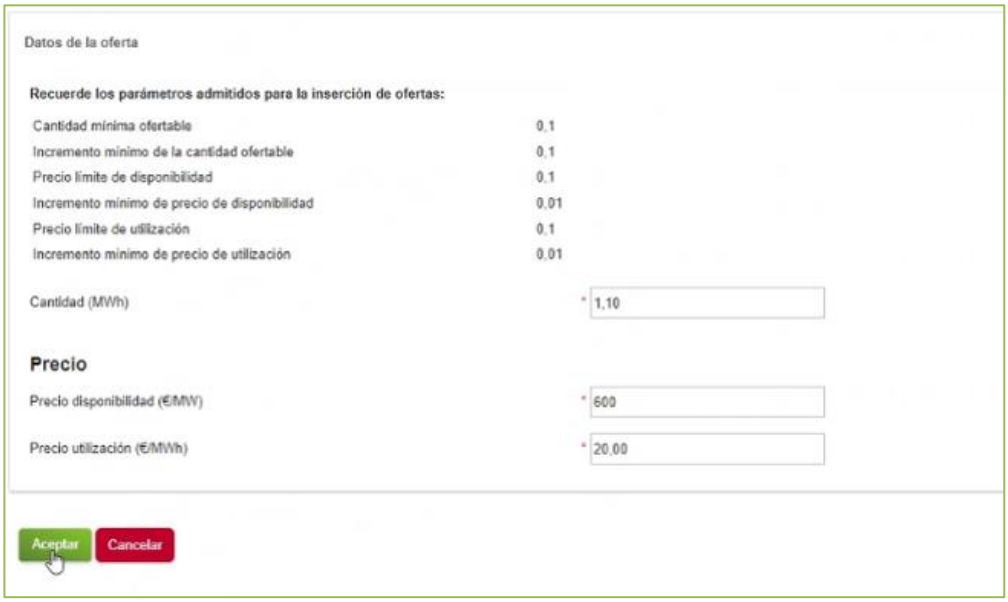

Figure 7-26: LT Platform – FSP bid

The following information has been included in the bid:

- Quantity (MWh), “Cantidad”: 1,10

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- Price, “Precio”:
- Availability fee (€/MW), “Término de disponibilidad (€/MW)”: 600
- Utilization fee (€/MWh), “Término de utilización (€/MWh): 20

4. **Bids received:**

Table 7-17 – Long term Murcia- Bids

BID ID	FSP ID	Volume Offered (kW)	Price
1	FSP-iDE-01: UMU	1.100	Availability (€/MW): 600
			Utilization fee (€/MWh): 20

5. **Market clearing:** The negotiation is done at 1pm. FSP and DSO has to log-on in the long-term platform to know the results:

Figure 7-27: LT Platform – Results

Table 7-18 – Long term Murcia – Market clearing

BID ID	Cleared (YES/NO)	Quantity Cleared (kW)	Price (€/MWh)
1	YES	1.100	Availability (€/MW): 600 Utilization fee (€/MWh): 20

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Table 7-19 shows a summary of the market phase:

Table 7-19 – Long term Murcia – market phase summary

Market Session ID	ES-iDE-03 Long-term Murcia
Request date	07/29/2022
Market session	08/05/2022 10am-1pm
Market clearing date/time	08/05/2022 1pm
Number of bids received	1
Volume of bids received - in kW or kWh	1.100
Number of bids cleared	1
Volume of bids cleared - in kW or kWh	1.100
Total cost of capacity/energy cleared	600€/MW / 20€/MWh
Average cost of capacity/energy cleared (in €/MWh)	600€/MW / 20€/MWh

7.3.4 Monitoring and Activation

Resources were asked by email, three hours ahead of time, to be activated during the service window on September 2nd, from 12:15 to 12:45 to avoid forecasted congestion.

Monitoring is done by FSP in its installation and by DSO in its monitored assets.

7.3.5 Measurement phase

Two elements are measured as it is shown in Figure 7-28:

- Limiting asset load: 20kV UMU feeder line (identified with blue color)
- Resource load/delivery: FSP, UMU (identified with orange color)

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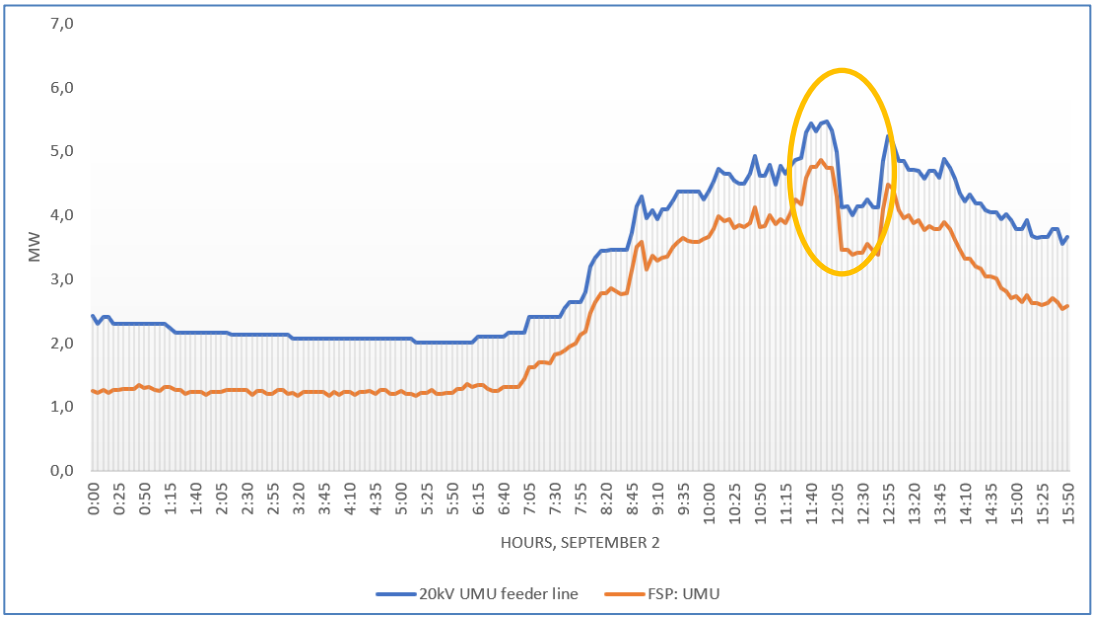

Figure 7-28: Long term Murcia – September 2nd, Load evolution

3. Limiting asset load: 20 kV UMU feeder line

Figure 7-29 shows the evolution of 20 kV UMU feeder during the activation time (12:15pm-12:45pm). The line has been below the critical load, 5,7 MW, during the whole period:

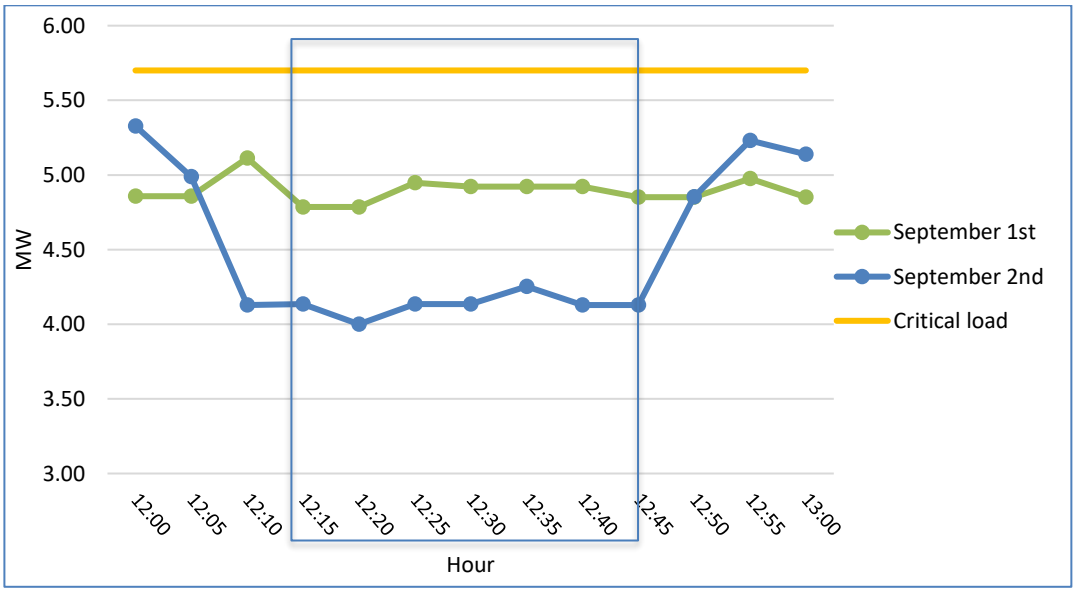

Figure 7-29: 20 kV UMU feeder line load

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4. **Resource load/delivery**: FSP, UMU

Figure 7-30 shows the evolution of UMU load during the activation time (12:15pm-12:45pm) and Figure 7-31 shows the delivered quantity considering as base line the day before load, 01/09/2022.

In this case, the activation was done 5 minutes before the required time to comply with the whole period.

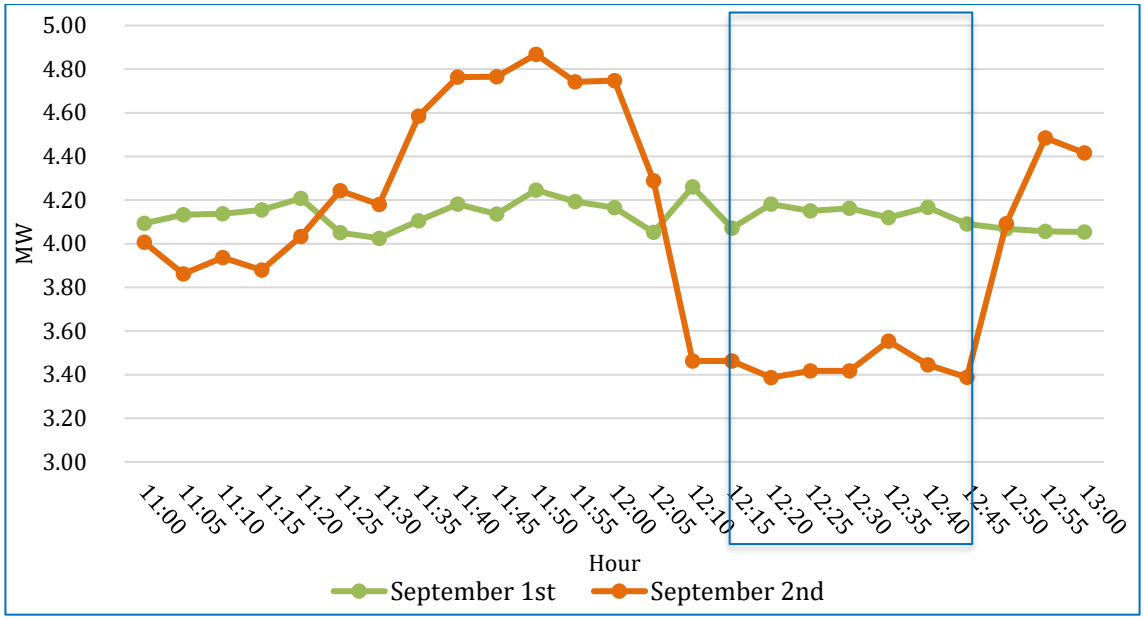

Figure 7-30: 20kV UMU load

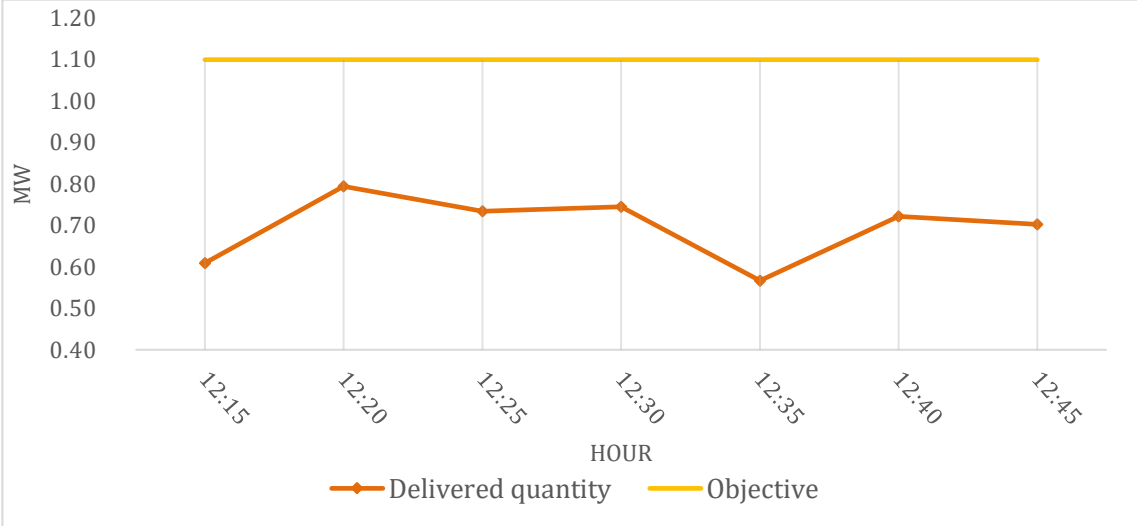

Figure 7-31: Long term Murcia –Delivery quantity evolution

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Figure 7-31 shows that the resources didn´t reach the targeted amount of flexibility, 1,1 MW, being 0,79 MW the largest amount, nevertheless the problem didn´t happen because the actual load was below the forecasted one during the requested period of time.

Maximum load in MW at DEMO limiting asset:	4,25
Forecasted load 3 hours in advanced (MW):	6,8
Initial limiting asset load (before activation)	4,99 (12:05)
Activation date:	02/09/2022
Minimum activated flexibility power (MW)*	0,57
Maximum activated flexibility power (MW)*	0,79
Energy delivery (MWh)*	0,35

*Using as reference 01/09

7.3.6 Settlement phase

- Compliance (Y/N): NO

  As for this case there is no compliance, a penalty would need to be applied. This is something that will be discussed in delivery D9.6, but for this case, as recommendation, is use a correction factor, defined in the following formula, which could be a possibility to calculate the penalty. If the value is less than 65%, there will be no payment at all:

$$Correction\ Factor\ (CF) = \frac{Real\ delivery\ energy\ (MWh)}{Capacity\ notification\ (MW) * \ Required\ time\ (hr)} * 100$$

- Penalties amount: Yes. Correction factor is applied:
  - $Correction\ Factor\ (CF) = \frac{Real\ delivery\ energy\ (MWh)}{Capacity\ notification\ (MW) * Required\ time\ (hr)} * 100 = \frac{0{,}35\ MWh}{1{,}1\ MW * 0{,}5\ h} * 100 = 64\ \%$
- Cost availability term: 0 € (Correction Factor is less than 65 %. No payment)
- Cost activation term: 0,35 MWh*20 €/MWh=7 €
- Total cost: 7 €

7.3.7 Demo KPI results

Table 7-20 – Long term Murcia – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 2.985€ $Cost_{flex}$: 1.606€	53%

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ID	Name	Formula	Variables	Value
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 1,1MW $\sum P_{Total_{in_{Area}}}$: 4,25MW	25%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right) . 100$	FC_{load} : 6,8MW RL_{load} : 4,99MW N=1	36%
5	Power exchange deviation	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 1,1MW $P_{activacted}$:0,57MW (minimum)	48% (below)
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 4,99MW AL_{final}: 4,25MW	15%

For this case, the results aren´t so positive as in previous cases, because although flexibility cost is most efficient, the percentage of flexibility is 25% of the demand, and the asset variation was up 15% of load, the delivery power didn´t reach the requested amount being in some cases 48% below the contracted amount.

Nevertheless, the problem didn´t happen because the forecast accuracy was 64% and the real load was below the predicted one, not been close to the critical load.

7.3.8 Challenges

The following objectives were reached in this demo:

- DSO was able to procure local flexibility in advance using OMIE long term platform.
- Prequalification notifications were sent via email by the long-term platform during the process.
- FSP resources were activated during the contracted period and activation was done before the requested time to cover the whole period.
- The FSP load reduction impacted the limiting asset load.
- The asset was below the critical load but the provider didn´t reach the requested amount during the activation period.

Challenges:

- It wasn´t possible to include the whole request, from 2022-2025, to delay the traditional project 3 years, as the long-term platform doesn´t allow to include more than one period in each request. If it is not possible to get flexibility for all the periods, the traditional solution can´t be delayed because there isn´t assurance to cover the whole period, 3 years in this case.

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- There aren't notifications to advise about the clearing. It is needed to log on in the platform to get the information.
- Notification of activation was done by email from DSO to resource.
- To keep activation more than 30 minutes could affect comfort.
- Activation needs to start before the contracted time to avoid violations at the beginning of the period.
- It is not recommended to use prior load as reference to calculate the delivery as it could be an increase just before it. A baseline needs to be established to avoid this and evaluate FSP delivery compliance.
- Penalty calculation: the targeted amount wasn´t reached but the problem didn´t happen because actual load was below forecasted load. A correction was applied to the availability term being the payment equal to 0 for this term.

7.4 ES-iDE-04 Short-term day ahead Madrid: scenario results (Two 30min tests)

The steps followed as indicated in the BUC WECL-ES-02, Short term congestion management were:

1. Prepare/Pre-qualification
2. Plan/Forecast
3. Market Phase
4. Monitoring and activation
5. Measurement phase

7.4.1 Prepare/Pre-qualification

- FSP units: Comillas Cantoblanco
- Prequalification date: 24/10/2022

Table 7-21 – Pre-qualification timeline

FSP	Date of Initial Prequalification Data Reception	Final Date of approval by MO	Final Date of approval by DSO	Was initial data submitted complete?
FSP-iDE-02: Comillas	15/09/22	15/09/22	24/10/22	Yes

- Results:

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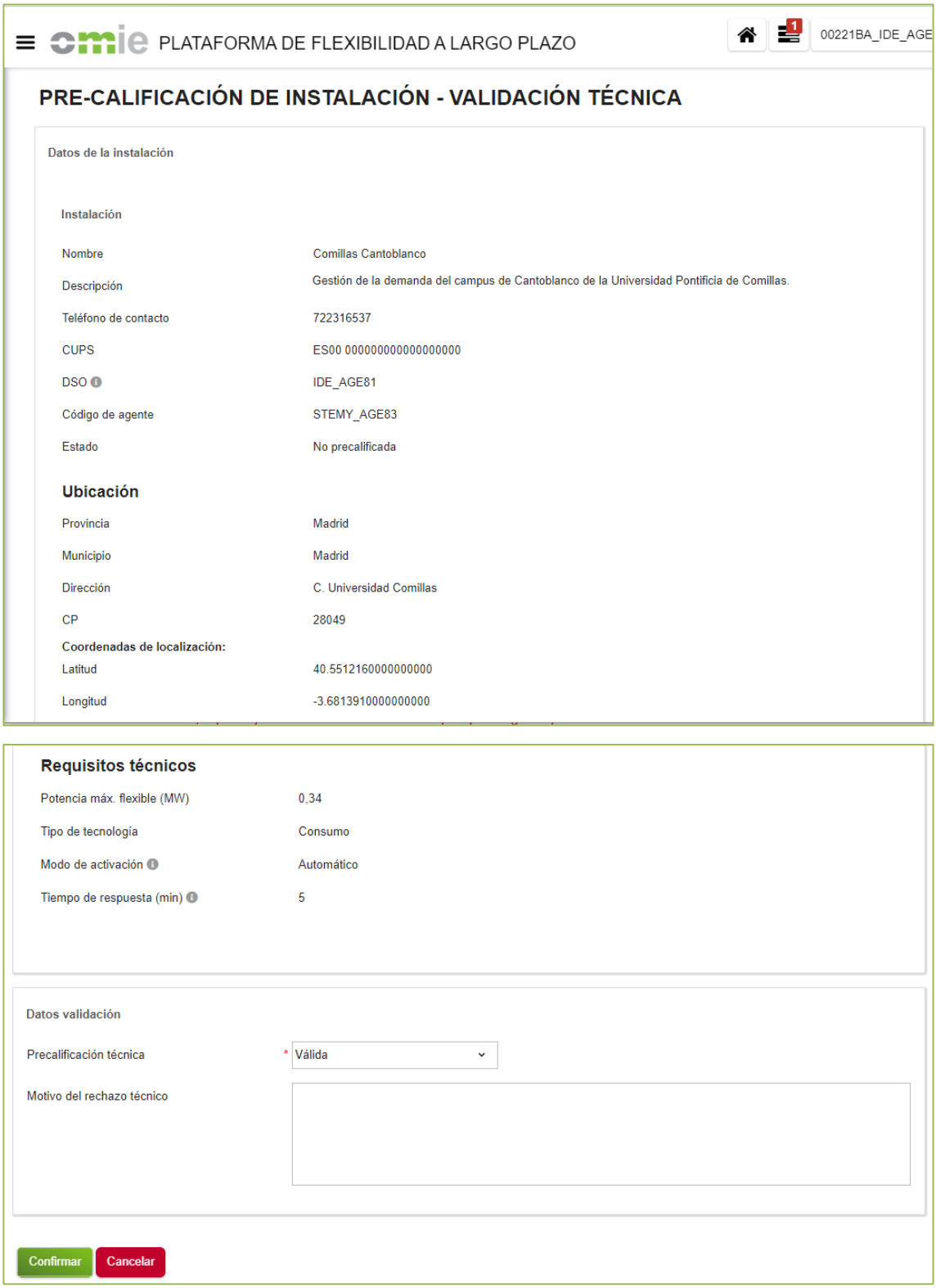

Figure 7-32: Prequalification scenario for Comillas University

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7.4.2 Plan/Forecast

The complete problem assessment is included in section 6.4, ES-iDE-04, Short-term day ahead Madrid:

- Timeline: 12:30-13:00, 14/01/2023 & 21/01/2023
- Limiting assets: Line 20kV feeder from substation 2
- Critical load (when the problem happens): 3MW (feeder line from substation 2)
- Forecast Load: 3,1 MW
- Requirement: 0,1 MW
- DSO requirement date: 13/01/2023 & 20/01/2023, day ahead, energy (activation)

7.4.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Market opening,
3. Qualification,
4. Bid collection,
5. Market clearing.

1. **DSO request**: Introduce DSO Day ahead request in OMIE short term platform, 13/01/2023 & 20/01/2023 before 1:35 pm:
   a. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside: i-DE_Cantoblanco

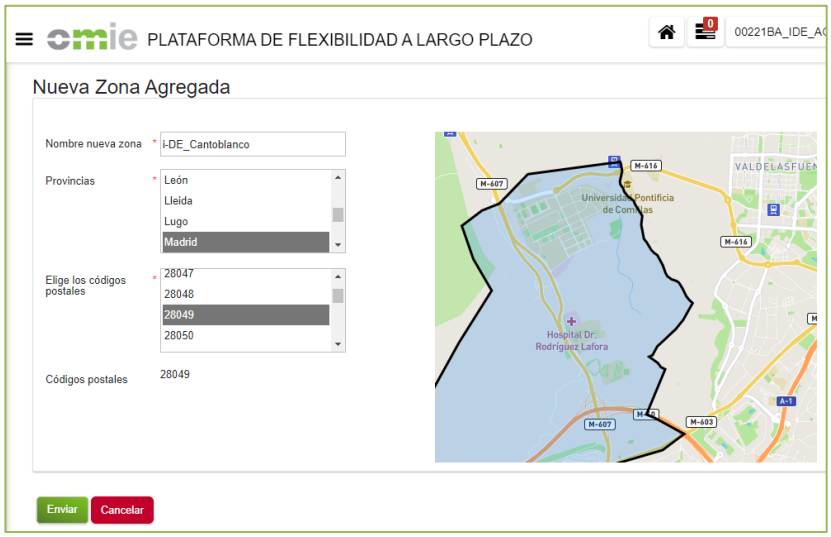

Figure 7-33: ST Cantoblanco 30min day ahead – Area creation in LT market platform

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b. Log on in Short-term OMIE Platform

c. Introduce request (January 13th and January 20th):

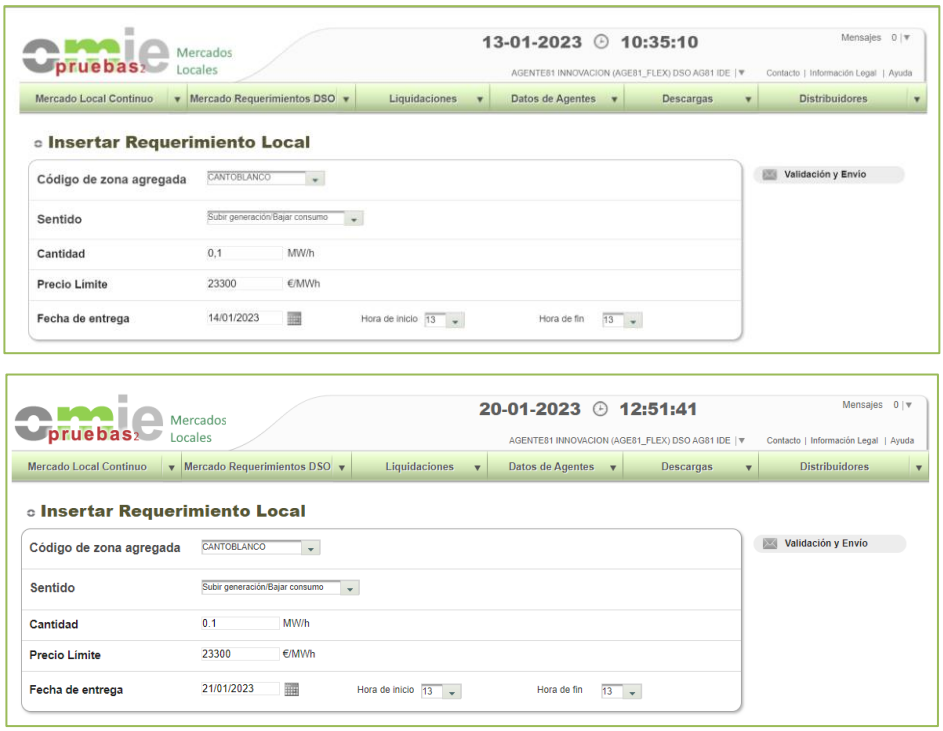

Figure 7-34: ST Cantoblanco 30min day ahead – DSO request (test 1/test 2)

DSO request is introduced in the screen shows in Figure 7-12 with the following information, as presented in the plan forecast:

- Area, "Código de zona agregada": i-DE Cantoblanco
- Activation direction, "Sentido": Downward consumption ("Subir generación/Bajar consumo")
- Quantity (MW/h), "Cantidad": 0,1*
- Limit Price (€/MWh), "Precio límite": 23.300**
- Delivery time, "Fecha de entrega":
  - Day: 14/01/2023 (test 1); 21/01/2023 (test 2)
  - Initial time, "Hora de inicio": 13***
  - Final time, "Hora de fin": 13***

Notes: * The value has been introduced as power to be kept during 1 hour, although is requested for 30 min (in the previous case it was completed as MWh); ** The price is in €/MWh (0.1 MW*0.5 h=0.05 MWh; 1.165 €/0.05 MWh=23.300 €/MWh) ***Initial time and final time selection are in 1 hour period; The number represents the final time. If the delivery is equal or less than 1 hour, initial and final period have to be the same. Currently there is no possibility of including duration less than 1 hour in the platform.

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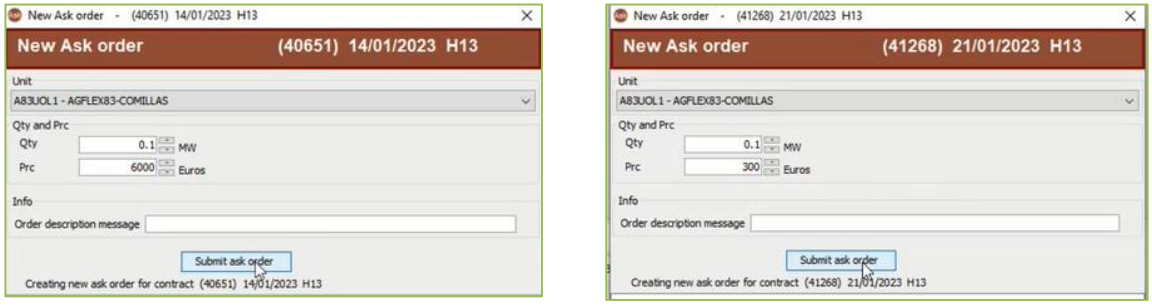
2. **Market opening**: The market is open from 1:40pm to 2pm 13/01/2023 for test 1, and 1:35pm-2pm on 20/01/2023 for test 2. (In general, short term day ahead markets have been scheduled for negotiation from 3pm to 3:45, although hours have been modified for the demo)

FSPs located in the selected area can bid from 1:40pm to 2pm (test 1) or 1:35pm-2pm (test2). Figure 7-35 shows the bid which was introduced by Comillas University:



Test January 14th *Test January 21st*

Figure 7-35: ST Comillas day ahead – FSP bids (January 14th & 21st)

NOTE: The price is in €/MWh

3. **Qualification**: only the bids of prequalified resources located in the area, participating with a quantity below its total recognized capacity are accepted.

4. **Bids received:**

Table 7-22 – ST Cantoblanco day ahead 30min– Bids (test 1&2)

Test (Delivery date)	Bid ID	FSP ID	Volume Offered (kW)	Price (€/MWh)
1: January 14th	**1.1**	FSP-iDE-02: COMILLAS	100	6.000
2: January 21st	**2.1**	FSP-iDE-02: COMILLAS	100	300

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5. **Market clearing:**

Table 7-23 – ST Cantoblanco day ahead 30min – Market clearing (test 1&2)

Test (Delivery date)	Cleared (YES/NO)	Bid ID	Quantity Cleared (kW)	Price (€/MWh)
1: January 14th	YES	**1.1**	100	6.000
2: January 21st	YES	2.1	100	300

Table 7-24 shows a summary of the market phase:

Table 7-24 – ST Cantoblanco day ahead 30min – market phase summary (test 1&2)

Market Session ID	ES-iDE-04 Short-term day ahead Cantoblanco January 14th (test 1)	ES-iDE-04 Short-term day ahead Cantoblanco January 21st (test 2)
Request date	13/01/2023 at 10:24am	20/01/2023 at 12:51pm
Market session	13/01/2023 1:40pm-2pm	20/01/2023 1:40pm-2pm
Market clearing date/time	13/01/2023 at 2:11pm	20/01/2023 at 2:03pm
Number of bids received	1	1
Volume of bids received - in kW or kWh	100kW/50kWh	100kW/50kWh
Number of bids cleared	1	1
Volume of bids cleared - in kW or kWh	100kW/50kWh	100kW/50kWh
Total cost of capacity/energy cleared (in €/MWh)	6.000	300
Average cost of capacity/energy cleared (in €/MWh)	6.000	300

7.4.4 Monitoring and Activation

Resources were activated by FSP on 14/01/2023 from 12:30 to 13:00 (test 1) and on 21/01/2023 from 12:30 to 13:00 (test 2) as contracted in the short-term local markets. Monitoring is done by FSP in its installation and by DSO in its monitored assets.

7.4.5 Measurement phase

Two elements are measured as it is shown in Figure 7-36:

- Limiting asset load: 20kV feeder from substation 2, Feeder Sub2 (identified with blue color)

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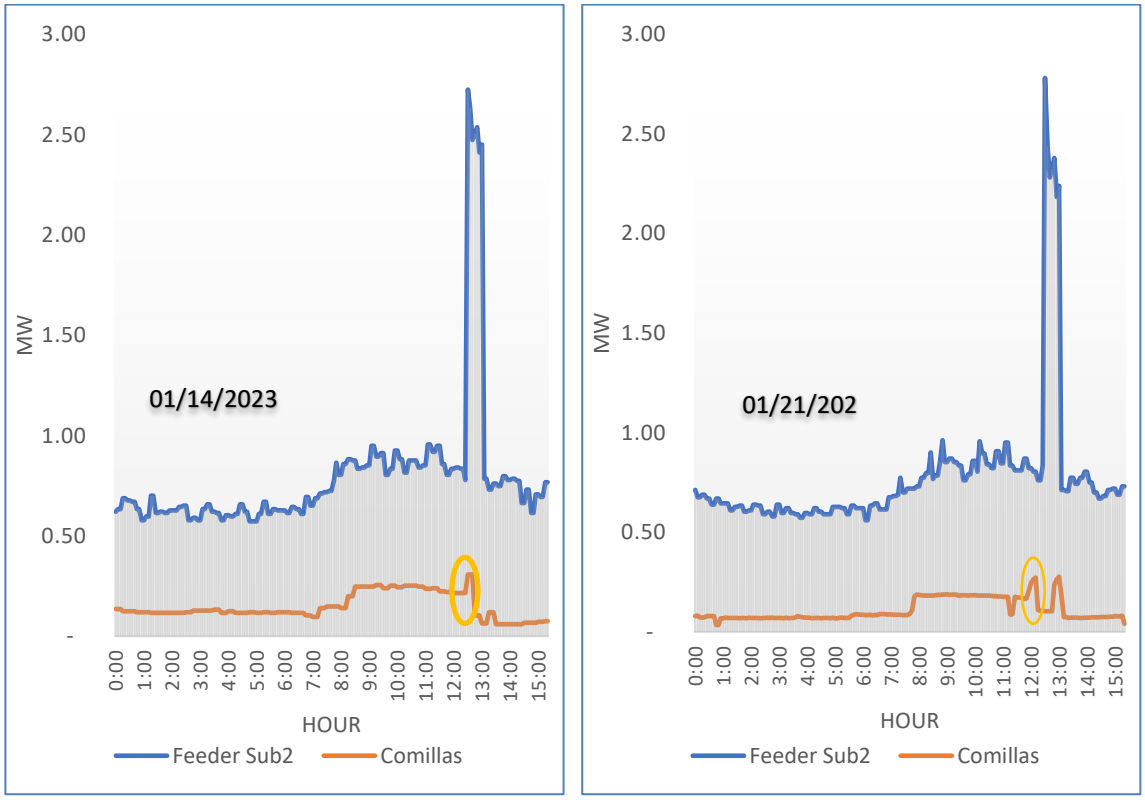
- Resource load/delivery: FSP, Comillas University, Comillas (identified with orange color)



Test January 14th

Test January 21st

Figure 7-36: ST Madrid, Cantoblanco – Load evolution

1. **Limiting asset load:** 20 kV Feeder Sub2

Figure 7-37 shows the evolution of 20 kV feeder during the activation time (12:30pm-13:00pm) after the breaker is opened and got the load from substation 1 feeder. The line has been below the critical load, 3MW, during the whole breaker maintenance period.

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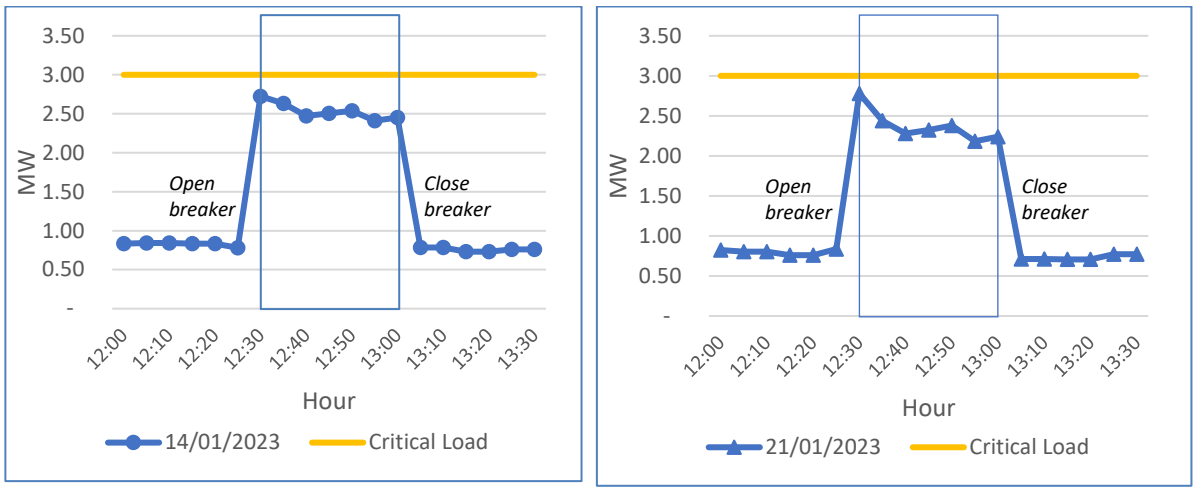

Test January 14th *Test January 21st*

Figure 7-37: 20 kV feeder from substation 2 load, 12:30-13:00

2. **Resource load/delivery**: FSP, Comillas University, Comillas

Figure 7-38 shows the evolution of Comillas load during the activation time (12:30pm-13:00pm) and Figure 7-39 shows the delivered quantity, for both tests, January 14th and January 21st.

Because of the tests were done in January, which is winter in Spain, and the demand respond came from the cooling systems, it was necessary heating the buildings to reach a summer temperature and then to proceed with the activation of the cooling systems to test the flexibility capabilities of these resources.

For that reason, the tests were done during the weekends, Saturdays, and it has been used as baseline the load just before activation, as that was a forced load situation.

In both tests, the delivery amount reached the objective (100 kW) on time and during the whole period, without having any activation problem an maintaining the temperatures in the comfort zone of the simulated summer day, except for the last point of test 2, as it looks like deactivation was done earlier.

A maximum of 244 kW and 168 kW were reached for test 1 (January 14th) and test 2 (January 21st) respectively, as it is shown in Figure 7-39.

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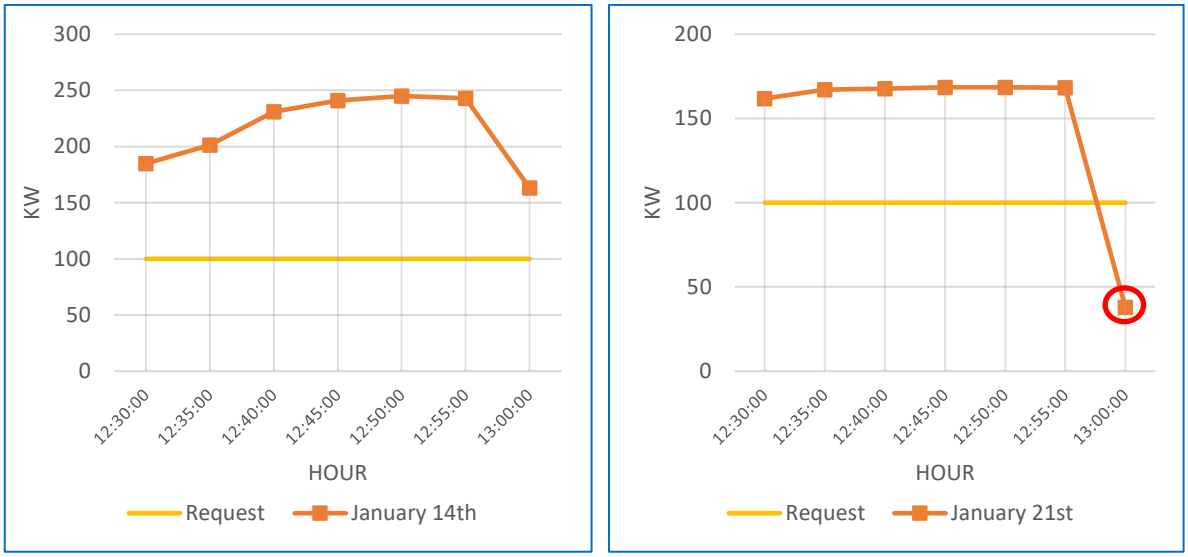
Test January 14th *Test January 21st*

Figure 7-38: 20 kV Comillas load, 12:30-13:00



Test January 14th *Test January 21st*

Figure 7-39: ST Comillas day ahead 30 min –Delivery quantity evolution

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Table 7-25 – ST Comillas day ahead 30min – Measurement information (2 tests)

	January 14th (test 1)	January 21st (test 2)
Maximum load in MW at DEMO limiting asset:	2,72	2,78
Forecasted load 1 day in advanced (MW)	3,1	3,1
Initial limiting asset load (before activation)	2,72	2,78
Activation date	14/01/2023	21/01/2023
Minimum activated flexibility power (MW)*	0,163	0,161 (0,379 last point)
Maximum activated flexibility power (MW)*	0,244	0,169
Energy delivery (MWh)*	0,111	0,078

*Using as reference time before activation

7.4.6 Settlement phase

- Compliance (Y/N): Y
- Penalties amount: NO
- Total cost:
  - Test 1: 6.000 €/MWh*0,05 MWh=300 €
  - Test 2: 300 €/MWh*0,05 MWh=15 €

NOTE: No additional payment over the agreed energy. That is the reason the calculation is done with 0,05 MWh instead of the delivered one, 0,111 MWh or 0,078 MWh.

7.4.7 Demo KPI results

Table 7-26 – ST Comillas day ahead 30min – KPI results (2 tests)

ID	Name	Formula	Variables	Value (test 1)	Value (test 2)
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 23.300 €/MWh $Cost_{flex}$: 6.000 €/MWh (1) $Cost_{flex}$: 300 €/MWh (2)	74%	98%
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,34M $\sum P_{Total_{in_{Area}}}$: 2,78MW	12%	12%

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ID	Name	Formula	Variables	Value (test 1)	Value (test 2)
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right).100$	FC_{load} : 3,1 MW RL_{load} : 2,72 MW (1) RL_{load} : 2,78 MW (2) N=1	14%	11%
5	Power exchange deviation	$= \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 100 kW $P_{activacted}$: 163 kW (1) $P_{activacted}$: 161 kW (2) (minimum)	63% (above)	61% (above)
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 2,72/2,78 MW AL_{final}: 2,45/2,24 MW	9%	19%

In general, KPI values show positive results in term of cost effectiveness, error of load forecast, power exchange deviation and asset load profile variation meaning the following:

- In economic terms, for both cases, it is most efficient to use flexibility than the traditional solution, diesel generation, as flexibility cost is 26% and 1%, respectively, of the traditional solution cost.
- Load forecast was accurate, close to 86% and 89% of the real demand.
- Requested power was delivered being up to 63% and 61% above the requested one.
- The asset was impacted by flexibility activation decreasing its load 9% and 19%

On the other side, available flexibility in the area is low, only 12% of the total area load, as only one customer participated with its flexibility in the demo site test.

7.4.8 Challenges

The following objectives were reached in this demo:

- DSO has been able to procure local flexibility day ahead using OMIE short term platform,
- FSP resources were activated at time during the contracted period,
- The goal was reached 100% and 91% for test 1 and test 2 respectively.

Challenges:

- There aren't notifications from the platform to FSPs to advise them about the coming of an intraday market. They must og on to know about it.
- Some labels need to be changed in the platform to complete the information.
- It is not possible to request activation for a 30-minute period in the platform.

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- To know which FSP has been cleared, it is necessary to log on in the long-term platform to get the information as it was not available at the short-term platform, only the FSP code is shown.
- It is difficult to see the impact of the FSP load reduction in the asset load because it is a small % of the total asset load, which has other small demands and generators.
- Because of the tests were done in January, which is winter in Spain, and the demand respond came from the cooling systems, it was necessary heating the buildings to reach a summer temperature and then to proceed with the activation of the cooling systems to test the flexibility capabilities of these resources. For that reason, the tests were done during the weekends, Saturdays, and it has been used as baseline the load just before activation, as that was a forced load situation.

7.5 ES-iDE-05 Short-term day ahead Madrid: scenario result (1 hour test)

The steps followed as indicated in the BUC WECL-ES-02, Short term congestion management were:

1. Prepare/Pre-qualification,
2. Plan/Forecast,
3. Market Phase,
4. Monitoring and activation,
5. Measurement phase.

7.5.1 Prepare/Pre-qualification

- FSP units: Comillas Cantoblanco
- Prequalification date: 24/10/2022

Table 7-27 – Pre-qualification timeline

FSP	Date of Initial Prequalification Data Reception	Final Date of approval by IMO	Final Date of approval by DSO	Was initial data submitted complete?
FSP-iDE-02: Comillas	15/09/22	15/09/22	24/10/22	Yes

- Results: same that previous case, Figure 7-32

7.5.2 Plan/Forecast

The complete problem assessment is included in section 6.5, ES-iDE-05, Short-term day ahead Madrid (1hr):

- Timeline: 11:00-12:00, 04/02/2023
- Limiting assets: Line 20 kV feeder from substation 2
- Critical load (when the problem happens): 3MW (feeder line from substation 2)
- Forecast Load: 3,1 MW

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- Requirement: 0,1 MW
- DSO requirement date: 03/02/2023, day ahead, energy (activation)

7.5.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Market opening,
3. Qualification,
4. Bid collection,
5. Market clearing.

1. **DSO request**: Introduce DSO Day ahead request in OMIE short term platform, 03/02/2023 before 11:30 am:
   a. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside: i-DE_Cantoblanco.
      In this case, the area was created for prior demo, Figure 7-33.
   b. Log on in Short-term OMIE Platform
   c. Introduce request (February 4th):

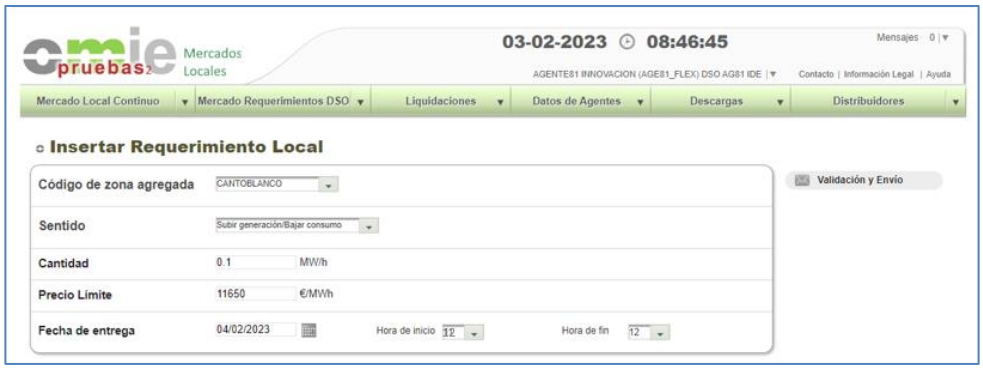

Figure 7-40: ST Cantoblanco 1hr day ahead – DSO request

DSO request is introduced in the screen shows in Figure 7-40 with the following information, as presented in the plan forecast:

- Area, “Código de zona agregada”: i-DE Cantoblanco
- Activation direction, “Sentido”: Downward consumption (“Subir generación/Bajar consumo”)
- Quantity (MW/h), “Cantidad”: 0,1*

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- Limit Price (€/MWh), “Precio límite”: 11.650**
- Delivery time, “Fecha de entrega”:
    - Day: 02/04/2023
    - Initial time, “Hora de inicio”: 12***
    - Final time, “Hora de fin”: 12***

Notes: * The value has been introduced as power to be kept during 1 hour, although is requested for 30 min (in Murcia cases it was completed as MWh); ** The price is in €/MWh (0.1MW*1h=0.1 MWh; 1.165€/0.1 MWh=11.650 €/MWh) ***Initial time and final time selection are in 1 hour period; The number represents the final time. In this case, as it is one hour, from 11 to 12, it is included the final time, 12.

2. **Market opening**: The market is open from 11:30am to 11:50am 03/02/2023 for test 1 (In general, short term day ahead markets have been scheduled for negotiation from 3pm to 3:45, although hours have been modified for the demo)

FSPs located in the selected area can bid from 11:30am to 11:50am. Figure 7-41 shows the bid which was introduced by Comillas University:

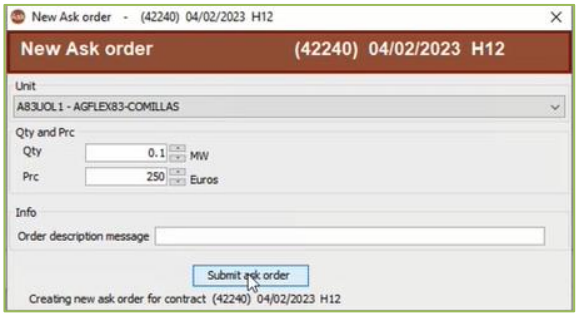

Figure 7-41: ST Comillas day ahead (1hr)– FSP bid

NOTE: The price is in €/MWh

3. **Qualification**: only the bids of prequalified resources located in the area, participating with a quantity below its total capacity are accepted.

4. **Bids received:**

Table 7-28 – ST Cantoblanco day ahead 1hr

Bid ID	FSP ID	Volume Offered (kW)	Price (€/MWh)
1	FSP-iDE-02: COMILLAS	100	250

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5. **Market clearing:**

Table 7-29 – ST Cantoblanco day ahead 1hr

Cleared (YES/NO)	Bid ID	Quantity Cleared (kW)	Price (€/MWh)
YES	1	100	250

Table 7-30 shows a summary of the market phase:

Table 7-30 – ST Cantoblanco 1 hr – market phase summary

Market Session ID	ES-iDE-05 Short-term day ahead Cantoblanco (1hr)
Request date	03/02/2023 at 8:46am
Market session	03/02/2023 11:30am-11:50am
Market clearing date/time	03/02/2023 at 11:53am
Number of bids received	1
Volume of bids received - in kW or kWh	100 kW/100 kWh
Number of bids cleared	1
Volume of bids cleared - in kW or kWh	100 kW/100 kWh
Total cost of capacity/energy cleared (in €/MWh)	250
Average cost of capacity/energy cleared (in €/MWh)	250

7.5.4 Monitoring and Activation

Resources were activated by FSP on 04/02/2023 from 11:00 to 12:00.

Monitoring is done by FSP in its installation and by DSO in its monitored assets.

7.5.5 Measurement phase

Two elements are measured as it is shown in Figure 7-42:

- Limiting asset load: 20kV feeder from substation 2, Feeder Sub2 (identified with blue color)
- Resource load/delivery: FSP, Comillas University, Comillas (identified with orange color)

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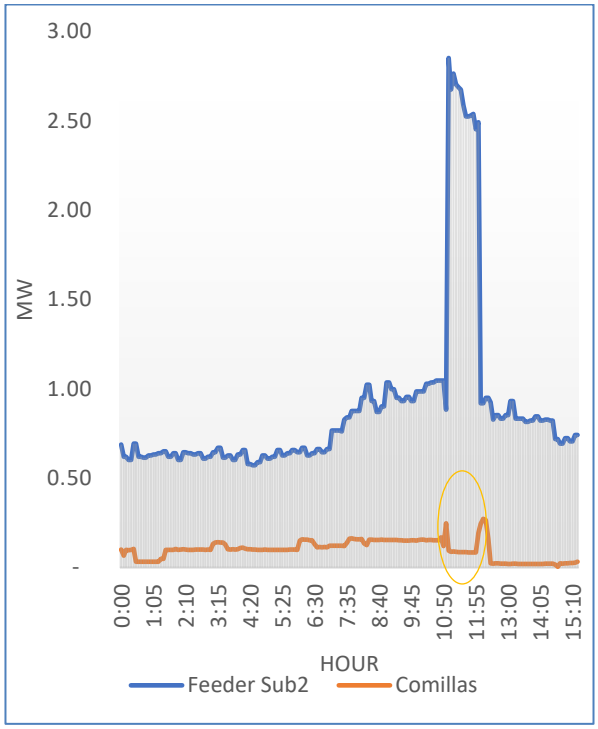

Figure 7-42: ST Madrid, Cantoblanco (1hr)– Load evolution

3. Limiting asset load: 20 kV Feeder Sub2

Figure 7-43 shows the evolution of 20 kV feeder during the activation time (11:00am-12:00pm) after the breaker is opened and got the load from substation 1 feeder. The line has been below the critical load, 3 MW, during the whole breaker maintenance period.

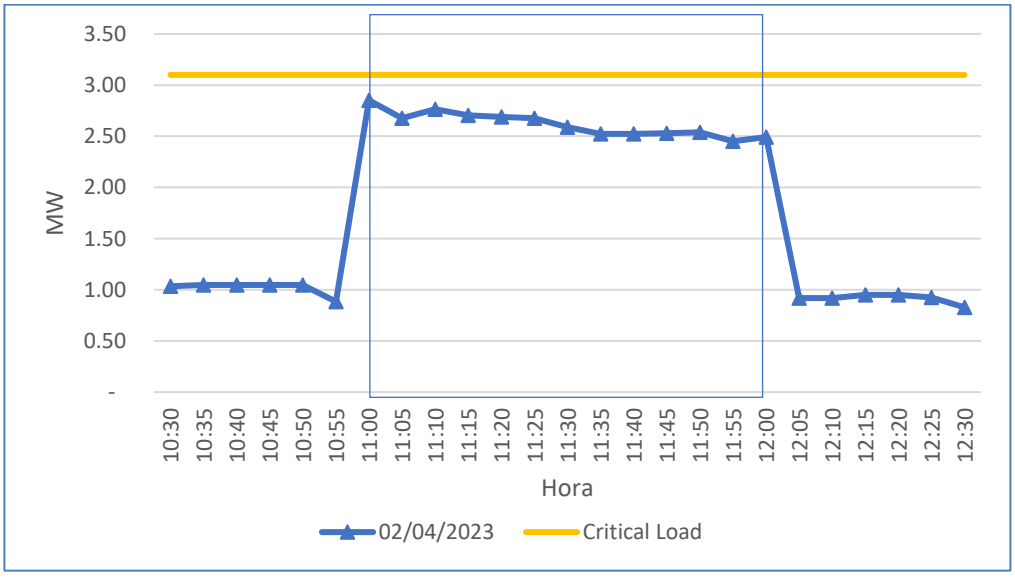

Figure 7-43: 20kV feeder from substation 2 load, 11:00-12:00

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4. **Resource load/delivery**: FSP, Comillas University, Comillas

Figure 7-44 shows the evolution of Comillas load during the activation time (11:00am-12:00pm) and Figure 7-45 shows the delivered quantity for the test done on February 4th.

Because of the tests were done in February, which is winter in Spain, and the demand respond came from the cooling systems, it was necessary heating the buildings to reach a summer temperature and then to proceed with the activation of the cooling systems to test the flexibility capabilities of these resources.

For that reason, the test was done during the weekend, Saturday, and it has been used as baseline the load just before activation, as that was a forced load situation.

The delivery amount reached the objective (100 kW) on time and during almost the whole period, except the last 5 minutes, without having any activation problem an maintaining the temperatures in the comfort zone of the simulated summer day.

A maximum of 163 kW was reached during the activation period.

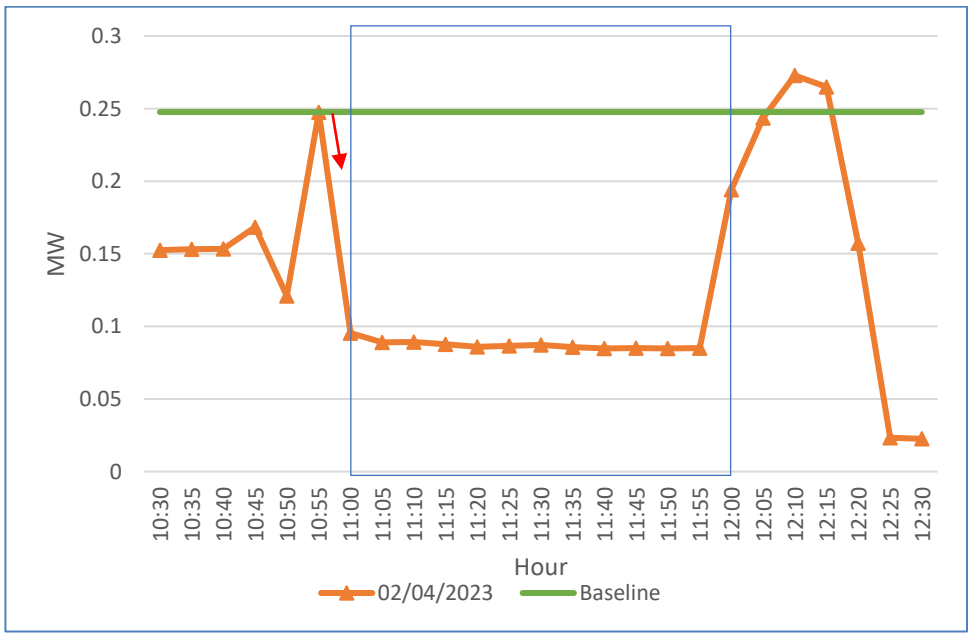

Figure 7-44: 20kV Comillas load, 11:00-12:00

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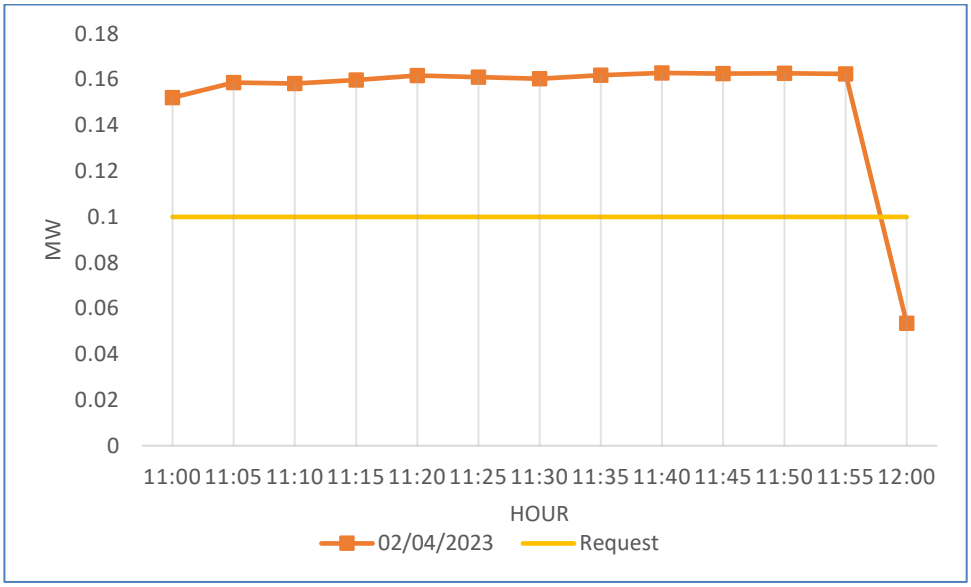

Figure 7-45: ST Comillas day ahead 1 hr –Delivery quantity evolution

Table 7-31 – ST Comillas day ahead 1hour – Measurement information

	February 4th
Maximum load in MW at DEMO limiting asset:	2,85
Forecasted load 1 day ahead (MW)	3,1
Initial limiting asset load (before activation)	2,85
Activation date	04/02/2023
Minimum activated flexibility power (MW)*	0,152
Maximum activated flexibility power (MW)*	0,163
Energy delivery (MWh)*	0,156

*Using as reference time before activation (without considering last point)

7.5.6 Settlement phase

- Compliance (Y/N): Y
- Penalties amount: N
- Total cost: 250 €/MWh*0.1 MWh=25 €

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NOTE: No additional payment over the agreed energy. That is the reason the calculation is done with 0,1 MWh instead of the delivered one, 0,156 MWh.

7.5.7 Demo KPI results

Table 7-32 – ST Comillas day ahead 1hour – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 11.650€/MWh $Cost_{flex}$: 250€/MWh	98%
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,34M $\sum P_{Total_{in_{Area}}}$: 2,85MW	12%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right) \cdot 100$	FC_{load} : 3,1MW RL_{load} : 2,85MW N=1	9%
5	Power exchange deviation	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 100kW $P_{activacted}$: 152kW (minimum)	52% (above)
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 2,85MW AL_{final}: 2,49MW	13%

In general, KPI values show positive results in term of cost effectiveness, error of load forecast, power exchange deviation and asset load profile variation meaning the following:

- In economic terms, for this case, it is most efficient to use flexibility than the traditional solution, diesel generation as flexibility cost is 2% of the traditional solution cost.
- Load forecast was accurate, close to 91% of the real demand.
- Requested power was delivered being up to 52% above the requested one.
- The asset was impacted by flexibility activation decreasing its load 13%

On the other side, available flexibility in the area is very low, only 12% of the total area load, as only one customer participated with its flexibility in the demo site test.

7.5.8 Challenges

<u>The following objectives were reached in this demo:</u>

- DSO has been able to procure local flexibility day ahead using OMIE short term platform.

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- FSP resources were activated at time during the contracted period.
- The goal was reach 96% of the activation requested time.

Challenges:

- There aren't notifications from the platform to FSPs to advise them about the coming of an intraday market. They must be log on to know about it.
- Some labels need to be changed in the platform to clarify the information which need to be completed.
- To know which FSP has been cleared, it is necessary to log on in the long-term platform to get the information as it was not available at the short-term platform, only the FSP code is shown.
- It is difficult to see the impact of the FSP load reduction in the asset load because it is a small % of the total asset load, which has other small demands and generators.

  Because of the tests were done in January, which is winter in Spain, and the demand respond came from the cooling systems, it was necessary heating the buildings to reach a summer temperature and then to proceed with the activation of the cooling systems to test the flexibility capabilities of these resources. For that reason, the tests were done during the weekends, Saturdays, and it has been used as baseline the load just before activation, as that was a forced load situation.

7.6 ES-UFD-01 Long-term day ahead Alcalá de Henares I: scenario results

The steps followed as indicated in the BUC WECL-ES-01, long term congestion management were:

1. Prepare/Pre-qualification,
2. Plan/Forecast,
3. Market Phase,
4. Monitoring and activation,
5. Measurement phase.

7.6.1 Prepare/Pre-qualification

- FSP units:

Table 7-33 – FSP Agents and FSP resources (UOL)

Name	Agents Code	Max. flexible power (MW)	Technology	Associated UOL
Fiesta Colombina Consumo	FIESTA_AGE82	0,77	Consumption	A82UOL1
Jardín demostrador ER	AYTOAH_AGE84	0,02	electric vehicle	A84UOL1
Ciudad deportiva el juncal	AYTOAH_AGE84	0,01	Consumption	A84UOL2

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Metalúrgica Madrileña SA	METAMSA_AGE86	0,30	Consumption	A86UOL1
Planta Biogas Alcalá	HERA_AGE98	1,00	Biomass	A98UOL1

- Prequalification dates:

Table 7-34 – Pre-qualification timeline

FSP	Date of Initial Prequalification Data Reception	Final Date of approval by MO	Final Date of approval by DSO	Was initial data submitted complete?
FIESTA_AGE82 A82UOL1	06-09-2022 12:32	06-09-2022	06-09-2022	Yes
AYTOAH_AGE84 A84UOL1	07-09-2022 8:59	07-09-2022	07-09-2022	Yes
AYTOAH_AGE84 A84UOL2	07-09-2022 8:50	07-09-2022	07-09-2022	Yes
METAMSA_AGE86 A86UOL1	22-07-2022 12:34	22-07-2022	22-07-2022	Yes
HERA_AGE98 A98UOL1	08-09-2022 16:20	08-09-2022	08-09-2022	Yes

- Results: Prequalification scenarios are presented in Figures 7-46 to Figure 7-50, respectively

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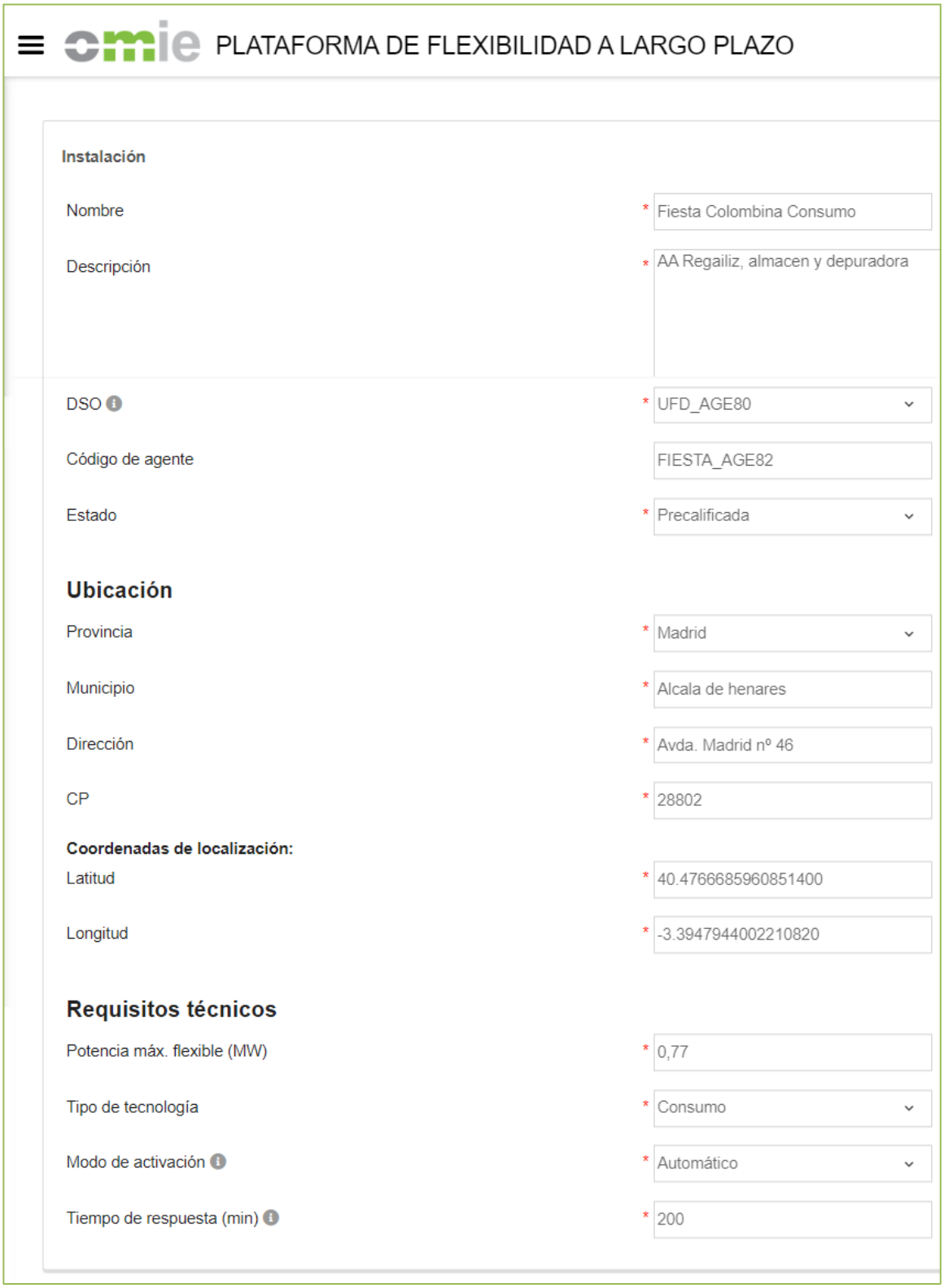

Figure 7-46: Prequalification scenario for Fiesta Colombina Consumo

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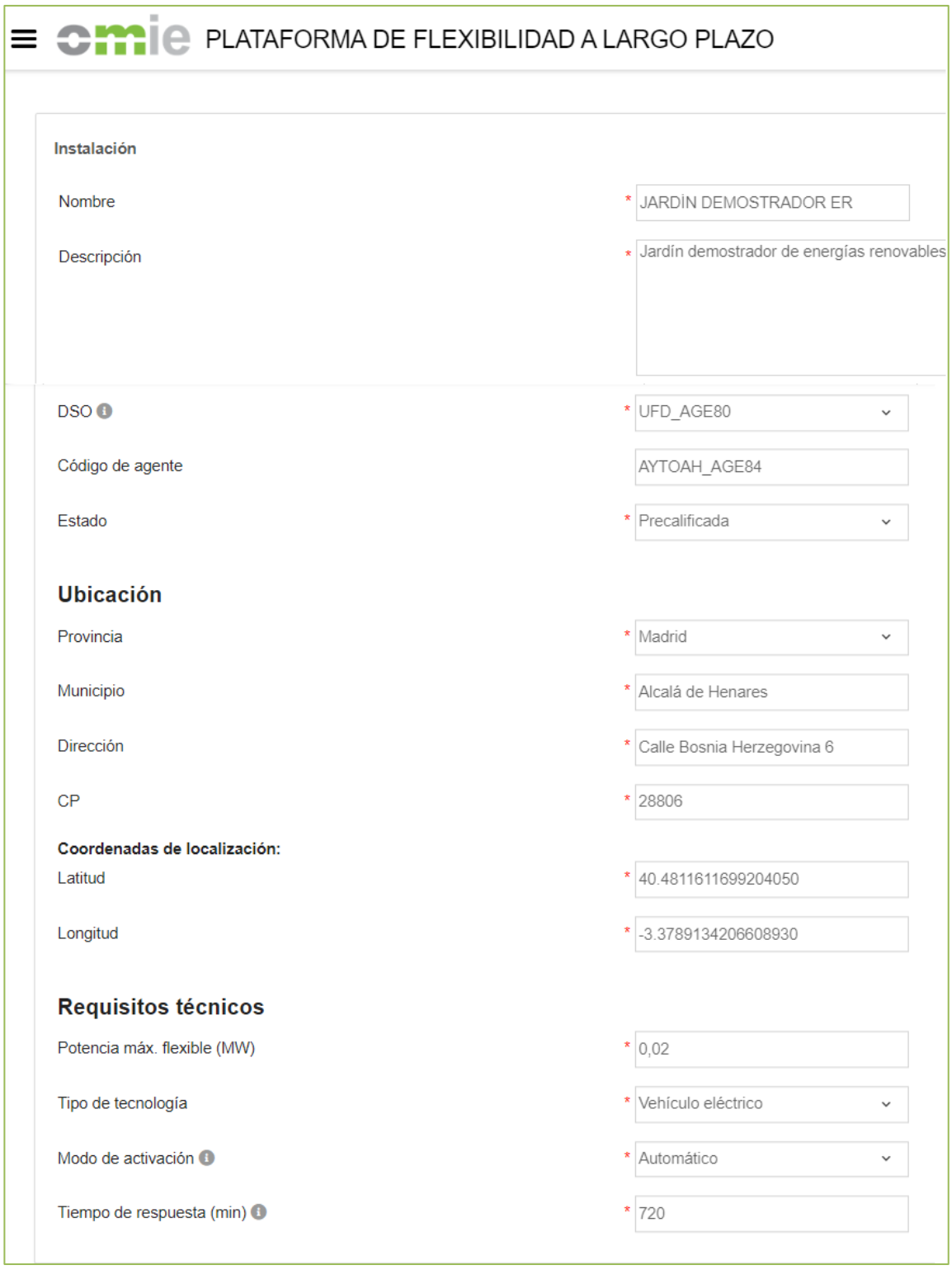

Figure 7-47: Prequalification scenario for Jardín Demostrador ER

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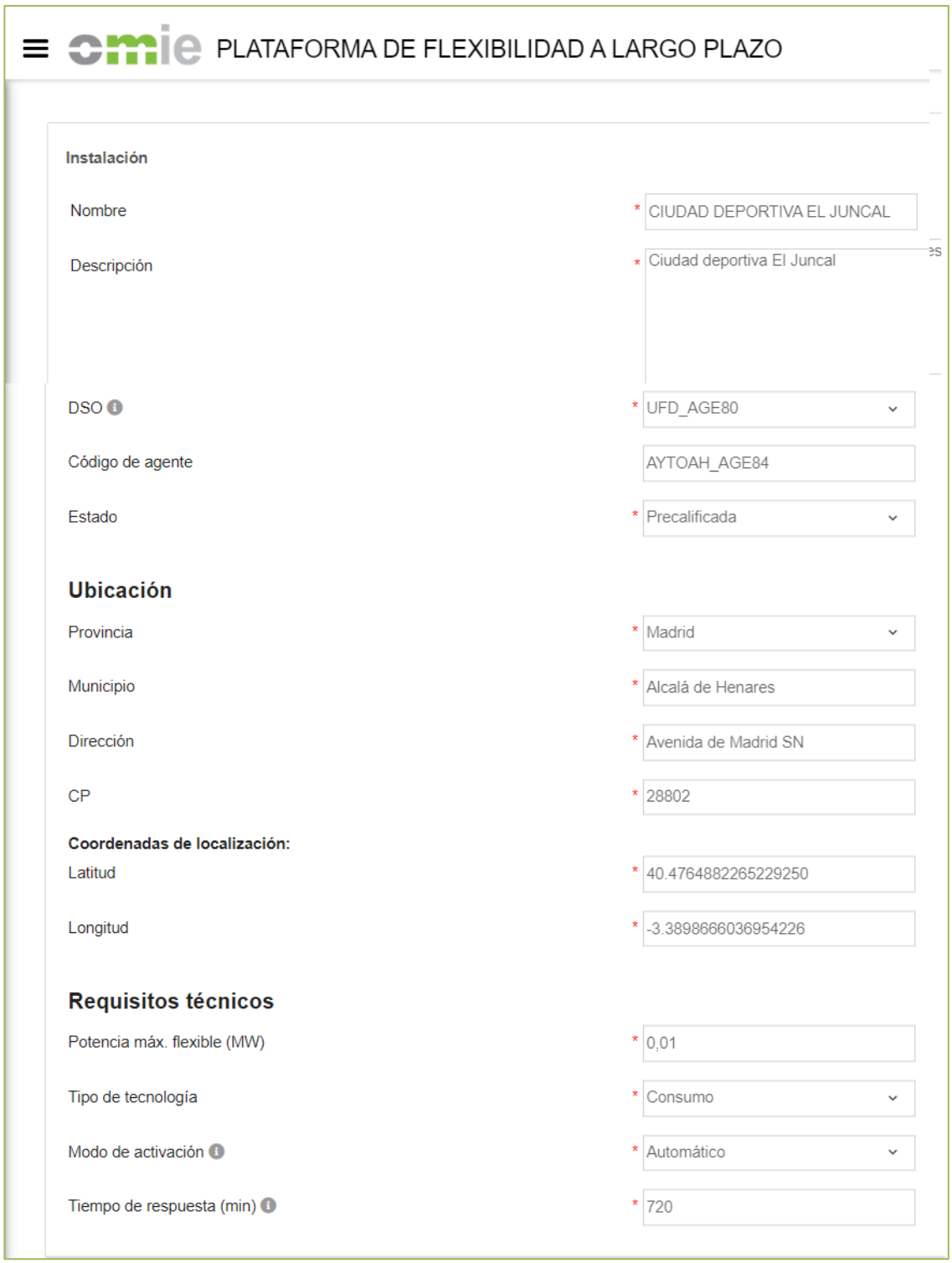

Figure 7-48: Prequalification scenario for Ciudad Deportiva El Juncal

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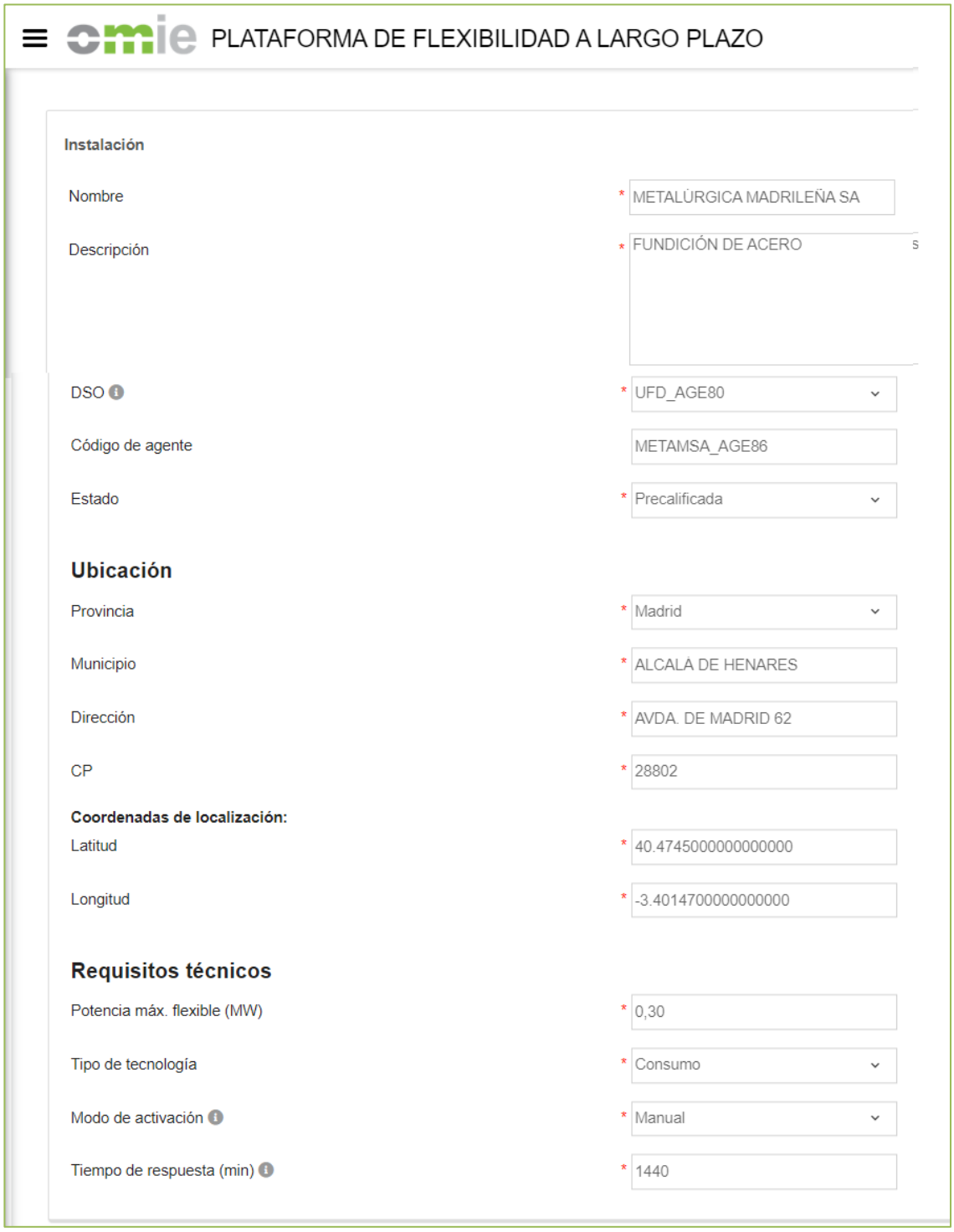

Figure 7-49: Prequalification scenario for Metalúrgica Madrileña SA

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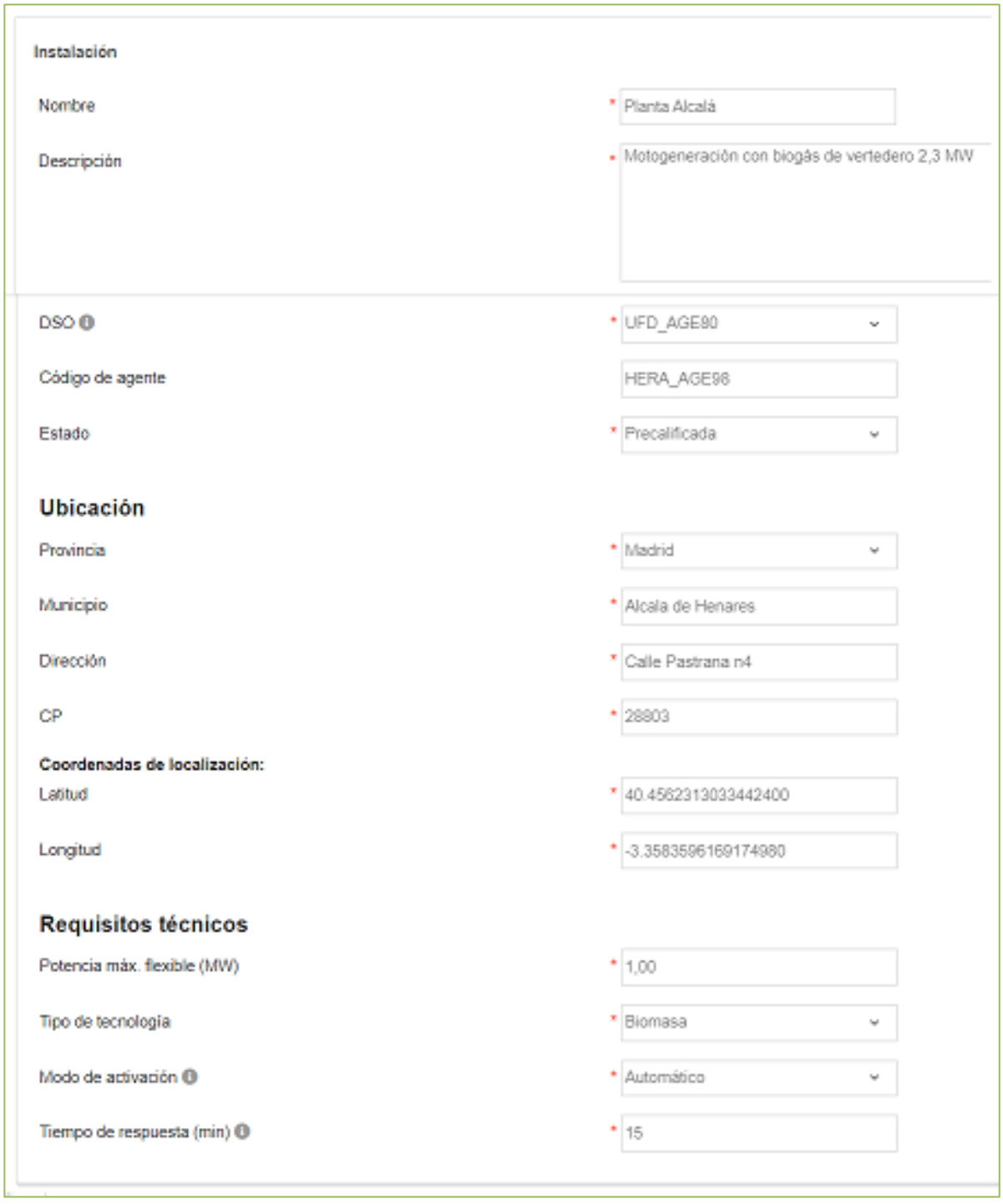

Figure 7-50: Prequalification scenario for Planta Biogas Alcalá

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7.6.2 Plan/Forecast

The complete problem assessment is included in section 6.6 ES-UFD-01: Long term Alcalá de Henares:

- Timeline: 1 year, 2023 (simulated in 2022) (September-December)

Table 7-35 – ES-UFD-01: Long term Alcalá de Henares – Timeline request

Year	Amount (MW)	Period	Service window	Days	Duration	%
2023	1,2	From 09/19/2022 to 12/08/2022	06:00-19:00	L-V	3 hours	17%

- Limiting assets: FSPs 15 kV feeder line in Alcalá de Henares
- Critical load (when the problem happens): 3,4 MW (feeder line). The value of the capacity is 65 % lower than the real one to find a valid case for the demo.
- Forecast Load/Requirement:

Table 7-36 – ES-UFD-01: Long term Alcalá de Henares – Forecast/requirement

Year	Winter Peak	Winter requirement
2023	4.6 MW 1,5 MW Demo*	1.1 MW

- DSO requirement date: Years/Weeks/days before need **(**Availability + Energy). For demo requirement was done 16/09/2022.

Note for the UFD Demo: *As explained, although the case is raised at the peak of the demand, to maximize the concurrence of FSPs the demo will take place from 5:00 p.m. to 6:00 p.m. For this reason, the values used for the prediction are different from the theoretical ones.

7.6.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Qualification,
3. Baseline,
4. Market opening,
5. Bid collection,
6. Market clearing.

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1. **DSO request**: Introduce DSO long term request in OMIE long term platform. It can be done years/weeks/days ahead of time. In this case, it was done 2022-09-14 08:05:22 for open negotiation 2022-09-16 10:00:00.

   1.1. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside.

   1.2. Introduce request:

      1.2.1. Negotiation date: 16/09/2022, Figure 7-51

      1.2.2. Area: OneNet_Alcalá de Henares, Figure 7-52

      1.2.3. Data information, Figure 7-53

      1.2.4. Service window, Figure 7-54

      1.2.5. Additional information, Figure 7-55

Figure 7-51: LT Platform – Negotiation date selection

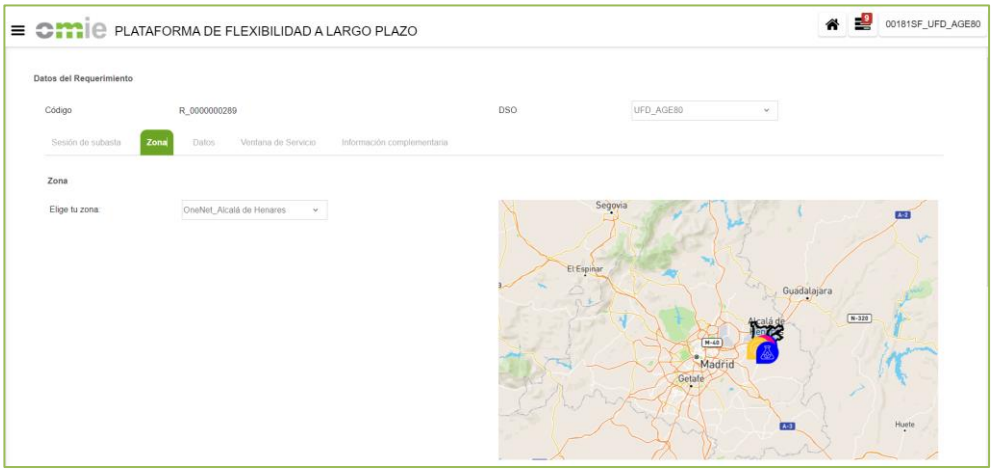

Figure 7-52: LT Platform – Area selection

The following information has been included:

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- Product type, “Categoria de producto”: A+E, “Activación firme”
- Quantity (MW), “Capacidad Requerida (MW)”: 1,2 (Although the need is for 1,1 MW, the market is opened for 1,2 MW to maximize the expected flexibility)
- Activation direction, “Sentido”: Downward consumption (“Subir generación/Bajar consumo”)
- Minimum required offer to participate, “Potencia mínima requerida a los DER cualificados para ofertar (MW)”: 0,1
- Price:
    - Availability fee (€/MW), “Término de disponibilidad (€/MW)”: N/A*
    - Utilization fee (€/MWh), “Término de utilización (€/MWh)”: N/A*

Notes: * As explained, this option was not used in the UFD Demos. The reason is to maximize the acceptance of offers from all FSPs. Being a Demo without payments, there is no risk of accepting an offer that is too expensive.

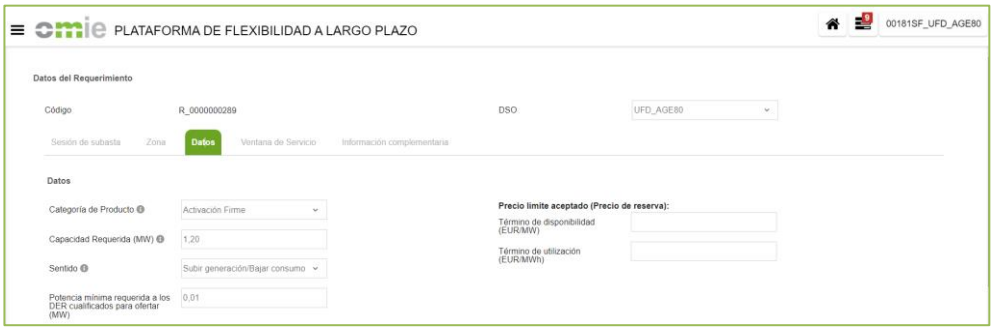

Figure 7-53: LT Platform – Data

The service window is introduced in Figure 7-54with the following information:

- Time period, “Rango temporal que abarca los diferentes periodos de activación”:
    - Initial date, “Fecha de inicio”: 19/09/2022
    - Final date, “Fecha de fin”: 08/12/2022
- Service days, “Días de servicio”: Monday “L”, Tuesday “M”, Wednesday “X”, Thursday “J” and Friday “V”
- Service hours, “Horas de servicio”:
    - From, “Hora de servicio desde”: 6 am
    - To, “Hora de servicio hasta”: 7 pm
- Include holiday days, “Servicio en días festivos”: Include, “Incluir”
- Approximated numbers of utilization hours: 120

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Figure 7-54: LT Platform – Service window

Figure 7-55: LT Platform – Additional information

1.3. Create request: The request is sent to the Market Operator (OMIE) who has to approve it. Once approved it, is shown in the long-term platform screen, Figure 7-56, to allow FSPs to apply for a qualification to be able to participate in the future market. In the same way, both the DSO and the Agents can view the details of the request. See Figure 7-57 and Figure 7-57.

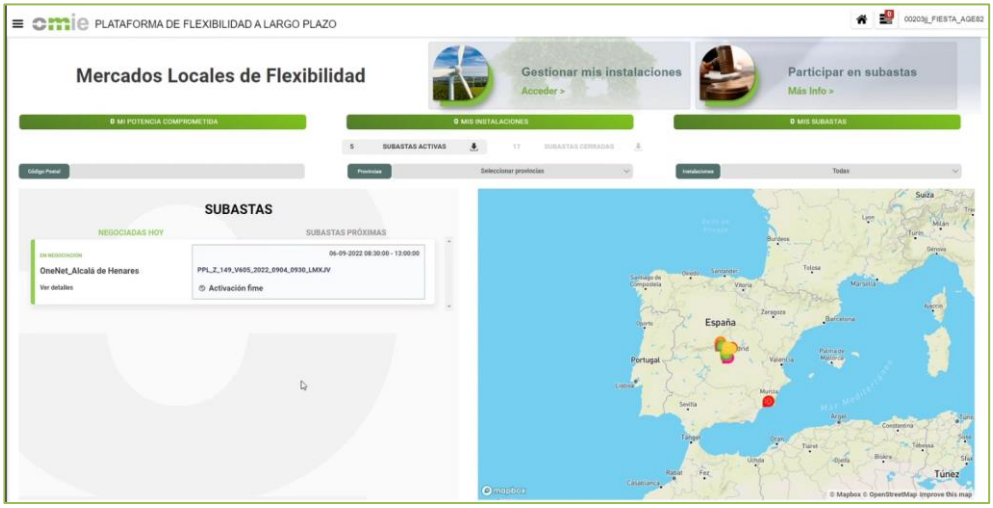

Figure 7-56: LT Platform – Long term request information

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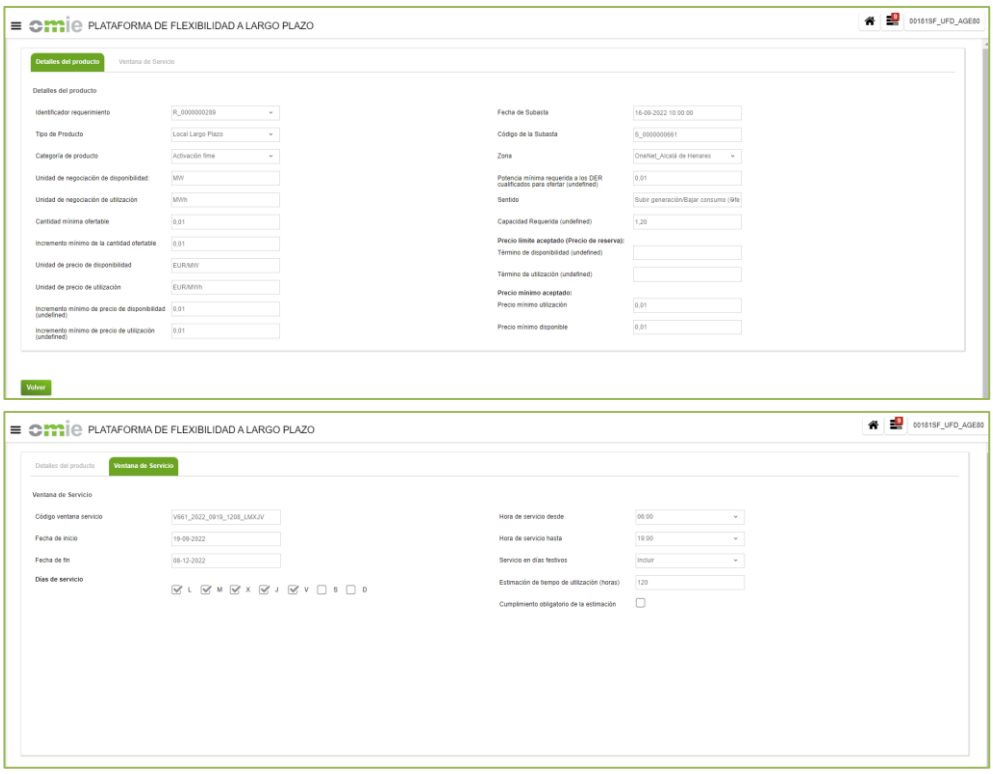

Figure 7-57: LT Platform – Long term request information

Figure 7-58: LT Platform – Long term request information: Service Details

2. **Qualification**: FSP introduces its information in order to be qualified by the DSO to participate in that market. The DSO has to approve ("Confirmar") or decline ("Cancelar"), after checking the technical conditions, Figure 7-59 and verify the quantity they are asking for qualification. In this case, it is equal to the request amount: 1,2 MW.

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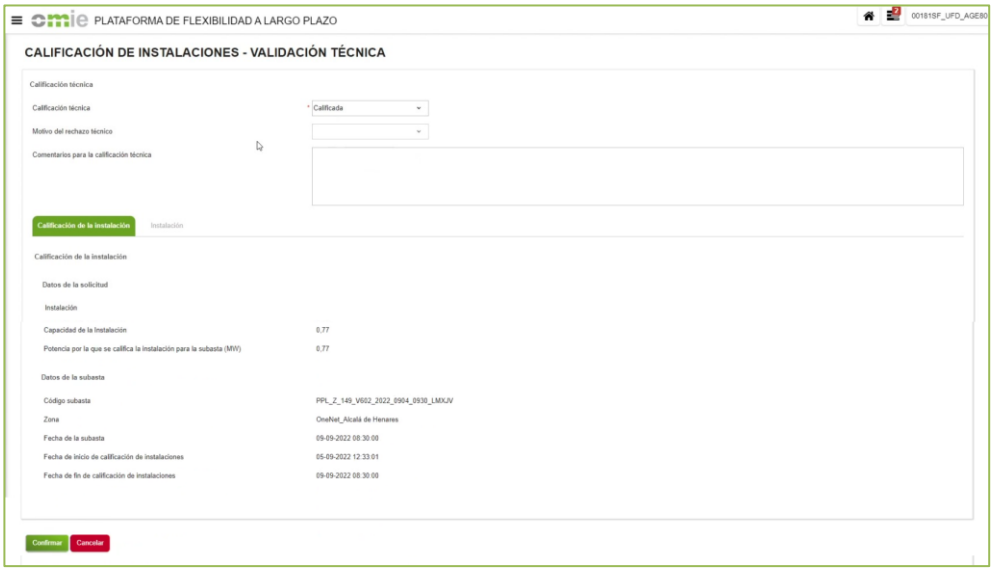

Figure 7-59: LT Platform – DSO Qualification validation screen (FIESTA_AGE8 – A82UOL1 case)

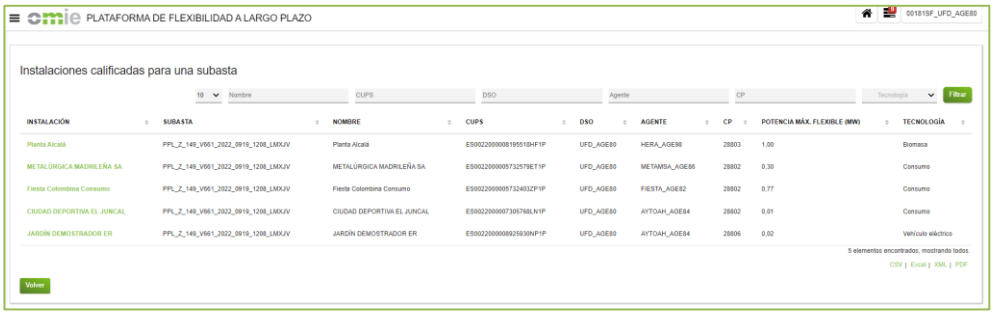

Figure 7-60: LT Platform – DSO list of facilities qualified in the auction

3. **DSO request**:

Before proceeding to the opening of the market, it is necessary to indicate the methodology agreed with the FSPs to determine the baseline with respect to which the two parties, DSO and FSPs, will be the reference value of the flexibility auctioned and delivered.

The agreed methodology consists of taking as a baseline the consumption/generation of the FSP the week prior to the delivery of each of the demo markets. It will be finalized with the FSP if that is the equivalent program for the scheduled week of delivery. And a fixed value will be set for all hours of the period. This value will be set as a baseline before the start of the market session.

The agreed values for ES-UFD-01: Long term Alcalá de Henares I are shown in the following table:

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Table 7-37 – ES-UFD-01: Long term Alcalá de Henares I – Baseline

UOL	Agent	Baseline (MW)
A82UOL1	FIESTA_AGE82	0,70
A84UOL1	AYTOAH_AGE84	0,03
A84UOL2	AYTOAH_AGE84	0,09
A86UOL1	METAMSA_AGE86	0,50

4. **Market opening**: The market is open from 10am to 1pm on 16/09/2022 at 10:00

Qualified FSPs located in the selected area can bid from 10pm to 1pm.

5. **Bids received:**

Table 7-38 – ES-UFD-01: Long term Alcalá de Henares – Bids received

UOL	Agent	Quantity Offered (MW)	Availability Price (€/MW)	Utilization fee (€/MWh)
A82UOL1	FIESTA_AGE82	0,25	350	350
A84UOL1	AYTOAH_AGE84	0,02	5.000	100
A84UOL2	AYTOAH_AGE84	0,01	4.000	80
A86UOL1	METAMSA_AGE86	0,30	100	20

6. **Market clearing:** The negotiation is done at 1pm. FSP and DSO has to log-on in the long-term platform to know the results:

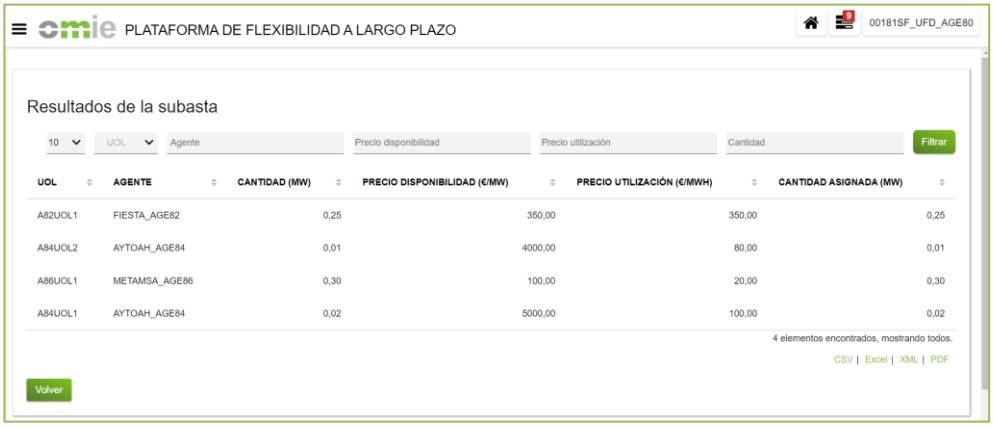

Figure 7-61: LT Platform – Results

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Table 7-39 – ES-UFD-01: Long term Alcalá de Henares – Market clearing

UOL	Agent	Availability Price (€/MW)	Utilization fee (€/MWh)	Quantity Cleared (MW)
A82UOL1	FIESTA_AGE82	350	350	0,25
A84UOL1	AYTOAH_AGE84	5000	100	0,02
A84UOL2	AYTOAH_AGE84	4000	80	0,01
A86UOL1	METAMSA_AGE86	100	20	0,30
Total				**0,58**

7.6.4 Monitoring and Activation

Resources were asked by email the day ahead of time to be activated during the service window September from 19th to 22nd, from 17:0 to 18:00 to avoid forecasted congestions.

Monitoring is done by FSP in its installation and by DSO in its monitored assets.

7.6.5 Measurement phase

1. FSP-UFD-04 Fiesta Colombina Measurement:

Figure 7-62 shows the quarter-hour measurements of FSP-UFD-04 Fiesta Colombina on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

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Figure 7-62: Fiesta Colombina quarter-hour load (kW)/Activation period zoomed in

2. FSP-UFD-01 Renewable Energy demonstration center Measurement:

Figure 7-63 shows the quarter-hour measurements of FSP-UFD-01 Renewable Energy demonstration center on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

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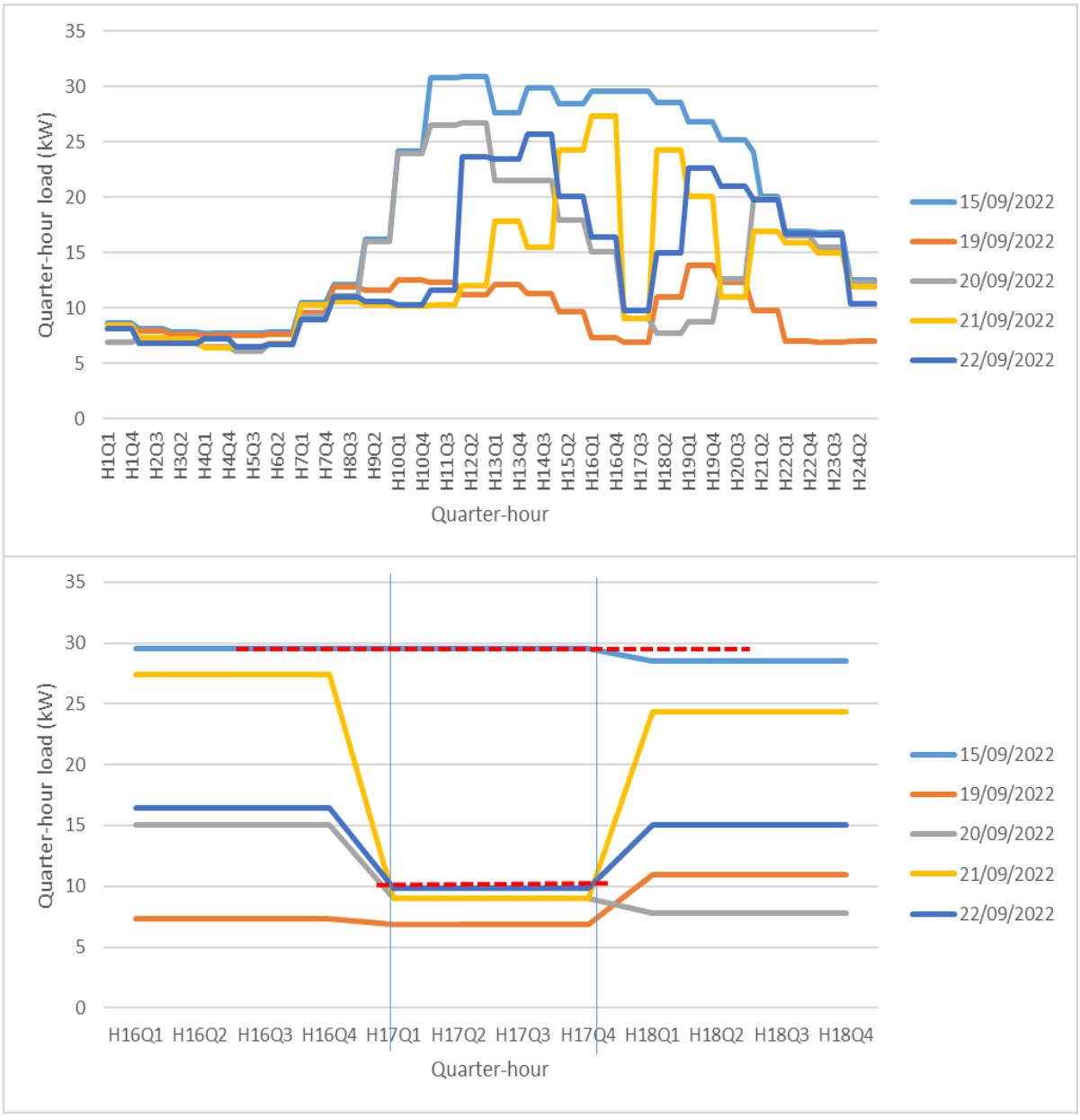

Figure 7-63: Renewable Energy demonstration center quarter-hour load (kW)/ Activation period zoomed in

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3. FSP-UFD-02 El Juncal Sport Center Measurement:

Figure 7-64 shows the quarter-hour measurements of FSP-UFD-02 El Juncal Sport Center on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

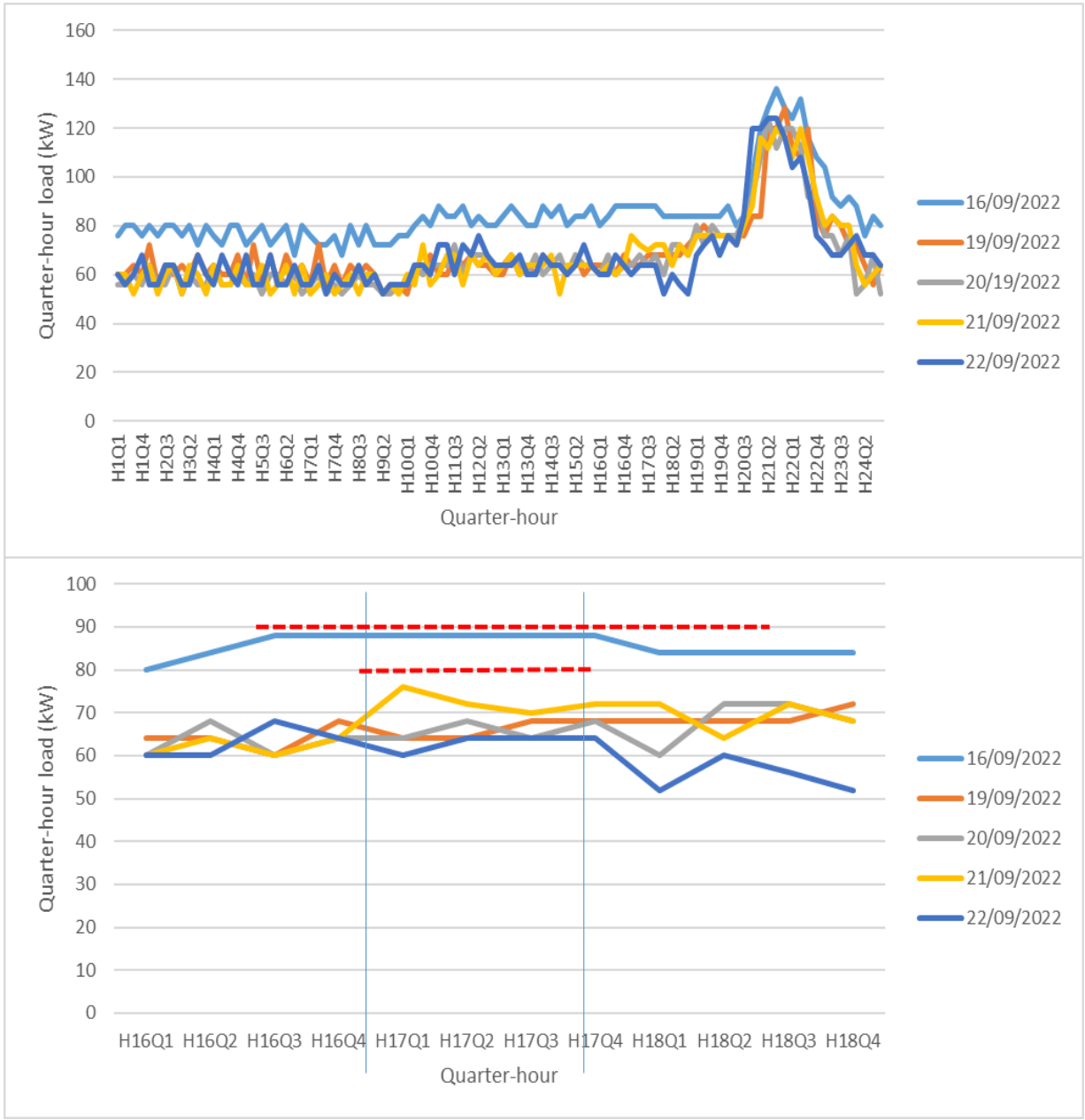

Figure 7-64: 02 El Juncal Sport Center quarter-hour load (kW) / Activation period zoomed in

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4. FSP-UFD-03 Metalúrgica Madrileña Measurement:

Figure 7-65 shows the quarter-hour measurements of FSP-UFD-03 Metalúrgica Madrileña on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

Figure 7-65: Metalúrgica Madrileña quarter-hour load (kW) / Activation period zoomed in

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5. Common 15 kV Feeder Measurement:

Figure 7-66 shows the measurements of the common 15 kV Feeder on the activation day and the previous day for comparison.

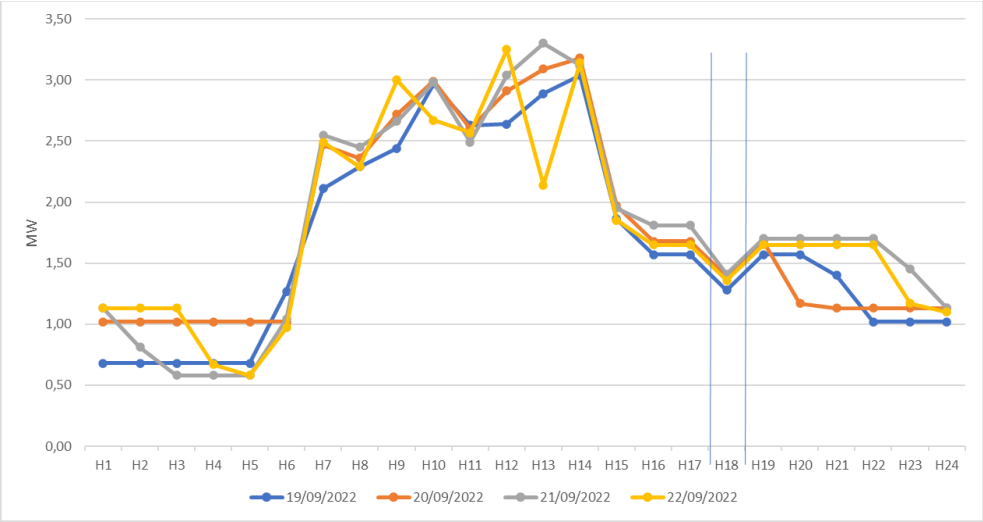

Figure 7-66: Common 15 kV Feeder (MW)– Load evolution

6. Summary of the measure and compliance:

Table 7-40 shows the summary of the measure and compliance for the participants in ES-UFD-01: Long term Alcalá de Henares.

Table 7-40 – ES-UFD-01: Long term Alcalá de Henares – Measure and compliance

Agente	Quantity Cleared (MW)	Baseline (MW)	Compliance (MW)	Compliance 19/09/2022	Compliance 20/09/2022	Compliance 21/09/2022	Compliance 22/09/2022
A82UOL1 FIESTA_AGE82	0,25	0,70	070	OK	OK	OK	OK
A84UOL1 AYTOAH_AGE84	0,02	0,03	0,03	OK	OK	OK	OK
A84UOL2 AYTOAH_AGE84	0,01	0,09	0,09	OK	OK	OK	OK
A86UOL1 METAMSA_AGE86	0,30	0,50	0,50	OK	OK	OK	OK

As can be seen in the figures above, all FSPs have fulfilled the flexibility service for the activated time. In the economic calculations of liquidation, it will be estimated that the total estimated hours have been fulfilled.

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7.6.6 Settlement phase

As can be seen in the figures above, all FSPs have fulfilled the flexibility service for the activated time. In the economic calculations of liquidation, it will be estimated that the total estimated hours have been fulfilled.

Table 7-41 – ES-UFD-01: Long term Alcalá de Henares – Settlement phase

Agente	Compliance	Availability Correction Factor %	Cost availability term	Cost activation term	Total Cost
A82UOL1 FIESTA_AGE82	OK	100%	87,5 €	10.500,0 €	10.587,5 €
A84UOL1 AYTOAH_AGE84	OK	100%	100,0 €	240,0 €	340,0 €
A84UOL2 AYTOAH_AGE84	OK	100%	40,0 €	96,0 €	136,0 €
A86UOL1 METAMSA_AGE86	OK	100%	30,0 €	720,0 €	750,0 €
Total			**257,5 €**	**11.556,0 €**	**11.813,5 €**

It is necessary to point out that the offer of one of the FSPs is excessive in its Activation price. As in the demo it was decided not to put cut prices so as not to expel agents from the cassation this offer has entered and therefore the price is not representative of the whole. In reality, the available Cap should have been used.

7.6.7 Demo KPI results

As the demo has been made from 17:00 to 18:00 instead of at the peak of demand and over 4 days as a representation of the complete period the values of the set of KPIs has been calculated as an average of those days.

Table 7-42 – Long term Murcia – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 17,218.84 € $Cost_{flex}$: 11,813.50 €	31%
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,58 MW $\sum P_{Total_{in_{Area}}}$: 2,10 MW	28%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right) \cdot 100$	FC_{load} : 1,6 MW RL_{load} : 1,57/1,68/1,76/1,65MW N=4	4,6%
5	Power exchange deviation	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 2,32 MW (demo week) $P_{activacted}$: 2,32 MW (demo week)	0%

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ID	Name	Formula	Variables	Value
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 1,68 MW (Average) AL_{final}: 1,36 MW (Average)	18,9%

In general, KPI values show positive results:

- In economic terms, for this case, it is most efficient to use flexibility than the traditional solution, as flexibility cost is 69% of the year avoided traditional solution cost.
- Available flexibility in the area is 28% of the load. It is noticed that more than 1 FSP is participating in this demo.
- Load forecast was very accurate, close to 95% of the real demand.
- Overall, the requested power was delivered being as requested, 0% deviation, although with different FSP performance.
- The asset was impacted by flexibility activation decreasing its load 19%.

7.6.8 Challenges

The following objectives were reached in this demo:

- DSO has been able to procure local flexibility day ahead using OMIE long term platform.
- FSP resources were activated during the contracted period.
- There has been a reduction in the load of the reference circuit due to the flexibility provided by the FSPs. However, the impact was small, due to the little final flexibility made available by the FSPs with respect to the maximum available. This was due to the final dates on which the demo could be carried out.
- The goal of high participation in the Long-Term market has been achieved. 4 of the 5 resources have participated.
- The objective of compliance in the activation has been achieved. The 4 cleared resources have met their commitments. One of the resources is partially in default, so it has had a reduction in its settlement.

Challenges:

- Some platform labels need to be changed to clarify the information to be completed. For example, the concepts of Auction / Auction Code / Product / Requirement identifier (Subasta / Código de la Subasta / Producto / Identificador requerimiento) are confusing.

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- There aren’t notifications from the platform to FSPs to advise them about the coming of an intraday market. They must log on to know about it.
- It is necessary to have tools for forecasting estimation ahead of time.
- Notification of activation was done by email from DSO to resource. The Platform must include this performance.
- There aren’t notifications to advice about the clearing. It is needed to log on in the platform to get the information.
- It wasn´t possible to include the whole request for multi-year periods, to delay the traditional project some years, as the long-term platform doesn´t allow to include more than one period in each request. If it is not possible to get flexibility for all the periods, the traditional solution can´t be delayed because there isn´t assurance to cover the whole period.
- Baseline: It is essential to define a Baseline before the opening of any market session. The platform must collect this value that will be defined after the qualification and must be a parameter always visible to the FSPs and DSOs to avoid confusion. In the Demo it has been decided to agree on a Baseline based on the real values of the previous week. Anyway, it must be an aspect that must be regulated in a homogeneous way.
- The issue of non-compliance is very important and must be properly regulated. In these Demos there have been some minor breaches that have resulted in economic sanctions. But widespread non-compliance could have led to significant cost overruns for the DSO considering that it would no longer be possible to adopt classical long term solutions.
- It is difficult to see the impact of the FSP load reduction in the asset load because it is a small % of the total asset load, which has other small demands and generators.
- Market results: Agents only know their matching result, but they do not know the overall result. Although there must be confidentiality with the agents' offers, it is necessary to know some results so that you know the reason for their partial matching or rejection and there may be some transparency about the matching for future markets (for example, matched energy, price of the last offer cleared)
- DSO-FSPs coordination: For long-term markets it is very important to coordinate with the available FSPs the products to be summoned. It may happen that the DSOs design markets that some FSPs cannot participate in. An example is the case of the UFD Demo, an LP market called for 3 months and in a window from 6:00 a.m. to 7:00 p.m. Two FSPs stated that in a market of real flexibility they would not have bid. One of them could not have had the power available for such a long period of time. The other indicated that his difficulty was incorporating morning and afternoon hours. The alternative that both proposed was to subdivide the market in two. However, this may not be a solution for the DSO, since if he wants to avoid an investment, he cannot risk not having resources available in any of the

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submarkets. Local holidays must also be considered. Perhaps because of a single day that is a holiday in the town, the FSP cannot bid in an entire window.

- High dependence on Air Conditioning. It is difficult to participate in LP markets with Air Conditioners in industries where these consumptions are electrically significant (in food industries and in general) since it is difficult in the long term to estimate a level of need.

7.7 ES-UFD-02 Long-term day ahead Alcalá de Henares II: scenario results

The steps followed as indicated in the BUC WECL-ES-01, long term congestion management were:

1. Prepare/Pre-qualification,
2. Plan/Forecast,
3. Market Phase,
4. Monitoring and activation,
5. Measurement phase.

7.7.1 Prepare/Pre-qualification

- FSP units:

Table 7-43 – FSP Agents and FSP resources (UOL)

Name	Agents Code	Max. flexible power (MW)	Technology	Associated UOL
Fiesta Colombina Consumo	FIESTA_AGE82	0,77	Consumption	A82UOL1
JARDÍN DEMOSTRADOR ER	AYTOAH_AGE84	0,02	electric vehicle	A84UOL1
CIUDAD DEPORTIVA EL JUNCAL	AYTOAH_AGE84	0,01	Consumption	A84UOL2
METALÚRGICA MADRILEÑA SA	METAMSA_AGE86	0,30	Consumption	A86UOL1
Planta Biogas Alcalá	HERA_AGE98	1,00	Biomass	A98UOL1

Prequalification is a one-time process, so the Prequalification Dates and Results are as reflected in point 7.6.1.

7.7.2 Plan/Forecast

The complete problem assessment is included in section 6.6 ES-UFD-01: Long term Alcalá de Henares:

- Timeline: 1 year, 2023 (simulated in 2022) (October-December)

Table 7-44 – ES-UFD-02: Long term Alcalá de Henares – Timeline request

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Year	Amount (MW)	Period	Service window	Days	Duration	%
2023	1,2	From 10/03/2022 to 12/22/2022	06:00-19:00	L-V	3 hours	17%

- Limiting assets: Common FSPs 15 kV feeder line in Alcalá de Henares
- Critical load (when the problem happens): 3.4 MW (feeder line). The value of the capacity is 65% lower than the real one to find a valid case for the demo.
- Forecast Load/Requirement:

Table 7-45 – ES-UFD-02: Long term Alcalá de Henares I– Forecast/requirement

Year	Winter Peak	Winter requirement
2023	4,6 MW 1,5 MW Demo*	1,1 MW

- DSO requirement date: Years/Weeks/days before need **(**Availability + Energy). For demo requirement was done 30/09/2022.

Note for the UFD Demo: *As explained, although the case is raised at the peak of the demand, to maximize the concurrence of FSPs the demo will take place from 5:00 p.m. to 6:00 p.m. For this reason, the values used for the prediction are different from the theoretical ones.

7.7.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Qualification,
3. Baseline,
4. Market opening,
5. Bid collection,
6. Market clearing.

1. **DSO request**: Introduce DSO long term request in OMIE long term platform. It can be done years/weeks/days ahead of time. In this case, it was done 2022-09-15 15:33:00 for open negotiation 2022-09-30 10:00:00.
   1.1. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside. In this case, the area was created previously.
   1.2. Introduce request:

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1.2.1. Negotiation date: 30/09/2022, Figure 7-67

1.2.2. Area: OneNet_Alcalá de Henares, Figure 7-68

1.2.3. Data information, Figure 7-69

1.2.4. Service window, Figure 7-70

1.2.5. Additional information, Figure 7-71

Figure 7-67: LT Platform – Negotiation date selection

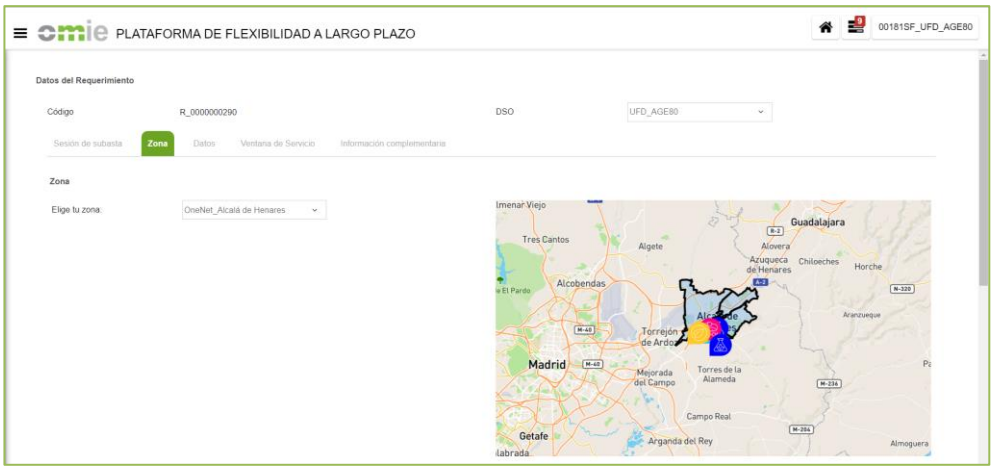

Figure 7-68: LT Platform – Area selection

The following information has been included:

- Product type, “Categoria de producto”: A+E, “Activación firme”
- Quantity (MW), “Capacidad Requerida (MW)”: 1,2 (Although the need is for 1,1 MW, the market is opened for 1.2 MW to maximize the expected flexibility)
- Activation direction, “Sentido”: Downward consumption (“Subir generación/Bajar consumo”)
- Minimum required offer to participate, “Potencia requerida a los DER cualificados para ofertar (MW)”: 0,1
- Price:
    - Availability fee (€/MW), “Término de disponibilidad (€/MW)”: N/A*

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- Utilization fee (€/MWh), "Término de utilización (€/MWh)": N/A*

Notes: * As explained, this option was not used in the UFD Demos. The reason is to maximize the acceptance of offers from all FSPs. Being a Demo without payments, there is no risk of accepting an offer that is too expensive.

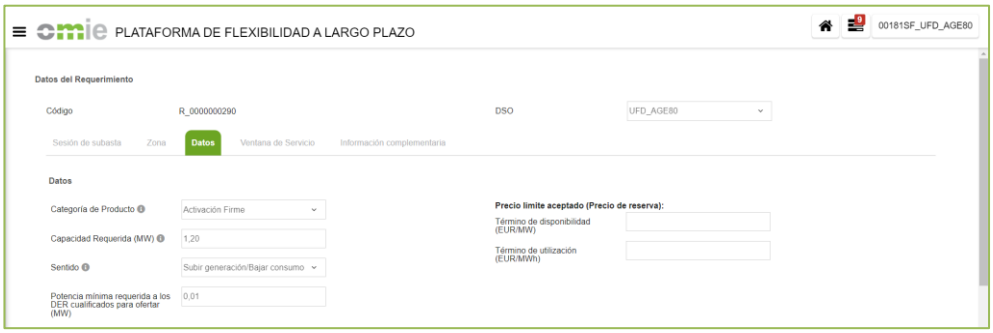

Figure 7-69: LT Platform – Data

The service window is introduced in Figure 7-70with the following information:

- Time period, "Rango temporal que abarca los diferentes periodos de activación":
  - Initial date, "Fecha de inicio": 03/10/2022
  - Final date, "Fecha de fin": 22/12/2022
- Service days, "Días de servicio": Monday "L", Tuesday "M", Wednesday "X", Thursday "J" and Friday "V"
- Service hours, "Horas de servicio":
  - From, "Hora de servicio desde": 6 am
  - To, "Hora de servicio hasta": 7 pm
- Include holiday days, "Servicio en días festivos": Include, "Incluir"
- Approximated numbers of utilization hours: 120

Figure 7-70: LT Platform – Service window

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Figure 7-71: LT Platform – 6.2.5. Additional information

1.3. Create request: The request is sent to the Market Operator (OMIE) who has to approve it. Once approved it, it is shown in the long-term platform screen, Figure 7-72, to allow FSPs to apply for a qualification to be able to participate in the future market. In the same way, both the DSO and the Agents can view the details of the request. See Figure 7-73

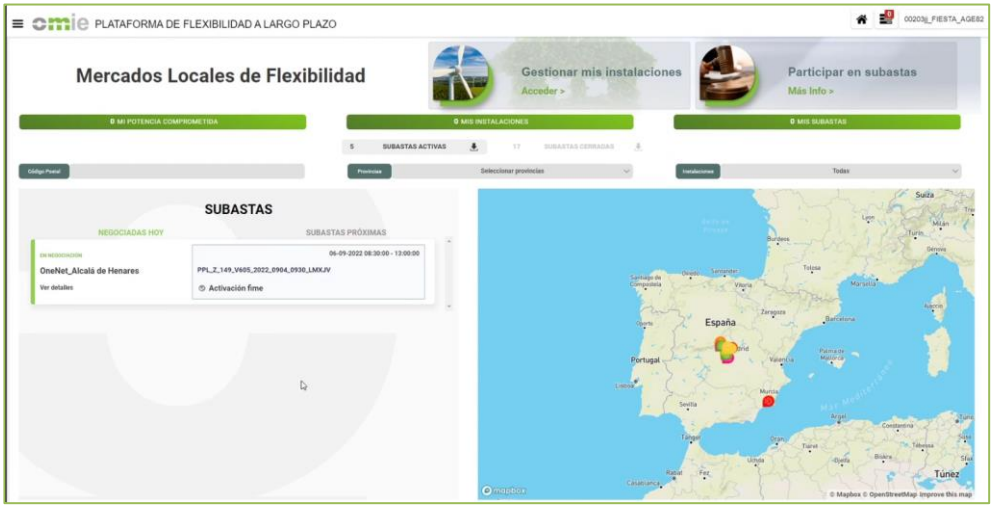

Figure 7-72: LT Platform – Long term request information

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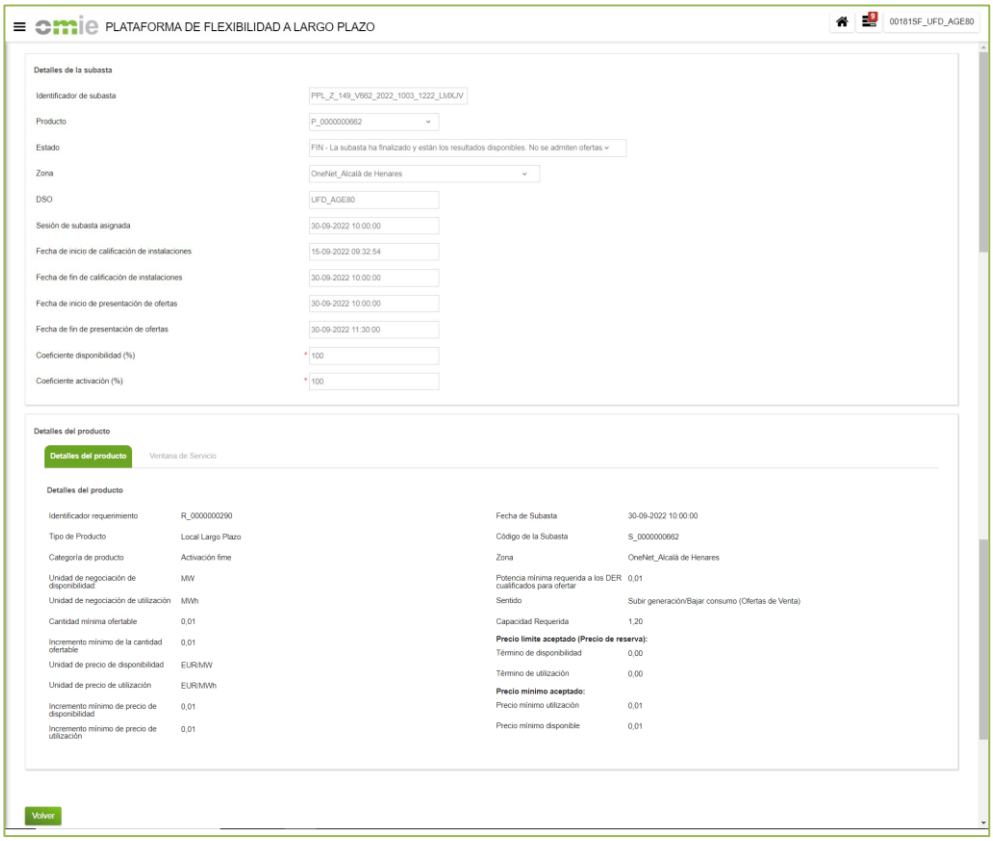

Figure 7-73: LT Platform – Long term request information: Product Details

Figure 7-74: LT Platform – Long term request information: Service Details

2. **Qualification**: FSP introduces its information in order to be qualified by the DSO to participate in that market. The DSO has to approve (“Confirmar”) or decline (“Cancelar”), after checking the technical conditions, Figure 7-75 and verify the quantity they are asking for qualification. In this case, it is equal to the request amount: 1,2 MW.

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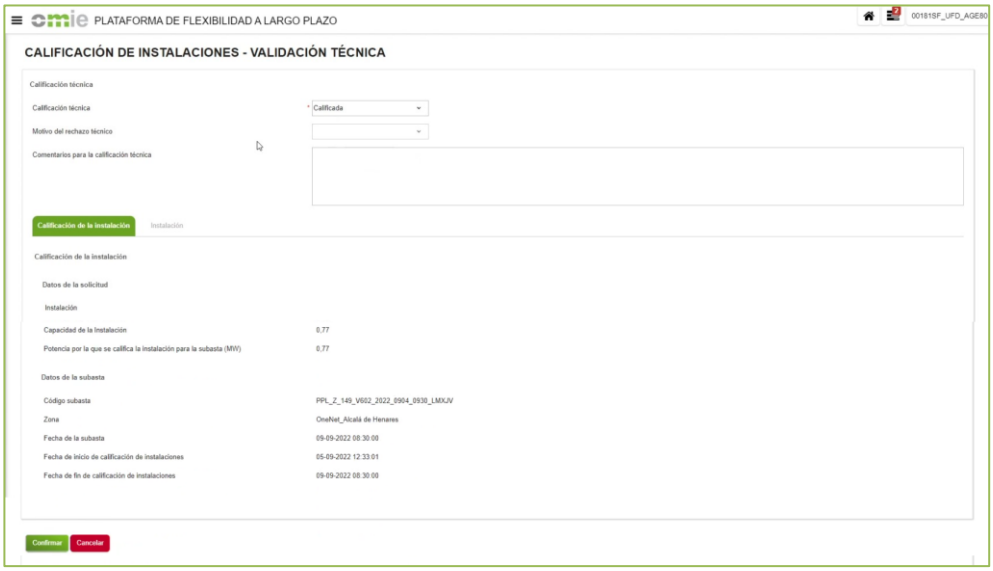

Figure 7-75: LT Platform – DSO Qualification validation screen (FIESTA_AGE8 – A82UOL1 case)

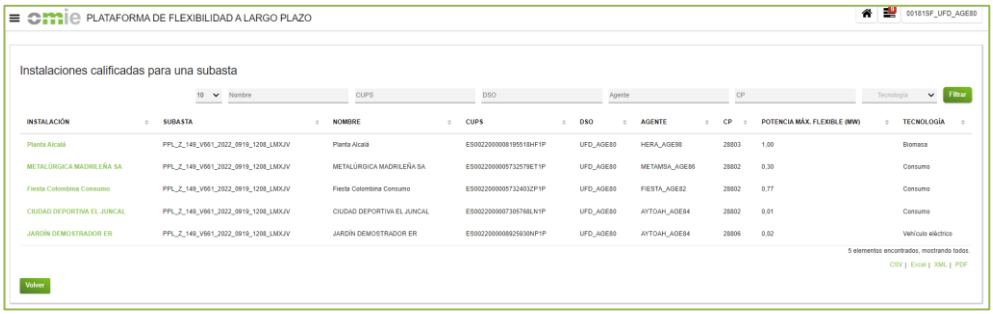

Figure 7-76: LT Platform – DSO list of facilities qualified in the auction

3. **DSO request**:

Before proceeding to the opening of the market, it is necessary to indicate the methodology agreed with the PSF to determine the baseline with respect to which the two parties, DSO and FSP, will be the reference value of the flexibility auctioned and delivered.

The agreed methodology consists of taking as a baseline the consumption/generation of the FSP of the week prior to the delivery of each of the demo markets. It will be finalized with the FSP if that is the equivalent program for the scheduled week of delivery. And a fixed value will be set for all hours of the period. This value will be set as a baseline before the start of the market session.

The agreed values for ES-UFD-02: Long term Alcalá de Henares II are shown in the following table.

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Table 7-46 – ES-UFD-02: Long term Alcalá de Henares – Baseline

UOL	Agent	Quantity (MW)	Baseline (MW)
A84UOL1	AYTOAH_AGE84	0,02	0,035
A84UOL2	AYTOAH_AGE84	0,01	0,08
A86UOL1	METAMSA_AGE86	0,30	0,50
A98UOL1	HERA_AGE98	0,10	2,40

4. **Market opening**: The market is open from 10am to 1pm on 16/09/2022 10:00

Qualified FSPs located in the selected area can bid from 10pm to 1pm.

5. **Bids received:**

Table 7-47 – ES-UFD-02: Long term Alcalá de Henares – Bids received

UOL	Agent	Quantity Offered (MW)	Availability Price (€/MW)	Utilization fee (€/MWh)
A84UOL1	AYTOAH_AGE84	0,02	4.000	100
A84UOL2	AYTOAH_AGE84	0,01	5.000	80
A86UOL1	METAMSA_AGE86	0,30	200	25
A98UOL1	HERA_AGE98	0,10	5.000	150

6. **Market clearing:** The negotiation is done at 1pm. FSP and DSO has to log-on in the long-term platform to know the results:

Figure 7-77: LT Platform – Results

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Table 7-48 – ES-UFD-02: Long term Alcalá de Henares – Market clearing

UOL	Agent	Availability Price (€/MW)	Utilization fee (€/MWh)	Quantity Cleared (MW)
A84UOL1	AYTOAH_AGE84	4.000	100	0,02
A84UOL2	AYTOAH_AGE84	5.000	80	0,01
A86UOL1	METAMSA_AGE86	200	25	0,30
A98UOL1	HERA_AGE98	5.000	150	0,10
Total				**0,43**

7.7.4 Monitoring and Activation

Resources were asked by email the day ahead of time to be activated during the service window October from 3rd to, 6th, from 17:00 to 18:00 to avoid forecasted congestions.

Monitoring is done by FSP in its installation and by DSO in its monitored assets.

7.7.5 Measurement phase

1. FSP-UFD-01 Renewable Energy demonstration center Measurement:

Figure 7-78 shows the quarter-hour measurements of FSP-UFD-01 Renewable Energy demonstration center on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

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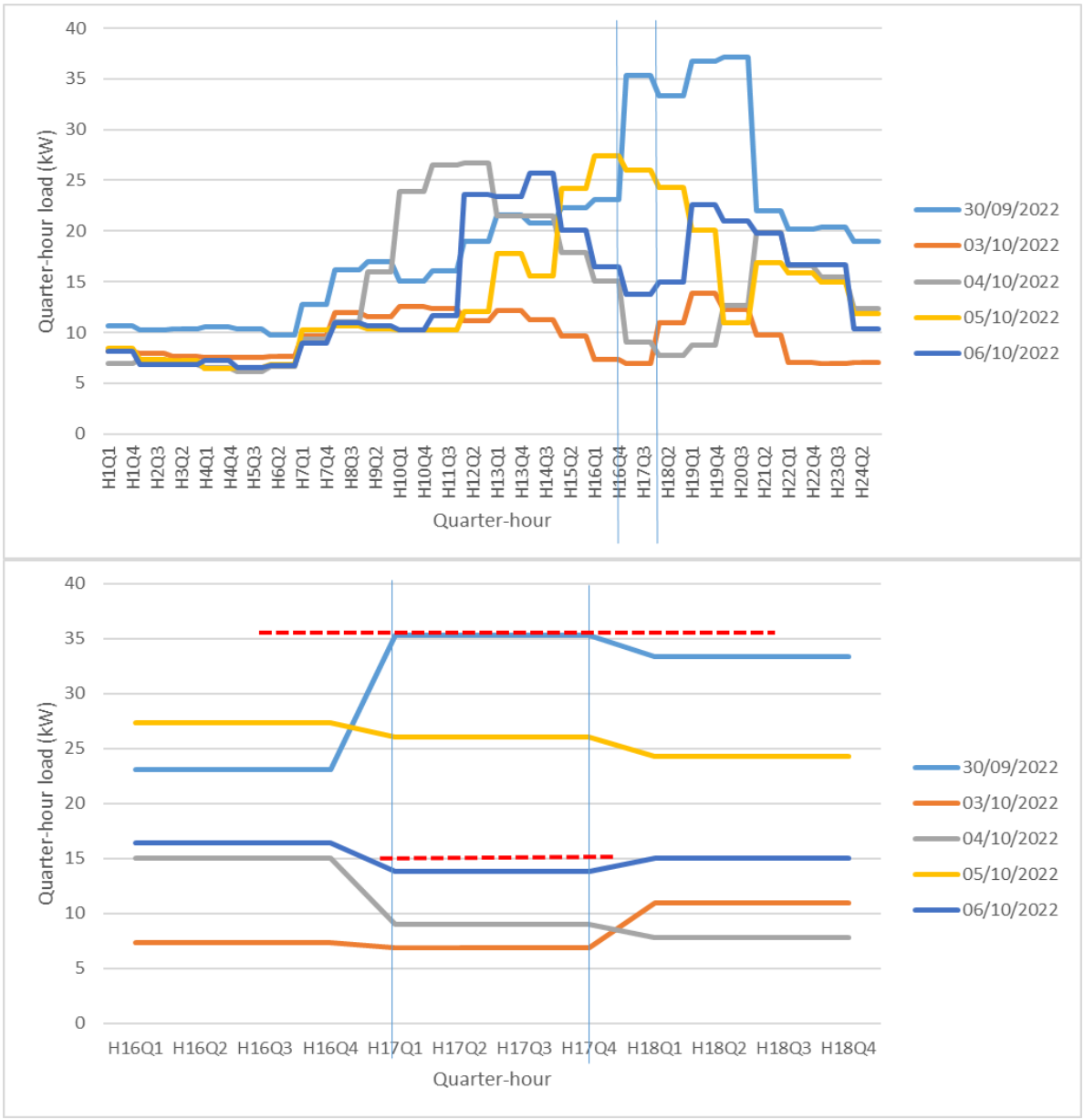

Figure 7-78: Renewable Energy demonstration center quarter-hour load (kW)/Activation period zoomed in

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2. FSP-UFD-02 El Juncal Sport Centre Measurement:

Figure 7-79 shows the quarter-hour measurements of FSP-UFD-02 El Juncal Sport Centre on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

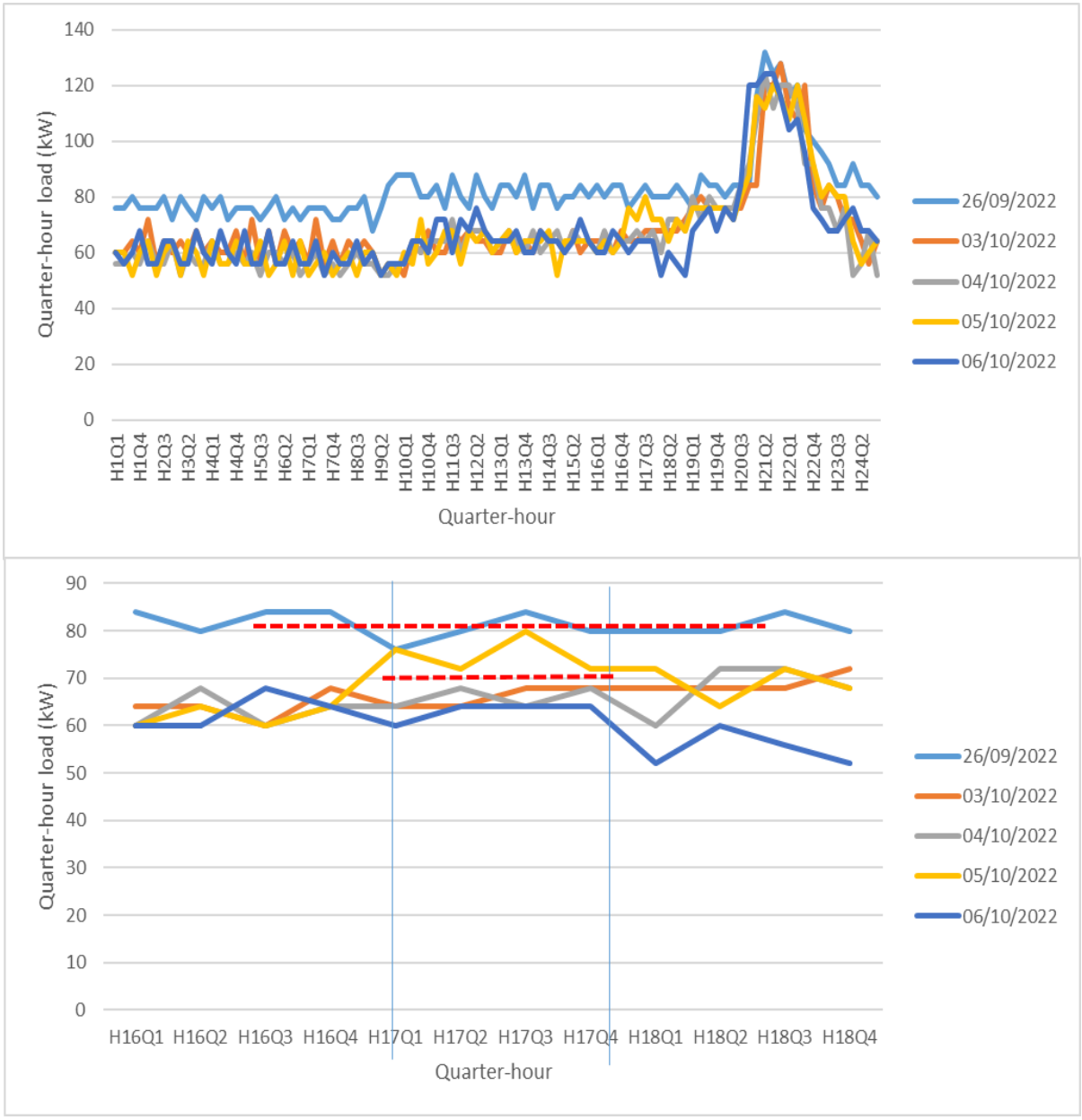

Figure 7-79: Juncal sport centre quarter-hour load (kW)/ Activation period zoomed in

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3. FSP-UFD-03 Metalúrgica Madrileña Measurement:

Figure 7-80 shows the quarter-hour measurements of FSP-UFD-03 Metalúrgica Madrileña on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

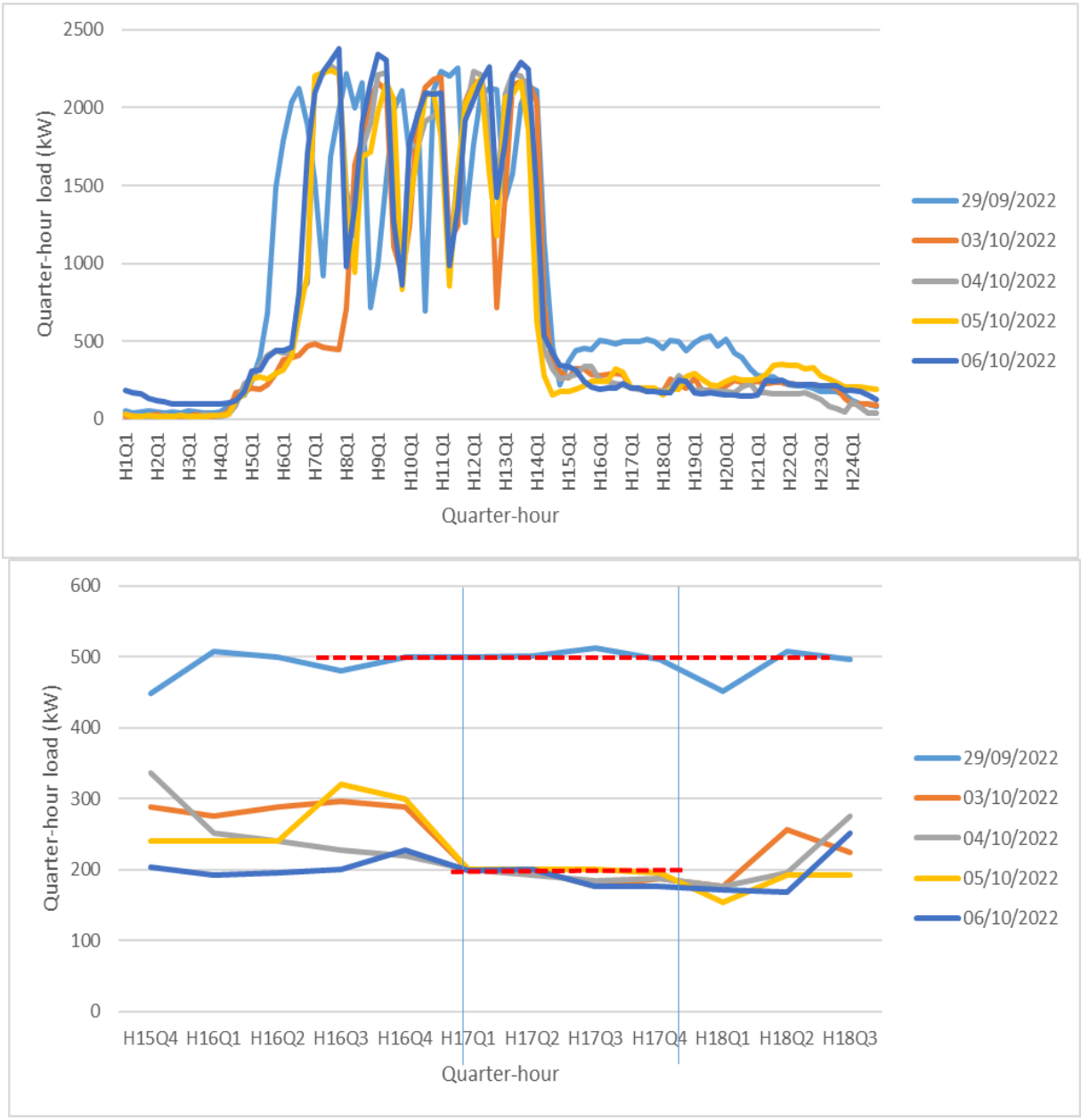

Figure 7-80: Metalúrgica Madrileña quarter-hour load (kW)/ Activation period zoomed in

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4. FSP-UFD-05 HERA biogas Measurement:

Figure 7-81 shows the quarter-hour measurements of FSP-UFD-05 HERA biogas on the 4 days of activation. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

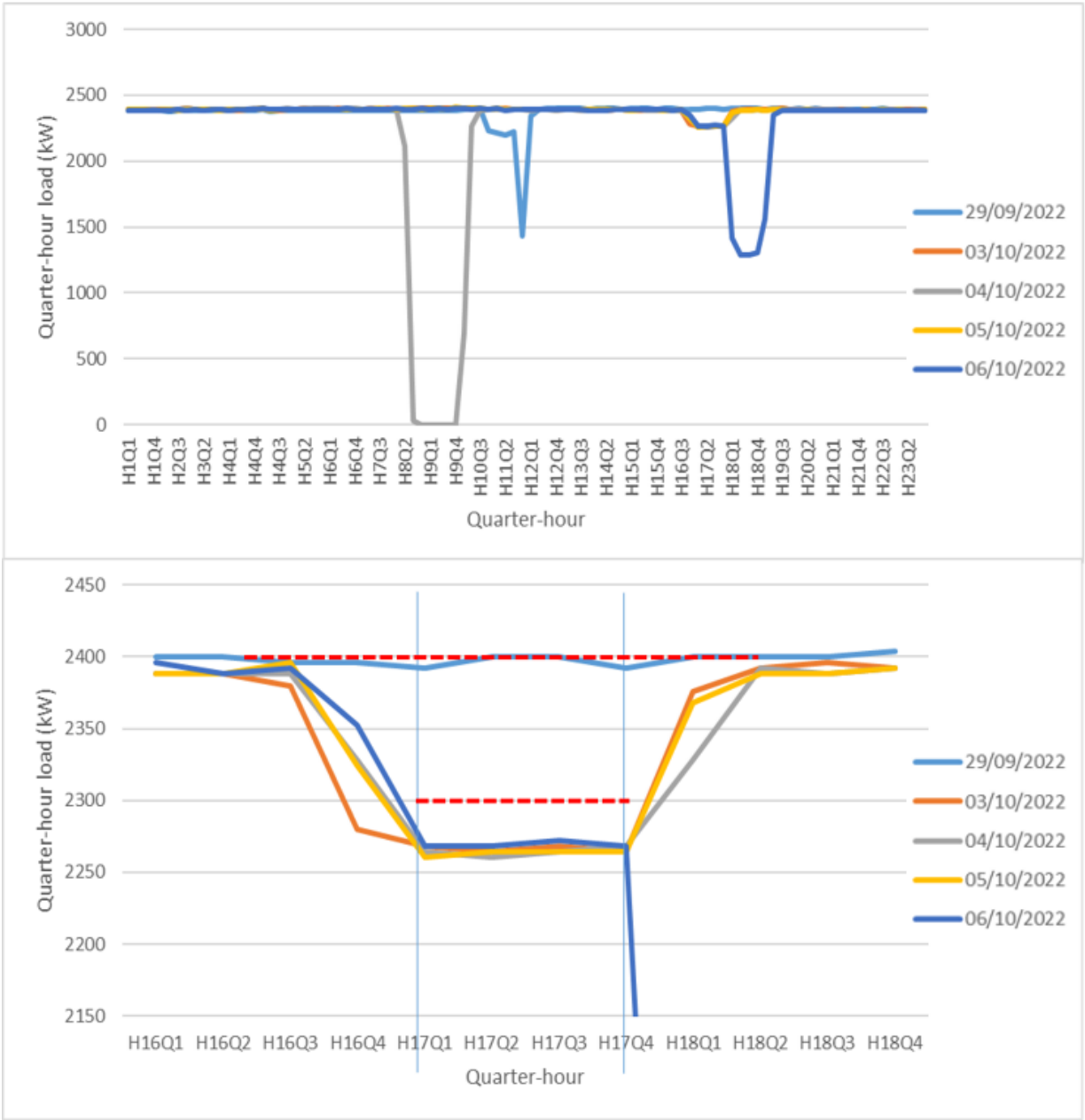

Figure 7-81: HERA biogas load quarter-hour (kW)/ Activation period zoomed in

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5. Common 15 kV Feeder Measurement:

Figure 7-82 shows the measurements of the common 15 kV Feeder on the activation day and the previous day for comparison.

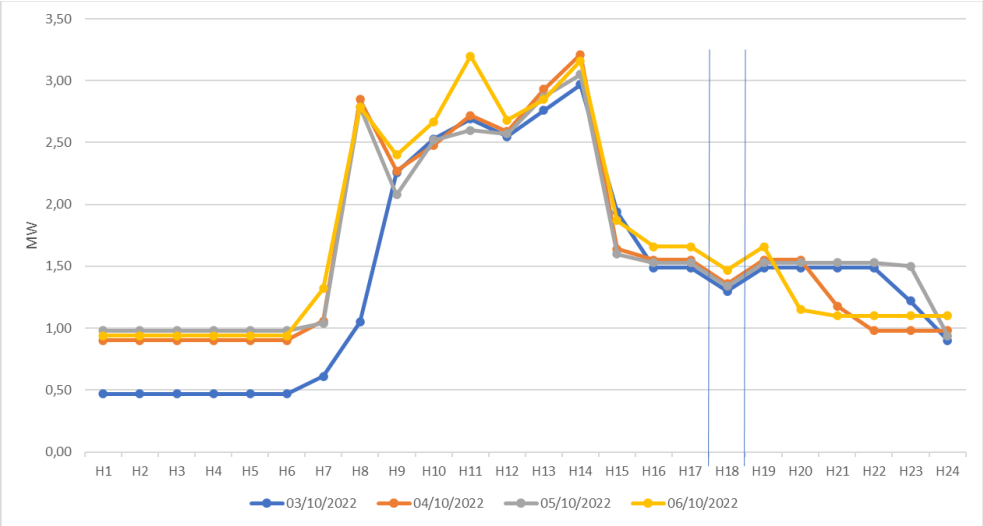

Figure 7-82: Common 15 kV Feeder (MW)– Load evolution

6. Summary of the measure and compliance:

Table 7-49 shows the summary of the measure and compliance for the participants in ES-UFD-02: Long term Alcalá de Henares.

Table 7-49 – ES-UFD-02: Long term Alcalá de Henares – Measure and compliance

Agente	Quantity Cleared (MW)	Baseline (MW)	Compliance (MW)	Compliance 03/10/2022	Compliance 04/10/2022	Compliance 05/10/2022	Compliance 06/10/2022
A84UOL1 AYTOAH_AGE84	0,02	0,035	0,015	OK	OK	NO	OK
A84UOL2 AYTOAH_AGE84	0,01	0,08	0,07	OK	OK	NO	OK
A86UOL1 METAMSA_AGE86	0,30	0,50	0,20	OK	OK	OK	OK
A98UOL1 HERA_AGE98	0,10	2,40	2,30	OK	OK	OK	OK

As can be seen in the figures above, two FSPs (Energy Center and Sport Center) have not complied with the agreement amount during activation time in October 5th. A penalty will be applied to them.

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7.7.6 Settlement phase

As we have seen, two FSPs have not complied 100% with the flexibility delivery, so it is necessary to calculate a penalty coefficient

A84UOL1 – AYTOAH_AGE84

- Penalties amount: Yes. Correction factor is applied:
  - $Correction\ Factor\ (CF) = \frac{Real\ delivery\ energy\ (MWh)}{Capacity\ notification\ (MW) * Required\ time\ (hr)} * 100 = \frac{35MWh}{10MW * 4h} * 100 = 88\%$
- A84UOL2 – AYTOAH_AGE84
  - $Correction\ Factor\ (CF) = \frac{Real\ delivery\ energy\ (MWh)}{Capacity\ notification\ (MW) * Required\ time\ (hr)} * 100 = \frac{69MWh}{20MW * 4h} * 100 = 86\%$

Table 7-50 – ES-UFD-02: Long term Alcalá de Henares – Settlement phase

Agente	Compliance	Availability Correction Factor %	Cost availability term	Cost activation term	Total Cost
A84UOL1 AYTOAH_AGE84	NO	86%	68,8 €	240,0 €	308,8 €
A84UOL2 AYTOAH_AGE84	NO	88%	44,0 €	96,0 €	140,0 €
A86UOL1 METAMSA_AGE86	OK	100%	60,0 €	900,0 €	960,0 €
A98UOL1 HERA_AGE98	OK	100%	500,0 €	1.800,0 €	2.300,0 €
Total			**672,8 €**	**3.036,0 €**	**3.708,8 €**

7.7.7 Demo KPI results

As the demo has been made from 17:00 to 18:00 instead of at the peak of demand and over 4 days as a representation of the complete period the values of the set of KPIs has been calculated as an average of those days.

Table 7-51 – ES-UFD-02: Long term Alcalá de Henares – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 17.218,84 € $Cost_{flex}$: 3.708,80 €	**78%**

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ID	Name	Formula	Variables	Value
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,43 MW $\sum P_{Total_{in_{Area}}}$: 2,10 MW	20%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right).100$	FC_{load} : 1,6 MW RL_{load} : 1,49/1,55/1,53/1,66MW N=4	4,7%
5	Power exchange deviation	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 1,72 MW (demo week) $P_{activacted}$: 1,57 MW (demo week)	9%
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 1,56 MW AL_{final}: 1,37 MW	12,2%

For this case, the results aren´t so positive as in previous cases, because although flexibility cost is most efficient, the percentage of flexibility is 20% of the demand, and the asset variation was up 12% of load, the delivery power didn´t reach the requested amount for the whole requested periods being in some cases 9% below the contracted amount.

Nevertheless, the problem didn´t happen although the forecast accuracy was 95%.

7.7.8 Challenges

The following objectives were reached in this demo:

- DSO has been able to procure local flexibility day ahead using OMIE long term platform.
- FSP resources were activated during the contracted period.
- There has been a reduction in the load of the reference circuit due to the flexibility provided by the FSPs. However, the impact was small, due to the little final flexibility made available by the FSPs with respect to the maximum available. This was due to the final dates in which the demo could be carried out.
- The goal of high participation in the Long-Term market has been achieved. 4 of the 5 resources have participated.
- The objective of compliance in the activation has been achieved partially.

Challenges:

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- Some platform labels need to be changed to complete the information. For example, the concepts of Auction / Auction Code / Product / Requirement identifier (Subasta / Código de la Subasta / Producto / Identificador requerimiento) are confusing.
- There aren't notifications from the platform to FSPs to advise them about the coming of an intraday market. They must be log on to know about it
- It is necessary to have tools for forecasting estimation ahead of time.
- Notification of activation was done by email from DSO to resource. The Platform must include this performance.
- There aren't notifications to advise about the clearing. It is needed to log on in the platform to get the information.
- It wasn´t possible to include the whole request for multi-year periods, to delay the traditional project some years, as the long-term platform doesn´t allow to include more than one period in each request. If it is not possible to get flexibility for all the periods, the traditional solution can´t be delayed because there isn´t assurance to cover the whole period.
- Baseline: It is essential to define a Baseline before the opening of any market session. The platform must collect this value that will be defined after the qualification and must be a parameter always visible to the FSPs and DSOs to avoid confusion. In the Demo it has been decided to agree on a Baseline based on the real values of the previous week. Anyway, it must be an aspect that must be regulated in a homogeneous way.
- The issue of non-compliance is very important and must be properly regulated. In these Demos there have been some minor breaches that have resulted in economic sanctions. But widespread non-compliance could have led to significant cost overruns for the DSO considering that it would no longer be possible to adopt classical long term solutions.
- It is difficult to see the impact of the FSP load reduction in the asset load because it is a small % of the total asset load, which has other small demands and generators.
- Market results: Agents only know their matching result, but they do not know the overall result. Although there must be confidentiality with the agents' offers, it is necessary to know some results so that you know the reason for their partial matching or rejection and there may be some transparency about the matching for future markets (for example, matched energy, price of the last offer cleared)
- DSO-FSPs coordination: For long-term markets it is very important to coordinate with the available FSPs the products to be summoned. It may happen that the DSOs design markets that some FSPs cannot participate in. An example is the case of the UFD Demo, a LP market called for 3 months and in a window from 6:00 a.m. to 7:00 p.m. Two FSPs stated that in a market of real flexibility they would not have bid. One of them could not have had the power available for such a long period of time. The other indicated that his difficulty was incorporating morning and afternoon hours. The alternative that both proposed

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was to subdivide the market in two. However, this may not be a solution for the DSO, since if he wants to avoid an investment, he cannot risk not having resources available in any of the submarkets. Local holidays must also be considered. Perhaps because of a single day that is a holiday in the town, the FSP cannot bid in an entire window.

- High dependence on Air Conditioning. It is difficult to participate in LP markets with Air Conditioners in industries where these consumptions are electrically significant (in food industries and in general) since it is difficult in the long term to estimate a level of need.

7.8 ES-UFD-03 Short-term day ahead Alcalá de Henares I: scenario results

The steps followed as indicated in the BUC WECL-ES-02, Short term congestion management were:

1. Prepare/Pre-qualification,
2. Plan/Forecast,
3. Market Phase,
4. Monitoring and activation,
5. Measurement phase.

7.8.1 Prepare/Pre-qualification

- FSP units:

Table 7-52 – FSP Agents and FSP resources (UOL)

Name	Agents Code	Max. flexible power (MW)	Technology	Associated UOL
Fiesta Colombina Consumo	FIESTA_AGE82	0,77	Consumption	A82UOL1
JARDÍN DEMOSTRADOR ER	AYTOAH_AGE84	0,02	electric vehicle	A84UOL1
CIUDAD DEPORTIVA EL JUNCAL	AYTOAH_AGE84	0,01	Consumption	A84UOL2
METALÚRGICA MADRILEÑA SA	METAMSA_AGE86	0,30	Consumption	A86UOL1
Planta Biogas Alcalá	HERA_AGE98	1,00	Biomass	A98UOL1

Prequalification is a one-time process, so the Prequalification Dates and Results are as reflected in point 7.6.1.

7.8.2 Plan/Forecast

The complete problem assessment is included in section 6.8, ES-UFD-03: Sort term Alcalá de Henares:

- Timeline: 04/10/2022 from 17:00 to 18:00
- Limiting assets: 15 kV feeder line from Alcalá substation

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- Critical load (when the problem happens): 3,4 MW (feeder line). The value of the capacity is 65% lower than the real one to find a valid case for the demo.
- Forecast Load: 3,1MW (1,5 MW Demo*)
- Requirement: 0,63MW
- DSO requirement date: 03/10/2022, day ahead, energy (activation)

Note for the UFD Demo: *As explained, although the case is raised at the peak of the demand, to maximize the concurrence of FSPs the demo will take place from 5:00 p.m. to 6:00 p.m. For this reason, the values used for the prediction are different from the theoretical ones.

7.8.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Market opening,
3. Qualification,
4. Bid collection,
5. Market clearing.

1. **DSO request**: Introduce DSO Day ahead request in OMIE short term platform, 03/10/2022:
   a. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside: OneNet_Alcalá deHenares. In this case, the area was created for prior LP demo,
   b. Log on in Short-term OMIE Platform
   c. Introduce request: October 3rd

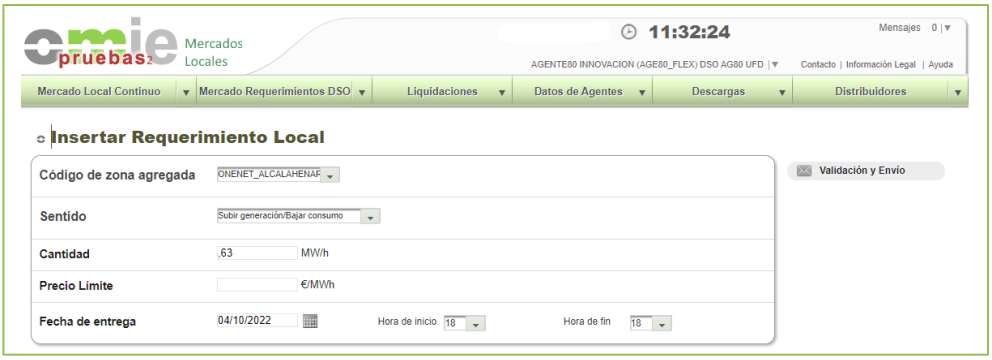

Figure 7-83: ES-UFD-03 Short-term day ahead Alcalá de Henares – DSO request

DSO request is introduced in the screen shows in Figure 7-83 with the following information, as presented in the plan forecast:

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- Area, “Código de zona agregada”: OneNet_Alcalá deHenares
- Activation direction, “Sentido”: Downward consumption (“Subir generación/Bajar consumo”)
- Quantity (MW/h), “Cantidad”: 0,63
- Limit Price (€/MWh), “Precio límite”: N/A
- Delivery time, “Fecha de entrega”:
    - Day: 04/10/2022
    - Initial time, “Hora de inicio”: H18
    - Final time, “Hora de fin”: H18

2. **Market opening**: The market is open 03/10/2022 from 09:30:01 to 10:00 for test ST1 (In general, short term day ahead markets have been scheduled for negotiation from 3pm to 3:45, although hours have been modified for the demo)
   FSPs located in the selected area can bid from 09:30:01 to 10:00.

3. **Qualification**: only the bids of prequalified resources located in the area, participating with a quantity below its total capacity are accepted.

4. **Bids received:**

Table 7-53 – ES-UFD-03 Short-term day ahead Alcalá de Henares - Bid

Bid Code	Agent - Unit	Transaction type	Volume Offered (kW)	Price (€/MWh)
2293	AG84 - A84UOL2	Ask	0,01	150
2291	AG98 - A98UOL1	Ask	0,10	180
2292	AG84 - A84UOL1	Ask	0,02	180
2289	AG86 - A86UO1	Ask	0,30	200
2290	AG82 - A82UOL1	Ask	0,15	250

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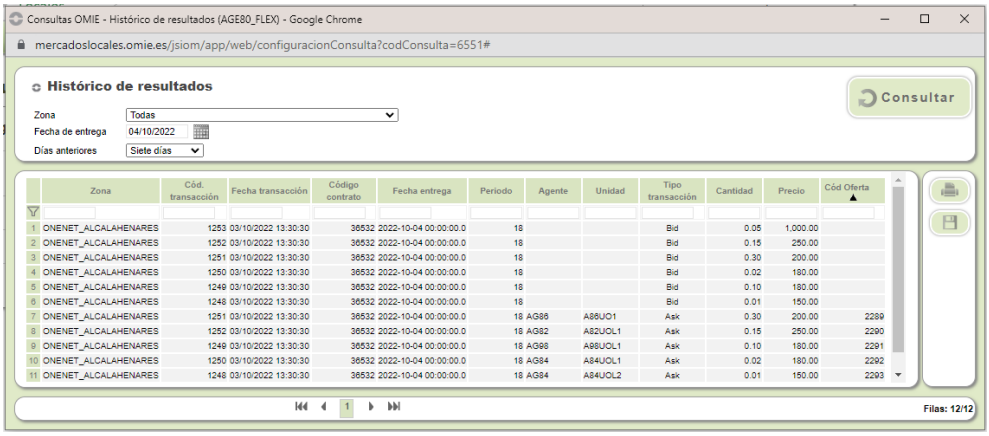
5. **Market clearing:**

Table 7-54 – ES-UFD-03 Short-term day ahead Alcalá de Henares I – Clear

Cleared	Bid Code	Agent - Unit	Volume Offered (kW)	Price (€/MWh)
Yes	2293	AG84 - A84UOL2	0,01	150
Yes	2291	AG98 - A98UOL1	0,10	180
Yes	2292	AG84 - A84UOL1	0,02	180
Yes	2289	AG86 - A86UO1	0,30	200
Yes	2290	AG82 - A82UOL1	0,15	250

The next Table shows a summary of the market phase:

Table 7-55 – ES-UFD-03 Short-term day ahead Alcalá de Henares I – market phase summary



7.8.4 Monitoring and Activation

Resources were activated by FSP on 04/10/2022 from 17:00 to 18:00.

Monitoring is done by FSP in its installation and by DSO in its monitored assets.

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7.8.5 Measurement phase

1. FSP-UFD-02 El Juncal Sport Center Measurement: Measurement:

Figure 7-84 shows the quarter-hour measurements of FSP-UFD-02 El Juncal Sport Center on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

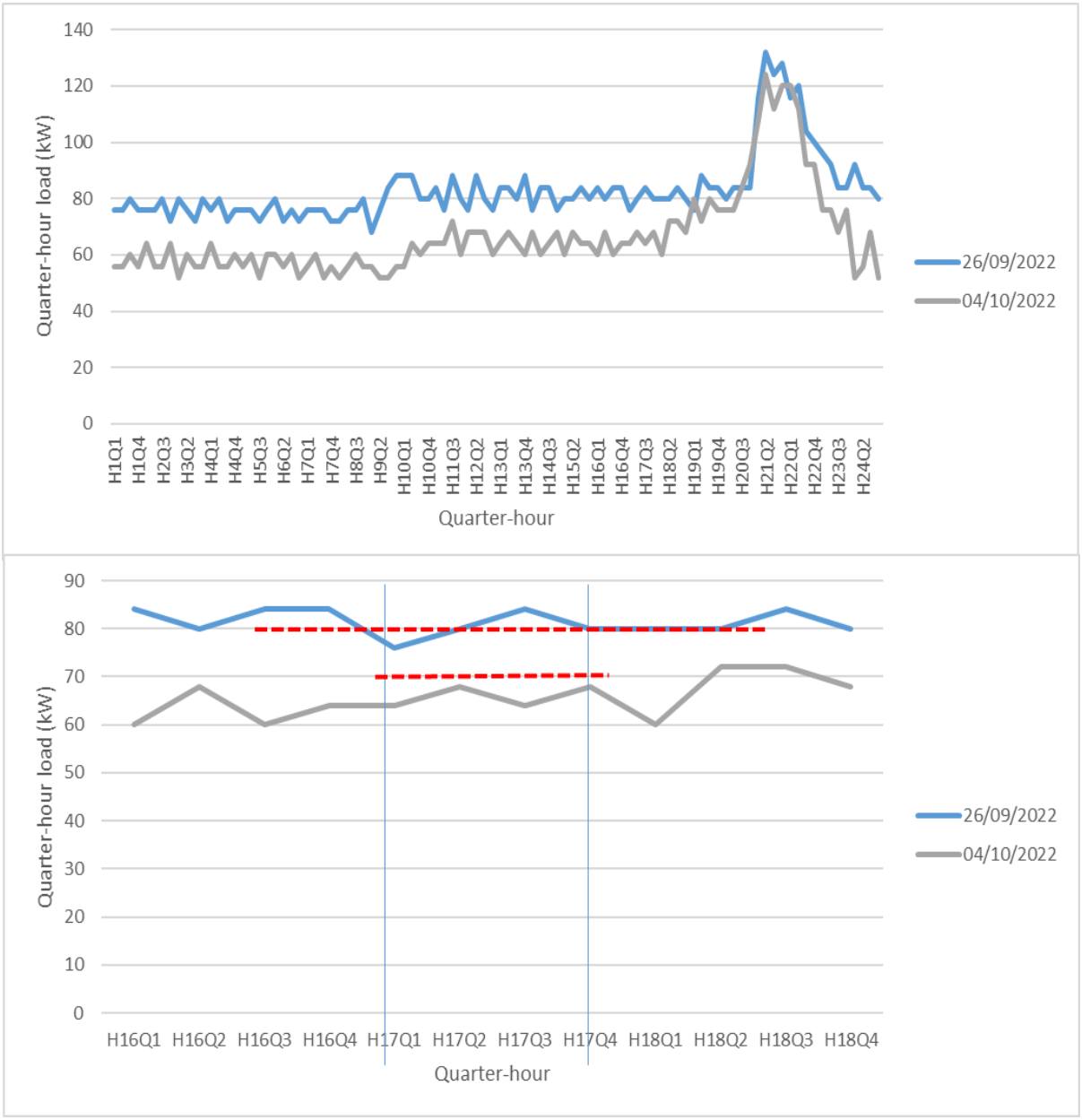

Figure 7-84: FSP-UFD-02 El Juncal Sport Centre quarter-hour daily load evolution (kW)/ Activation period zoomed in

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2. FSP-UFD-05 HERA biogas Measurement:

Figure 7-85 shows the quarter-hour measurements of FSP-UFD-05 HERA biogas on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

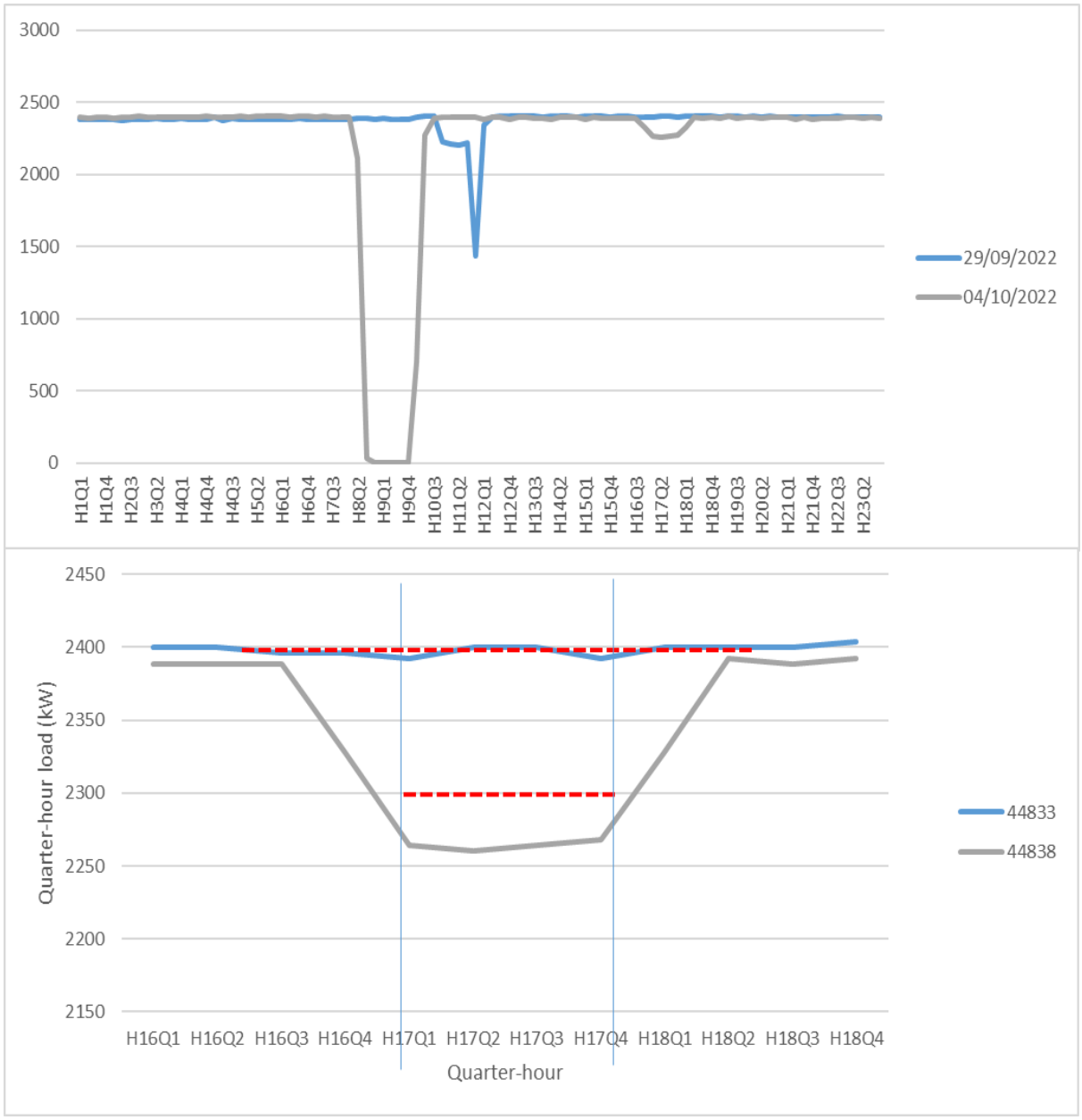

Figure 7-85: FSP-UFD-05 HERA biogas quarter- hour daily load evolution (kW)/ Activation period zoomed in

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3. FSP-UFD-01 Renewable Energy demonstration center Measurement:

Figure 7-86 shows the quarter-hour measurements of FSP-UFD-01 Renewable Energy demonstration center on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

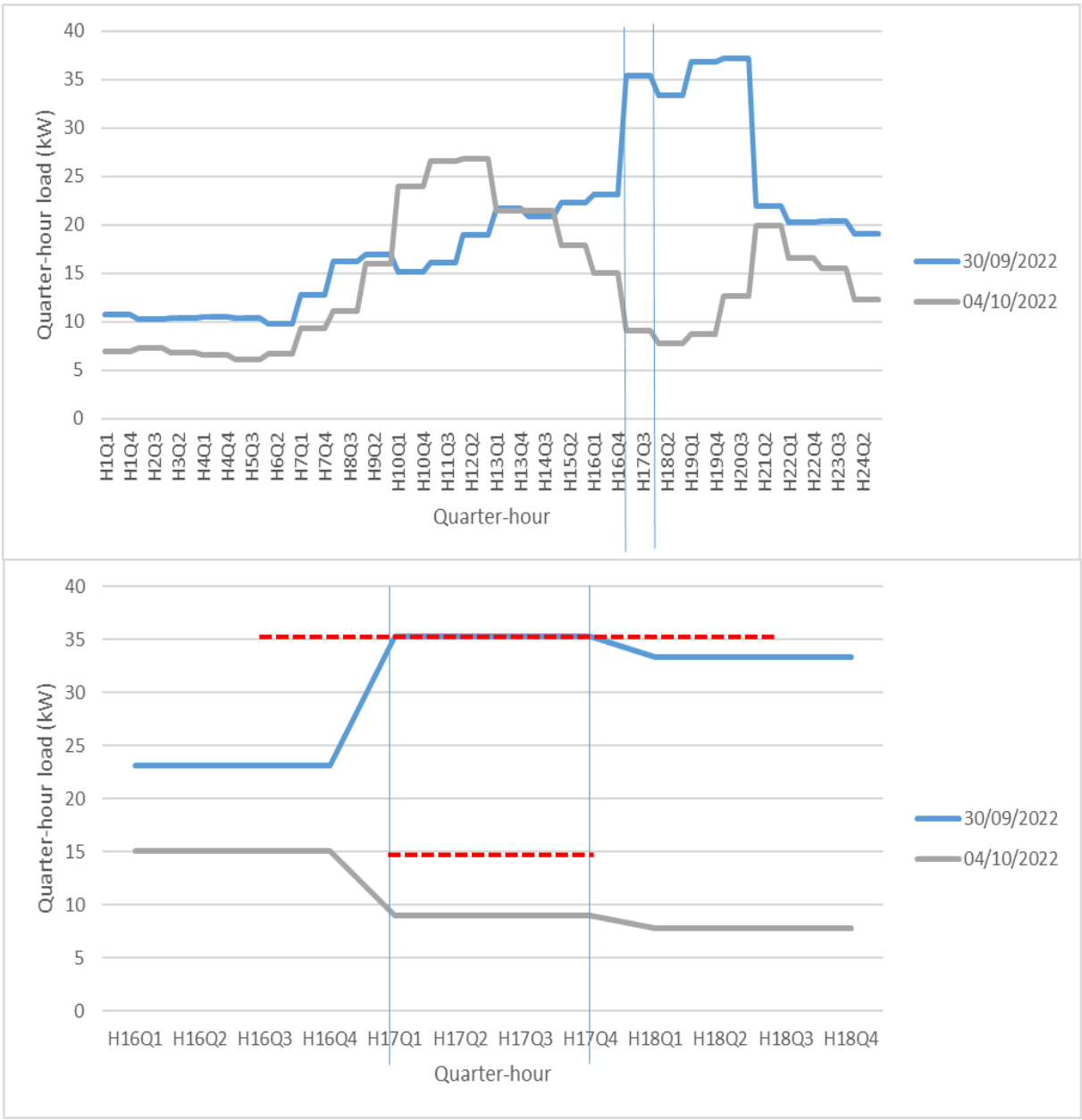

Figure 7-86: FSP-UFD-01 Renewable Energy demonstration center quarter- hour daily load evolution (kW) / Activation time zoomed in

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4. FSP-UFD-03 Metalúrgica Madrileña Measurement:

Figure 7-87 shows the quarter-hour measurements of FSP-UFD-03 Metalúrgica Madrileña on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

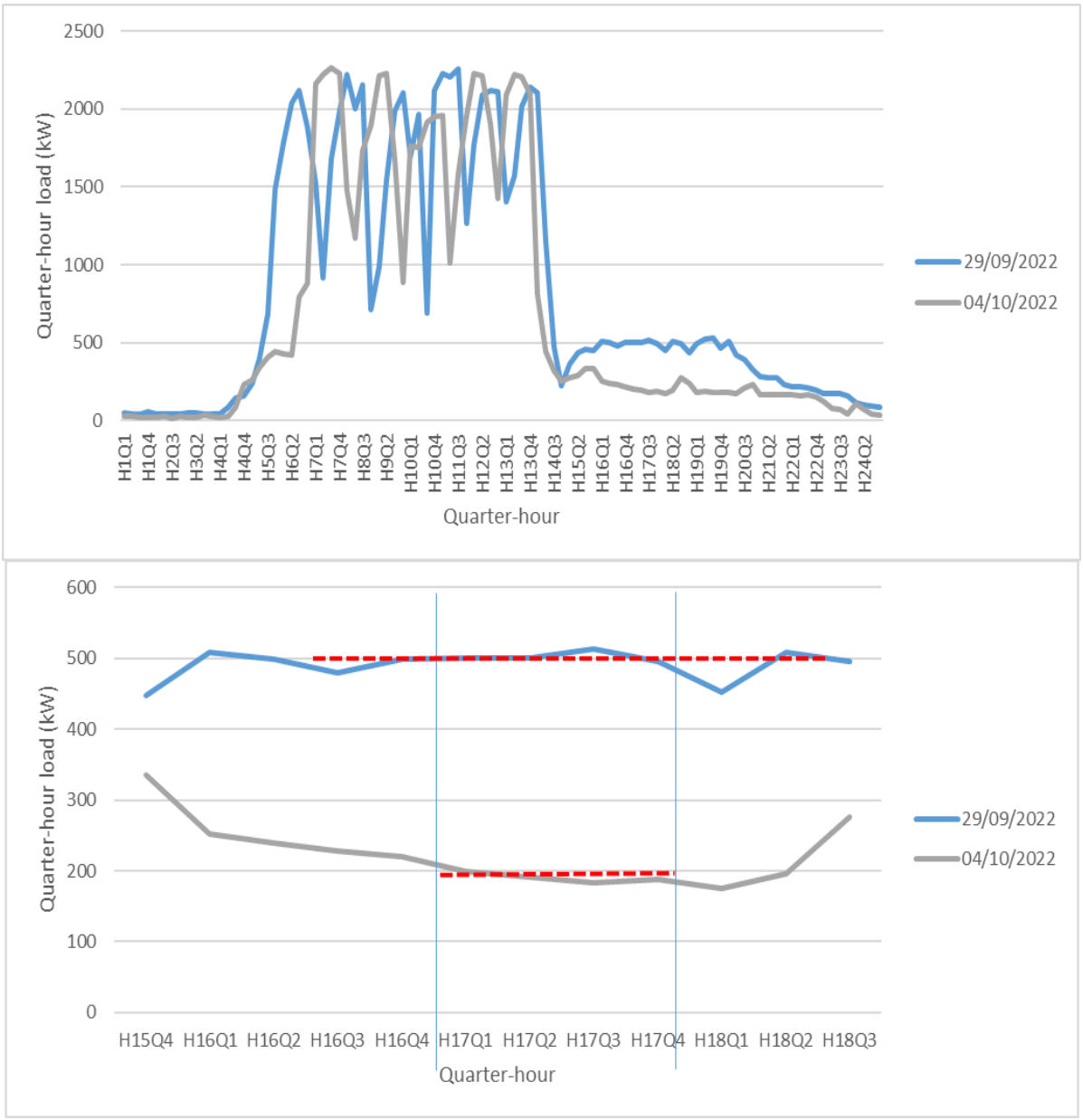

Figure 7-87: FSP-UFD-03 Metalúrgica Madrileña quarter-hour daily load evolution (kW)/ Activation period zoomed in

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5. FSP-UFD-04 Fiesta Colombina Measurement:

Figure 7-88 shows the quarter-hour measurements of FSP-UFD-04 Fiesta Colombina on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

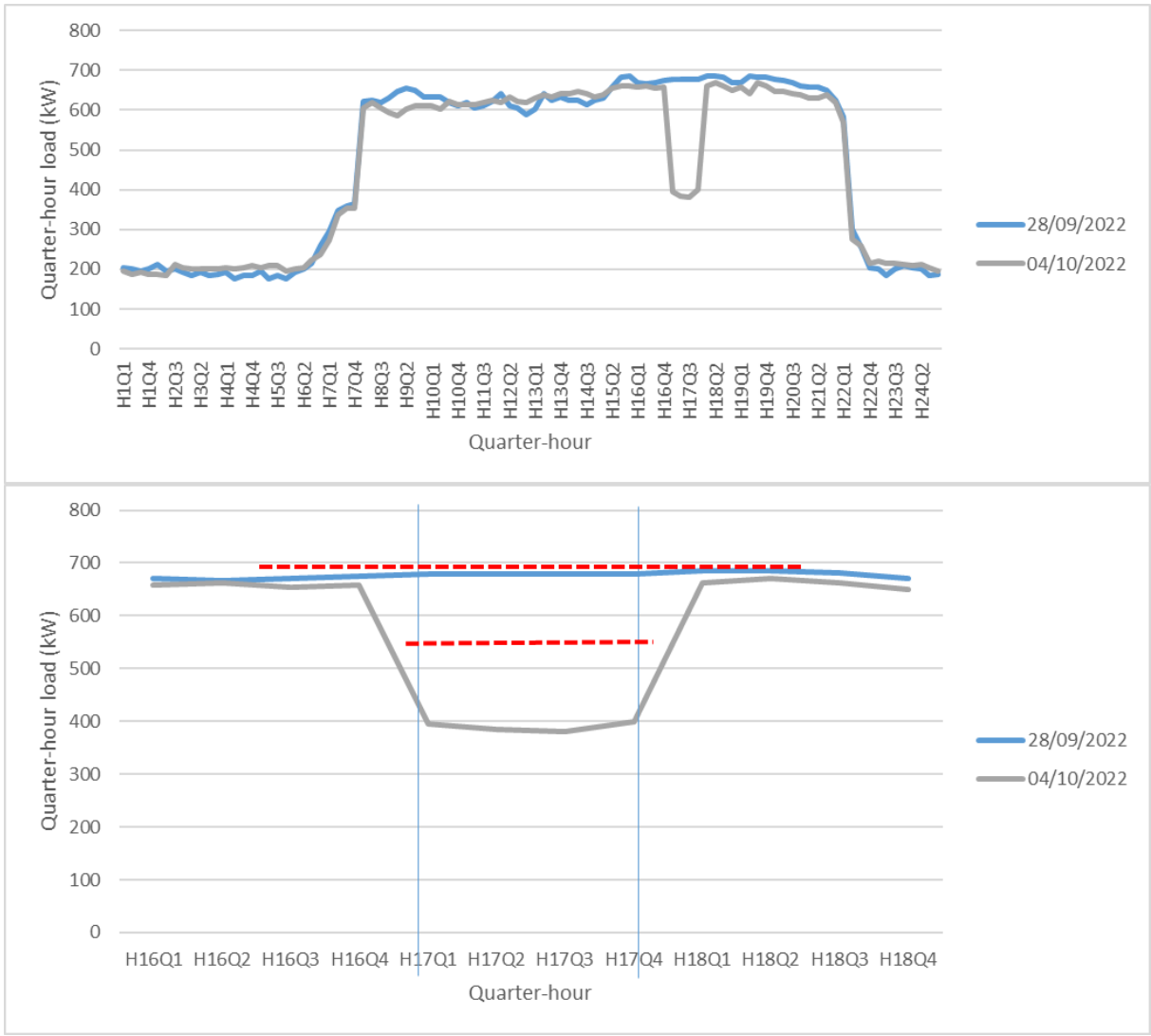

Figure 7-88: FSP-UFD-04 Fiesta Colombina daily load evolution (kW) / Activation period zoomed in

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

7. Common 15 kV Feeder Measurement:

Figure 7-89 shows the measurements of the common 15 kV Feeder on the activation day and the previous day for comparison.

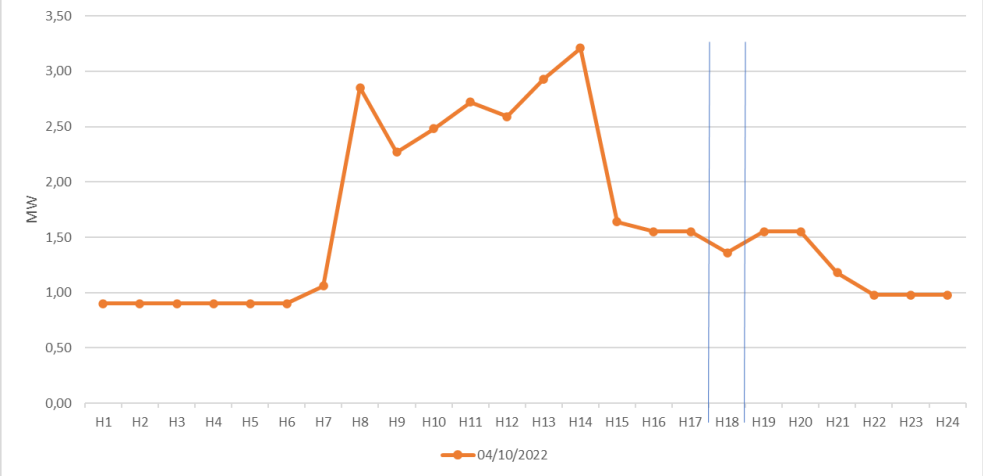

Figure 7-89: Common 15 kV Feeder (MW)– Load evolution

8. Summary of the measure and compliance:

Table 7-56 shows the summary of the measure and compliance for the participants in ES-UFD-03 Short-term day ahead Alcalá de Henares I.

Table 7-56 – ES-UFD-03 Short-term day ahead Alcalá de Henares I – Measure and compliance

Agent - Unit	Quantity Cleared (MW)	Baseline (MW)	Compliance (MW)	Compliance 04/10/2022
A84UOL2 - AYTOAH_AGE84	0,01	0,08	0,07	**OK**
A98UOL1 - HERA_AGE98	0,10	2,40	2,30	**OK**
A84UOL1 - AYTOAH_AGE84	0,02	0,04	0,02	**OK**
A86UOL1 - METAMSA_AGE86	0,30	0,50	0,20	**OK**
A82UOL1 - FIESTA_AGE82	0,15	0,70	0,55	**OK**

As can be seen in the figures above, all FSPs have fulfilled the flexibility service for the activated time. In the economic calculations of liquidation, it will be estimated that the total estimated hours have been fulfilled.

7.8.6 Settlement phase

As we have seen all FSPs have complied 100% with the flexibility delivery, so it is not necessary to calculate a penalty coefficient.

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Table 7-57 – ES-UFD-03 Short-term day ahead Alcalá de Henares I – Settlement phase

Agent - Unit	Compliance 04/10/2022	Quantity Cleared (MW)	Price (€/MWh)	Total Cost (€)
A84UOL2 - AYTOAH_AGE84	OK	0,01	150	1,50
A98UOL1 - HERA_AGE98	OK	0,10	180	18,00
A84UOL1 - AYTOAH_AGE84	OK	0,02	180	3,60
A86UOL1 - METAMSA_AGE86	OK	0,30	200	60,00
A82UOL1 - FIESTA_AGE82	OK	0,15	250	37,50
		0,58		**120,60**

7.8.7 Demo KPI results

Table 7-58 – ST Comillas day ahead 1hour – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 977,00 €/MWh $Cost_{flex}$: 120,60 €/MWh	88%
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,58 MW $\sum P_{Total_{in_{Area}}}$: 2,10 MW	28%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right) \cdot 100$	FC_{load} : 1,5 MW (demo week) RL_{load} : 1,55 MW (demo week) N=4	3,2%
5	Power exchange deviation	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 0,58 MW $P_{activacted}$: 0,58 MW	0 %
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 1,55 MW AL_{final}: 1,36 MW	12,3%

In general, KPI values show positive results:

- In economic terms, for this case, it is most efficient to use flexibility than the traditional solution, diesel generation as flexibility cost is 12% of the traditional solution cost.
- Available flexibility in the area is 28% of the load. It is noticed that more than 1 FSP is participating in this demo.
- Load forecast was very accurate, close to 97% of the real demand.
- Overall, the requested power was delivered being as requested, 0% deviation, although with different FSP performance.

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- The asset was impacted by flexibility activation decreasing its load 12%

7.8.8 Challenges

The following objectives were reached in this demo:

- DSO has been able to procure local flexibility day ahead using OMIE sort term platform.
- FSP resources were activated during the contracted period.
- There has been a reduction in the load of the reference circuit due to the flexibility provided by the FSPs. However, the impact was small, due to the little final flexibility made available by the FSPs with respect to the maximum available. This was due to the final dates on which the demo could be carried out.
- The goal of high participation in the Long-Term market has been achieved. Five resources have participated.
- The objective of compliance in the activation has been achieved. The 5 resources have met their commitments.

Challenges:

- Some platform labels need to be changed to complete the information. For example, the concepts of Auction / Auction Code / Product / Requirement identifier (Subasta / Código de la Subasta / Producto / Identificador requerimiento) are confusing.
- To know which FSP has been cleared in SP, it is necessary to log on in the long-term platform to get the information as it was not available at the short-term platform, only the FSP code is shown.
- There aren't notifications from the platform to FSPs to advise them about the coming of an intraday market. They must be log on to know about it.
- It is necessary to have tools for demand forecasting estimation ahead of time.
- There aren't notifications to advise about the clearing. It is needed to log on in the platform to get the information.
- Currently a market is void if the total energy summoned by the DSP is not reached. A very interesting option to include would be partial clearing. It is interesting because, although the DSO does not obtain all the energy it needs, it can minimize the total cost of the problem to be solved, for example, one generator set versus two.
- Baseline: It is essential to define a Baseline before the opening of any market session. The platform must collect this value that will be defined after the qualification and must be a parameter always visible to the FSPs and DSOs to avoid confusion. In the Demo it has been decided to agree on a Baseline

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based on the real values of the previous week. Anyway, it must be an aspect that must be regulated in a homogeneous way.

- The issue of non-compliance is very important and must be properly regulated. In these Demos there have been some minor breaches that have resulted in economic sanctions. But widespread non-compliance could have led to significant cost overruns for the DSO considering that it would no longer be possible to adopt classical long term solutions.
- It is difficult to see the impact of the FSP load reduction in the asset load because it is a small % of the total asset load, which has other small demands and generators.
- Market results: Agents only know their matching result, but they do not know the overall result. Although there must be confidentiality with the agents' offers, it is necessary to know some results so that you know the reason for their partial matching or rejection and there may be some transparency about the matching for future markets (for example, matched energy, price of the last offer cleared).

7.9 ES-UFD-04 Short-term day ahead Alcalá de Henares II: scenario results

The steps followed as indicated in the BUC WECL-ES-02, Short term congestion management were:

1. Prepare/Pre-qualification,
2. Plan/Forecast,
3. Market Phase,
4. Monitoring and activation,
5. Measurement phase

7.9.1 Prepare/Pre-qualification

- FSP units:

Table 7-59 – FSP Agents and FSP resources (UOL)

Name	Agents Code	Max. flexible power (MW)	Technology	Associated UOL
Fiesta Colombina Consumo	FIESTA_AGE82	0,77	Consumption	A82UOL1
JARDÍN DEMOSTRADOR ER	AYTOAH_AGE84	0,02	electric vehicle	A84UOL1
CIUDAD DEPORTIVA EL JUNCAL	AYTOAH_AGE84	0,01	Consumption	A84UOL2
METALÚRGICA MADRILEÑA SA	METAMSA_AGE86	0,30	Consumption	A86UOL1
Planta Biogas Alcalá	HERA_AGE98	1,00	Biomass	A98UOL1

Prequalification is a one-time process, so the Prequalification Dates and Results are as reflected in point 7.6.1.

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7.9.2 Plan/Forecast

The complete problem assessment is included in section 6.8, ES-UFD-03: Sort term Alcalá de Henares:

- Timeline: 06/10/2022 from 17:00 to 18:00
- Limiting assets: 15 kV feeder line from Alcalá substation
- Critical load (when the problem happens): 3,4 MW (feeder line). The value of the capacity is 65% lower than the real one to find a valid case for the demo.
- Forecast Load: 3,1MW (1,5 MW Demo*)
- Requirement: 1,0MW
- DSO requirement date: 05/10/2022, day ahead, energy (activation)

Note for the UFD Demo: *As explained, although the case is raised at the peak of the demand, to maximize the concurrence of FSPs the demo will take place from 5:00 p.m. to 6:00 p.m. For this reason, the values used for the prediction are different from the theoretical ones.

7.9.3 Market Phase

Market phase includes the following steps:

1. DSO request,
2. Market opening,
3. Qualification,
4. Bid collection,
5. Market clearing.

1. **DSO request**: Introduce DSO Day ahead request in OMIE short term platform, 05/10/2022 :
   a. Log on in Long-term local platform and create the area where the problem is (if it hasn´t been created previously) to choose only the resources located inside: OneNet_Alcalá de Henares.
      In this case, the area was created for prior LP demo,
   b. Log on in Short-term OMIE Platform
   c. Introduce request: October 6th

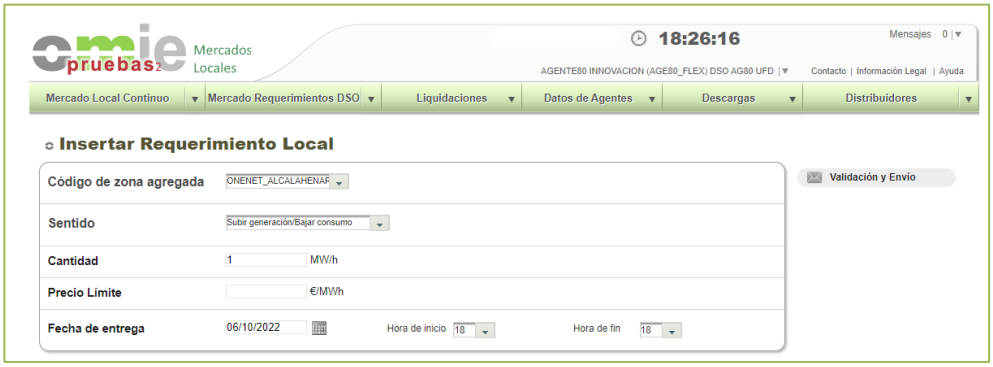

Figure 7-90: ES-UFD-04 Short-term day ahead Alcalá de Henares II – DSO request

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DSO request is introduced in the screen shows in Figure 7-90 with the following information, as presented in the plan forecast:

- Area, "Código de zona agregada": OneNet_Alcalá deHenares
- Activation direction, "Sentido": Downward consumption ("Subir generación/Bajar consumo")
- Quantity (MW/h), "Cantidad": 1,0
- Limit Price (€/MWh), "Precio límite": N/A
- Delivery time, "Fecha de entrega":
    - Day: 06/10/2022
    - Initial time, "Hora de inicio": H18
    - Final time, "Hora de fin": H18

2. **Market opening**: The market is open 06/10/2022 from 09:00:01 to 09:30 for test ST 2 (In general, short term day ahead markets have been scheduled for negotiation from 3pm to 3:45, although hours have been modified for the demo)
   FSPs located in the selected area can bid from 09:00:01 to 09:30:00.

3. **Qualification**: only the bids of prequalified resources located in the area, participating with a quantity below its total capacity are accepted.

4. **Bids received:**

Table 7-60– ES-UFD-04 Short-term day ahead Alcalá de Henares II - Bid

Bid Code	Agent – Unit	Transaction type	Volume Offered (kW)	Price (€/MWh)
2313	AG98 - A98UOL1	Ask	0,10	90
2311	AG84 - A84UOL1	Ask	0,02	150
2312	AG84 - A84UOL2	Ask	0,01	200
2308	AG82 - A82UOL1	Ask	0,15	250
2309	AG86 - A86UO1	Ask	0,30	500

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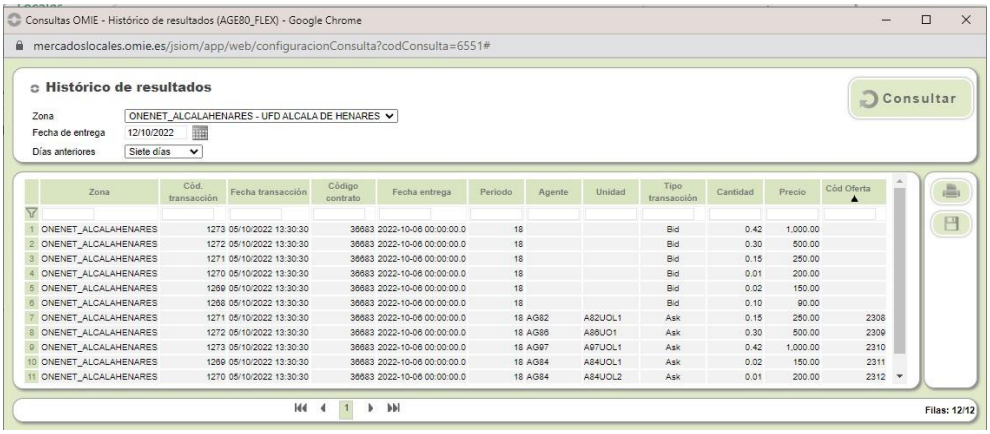
5. **Market clearing:**

Table 7-61 – ES-UFD-04 Short-term day ahead Alcalá de Henares II – Clear

Cleared	Bid Code	Agent - Unit	Volume Offered (kW)	Price (€/MWh)
Yes	2293	AG98 - A98UOL1	0,10	90
Yes	2291	AG84 - A84UOL1	0,02	150
Yes	2292	AG84 - A84UOL2	0,01	200
Yes	2289	AG82 - A82UOL1	0,15	250
Yes	2290	AG86 - A86UO1	0,30	500

The next Table shows a summary of the market phase:

Table 7-62 – ES-UFD-04 Short-term day ahead Alcalá de Henares II – market phase summary



7.9.4 Monitoring and Activation

Resources were activated by FSP on 06/10/2022 from 17:00 to 18:00. Monitoring is done by FSP in its installation and by DSO in its monitored assets.

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7.9.5 Measurement phase

1. FSP-UFD-05 HERA biogas Measurement:

Figure 7-91 shows the quarter-hour measurements of FSP-UFD-05 HERA biogas on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

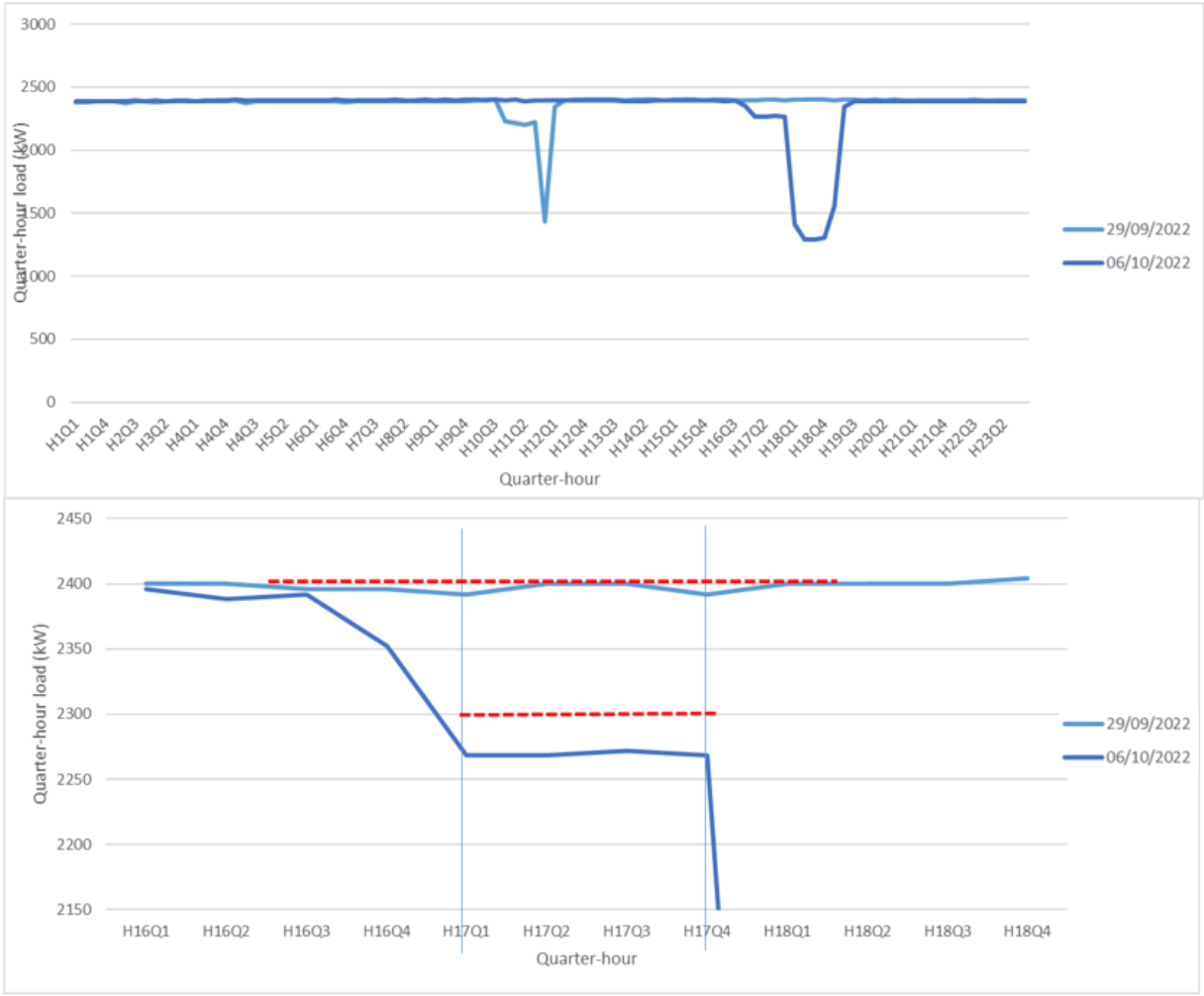

Figure 7-91: FSP-UFD-05 HERA biogas quarter-hour daily load (kW)/ Activation period zoomed in

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2. FSP-UFD-01 Renewable Energy demonstration center Measurement:

Figure 7-92 shows the quarter-hour measurements of FSP-UFD-01 Renewable Energy demonstration center on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

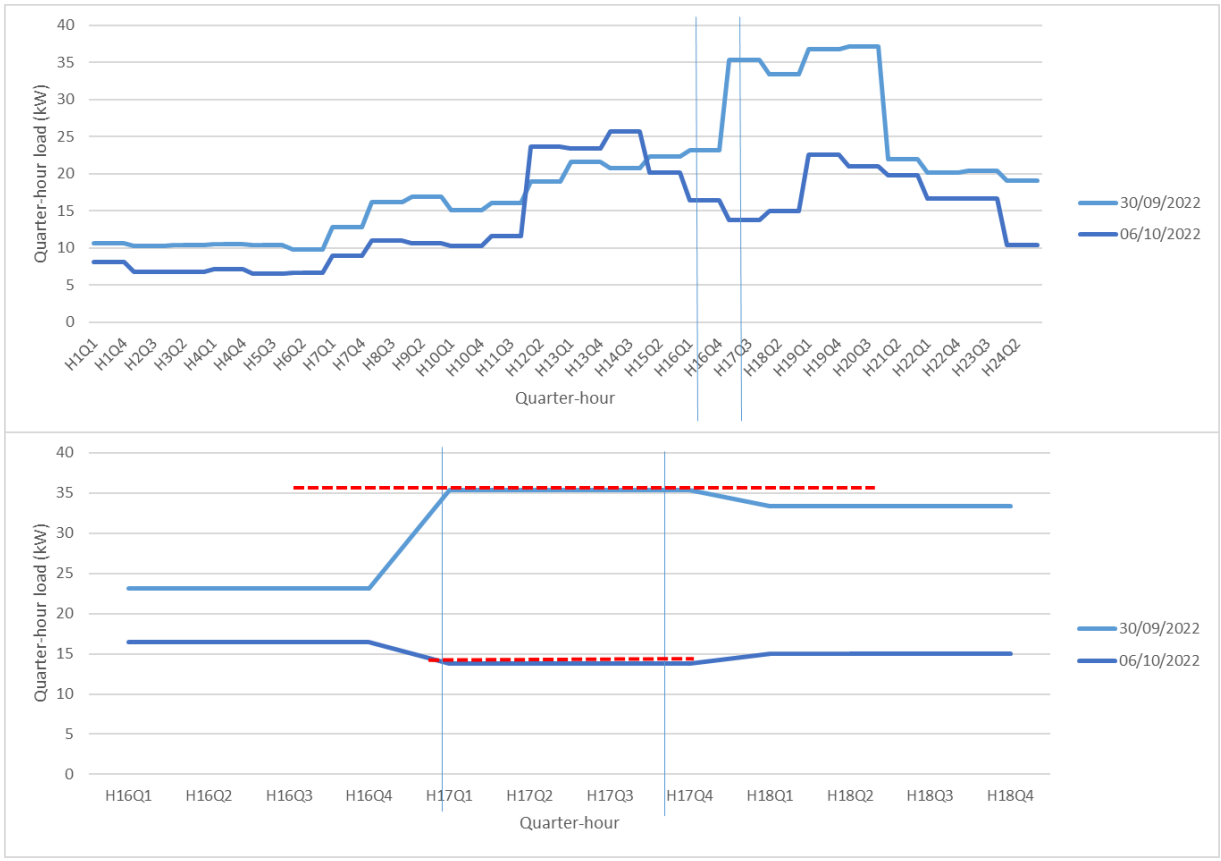

Figure 7-92: -: FSP-UFD-01 Renewable Energy demonstration center quarter-hour daily load evolution (kW)/ Activation period zoomed in

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3. FSP-UFD-02 El Juncal Sport Centre Measurement:

Figure 7-93 shows the quarter-hour measurements of FSP-UFD-02 El Juncal Sport Centre on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

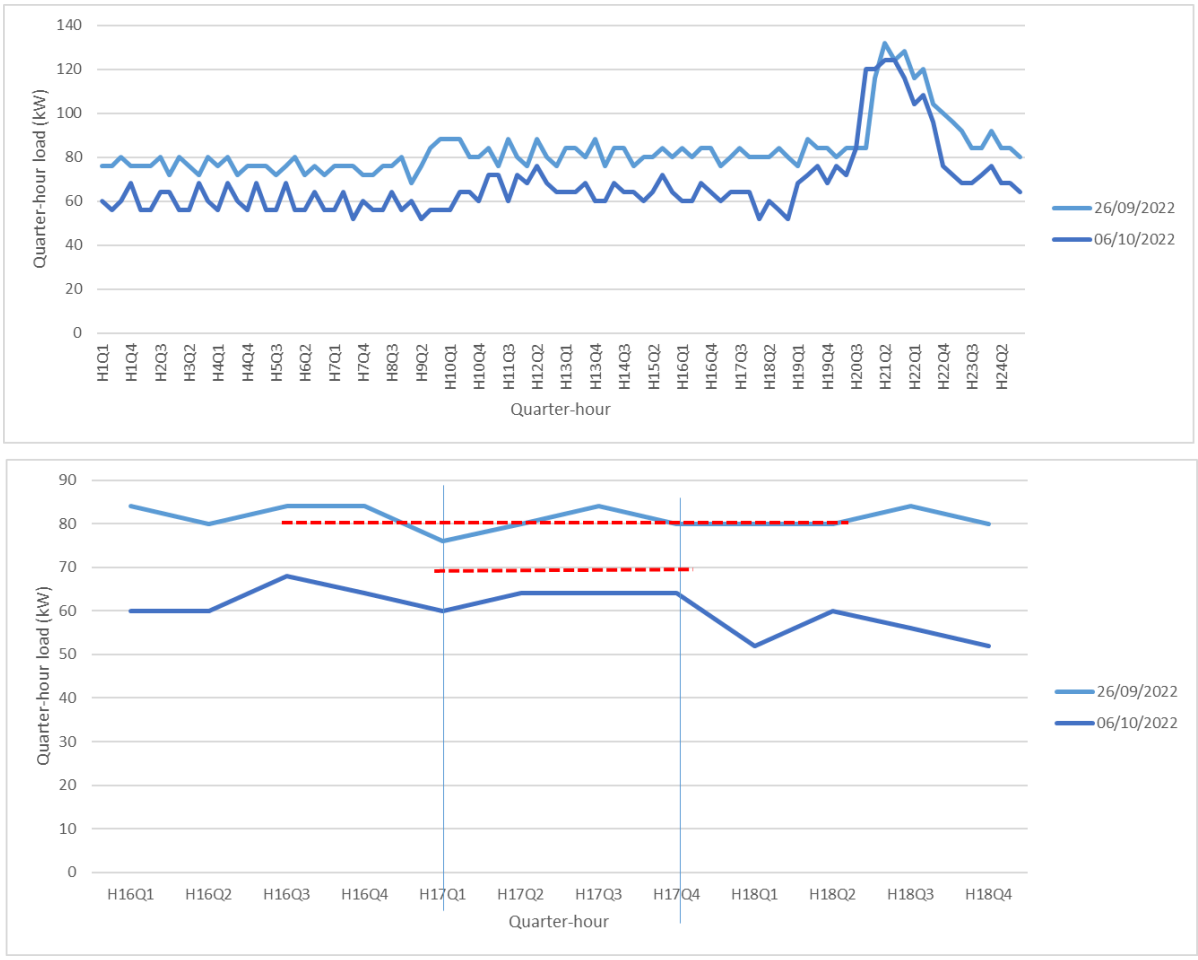

Figure 7-93: FSP-UFD-02 El Juncal Sport Center quarter-hour daily load evolution (kW) / Activation period zoomed in

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4. FSP-UFD-04 Fiesta Colombina Measurement:

Figure 7-94 shows the quarter-hour measurements of FSP-UFD-04 Fiesta Colombina on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

Figure 7-94: FSP-UFD-04 Fiesta Colombina load (kW) quarter-hour daily load evolution (kW) / Activation period zoomed in

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5. FSP-UFD-03 Metalúrgica Madrileña Measurement:

Figure 7-95 shows the quarter-hour measurements of FSP-UFD-03 Metalúrgica Madrileña on the activation day. Likewise, the day agreed to choose the baseline is shown in dark blue. Both the base line and the compliance limit value can also be seen in the red dashed line after the settled offer.

Figure 7-95: FSP-UFD-03 Metalúrgica Madrileña quarter-hour daily load evolution (kW)/ Activation period zoomed in

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Common 15 kV Feeder Measurement:

Figure 7-96 shows the measurements of the common 15 kV Feeder on the activation day and the previous day for comparison.

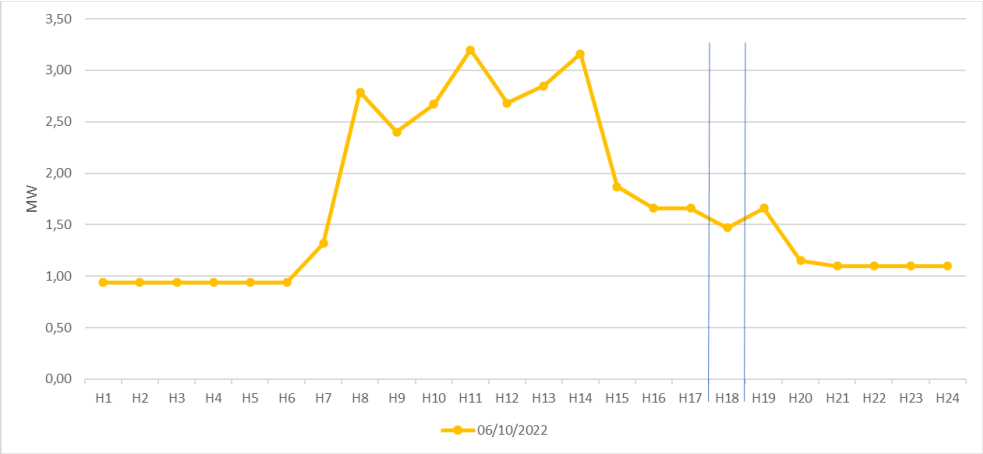

Figure 7-96: Common 15 kV Feeder (MW)– Load evolution

9. Summary of the measure and compliance:

Table 7-63 shows the summary of the measure and compliance for the participants in ES-UFD-03 Short-term day ahead Alcalá de Henares I.

Table 7-63– ES-UFD-04 Short-term day ahead Alcalá de Henares II – Measure and compliance

Agent - Unit	Quantity Cleared (MW)	Baseline (MW)	Compliance (MW)	Compliance 06/10/2022
A98UOL1 - HERA_AGE98	0,10	2,40	2,30	**OK**
A84UOL1 - AYTOAH_AGE84	0,02	0,05	0,02	**OK**
A84UOL2 - AYTOAH_AGE84	0,01	0,08	0,07	**OK**
A82UOL1 - FIESTA_AGE82	0,15	0,70	0,55	**OK**
A86UOL1 - METAMSA_AGE86	0,30	0,50	0,20	**OK**

As can be seen in the figures above, all FSPs have fulfilled the flexibility service for the activated time. In the economic calculations of liquidation, it will be estimated that the total estimated hours have been fulfilled.

7.9.6 Settlement phase

As we have seen all FSPs have complied 100% with the flexibility delivery, so it is not necessary to calculate a penalty coefficient.

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Table 7-64 – ES-UFD-04 Short-term day ahead Alcalá de Henares II – Settlement phase

Agent - Unit	Compliance 04/10/2022	Quantity Cleared (MW)	Price (€/MWh)	Total Cost (€)
A84UOL2 - AYTOAH_AGE84	**OK**	0,01	150	1,50
A98UOL1 - HERA_AGE98	**OK**	0,10	180	18,00
A84UOL1 - AYTOAH_AGE84	**OK**	0,02	180	3,60
A86UOL1 - METAMSA_AGE86	**OK**	0,30	200	60,00
A82UOL1 - FIESTA_AGE82	**OK**	0,15	250	37,50
		0,58		**120,60 €**

7.9.7 Demo KPI results

Table 7-65 – ES-UFD-04 Short-term day ahead Alcalá de Henares II – KPI results

ID	Name	Formula	Variables	Value
1	Cost effectiveness	$Cost_{effectiveness} = \left(1 - \frac{Cost_{flex}}{Cost_{Sub}}\right) \cdot 100$	$Cost_{Sub}$: 977,00 €/MWh $Cost_{flex}$: 201,50 €/MWh	**79%**
3	Available Flexibility	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$	$\sum P_{Available_{Flexibility}}$: 0,58 MW $\sum P_{Total_{in_{Area}}}$: 2,10 MW	28%
4	Error of load forecast	$Load_{FA_{T,h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\|\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\|\right) \cdot 100$	FC_{load} : 1,5 MW (demo week) RL_{load} : 1,66 MW (demo week) N=4	9,6%
5	Power exchange deviation	$P_{Deviation} = \frac{\left\|P_{accepted} - P_{activacted}\right\|}{P_{accepted}} \cdot 100$	$P_{accepted}$: 0,58 MW $P_{activacted}$: 0,58 MW	0 %
6	Asset load profile variation	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$	$AL_{initial}$: 1,66 MW AL_{final}: 1,47 MW	11,4%

In general, KPI values show positive results:

- In economic terms, for this case, it is most efficient to use flexibility than the traditional solution, diesel generation as flexibility cost is 21% of the traditional solution cost.
- Available flexibility in the is 28% of the load. It is noticed that more than 1 FSP is participating in this demo.
- Load forecast was accurate, close to 90% of the real demand.
- Requested power was delivered being as requested, 0% deviation.

  The asset was impacted by flexibility activation decreasing its load 11%.

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7.9.8 Challenges

The following objectives were reached in this demo:

- DSO has been able to procure local flexibility day ahead using OMIE sort term platform.
- FSP resources were activated during the contracted period.
- There has been a reduction in the load of the reference circuit due to the flexibility provided by the FSPs. However, the impact was small, due to the little final flexibility made available by the FSPs with respect to the maximum available. This was due to the final dates in which the demo could be carried out.
- The goal of high participation in the Long-Term market has been achieved. The 5 resources have participated.
- The objective of compliance in the activation has been achieved. The 5 resources have met their commitments.

Challenges:

- Some platform labels need to be changed to complete the information. For example, the concepts of Auction / Auction Code / Product / Requirement identifier (Subasta / Código de la Subasta / Producto / Identificador requerimiento) are confusing.
- To know which FSP has been cleared in SP, it is necessary to log on in the long-term platform to get the information as it was not available at the short-term platform, only the FSP code is shown.
- There aren't notifications from the platform to FSPs to advise them about the coming of an intraday market. They must be log on to know about it.
- It is necessary to have tools for forecasting estimation ahead of time.
- There aren't notifications to advise about the clearing. It is needed to log on to the platform to get the information.
- Currently a market is void if the total energy summoned by the DSP is not reached. A very interesting option to include would be partial clearing. It is interesting because, although the DSO does not obtain all the energy it needs, it can minimize the total cost of the problem to be solved, for example, one generator set versus two.
- Baseline: It is essential to define a Baseline before the opening of any market session. The platform must collect this value that will be defined after the qualification and must be a parameter always visible to the FSPs and DSOs to avoid confusion. In the Demo it has been decided to agree on a Baseline based on the real values of the previous week. Anyway, it must be an aspect that must be regulated in a homogeneous way.

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- The issue of non-compliance is very important and must be properly regulated. In these Demos there have been some minor breaches that have resulted in economic sanctions. But widespread non-compliance could have led to significant cost overruns for the DSO considering that it would no longer be possible to adopt classical long term solutions.
- It is difficult to see the impact of the FSP load reduction in the asset load because it is a small % of the total asset load, which has other small demands and generators.
- Market results: Agents only know their matching result, but they do not know the overall result. Although there must be confidentiality with the agents' offers, it is necessary to know some results so that you know the reason for their partial matching or rejection and there may be some transparency about the matching for future markets (for example, matched energy, price of the last offer cleared).
- It is difficult to see the impact of the FSP load reduction in the asset load because it is a small % of the total asset load, which has other small demands and generators.
- Market results: Agents only know their matching result, but they do not know the overall result. Although there must be confidentiality with the agents' offers, it is necessary to know some results so that you know the reason for their partial matching or rejection and there may be some transparency about the matching for future markets (for example, matched energy, price of the last offer cleared).
- DSO-FSPs coordination: For long-term markets it is very important to coordinate with the available FSPs the products to be summoned. It may happen that the DSOs design markets that some FSPs cannot participate in. An example is the case of the UFD Demo, a LP market called for 3 months and in a window from 6:00 a.m. to 7:00 p.m. Two FSPs stated that in a market of real flexibility they would not have bid. One of them could not have had the power available for such a long period of time. The other indicated that his difficulty was incorporating morning and afternoon hours. The alternative that both proposed was to subdivide the market in two. However, this may not be a solution for the DSO, since if he wants to avoid an investment, he cannot risk not having resources available in any of the submarkets. Local holidays must also be considered. Perhaps because of a single day that is a holiday in the town, the FSP cannot bid in an entire window.
- High dependence on Air Conditioning. It is difficult to participate in LP markets with Air Conditioners in industries where these consumptions are electrically significant (in food industries and in general) since it is difficult in the long term to estimate a level of need.

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8 Conclusions

The Spanish demonstrator develops activities at two Spanish DSO networks to address local constraints in both long-term and short-term local markets. The objectives include testing market procedures to obtain flexibility services that meet DSO requirements, demonstrating the suitability of solving network congestions with demand response from different Distributed Energy Resources (DERs), implementing the flexibility provision and acquisition of it through market platforms.

Overall, the demonstrations aim to showcase the potential of various flexibility services to address local congestions efficiently and sustainably, using a combination of market-based approaches and collaboration among different DERs (mainly industrial and residential customers) comparing both traditional and flexibility solutions. The Spanish demonstrator considered providers located in selected areas where DSOs operates: i-DE in Murcia and in Madrid (Cantoblanco) areas and UFD in Alcalá de Henares, Madrid.

The study tested the different market phases obtaining satisfactory results. The FSPs could be efficiently connected to the market platforms developed by OMIE, where different tests were carried out to demonstrate all market phases: from prequalification, forecasts, market clearing, monitoring and activation until settlement.

The results show how the use of local flexibility markets, to acquire flexibility, can work as an alternative to traditional network reinforcement for DSOs to address congestion problems in the distribution network using distributed resource flexibility. The demonstrator utilized OMIE platforms to acquire flexibility, covering successfully all the tasks involved in the acquisition process: receive DSOs' needs, open market sessions for flexibility procurement, receive bids from FSPs, perform the market clearing, and communication of market results to different stakeholders. Additionally, the long-term platform worked as an FSP register as part of the prequalification process.

The flexibility providers were able to deliver the contracted amount on time and duration in almost all cases. However, some barriers were identified during the development of the demos, including customer engagement challenges, maintaining customer comfort, baseline calculation, adjusting market production needs for industrial providers and lack of regulatory rules for incentives/penalties.

Lack of customer participation was identified as the biggest challenge, for that reason, demo site selection was motivated more by the feasibility to engage potential flexibility providers in a trial framework than by the network need, which was simulated accordingly.

To overcome the rest of the barriers, demo site dates (days and activation flexibility schedule) were selected in agreement with the engaged FSPs to avoid possible inconvenient to building users or production development in the case of industrial participants.

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Some of the features in the platform are still to be further developed such as the absence of notifications to FSPs about the opening of an intraday market and the need for certain labels to provide complete information. Additionally, it is currently necessary to log onto the long-term platform to obtain information about which FSP has been selected to provide the service, as it is not available in the short-term platform. This would enhance the communication among actors and provide information to the market operator for the settlement.

The demonstrator highlights the challenges of measuring the impact of FSP load reduction on the asset load as it constitutes a small percentage of the total asset load. Finally, due to delays in customer engagement, Cantoblanco tests were conducted in a forced situation during winter in Spain, and additional heating was required to test the cooling systems' flexibility capabilities, which were evaluated on Saturdays using the load before activation as baseline. These findings suggest that further improvements are necessary to optimize the testing process and ensure accurate and real conditions.

Overall, the demonstrator highlights the potential of local flexibility markets to address network constraints in a cost-effective manner. Nonetheless, further efforts are required to overcome the identified barriers and make these markets a reality. The demonstrator provides valuable insights into the challenges and opportunities of local flexibility markets and can inform future research and policy decisions in this area. The successful implementation of these objectives could pave the way for more widespread adoption of flexibility services in the Spanish electricity system, leading to a more resilient and cost-effective solutions providing relevant inputs for the European development.

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Annex A Appendices

A.1 WECL-ES-01: Long-term congestion management

WECL-ES-01 - Long-term congestion management

Based on IEC 62559-2 edition 1

1. Description of the use case

1.1. Name of use case

Use case identification		
ID	***Domain***	***Name of use case***
WECL-ES-01	Local congestion management	Long-term congestion management

1.2. Version management

Version management				
Version No.	***Date***	***Name of author(s)***	***Changes***	***Approval status***
0.1	27/04/2021	COMILLAS, i-DE, UFD, OMIE		Draft
0.2	21/05/2021	COMILLAS, i-DE, UFD, OMIE	Up to section 3.2	Draft
0.3	26/06/2021	COMILLAS, i-DE, UFD, OMIE	Up to section 5	Draft
1.0	07/09/2021	COMILLAS, i-DE, UFD, OMIE	KPIs included	Approved
1.1	20/04/2023	COMILLAS, i-DE, UFD, OMIE	KPIS updated	

1.3. Scope and objectives of use case

Scope and objectives of use case	
Scope	This BUC is focused on the long-term procurement of congestion management products by the DSO. The main objective of the BUC is to ensure that the DSO can procure flexibility in advance to solve specific local system loading issues on the distribution system thus deferring/eliminating the need for traditional system upgrades
Objective(s)	1. To apply market procedures to obtain flexibility services attending DSO requirements. 2. Demonstrate that long term agreements are suitable amongst different available DERs 3. Implement flexibility provision/usage through a market platform. 4. Use consumer's demand-response in efficient flexibility services.
Related business case(s)	WECL-ES-02

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1.4. Narrative of Use Case

Narrative of use case
Short description
This BUC describes the DSO long term procurement of flexibility services through a market mechanism to avoid congestions at the distribution medium or low voltage networks. It describes the exchange of information and processes that should be established between DSO, Independent Market Operator (IMO) and Flexibility Provider (FSP). This BUC is divided into five scenarios, namely the five service steps defined in the Active System Management (ASM) report listed in Ch. 3.2 below: · Prepare/Pre-qualification: The process in which it is checked whether a unit can deliver the product it intends to sell. · Plan/Forecast: Planning of grid utilization and identifying potential congestions. · Market Phase: Market opening, qualification, bids collection, market clearing and communication of results. · Monitoring and Activation: Grid monitoring and flexibility bids activation to solve the forecasted congestion management · Measurement phase: Validation of delivery
Complete description
This BUC will demonstrate the long-term congestion management procurement of local flexibility products by the DSO. This BUC describes the exchanges of information and the processes that should be established between DSO, IMO and FSP to solve distribution network local congestions. The objective is to procure products to ensure the network remains secure and does not go beyond its firm capacity at times of peak demand. The products can be procured from weeks to years ahead delivery and is aimed towards MV/LV flexibility providers. The DSO procures the product in the long-term (years to weeks ahead delivery). The DSO procures a band of flexibility that will be activated when needed or as scheduled, one or more times during the life of the contract. The flexibility providers receive a payment for the availability during the life of the contract and if activation is needed, the flexibility provider may receive an additional utilisation payment or not (to be defined at the contract). If the activation is not delivered, penalties may be applied to the flexibility provider. If the flexibility is delivered as contracted, the DSO proceeds with the settlement as agreed at the contract. **Scenarios**: **1. Prepare/Pre-qualification:** The pre-qualification process starts once the flexibility service provider expresses interest in entering the flexibility market. This process serves to ensure that a particular flexibility service provider is capable of delivering a given product. This has to be ensured from two perspectives, namely the grid pre-qualification and product pre-qualification. The former ensures that the resource meets the technical requirements to be able to deliver the product and proceed to the market phase and eventually be selected by a system operator. In principle, the grid pre-qualification will be done by the DSO, as FSPs in this BUC are connected to MV and LV grids. The grid pre-qualification may involve both internal simulations by the DSO and/or specific field tests with the FSP.

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The market or product pre-qualification aims at ensuring that the FSP can participate in a particular market and can provide a particular service considering market and product design aspects. In principle, the product pre-qualification should be done by IMO.

If the results of the two types of pre-qualification are approved, the entry of the FSP into the flexibility market is allowed. The validity of the pre-qualification can be indefinite, limited to a certain period of time or conditioned to predefined aspects (e.g. grid conditions).

Considering that this BUC WECL-ES-01 describes the long-term products for the Spanish demonstration, it is also possible that the pre-qualification process starts once a market session is open, considering that a market session can last for weeks or longer.

Whenever possible, the pre-qualification processes (grid and product) will be combined or coordinate, aiming at having the simplest possible process for the FSP. Likewise, the pre-qualification processes of WECL-ES-01 and WECL-ES-02 will also aim at coordination and simplification whenever the requirement allow to.

2. **Plan/Forecast:**

In this service phase, the DSO carries internal analysis (e.g. forecasts, power flows) to detect congestions in the grid, which could be solved by the long-term procurement of flexibility. This service phase happens years to weeks ahead.

3. **Market Phase**:

Based on the flexibility needs identified in the previous market phase, the DSO is able to call a market through the market platform (described in SUC-ES-01). This market, operated by the independent market operator, will procure either availability only or availability and activation. The availability means a capacity band (e.g. in kW) with a start and finish times defined, in which the FSP is expected to provide the flexibility upon the DSO's call. Alternatively, the availability can also mean that the FSP is obliged to bid in the short-term local congestion management markets (defined in WECL-ES-02) activation products, in which capacity and duration of activation are predefined (in kWh). It is also possible to the DSO to procure activation in the long-term, defining weeks/months in advance the day, time, capacity and duration of activations.

This market phase can be classified as a **local market model**. It is an auction type of market, in which the gate opening time takes place from than more than year-ahead to weeks ahead. The gate closure time takes place a week-ahead delivery. FSPs participating should have resources connected to medium or low voltage levels.

During this phase there is a qualification process to check if the flexibility provider is able to provide the demand service in terms of quality and cost.

The results of the auction will be published.

4. **Monitoring and Activation**:

This service phase takes place close to real-time and in real-time. The DSO will monitor the conditions of the grid in real time and send the activation signals to the FSPs committed in the market phase, in accordance to the type of product procured.

When activating the FSPs, the DSO will consider the actual state of the grid. Emergency states in which the procured flexibility activations cannot be concluded are outside the scope of this BUC WECL-ES-01. Emergency states are situations in which market procedures are no longer appropriate to ensure the security of the system.

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5. **Measurement phase**:

In this final service phase, the MO and/or DSO will verify if the flexibility was provided in accordance to the product procured in the market phase. This service phase can take place in the real-time and/or after the real-time. For the measurement of flexibility, a baseline has to be previously defined, to which the actual metered data of the FSP can be compared too. If the FSP is not able to deliver the flexibility in accordance to the predefined market conditions and agreed baseline, penalties may apply, which would decrease the remuneration received by FSP.

1.5. Key performance indicators (KPI)

Key performance indicators			
ID	***Name***	***Description***	***Reference to mentioned use case objectives***
1	Cost effectiveness	Compare cost for flexibility with avoided traditional grid cost (Cost of the flexibility solution against traditional solution).	All
2	ICT costs	The term ICT cost comprises the information and communication technologies necessaries for DSO-MO-FSP coordination through platforms to develop new local markets.	• Implement flexibility provision/usage through a market platform. • Use consumer's demand-response in efficient flexibility services.
3	Available Flexibility	Flexible power that can be used for congestion management at a specific grid segment, i.e., the available power flexibility in a defined period (eg. per day) that can be allocated by the DSO at a specific grid segment, measured in MW. This is in relation with the total amount of power in the specific grid segment in the same period.	• Demonstrate that long term agreements are suitable amongst different available DERs • Use consumer's demand-response in efficient flexibility services.
4	Error of load forecast	Error of load forecast calculated T hours in advance	• To apply market procedures to obtain flexibility services attending DSO requirements. • Use consumer's demand-response in efficient flexibility services.
5	Power Exchange Deviation	Tracking error between a set-point requested by the SO and the measure	All
6	Asset load profile variation	This indicator measures the percentage decrease of load demand in the requested asset by a flexibility provider resource.	All
7	Volume of transactions (Power)	This indicator measures the volume of transactions in kW. This indicator will be used to measure the volume of transactions (cleared bids) during the examined period T for each product.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform.

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Key performance indicators			
ID	***Name***	***Description***	***Reference to mentioned use case objectives***
			• Demonstrate that long term agreements are suitable amongst different available DERs
8	Number of transactions	This indicator measures the number of transactions. This indicator will be used to measure the number of offered and cleared bids for each product	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
9	Number of products per demo	This indicator measures the percentage of products tested in the demos with respect to the number of products initially targeted by the demos.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
10	Active participation	This indicator measures the percentage of customers actively participating in the demo with respect to the total customers that accepted the participation. This indicator will be used to evaluate customer engagement plan.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
11	Number of FSPs	Number of FSPs joining the platform	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform.
12	Ease of access	Ease of access to the flexibility market for flexibility service providers, including accessibility, no redundant barriers to entry, user-friendliness.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
13	Number of avoided technical restrictions	Avoided congestions thanks to the measures implemented in the demo	All

1.6. Use case conditions

Use case conditions
Assumptions
The DSO is allowed to use flexibility solutions to defer/eliminate traditional capital investments where they are appropriate and cost-effective.

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A congestion constraint and the associated investment to solve it, will be simulated in the demo in order to compare it with a flexibility solution. It is assumed that settlement conditions are well defined and clearly state eventual needs for compensations and/or financial adjustments among affected parties in the flexibility provision process (e.g. BRPs, BSPs, Aggregators).
Prerequisites
For the demo: To have at least one flexibility provider in an area where a congestion can be simulated. Analyze the area and define possible congestion and solutions with and without flexibility providers. To include in business regulation needs to be defined: Individual DERs, aggregators, and independent aggregators have to be allowed by regulation to provide flexibility to the DSO. DSO have to be able to procure flexibility from FSPs, as well as receive financial compensation for the flexibility procurement and have economic incentives to do so.

1.7. Further information to the use case for classification/mapping

Classification information
Relation to other use cases
WECL-ES-02, SUC-ES-01
Level of depth
Generic
Prioritisation
High priority
Generic, regional or national relation
National
Nature of the use case
Business Use Case
Further keywords for classification
Local congestion management, Distributed energy resources, flexible providers, traditional investment, long term

1.8. General remarks

2. Diagrams of use case

Diagram(s) of use case

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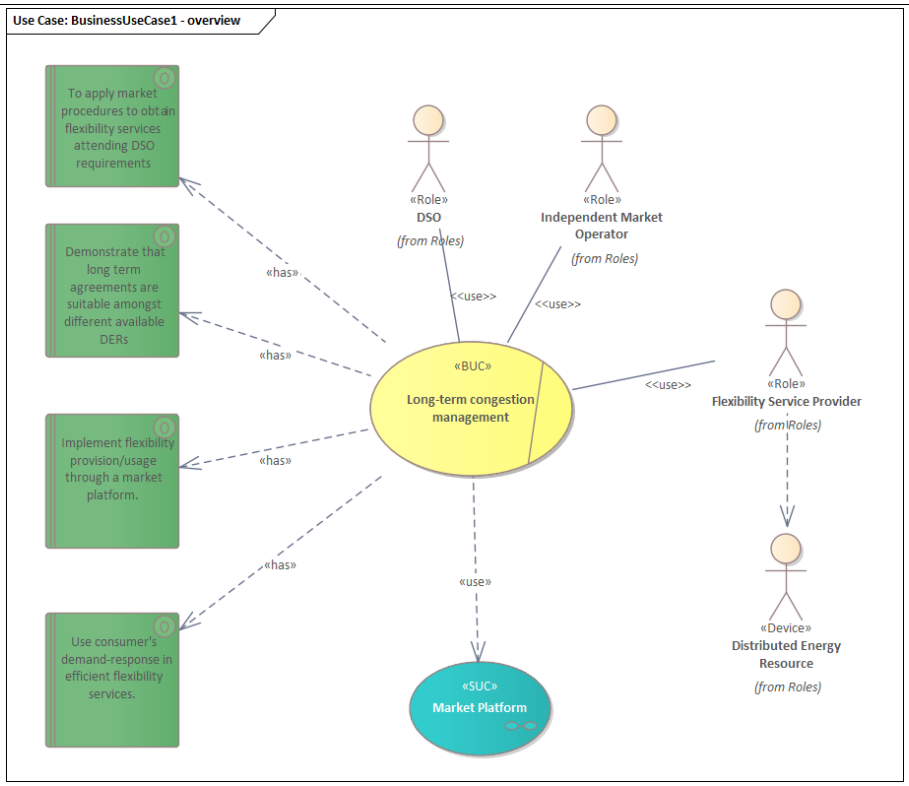

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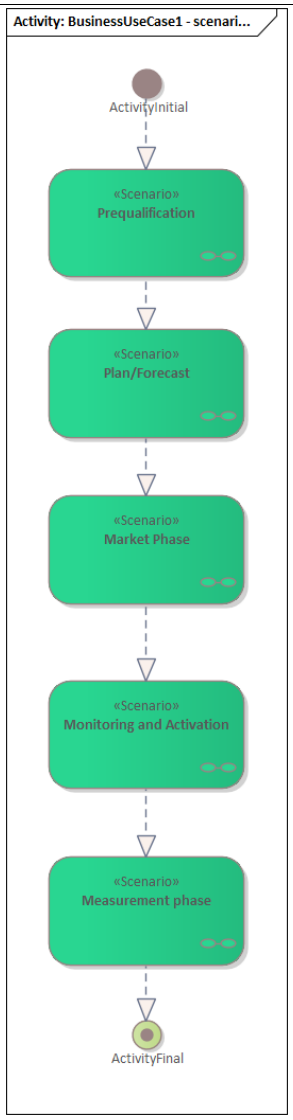

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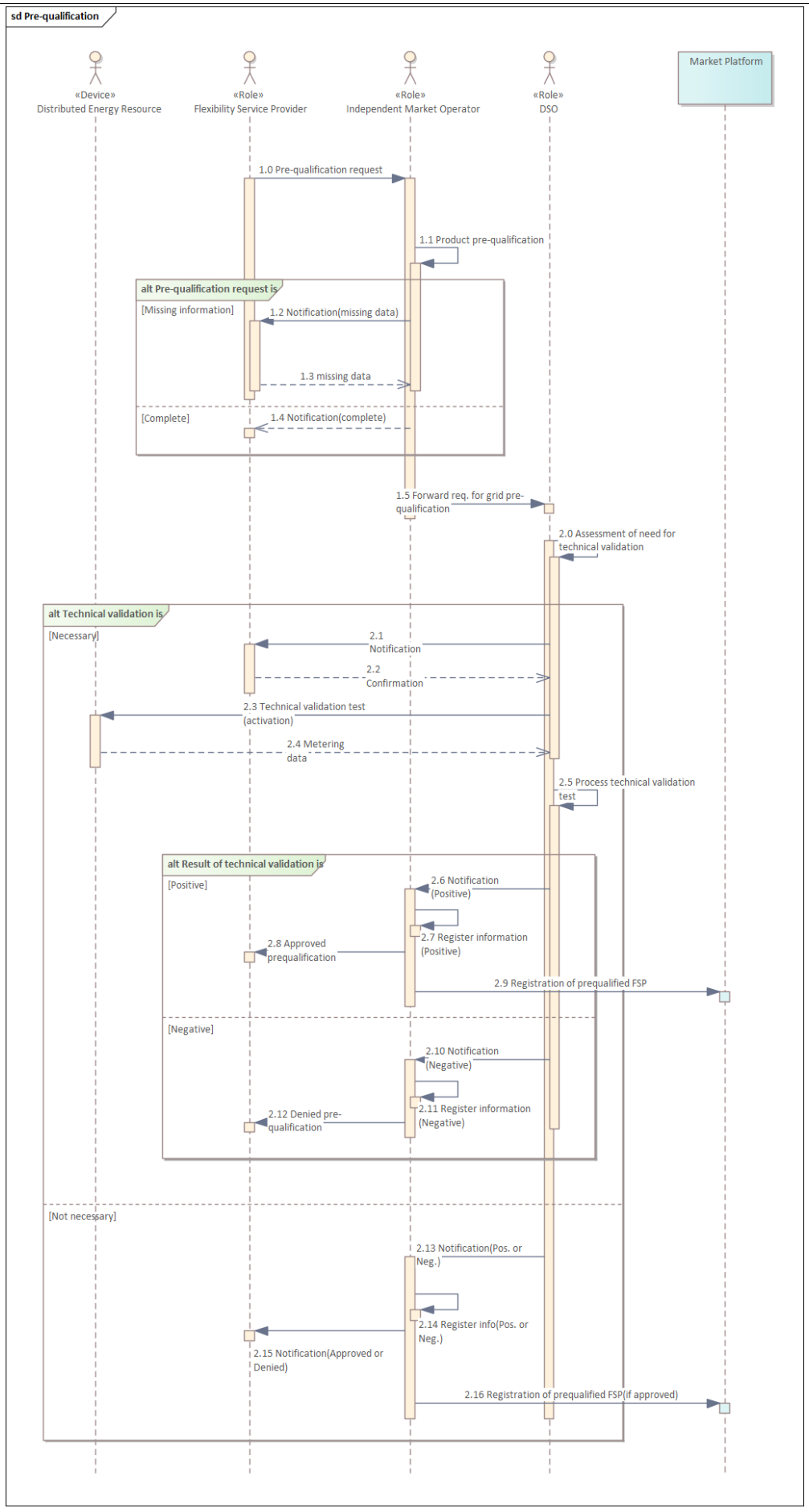
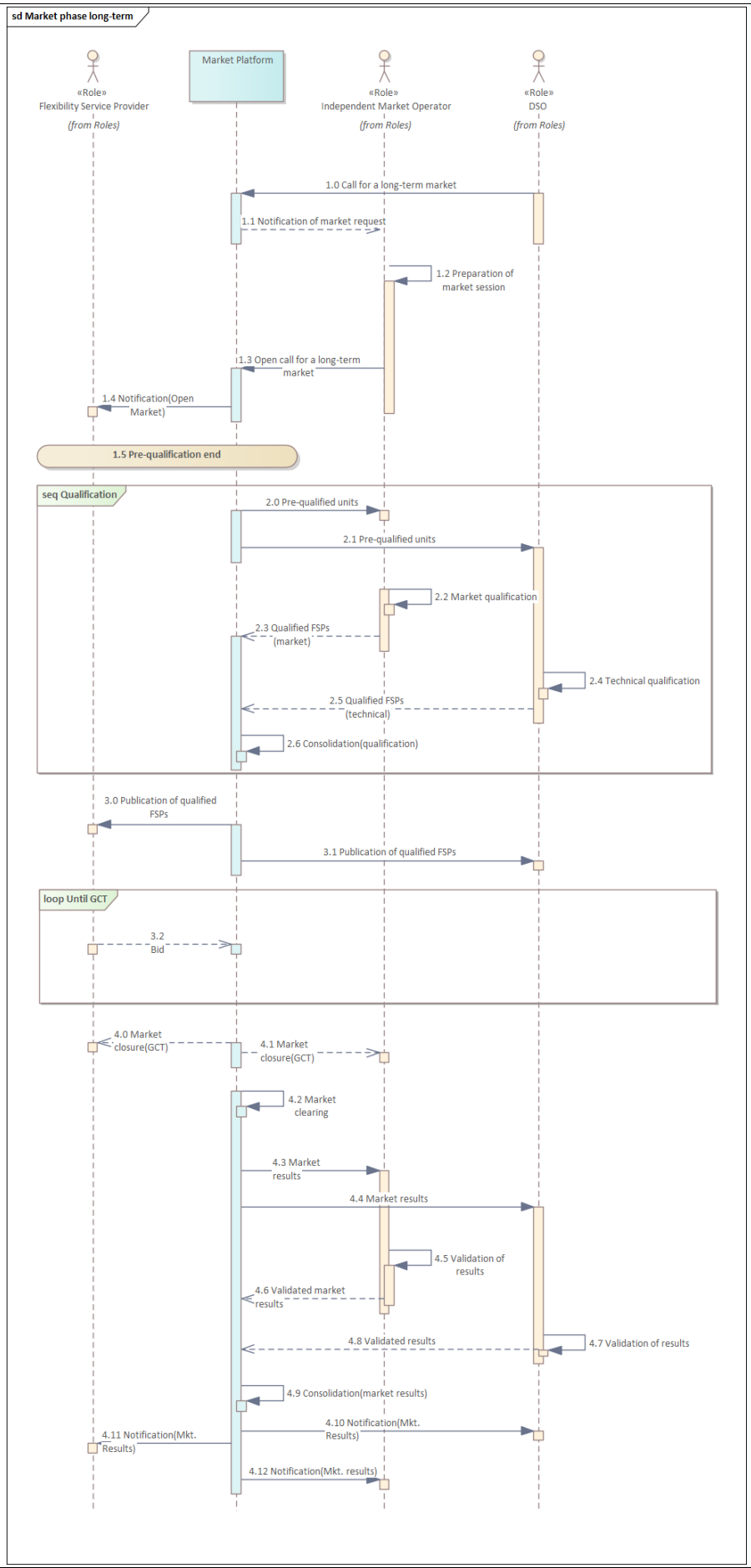
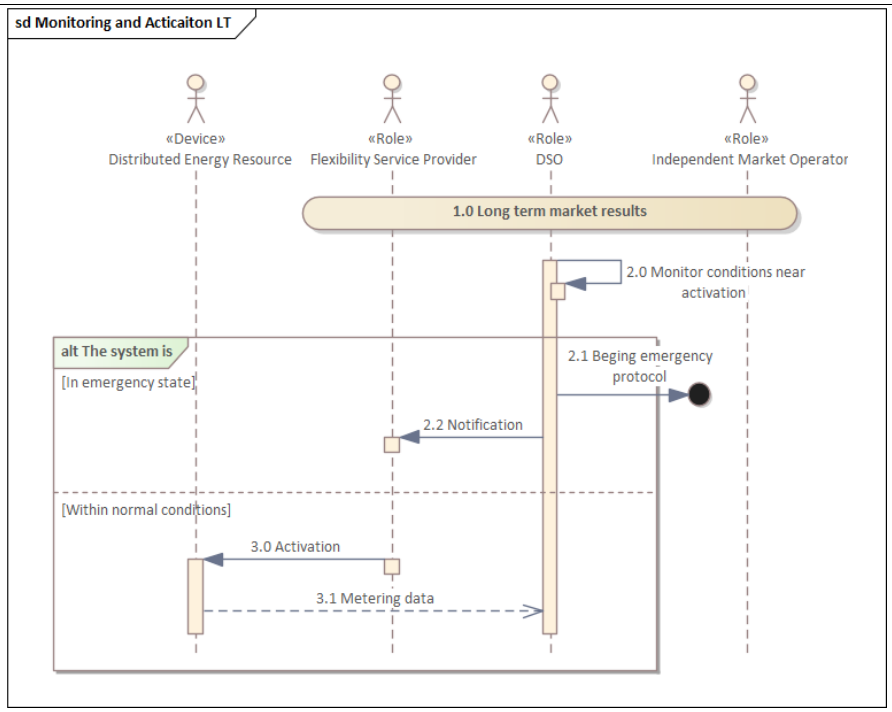
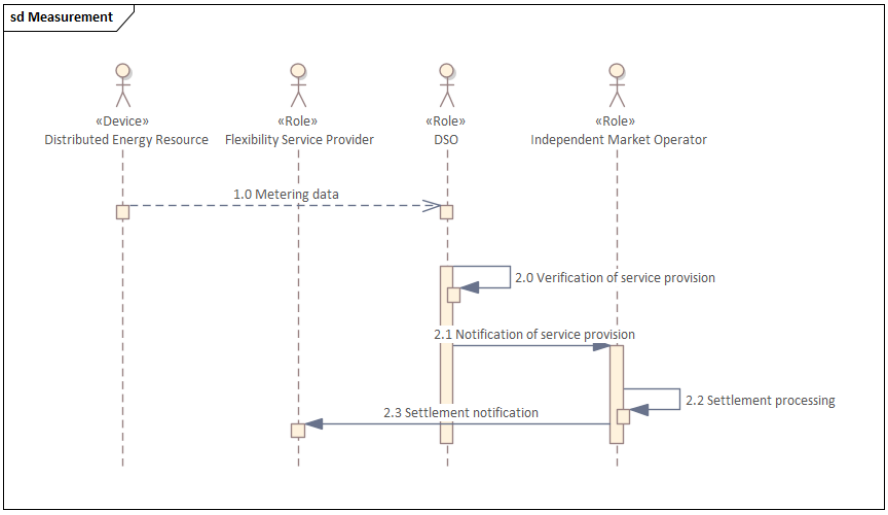

sd Pre-qualification
«Device»
Distributed Energy Resource
«Role»
Flexibility Service Provider
«Role»
Independent Market Operator
«Role»
DSO
Market Platform
1.0 Pre-qualification request
1.1 Product pre-qualification
alt Pre-qualification request is
[Missing information]
1.2 Notification(missing data)
1.3 missing data
[Complete]
1.4 Notification(complete)
1.5 Forward req. for grid pre-qualification
2.0 Assessment of need for technical validation
alt Technical validation is
[Necessary]
2.1 Notification
2.2 Confirmation
2.3 Technical validation test (activation)
2.4 Metering data
2.5 Process technical validation test
alt Result of technical validation is
[Positive]
2.6 Notification (Positive)
2.7 Register information (Positive)
2.8 Approved prequalification
2.9 Registration of prequalified FSP
[Negative]
2.10 Notification (Negative)
2.11 Register information (Negative)
2.12 Denied pre-qualification
[Not necessary]
2.13 Notification(Pos. or Neg.)
2.14 Register info(Pos. or Neg.)
2.15 Notification(Approved or Denied)
2.16 Registration of prequalified FSP(if approved)


sd Market phase long-term
«Role»
Flexibility Service Provider
(from Roles)
Market Platform
«Role»
Independent Market Operator
(from Roles)
«Role»
DSO
(from Roles)
1.0 Call for a long-term market
1.1 Notification of market request
1.2 Preparation of market session
1.3 Open call for a long-term market
1.4 Notification(Open Market)
1.5 Pre-qualification end
seq Qualification
2.0 Pre-qualified units
2.1 Pre-qualified units
2.2 Market qualification
2.3 Qualified FSPs (market)
2.4 Technical qualification
2.5 Qualified FSPs (technical)
2.6 Consolidation(qualification)
3.0 Publication of qualified FSPs
3.1 Publication of qualified FSPs
loop Until GCT
3.2 Bid
4.0 Market closure(GCT)
4.1 Market closure(GCT)
4.2 Market clearing
4.3 Market results
4.4 Market results
4.5 Validation of results
4.6 Validated market results
4.8 Validated results
4.7 Validation of results
4.9 Consolidation(market results)
4.10 Notification(Mkt. Results)
4.11 Notification(Mkt. Results)
4.12 Notification(Mkt. results)





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3. Technical details

3.1. Actors

Actors			
Grouping (e.g. domains, zones)		*Group description*	
Actor name	*Actor type*	*Actor description*	*Further information specific to this use case*
Distribution System Operator (DSO)	Role	According to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution 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 distribution of electricity".	
Independent Market Operator (IMO)	Role	Responsible for calling, clearing, communicating results and possibly settling the provision of distributed flexibility. This role can be taken by an independent market operator, an existing one (e.g. a NEMO), or a system operator.	
Distributed Energy Resource (DER)	Device	Resources connected at the distribution grid capable of providing active power flexibility, either upward/downward or both. It can comprise several different roles and devices such as demand response (actor/role), distributed generation, electric vehicles, and storage systems.	
Flexibility Service Provider (FSP)	Role	Generic role which links the role customer and its possibility to provide flexibility to the roles market and grid; generic role that could be taken by many stakeholders, such as an aggregator or individual distributed energy resources.	

3.2. References

ENTSO-E Role Model;

CEDEC, EDSO, ENTSO-E, Eurelectric, and GEODE, “TSO-DSO Report: An Integrated Approach to Active System Management,” 2019. Accessed: Jul. 19, 2019. [Online]. Available: https://www.entsoe.eu/news/2019/04/16/a-toolbox-for-tsos-and-dsos-to-make-use-of-new-system-and-grid-services/

4. Step by step analysis of use case

4.1. Overview of scenarios

Scenario conditions						
No.	*Scenario name*	*Scenario description*	*Primary actor*	*Triggering event*	*Pre-condition*	*Post-condition*
1	Prepare/Pre-qualification	The process in which it is checked whether a unit can	DSO	The DSO and/or the IMO receives a request from a FSP	The FSP complies with the prerequisites	The FSP is successfully verified and tested, receiving

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Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
		deliver the product it intends to sell.		to be pre-qualified to offer the long-term local congestion management products	publicly made available by the DSO/IMO	the permission to offer the products to which the prequalification was aimed at.
2	Plan/Forecast	Planning of grid utilization and identifying potential congestions.	DSO	The distribution system optimizer quantifies the amount of flexibility needed	The DSO identifies a situation in which congestion are expected in the medium or long term.	The DSO computes the amount of flexibility needed for the different types of products in the different timesteps and calls a market.
3	Market phase	Market opening, qualification, bids collection, market clearing and communication of results	IMO	The DSO calls a market for the procurement of flexibility calculated in scenario 2.	FSP are prequalified to provide the service. Further qualification is evaluated within this scenario.	Markets are cleared and FSPs are nominated to deliver the product.
4	Monitoring and activation	Grid monitoring and flexibility bids activation to solve the forecasted congestion management	DSO	The real-time for the provision of a service procured in scenario 4 approached	The FSP and the DSO have the necessary communication infrastructure for the activation order to be sent	The FSP successfully receives the order to provide the flexibility.
5	Measurement phase	Validation of service delivery	DSO	The service is being provided in real-time or it has been already provided	Metering data is successfully received by the DSO with the necessary granularity and a baseline method was determined	The DSO compares the metered data with the baseline previously computed or sent by the FSP.

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4.2. Steps – Scenarios

Prepare/Pre-qualification

Scenario #1 description

The process in which it is checked whether a unit can deliver the product it intends to sell.

Scenario step by step analysis

Scenario								
Scenario name		Prepare/Pre-qualification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	FSP requests to be pre-qualified	Pre-qualification request	The FSP requests to the IMO to be pre-qualified to offer a certain type of product	CREATE	FSP	IMO	I.E.01 I.E.02 I.E.03 I.E.04	
1.1	IMO processes market prequalification	Product prequalification	The IMO processes the market prequalification.	EXECUTE	IMO	IMO		
1.2	FSP is notified if information provided is incomplete	Notification (missing data)	The IMO requests missing data	GET	IMO	FSP	I.E.03 I.E.04	
1.3	FSP reports back missing data	Missing data	The FSP reports back missing data	REPORT	FSP	IMO	I.E.03 I.E.04	
1.4	IMO notifies the completion of data collection	Notification(complete)	The notifies the completion on data collection process for the purpose of pre-qualification	CLOSE	IMO	FSP		

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Scenario								
Scenario name		Prepare/Pre-qualification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.5	IMO forwards pre-qualification request for technical prequalification	Forward req. for grid pre-qualification	The IMO forwards pre-qualification request for technical prequalification	REPORT	IMO	DSO	I.E.03 I.E.04	
2.0[1]	DSO assess the need for a technical validation	Assessment of need for technical validation	The DSO may decide that field tests are necessary to ensure that flexibility can be provided by the applicant FSP. In this step, the DSO assess internally the need for field tests	EXECUTE	DSO	DSO		
2.1	DSO communicates the need for a technical validation	Notification	If a technical validation is necessary, the FSP is communicated on the new requirement, as well as the details for the technical validation.	REPORT	DSO	FSP		
2.2	FSP acknowledges the technical validation need	Confirmation	The FSP acknowledges the technical validation need	REPORT	FSP	DSP		
2.3	Technical validation test	Technical validation test	The DSO may send a setpoint directly to the DER at the moment of the activation.	GET	DSO	DER		

[1] Changes in numbering at the step-by-step analysis (e.g. 1.5 to 2.0) are meant to provide a more intuitive visualization of the sequence diagrams, signalling the end of one process and the start of another.

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Scenario								
Scenario name	Prepare/Pre-qualification							
Step No	**Event**	**Name of process/activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged (IDs)**	**Requirement, R-IDs**
2.4	DER sends metering data	Metering data	The DER sends metering data regarding the technical pre-qualification directly to the DSO.	REPORT	DER	DSO	I.E.06	
2.5	DSO processes the results from technical validation	Process technical validation	The DSO internally processes the results of the technical validation test	EXECUTE	DSO	DSO		
2.6	DSO notifies on successful technical validation	Notification(positive)	The DSO notifies the IMO on the result of the technical validation	REPORT	DSO	IMO		
2.7	The IMO registers internally the FSP as pre-qualified	Register information(positive)	The IMO registers internally the FSP as pre-qualified	CREATE	IMO	IMO		
2.8	The FSP is communicated on the successful pre-qualification	Approved prequalification	The FSP is communicated on the successful pre-qualification	GET	IMO	FSP		
2.9	The IMO registers to the Market Platform the successful pre-qualification	Registration of pre-qualified FSP	The IMO registers to the Market Platform the successful pre-qualification	CREATE	IMO	Market Platform		
2.10	DSO notifies on unsuccessful technical validation	Notification(negative)	The DSO notifies the IMO on the result of the technical validation	REPORT	DSO	IMO		

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Scenario								
Scenario name	Prepare/Pre-qualification							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
2.11	The IMO registers internally the FSP as not pre-qualified	Register information (negative)	The IMO registers internally the FSP as not pre-qualified	CREATE	IMO	IMO		
2.12	The FSP is communicated on the unsuccessful pre-qualification	Denied pre-qualification	The FSP is communicated on the unsuccessful pre-qualification	GET	IMO	FSP		
2.13	If no technical validation is necessary, DSO informs no technical pre-qualification result	Notification (positive or negative)	If no technical validation is necessary, DSO informs no technical pre-qualification result	REPORT	DSO	IMO		
2.14	The IMO registers internally the result of the pre-qualification process (positive or negative)	Register information (positive or negative)	The IMO registers internally the result of the pre-qualification process (positive or negative)	CREATE	IMO	IMO		
2.15	The FSP is communicated on the pre-qualification result (positive or negative)	Notification (Approved or Denied)	The FSP is communicated on the pre-qualification result (positive or negative)	REPORT	IMO	FSP		
2.16	The IMO registers to the Market Platform the successful pre-qualification	Registration of pre-qualified FSP (if approved)	The IMO registers to the Market Platform the successful pre-qualification	CREATE	IMO	Market Platform		

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- Step No 1.x / Name of process

Business section:

Information sent:

Business object	*Instance name*	*Instance description*

Plan/Forecast

Scenario #2 description

Planning of grid utilization and identifying potential congestions.

Scenario step by step analysis

Scenario								
Scenario name		Offering						
Step No	*Event*	*Name of process/activity*	*Description of process/activity*	*Service*	*Information producer (actor)*	*Information receiver (actor)*	*Information exchanged (IDs)*	*Requirement, R-IDs*
1.0	DSO evaluates the need for a long-term market for flexibility	DSO evaluates the need for a long-term market for flexibility	The DSO evaluates internally the need for a long-term market for flexibility. This step is an internal activity exclusive to the DSO, and therefore no information exchanges with other actors take place. Therefore, the internal steps carried out by the DSO are not modelled in detail.	EXECUTE	DSO	DSO		

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Market phase: long-term

Scenario #3 description

Market opening, qualification, bids collection, market clearing and communication of results

Scenario step by step analysis

Scenario								
Scenario name								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	DSO requests a long-term market	Call for a long-term market	DSO requests a long-term market based on the results of scenario 2 (plan and forecast). At this request, several parameters will have to be informed by the DSO. These parameters are grouped into (i) generic attributes and (ii) product parameters	CREATE	DSO	Market Platform	I.E.07 (generic attributes) I.E.08 (product parameters)	
1.1	Notification of market request	Notification of market request	The IMO is notified that a market request was created by the DSO	REPORT	Market platform	IMO		
1.2	IMO validates and prepares a market session	Preparation of market session	The IMO validates the information provided by the DSO (IE07 and IE08). N.B.: Intermediated steps in which the IMO may identify missing information, request completion from the DSO, and final completion by the DSO are omitted for the sake of simplicity.	EXECUTE	IMO	IMO		

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Scenario								
Scenario name								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.3	IMO opens call for a long-term market	Open call for a long-term market	The IMO, after validating the market session, opens the market session in the Market Platform	EXECUTE	IMO	Market Platform		
1.4	FSPs are notified of a market opening	Notification (Open Market)	The Market Platform notifies the FSP about a market opening.	REPORT	Market Platform	FSP	I.E.08 (not all parameters)	
1.5	Pre-qualification period ends	Pre-qualification end	Considering that the long-term products can be negotiated for weeks or months, it is possible for the pre-qualification phase to run in parallel with the market phase. Nevertheless, for FSPs to be able to participate in a market session, the pre-qualification process should be concluded at this step no. 1.5	N/A	N/A	N/A	N/A	
2.0	IMO is informed of pre-qualified units	Pre-qualified units	This step market the beginning of the qualification process. The IMO receives a list of pre-qualified units for that market session	GET	Market Platform	IMO	I.E.09	
2.1	DSO is informed of pre-qualified units	Pre-qualified units	This step market the beginning of the qualification process. The DSO receives a list of pre-qualified units for that market session	GET	Market Platform	IMO	I.E.09	
2.2	IMO proceeds with the market qualification	Market qualification	The IMO proceeds with the market qualification. The IMO checks the maximum power to bid from FSPs and the existence of financial warranties.	EXECUTE	IMO	IMO		

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Scenario								
Scenario name								
Step No	**Event**	**Name of process/activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged (IDs)**	**Requirement, R-IDs**
2.3	IMO registers a list of qualified units (market qualification)	Qualified FSPs (market)	The IMO registers a list of qualified units (market qualification)	REPORT	IMO	Market Platform	I.E.10 (market)	
2.4	DSO proceeds with the technical qualification	Technical qualification	A process by which the DSO verifies the DER capacity to meet the requisites of the specific requirement. All the resources in the specific area will be checked to determine which ones are capable of providing the required service.	EXECUTE	DSO	DSO		
2.5	DSO registers a list of qualified units (technical qualification)	Qualified FSPs (technical)	The DSO registers a list of qualified units (Technical qualification)	REPORT	DSO	Market Platform	I.E.10 (technical)	
2.6	The Market Platform crosschecks both qualification lists and produces the consolidated list	Consolidation (qualification)	The Market Platform crosschecks both qualification lists and produces the consolidated list	CREATE	Market Platform	Market Platform	I.E.10 (consolidated)	
3.0	The Market Platform publishes/notifies qualified FSPs	Publication of qualified FSPs	The Market Platform publishes/notifies qualified FSPs	REPORT	Market Platform	FSP	I.E.10 (consolidated)	
3.1	The Market Platform publishes/notifies qualified FSPs to the DSO	Publication of qualified FSPs	The Market Platform publishes/notifies qualified FSPs to the DSO	REPORT	Market Platform	DSO	I.E.10 (consolidated)	

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Scenario								
Scenario name								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
3.2	FSP bids to market session	Bid	Qualified FSPs may bid to the market session as long as market session is open (before the Gate Closer Time [GCT])	CREATE	FSP	Market Platform	I.E.11	
4.0; 4.1	Market platform notifies the GCT	Market closure (GCT)	Market platform notifies the GCT	REPORT	Market Platform	FSP;IMO		
4.2	Market Platform clears the market	Market clearing	Market Platform clears the market	EXECUTE	Market Platform	Market Platform		
4.3; 4.4	Market Platform reports market results	Market results	Market Platform reports market results	REPORT	Market Platform	IMO;DSO		
4.5	IMO validates the market results	Validation of results	The IMO checks the market results for inconsistences. After that, results are validated	EXECUTE	IMO	IMO		
4.6	IMO registers the validated market results	Validated market results	IMO registers the validated market results	REPORT	IMO	Market platform	I.E.12 (market)	
4.7	DSO validates the market results	Validation of results	The DSO checks the market results for inconsistences (from a technical perspective).	EXECUTE	DSO	DSO	I.E.12 (technical)	
4.8	DSO registers the validated market results	Validated market results	DSO registers the validated market results	REPORT	DSO	Market platform	I.E.12 (technical)	
4.9	The Market Platform consolidates the market results	Consolidation (market results)	The Market Platform consolidates the market results based on the validation by the IMO and the DSO	CREATE	Market Platform	Market Platform	I.E.12 (consolidated)	

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Scenario								
Scenario name								
Step No	**Event**	**Name of process/activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged (IDs)**	**Requirement, R-IDs**
4.10; 4.11; 4.12	Market participants and IMO are informed of final market results	Notification (market results)	Market participants (DSO, FSPs) and IMO are informed of final market results	REPORT	Market Platform	DSO;FSP;IMO	I.E.12 (consolidated)	

Monitoring and Activation

Scenario #4 description

Grid monitoring and flexibility bids activation to solve the forecasted congestion management.

Scenario step by step analysis

Scenario								
Scenario name								
Step No	**Event**	**Name of process/activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged (IDs)**	**Requirement, R-IDs**
2.0	The DSO monitors the state of the grid near real-time (activation)	Monitoring conditions near activation	The DSO monitor the sate of the grid near activation in order to ensure the security of the grid	EXECUTE	DSO	DSO		
2.1	If the grid is an emergency state, the DSO starts the	Beginning emergency state	If the grid is an emergency state, the DSO starts the emergency protocol and the BUC is	EXECUTE; CLOSE	DSO	DSO		

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	emergency protocol and the BUC is terminated		terminated, as this situation lays outside the scope of this BUC.					
2.2	If the grid is an emergency state, the DSO notifies the FSP to proceed according the emergency protocol (outside the scope of the BUC)	Notification	If the grid is an emergency state, the DSO notifies the FSP to proceed according the emergency protocol (outside the scope of the BUC). For example, the FSP may be requested to proceed on a previously agreed way, may be exempted from providing flexibility, or may not be notified at all. This situation is outside the scope of this BUC.	REPORT	DSO	FSP		
3.0	If the state is within normal conditions, the FSP proceeds with the activation in real-time according to the market results.	Activation	If the state is within normal conditions, the FSP proceeds with the activation in real-time according to the market results.	EXECUTE	FSP	DER		
3.1	DER reports metering data	Metering data	DER reports metering data directly to the DSO	REPORT	DER	DSO	I.E.06	

Measurement phase

Scenario #5 description

Validation of service delivery.

Scenario step by step analysis

Scenario

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Scenario name								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	DSO receives metering data	Metering data	DSO receives metering data (step 3.1 of scenario 4)	GET	DER	DSO	I.E.06	
2.0	The DSO validates the service provision	Verification of service provision	The DSO validates the service provision. To do so, the DSO compares the metered data with the service procured and the baseline predefined.	EXECUTE	DSO	DSO		
2.1	The DSO notifies the IMO on the service provision	Notification of service provision	The DSO informs the IMO on the level of service provision (e.g. percentage of service provision based on the deviation of the metering data to the agreed flexibility)	REPORT	DSO	IMO		
2.2	IMO proceeds with the settlement processing	Settlement processing	The IMO proceeds with the settlement processing. According to the level of service provision, penalties (reduction of agreed price/payment) may occur.	EXECUTE	IMO	IMO		
2.3	The FSP is notified on the final settlement	Settlement notification	The FSP is notified on the final settlement	REPORT	IMO	FSP		

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5. Information exchanged

Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
I.E.01	Basic Participant Information	Register and basic information about the market participant such as username and password	
I.E.02	Market participant pre-qualification information	Contact information; Fiscal data; Access contract; bank details; power of representation; confidentiality agreement; declaration of non-collusion	
I.E.03	Market resource pre-qualification information	Market participants provide information on the resources they want to prequalify: Facility/resource name; Type of technology; Location; Market participant; etc.	
I.E.04	Technical resource pre-qualification information	Verification of the installed capacity to provide the service: Power; CUPS (Universal Supply Point Code acronym in Spanish); Maximum quantity; Response time, Etc	
I.E.05	Technical validation for pre-qualification	In case of the need of a technical validation for prequalification, the FSP receives the information on the when and how the test will be conducted: day; time; power to reduce/increase; duration of the test; etc.	
I.E.06	Metering data	Metering data from DER	
I.E.07	Generic attributes	Composed of generic parameters concerning the market session being requested. E.g.: • Auction identifier • Associated DSO • Product Type: Flexibility Product • Type of negotiation: Auction • Area: Basic or aggregated.	
I.E.08	Product parameters	Composed of product parameters concerning the market session being requested. E.g.: 1. Service window: Selection of the required date and duration of the service	

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Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
		o Start date: 01/06/2021 o Duration: 2 months o Selection of days: M, T, W, T, F, S and S. o Opening time: 8:00 PM o Closing time: 10:00 PM 2. Availability: Selection of the capacity, the direction and the estimated hours of activation. o Capacity: 4MW o Direction: Upwards (up for generation, down for consumption) o Estimated hours of activation: 120h 3. Activation window (in case of activation product): Specific subperiod in an activation window when a particular DER could be activated and thus it must be available. Multiple sets of activation windows can be defined. E.g.: o Day: 01/06/2021 o Hour: 19h o Duration: 2h o Capacity to modify: 1MW o Direction: Upward 4. Local area: Selection of the trading area. Choice by postal code, connection point, lines… (to be determined). o Area: postal code 5. Activation Announcement: Time in advance that a DSO informs a DER that its activation is programmed confirmed. 6. Form of Remuneration: It establishes form of payment to winner DERs Two different terms are defined availability and activation (depending on the product). o Type of product: availability/activation o Availability/Activation cap price: X €/MW or X €/MWh	
I.E.09	List of pre-qualified units	List of pre-qualified units for a given market session	

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Information exchanged			
Information exchanged, ID	***Name of information***	***Description of information exchanged***	***Requirement, R-IDs***
I.E.10	List of qualified units (market, technical or consolidated)	List of qualified units for a given market session. The list can refer to the market qualification, technical qualification or the consolidated list.	
I.E.11	Bid	Composed of bidding information 1. General attributes • FSP identifier 2. Availability: Selection of the capacity, the direction and the estimated hours of activation. • Period of availability (multiple periods may be possible within the service window) • Price: for availability and/or activation Additional parameters (complex bids) may be considered (under discussion).	
I.E.12	Validate market results	Validated market results by either the IMO (market), the DSO (technical) or the consolidated market results.	

6. Requirements (optional)
7. Common terms and definitions
8. Custom information (optional)

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A.2 WECL-ES-02: Short-term congestion management

WECL-ES-02 - Short-term congestion management

Based on IEC 62559-2 edition 1

1. Description of the use case

1.1. Name of use case

Use case identification		
ID	***Domain***	***Name of use case***
WECL-ES-02	Local congestion management	Short-term congestion management

1.2. Version management

Version management				
Version No.	***Date***	***Name of author(s)***	***Changes***	***Approval status***
0.1	27/04/2021	COMILLAS, i-DE, UFD, OMIE		
0.2	21/05/2021	COMILLAS, i-DE, UFD, OMIE	Up to section 3.2	Draft
0.3	26/06/2021	COMILLAS, i-DE, UFD, OMIE	Up to section 5	Draft
1.0	07/09/2021	COMILLAS, i-DE, UFD, OMIE	KPIs included	Approved
1.1	20/04/2023	COMILLAS, i-DE, UFD, OMIE	KPIs updated	

1.3. Scope and objectives of use case

Scope and objectives of use case	
Scope	This BUC will demonstrate the short-term local congestion management procurement of local flexibility by the DSO. Flexibility providers at both LV and MV will be able to participate. Two time frame markets will be considered: Day ahead and intraday.
Objective(s)	1-To apply market procedures to obtain flexibility services attending short term DSO requirements, 2- Implement flexibility provision/usage through a market platform. 3- Use consumer's demand-response in efficient flexibility services.
Related business case(s)	WECL-ES-01

1.4. Narrative of Use Case

Narrative of use case
Short description

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This BUC describes the DSO short term procurement of flexibility services through a market mechanism to avoid congestion management at the distribution medium or low voltage network. Two time frame markets are considered: Day ahead and intraday.

It describes the exchange of information and processes that should be established between DSO, Independent Market Operator (IMO) and Flexibility Provider (FSP). This BUC is divided into five scenarios, namely the five service steps defined in the Active System Management (ASM) report listed in Ch. 3.2 below:

- Prepare/Pre-qualification: The process in which it is checked whether a unit can deliver the product it intends to sell.
- Plan/Forecast: Planning of grid utilization and identifying potential congestions.
- Market Phase: Market opening, qualification, bids collection, market clearing and communication of results.
- Monitoring and Activation: Grid monitoring and flexibility bids activation to solve the forecasted congestion management.

Complete description

This BUC will demonstrate the short-term congestion management procurement of local flexibility products by the DSO.

This BUC describes the exchanges of information and the processes that should be established between DSO, MO and FSP to solve distribution network local congestions

Two time frame markets are considered: Day ahead and intraday.

The “day-ahead” market will be used for short-term procurement of flexibility availability to support the network in the event of an expected/programmed fault conditions as maintenance work. The DSO will procure a band of flexibility that could be activated one or more times (to be defined in the product specifications) during the life of the contract. The flexibility providers will receive a payment for the availability during the life of the contract. If activation is needed, the flexibility provider may receive an additional utilisation payment or not (to be defined in the product specifications). If activation is needed and the flexibility provider is not able to deliver it as contracted, a penalty may apply.

The “intraday market will be used for short-term procurement of flexibility availability to help restoration or reduce the stress on the network following an unexpected failure of equipment. The product will be contracted close to real-time, when constraints in the network may arise. The product will be set as an energy product. In this product, the DSO procures flexibility with predefined activation characteristics (e.g. time of activation, duration, ramping periods etc). At activation time, the DSO monitors the delivery of the service. . If the flexibility provider delivers the service, the DSO proceeds with the settlement. If the flexibility provider does not deliver the service as contracted, a penalty may apply.

Scenarios:

1. **Prepare/Pre-qualification:**

The pre-qualification process should start after a flexibility service provider expresses interest in entering the flexibility market. This process serves to ensure that a particular flexibility service provider is capable of delivering a given product. This has to be ensured from two perspectives, namely the grid pre-qualification and product pre-qualification.

The former ensures that the resource contains the technical requirements to be able to deliver the product and proceed to the market phase and eventually be selected by a system operator. In principle, the grid pre-

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qualification will be done by the DSO, as FSP in this BUC are connected to MV and LV grids. The objective of the grid pre-qualification is to ensure that the network is capable to cope with the flexibility provision by a particular FSP. The grid pre-qualification may involve both internal simulations by the DSO and/or specific field tests with the FSP.

The market or product pre-qualification aims at ensuring that the FSP can participate in a particular market and can provide a particular service considering market and product design aspects. In principle, the product pre-qualification should be done by IMO.

If the results of the two types of pre-qualification are approved, the entry of the FSP into the flexibility market is allowed. The validity of the pre-qualification can be indefinite, limited to a certain period of time or conditioned to predefined aspects (e.g. grid conditions).

Whenever possible, the pre-qualification processes (grid and product) will be combined or coordinate, aiming at having the simplest possible process for the FSP. Likewise, the pre-qualification processes of WECL-ES-01 and WECL-ES-02 will also aim at coordination and simplification whenever the requirement allow to.

2. **Plan/Forecast:**

In this service phase, the DSO carries internal analysis (e.g. forecasts, power flows) to detect structural congestions in the grid, which could be solved by the short-term procurement of flexibility.

This service phase may happen in the day-ahead or in the intraday. Results from previous markets (e.g. from long-term markets described in WECL-ES-01) are also taken into account in order to quantify the flexibility need.

3. **Market Phase**:

Based on the flexibility needs identified in the previous market phase, the DSO is able to call a market through the market platform. This market will procure either availability or availability and activation. Availability means a capacity band (product defined in kW) with a start and finish times defined, in which the FSP is expected to provide the flexibility upon the DSO's call. Activation is predefined in terms of day, time, capacity and duration of activations (product defined in kWh). In principle, the day-ahead market will be open for availability and activation procurement, while the intraday will be used for activation procurement.

This market phase can be classified as a **local market model**.

During this phase there is a qualification process to check if the flexibility provider is able to provide the demand service in terms of quality and cost.

The results of the auction will be published to market participants. In addition, the scheduling of FSPs is integrated into to the notification sent to the TSO.

4. **Monitoring and Activation**:

This service phase takes place close to real-time and in real-time. The DSO will monitor the conditions of the grid in real time and send the activation signals to the FSPs committed in the market phase, in accordance to the type of product procured. When activating the FSPs, the DSO will consider the actual state of the grid. Emergency situations in which the procured flexibility activations cannot be concluded are outside the scope of this BUC WECL-ES-01.

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Considering that this BUC describes services that could be requested close to real-time, it also foresees the possibility of both manual and automatic activation by the DSO. In the case of the latter, the DSO could send activation setpoints directly to the DER, while in the case of the former, activation setpoints are sent to the FSP that manually activates the DER's flexibility.

5. **Measurement phase**:

In this final service phase, the MO and/or DSO will verify if the flexibility was provided in accordance with the product procured in the market phase. This service phase can take place in real-time and/or after the real-time. For the measurement of flexibility, a baseline has to be previously defined, to which the actual metered data of the FSP can be compared too. If the FSP is not able to deliver the flexibility in accordance with the predefined market conditions and agreed baseline, penalties may apply, which would decrease the remuneration received by FSP.

1.5. Key performance indicators (KPI)

Key performance indicators			
ID	***Name***	***Description***	***Reference to mentioned use case objectives***
1	Cost effectiveness	Compare cost for flexibility with avoided traditional grid cost (Cost of the flexibility solution against traditional solution).	All
2	ICT costs	The term ICT cost comprises the information and communication technologies necessaries for DSO-MO-FSP coordination through platforms to develop new local markets.	• Implement flexibility provision/usage through a market platform. • Use consumer's demand-response in efficient flexibility services.
3	Available Flexibility	Flexible power that can be used for congestion management at a specific grid segment, i.e., the available power flexibility in a defined period (e.g. per day) that can be allocated by the DSO at a specific grid segment, measured in MW. This is in relation with the total amount of power in the specific grid segment in the same period.	• Demonstrate that long term agreements are suitable amongst different available DERs • Use consumer's demand-response in efficient flexibility services.
4	Error of load forecast	Error of load forecast calculated T hours in advance	• To apply market procedures to obtain flexibility services attending DSO requirements. • Use consumer's demand-response in efficient flexibility services.
5	Power Exchange Deviation	Tracking error between a set-point requested by the SO and the measure	All
6	Asset load profile variation	This indicator measures the percentage decrease of load demand in the requested asset by a flexibility provider resource.	All

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Key performance indicators			
ID	***Name***	***Description***	***Reference to mentioned use case objectives***
7	Volume of transactions (Power)	This indicator measures the volume of transactions in kW. This indicator will be used to measure the volume of transactions (cleared bids) during the examined period T for each product.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
8	Number of transactions	This indicator measures the number of transactions. This indicator will be used to measure the number of offered and cleared bids for each product	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
9	Number of products per demo	This indicator measures the percentage of products tested in the demos with respect to the number of products initially targeted by the demos.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
10	Active participation	This indicator measures the percentage of customers actively participating in the demo with respect to the total customers that accepted the participation. This indicator will be used to evaluate customer engagement plan.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
11	Number of FSPs	Number of FSPs joining the platform	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform.
12	Ease of access	Ease of access to the flexibility market for flexibility service providers, including accessibility, no redundant barriers to entry, user-friendliness.	• To apply market procedures to obtain flexibility services attending DSO requirements. • Implement flexibility provision/usage through a market platform. • Demonstrate that long term agreements are suitable amongst different available DERs
13	Number of avoided	Avoided congestions thanks to the measures implemented in the demo	All

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Key performance indicators			
ID	*Name*	*Description*	*Reference to mentioned use case objectives*
	technical restrictions		

1.6. Use case conditions

Use case conditions
Assumptions
It is allowed to use flexibility solutions to secure or restore the network following an expected or unexpected failure if they are appropriate and cost-effective. It is assumed that settlement conditions are well defined and clearly state eventual needs for compensations and/or financial adjustments among affected parties in the flexibility provision process (e.g. BRPs, BSPs, Aggregators).
Prerequisites
To have at least one flexibility provider in an area where a congestion can be simulated. Analyze the area and define possible congestion and short-term solutions with and without flexibility providers. Individual DERs, aggregators, and independent aggregators have to be allowed by regulation to provide flexibility to the DSO. DSO have to be able to procure flexibility from FSPs, as well as receive financial compensation for the flexibility procurement and have economic incentives to do so.

1.7. Further information to the use case for classification/mapping

Classification information
Relation to other use cases
WECL-ES-01, SUC-ES-01
Level of depth
Generic
Prioritisation
High-priority
Generic, regional or national relation
National
Nature of the use case
Business Use Case
Further keywords for classification
Local congestion management, Distributed energy resources, flexible providers, traditional short term solutions, short term

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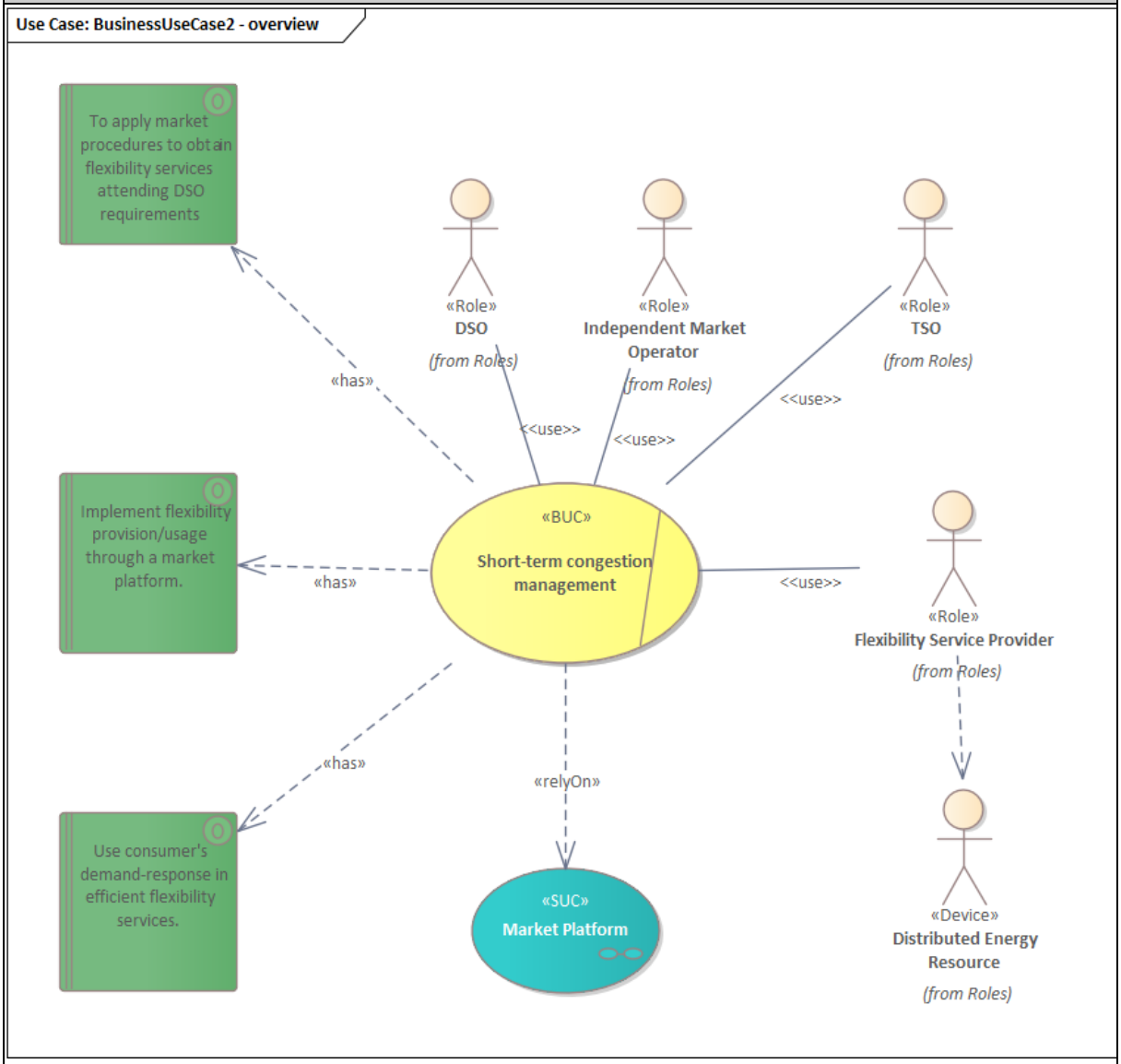
1.8. General remarks

2. Diagrams of use case

Diagram(s) of use case



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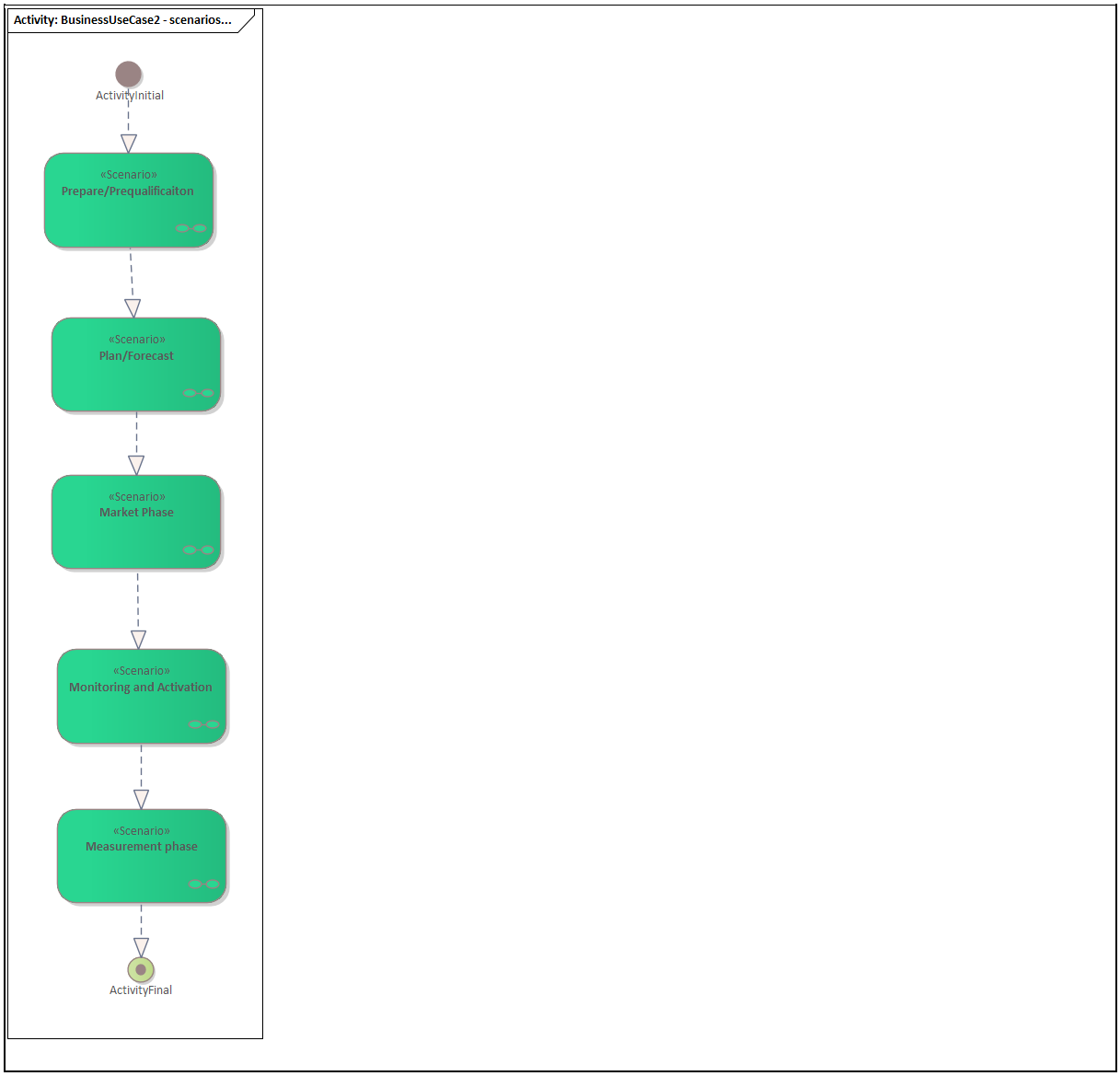

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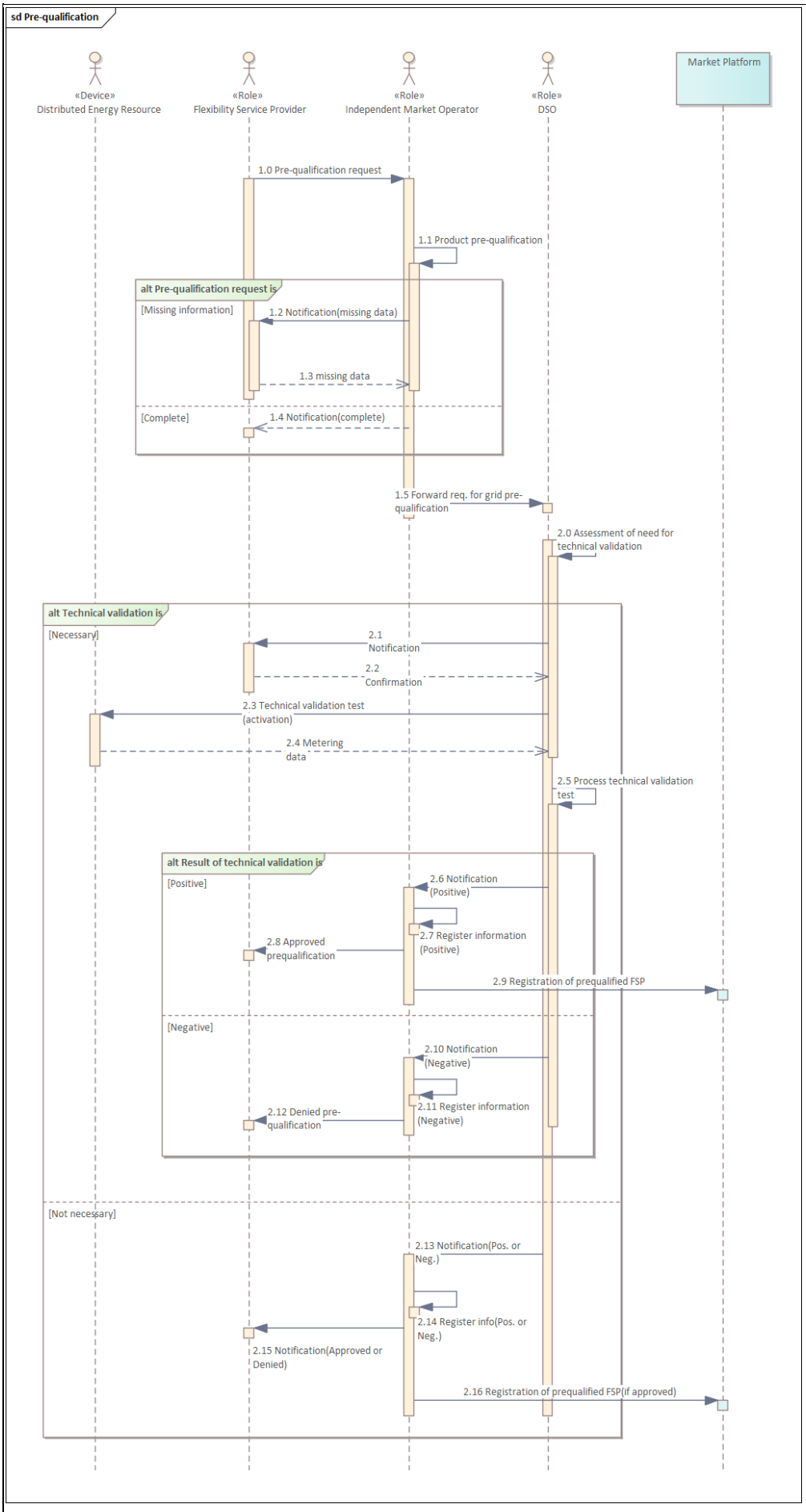
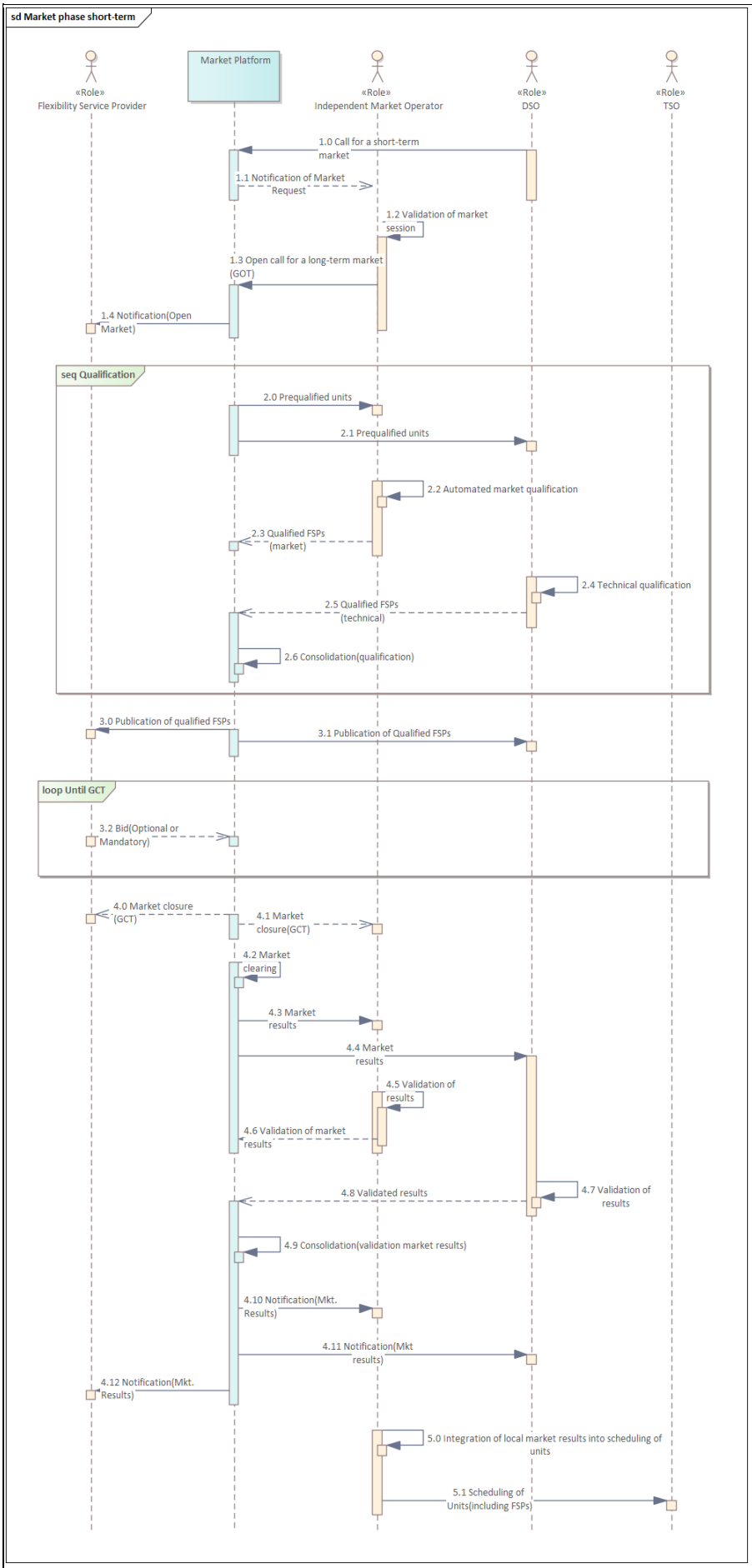
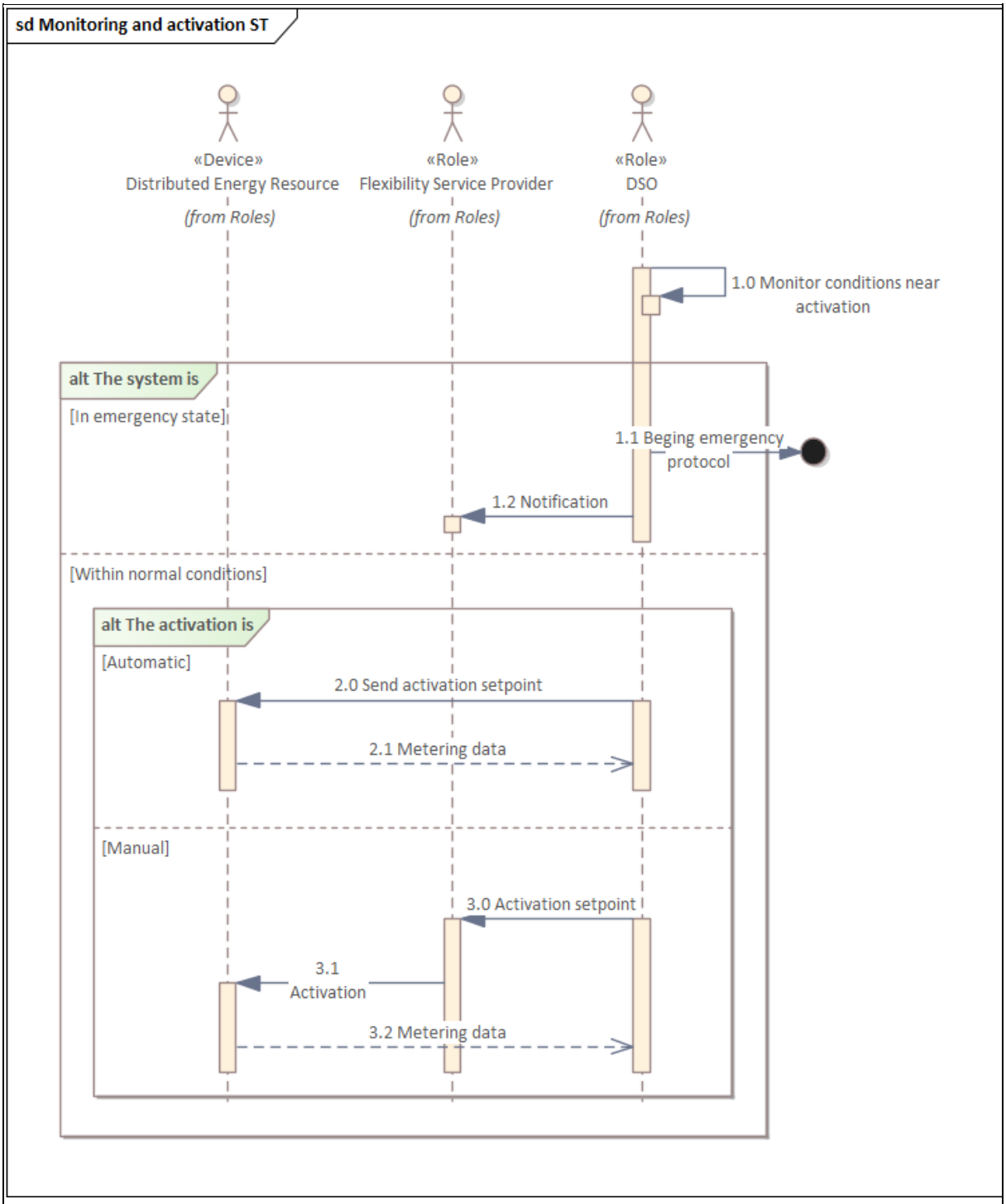

sd Pre-qualification
«Device»
Distributed Energy Resource
«Role»
Flexibility Service Provider
«Role»
Independent Market Operator
«Role»
DSO
Market Platform
1.0 Pre-qualification request
1.1 Product pre-qualification
alt Pre-qualification request is
[Missing information]
1.2 Notification(missing data)
1.3 missing data
[Complete]
1.4 Notification(complete)
1.5 Forward req. for grid pre-qualification
2.0 Assessment of need for technical validation
alt Technical validation is
[Necessary]
2.1 Notification
2.2 Confirmation
2.3 Technical validation test (activation)
2.4 Metering data
2.5 Process technical validation test
alt Result of technical validation is
[Positive]
2.6 Notification (Positive)
2.7 Register information (Positive)
2.8 Approved prequalification
2.9 Registration of prequalified FSP
[Negative]
2.10 Notification (Negative)
2.11 Register information (Negative)
2.12 Denied pre-qualification
[Not necessary]
2.13 Notification(Pos. or Neg.)
2.14 Register info(Pos. or Neg.)
2.15 Notification(Approved or Denied)
2.16 Registration of prequalified FSP(if approved)


sd Market phase short-term
«Role»
Flexibility Service Provider
Market Platform
«Role»
Independent Market Operator
«Role»
DSO
«Role»
TSO
1.0 Call for a short-term market
1.1 Notification of Market Request
1.2 Validation of market session
1.3 Open call for a long-term market (GOT)
1.4 Notification(Open Market)
seq Qualification
2.0 Prequalified units
2.1 Prequalified units
2.2 Automated market qualification
2.3 Qualified FSPs (market)
2.4 Technical qualification
2.5 Qualified FSPs (technical)
2.6 Consolidation(qualification)
3.0 Publication of qualified FSPs
3.1 Publication of Qualified FSPs
loop Until GCT
3.2 Bid(Optional or Mandatory)
4.0 Market closure (GCT)
4.1 Market closure(GCT)
4.2 Market clearing
4.3 Market results
4.4 Market results
4.5 Validation of results
4.6 Validation of market results
4.7 Validation of results
4.8 Validated results
4.9 Consolidation(validation market results)
4.10 Notification(Mkt. Results)
4.11 Notification(Mkt results)
4.12 Notification(Mkt. Results)
5.0 Integration of local market results into scheduling of units
5.1 Scheduling of Units(including FSPs)



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3. Technical details

3.1. Actors

Actors			
Grouping (e.g. domains, zones)		*Group description*	
Actor name	*Actor type*	*Actor description*	*Further information specific to this use case*
Distribution System Operator (DSO)	Role	According to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution 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 distribution of electricity".	
Transmission System Operator (TSO)	Role	According to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person 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". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.	
Independent Market Operator (IMO)	Role	Responsible for calling, clearing, communicating results and possibly settling the provision of distributed flexibility. This role can be taken by an independent market operator, an existing one (e.g. a NEMO), or a system operator.	
Distributed Energy Resource (DER)	Device	Resources connected at the distribution grid capable of providing active power flexibility, either upward/downward or both. It can comprise several different roles and devices such as demand response (actor/role), distributed generation, electric vehicles, and storage systems.	
Flexibility Service Provider (FSP)	Role	Generic role which links the role customer and its possibility to provide flexibility to the roles market and grid; generic role that could be taken by many stakeholders, such as an aggregator or individual distributed energy resources.	

3.2. References

ENTSO-E Role Model;

CEDEC, EDSO, ENTSO-E, Eurelectric, and GEODE, “TSO-DSO Report: An Integrated Approach to Active System Management,” 2019. Accessed: Jul. 19, 2019. [Online]. Available: https://www.entsoe.eu/news/2019/04/16/a-toolbox-for-tsos-and-dsos-to-make-use-of-new-system-and-grid-services/

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4. Step by step analysis of use case

4.1. Overview of scenarios

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Prepare/Pre-qualification	The process in which it is checked whether a unit can deliver the product it intends to sell.	DSO	The DSO and/or the IMO receives a request from a FSP to be pre-qualified to offer the long term local congestion management products	The FSP complies with the prerequisites publicly made available by the DSO/IMO	The FSP is successfully verified and tested, receiving the permission to offer the products to which the prequalification was aimed at.
2	Plan/Forecast	Planning of grid utilization and identifying potential congestions.	DSO	The distribution system optimizer quantifies the amount of flexibility needed	The DSO identifies a situation in which congestion are expected in the medium or long term.	The DSO computes the amount of flexibility needed for the different types of products in the different timesteps and calls a market.
3	Market phase	Market opening, qualification, bids collection, market clearing and communication of results	IMO	The DSO calls a market for the procurement of flexibility calculated in scenario 2.	FSP are prequalified to provide the service	Markets are cleared and FSPs are nominated to provide the product.
4	Monitoring and activation	Grid monitoring and flexibility bids activation to solve the forecasted congestion management	DSO	The real-time for the provision of a service procured in scenario 4 approached	The FSP and the DSO have the necessary communication infrastructure for the activation order to be sent	The FSP successfully receives the order to provide the flexibility.
5	Measurement phase	Validation of service delivery	DSO	The service is being provided in real-time or it has been already provided	Metering data is successfully received by the DSO with the necessary granularity and a baseline method was determined	The DSO compares the metered data with the baseline previously computed or sent by the FSP.

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4.2. Steps - Scenarios

Prepare/Pre-qualification

Scenario #1 description

The process in which it is checked whether a unit can deliver the product it intends to sell.

Scenario step by step analysis

Scenario								
Scenario name		Prepare/Pre-qualification						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	FSP requests to be pre-qualified	Pre-qualification request	The FSP requests to the IMO to be pre-qualified to offer a certain type of product	CREATE	FSP	IMO	I.E.01 I.E.02 I.E.03 I.E.04	
1.1	IMO processes market prequalification	Product prequalification	The IMO processes the market prequalification.	EXECUTE	IMO	IMO		
1.2	FSP is notified if information provided is incomplete	Notification (missing data)	The IMO requests missing data	GET	IMO	FSP	I.E.03 I.E.04	
1.3	FSP reports back missing data	Missing data	The FSP reports back missing data	REPORT	FSP	IMO	I.E.03 I.E.04	
1.4	IMO notifies the completion of data collection	Notification(complete)	The notifies the completion on data collection process for the purpose of pre-qualification	CLOSE	IMO	FSP		

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1.5	IMO forwards pre-qualification request for technical prequalification	Forward req. for grid pre-qualification	The IMO forwards pre-qualification request for technical prequalification	REPORT	IMO	DSO	I.E.03 I.E.04	
2.0[2]	DSO assess the need for a technical validation	Assessment of need for technical validation	The DSO may decide that field tests are necessary to ensure that flexibility can be provided by the applicant FSP. In this step, the DSO assess internally the need for field tests	EXECUTE	DSO	DSO		
2.1	DSO communicates the need for a technical validation	Notification	If a technical validation is necessary, the FSP is communicated on the new requirement, as well as the details for the technical validation.	REPORT	DSO	FSP		
2.2	FSP acknowledges the technical validation need	Confirmation	The FSP acknowledges the technical validation need	REPORT	FSP	DSP		
2.3	Technical validation test	Technical validation test	The DSO may send a setpoint directly to the DER at the moment of the activation.	GET	DSO	DER		
2.4	DER sends metering data	Metering data	The DER sends metering data regarding the technical pre-qualification directly to the DSO.	REPORT	DER	DSO	I.E.06	
2.5	DSO processes the results from technical validation	Process technical validation	The DSO internally processes the results of the technical validation test	EXECUTE	DSO	DSO		

[2] Changes in numbering at the step-by-step analysis (e.g. 1.5 to 2.0) are meant to provide a more intuitive visualization of the sequence diagrams, signalling the end of one process and the start of another.

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2.6	DSO notifies on successful technical validation	Notification(positive)	The DSO notifies the IMO on the result of the technical validation	REPORT	DSO	IMO		
2.7	The IMO registers internally the FSP as pre-qualified	Register information(positive)	The IMO registers internally the FSP as pre-qualified	CREATE	IMO	IMO		
2.8	The FSP is communicated on the successful pre-qualification	Approved prequalification	The FSP is communicated on the successful pre-qualification	GET	IMO	FSP		
2.9	The IMO registers to the Market Platform the successful pre-qualification	Registration of pre-qualified FSP	The IMO registers to the Market Platform the successful pre-qualification	CREATE	IMO	Market Platform		
2.10	DSO notifies on unsuccessful technical validation	Notification(negative)	The DSO notifies the IMO on the result of the technical validation	REPORT	DSO	IMO		
2.11	The IMO registers internally the FSP as not pre-qualified	Register information(negative)	The IMO registers internally the FSP as not pre-qualified	CREATE	IMO	IMO		
2.12	The FSP is communicated on the unsuccessful pre-qualification	Denied pre-qualification	The FSP is communicated on the unsuccessful pre-qualification	GET	IMO	FSP		
2.13	If no technical validation is necessary, DSO informs no technical pre-qualification result	Notification (positive or negative)	If no technical validation is necessary, DSO informs no technical pre-qualification result	REPORT	DSO	IMO		
2.14	The IMO registers internally the result of the pre-qualification	Register information(positive or negative)	The IMO registers internally the result of the pre-qualification process (positive or negative)	CREATE	IMO	IMO		

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	process (positive or negative)							
2.15	The FSP is communicated on the pre-qualification result (positive or negative)	Notification(Approved or Denied)	The FSP is communicated on the pre-qualification result (positive or negative)	REPORT	IMO	FSP		
2.16	The IMO registers to the Market Platform the successful pre-qualification	Registration of pre-qualified FSP(if approved)	The IMO registers to the Market Platform the successful pre-qualification	CREATE	IMO	Market Platform		

Plan/Forecast

Scenario #2 description

Planning of grid utilization and identifying potential congestions.

Scenario step by step analysis

Scenario								
Scenario name	Offering							
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	DSO evaluates the need for a short-term	DSO evaluates the need for a short-term market for flexibility	The DSO evaluates internally the need for a short-term market for flexibility. This step is an internal activity exclusive to the DSO, and therefore no information exchanges with other	EXECUTE	DSO	DSO		

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	market for flexibility		actors take place. Therefore, the internal steps carried out by the DSO are not modelled in detail.					

Market phase: short-term

Scenario #3 description

Add activity or activity set diagram.

Scenario step by step analysis

Scenario								
Scenario name								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	DSO requests a short-term market	Call for a short-term market	DSO requests a short-term market based on the results of scenario 2 (plan and forecast). At this request, several parameters will have to be informed by the DSO. These parameters are grouped into (i) generic attributes and (ii) product parameters	CREATE	DSO	Market Platform	I.E.07 (generic attributes) I.E.08 (product parameters)	
1.1	Notification of market request	Notification of market request	The IMO is notified that a market request was created by the DSO	REPORT	Market platform	IMO		
1.2	IMO validates and prepares a market session	Preparation of market session	The IMO validates the information provided by the DSO (IE07 and IE08). N.B.: Intermediated steps in which the IMO may identify missing information,	EXECUTE	IMO	IMO		

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			request completion from the DSO, and final completion by the DSO are omitted for the sake of simplicity.					
1.3	IMO opens call for a short-term market	Open call for a short-term market	The IMO, after validating the market session, opens the market session in the Market Platform	EXECUTE	IMO	Market Platform		
1.4	FSPs are notified of a market opening	Notification (Open Market)	The Market Platform notifies the FSP about a market opening.	REPORT	Market Platform	FSP	I.E.08 (not all parameters)	
2.0	IMO is informed of pre-qualified units	Pre-qualified units	This step market the beginning of the qualification process. The IMO receives a list of pre-qualified units for that market session. Differently from the long-term market, at the beginning of the market phase, all FSPs should already be pre-qualified.	GET	Market Platform	IMO	I.E.09	
2.1	DSO is informed of pre-qualified units	Pre-qualified units	This step market the beginning of the qualification process. The DSO receives a list of pre-qualified units for that market session. Differently from the long-term market, at the beginning of the market phase, all FSPs should already be pre-qualified.	GET	Market Platform	IMO	I.E.09	
2.2	IMO proceeds with the market qualification	Market qualification	The IMO proceeds with the market qualification. The IMO checks the maximum power to bid from FSPs and the existence of financial warranties.	EXECUTE	IMO	IMO		
2.3	IMO registers a list of qualified units (market qualification)	Qualified FSPs (market)	The IMO registers a list of qualified units (market qualification)	REPORT	IMO	Market Platform	I.E.10 (market)	

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2.4	DSO proceeds with the technical qualification	Technical qualification	A process by which the DSO verifies the DER capacity to meet the requisites of the specific requirement. All the resources in the specific area will be checked to determine which ones are capable of providing the required service.	EXECUTE	DSO	DSO		
2.5	DSO registers a list of qualified units (technical qualification)	Qualified FSPs (technical)	The DSO registers a list of qualified units (Technical qualification)	REPORT	DSO	Market Platform	I.E.10 (technical)	
2.6	The Market Platform crosschecks both qualification lists and produces the consolidated list	Consolidation (qualification)	The Market Platform crosschecks both qualification lists and produces the consolidated list	CREATE	Market Platform	Market Platform	I.E.10 (consolidated)	
3.0	The Market Platform publishes/notifies qualified FSPs	Publication of qualified FSPs	The Market Platform publishes/notifies qualified FSPs	REPORT	Market Platform	FSP	I.E.10 (consolidated)	
3.1	The Market Platform publishes/notifies qualified FSPs to the DSO	Publication of qualified FSPs	The Market Platform publishes/notifies qualified FSPs to the DSO	REPORT	Market Platform	DSO	I.E.10 (consolidated)	
3.2	FSP bids to market session	Bid	Qualified FSPs may bid to the market session as long as market session is open (before the Gate Closer Time [GCT])	CREATE	FSP	Market Platform	I.E.11	
4.0; 4.1	Market platform notifies the GCT	Market closure (GCT)	Market platform notifies the GCT	REPORT	Market Platform	FSP;IMO		
4.2	Market Platform clears the market	Market clearing	Market Platform clears the market	EXECUTE	Market Platform	Market Platform		

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4.3; 4.4	Market Platform reports market results	Market results	Market Platform reports market results	REPORT	Market Platform	IMO;DSO		
4.5	IMO validates the market results	Validation of results	The IMO checks the market results for inconsistences. After that, results are validated	EXECUTE	IMO	IMO		
4.6	IMO registers the validated market results	Validated market results	IMO registers the validated market results	REPORT	IMO	Market platform	I.E.12 (market)	
4.7	DSO validates the market results	Validation of results	The DSO checks the market results for inconsistences (from a technical perspective).	EXECUTE	DSO	DSO	I.E.12 (technical)	
4.8	DSO registers the validated market results	Validated market results	DSO registers the validated market results	REPORT	DSO	Market platform	I.E.12 (technical)	
4.9	The Market Platform consolidates the market results	Consolidation (market results)	The Market Platform consolidates the market results based on the validation by the IMO and the DSO	CREATE	Market Platform	Market Platform	I.E.12 (consolidated)	
4.10; 4.11; 4.12	Market participants and IMO are informed of final market results	Notification (market results)	Market participants (DSO, FSPs) and IMO are informed of final market results	REPORT	Market Platform	DSO;FSP;IMO	I.E.12 (consolidated)	
5.0	The IMO integrates the market results in the short term with all other market results	Integration of local market results into scheduling of units	The IMO integrates the market results in the short term with all other market results	CREATE	IMO	IMO		
5.1	The IMO reports the scheduling of units, including the results of local flexibility markets, to the TSO	Scheduling of Units	The IMO reports the scheduling of units, including the results of local flexibility markets, to the TSO	REPORT	IMO	TSO	I.E.13	

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Monitoring and activation

Scenario #3 description

Grid monitoring and flexibility bids activation to solve the forecasted congestion management.

Scenario step by step analysis

Scenario								
Scenario name								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	The DSO monitors the state of the grid near real-time (activation)	Monitoring conditions near activation	The DSO monitor the sate of the grid near activation in order to ensure the security of the grid	EXECUTE	DSO	DSO		
1.1	If the grid is an emergency state, the DSO starts the emergency protocol and the BUC is terminated	Beginning emergency state	If the grid is an emergency state, the DSO starts the emergency protocol and the BUC is terminated, as this situation lays outside the scope of this BUC.	EXECUTE; CLOSE	DSO	DSO		
1.2	If the grid is an emergency state, the DSO notifies the FSP to proceed according the emergency protocol (outside the scope of the BUC)	Notification	If the grid is an emergency state, the DSO notifies the FSP to proceed according the emergency protocol (outside the scope of the BUC). For example, the FSP may be requested to proceed on a previously agreed way, may be exempted from providing flexibility, or may not be notified at all. This situation is outside the scope of this BUC.	REPORT	DSO	FSP		

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2.0	If the state is within normal conditions and the activation type is automatic, the DSO sends the setpoint directly to the DER	Send activation setpoint	If the state is within normal conditions and the activation type is automatic, the DSO sends the setpoint directly to the DER	REPORT; EXECUTE	DSO	DER		
2.1	DER reports metering data	Metering data	DER reports metering data directly to the DSO	REPORT	DER	DSO	I.E.06	
3.0	If the state is within normal conditions and the activation type is manual, the DSO sends the setpoint to the FSP	Activation setpoint	If the state is within normal conditions and the activation type is manual, the DSO sends the setpoint to the FSP	REPORT	DSO	FSP		
3.1	The FSP proceeds with the activation in real-time according to the market results.	Activation	If the state is within normal conditions, the FSP proceeds with the activation in real-time according to the market results.	EXECUTE	FSP	DER		
3.2	DER reports metering data	Metering data	DER reports metering data directly to the DSO	REPORT	DER	DSO	I.E.06	

Measurement phase

Scenario #3 description

Validation of service delivery

Scenario step by step analysis

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Scenario								
Scenario name								
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	DSO receives metering data	Metering data	DSO receives metering data (step 3.1 of scenario 4)	GET	DER	DSO	I.E.06	
2.0	The DSO validates the service provision	Verification of service provision	The DSO validates the service provision. To do so, the DSO compares the metered data with the service procured and the baseline predefined.	EXECUTE	DSO	DSO		
2.1	The DSO notifies the IMO on the service provision	Notification of service provision	The DSO informs the IMO on the level of service provision (e.g. percentage of service provision based on the deviation of the metering data to the agreed flexibility)	REPORT	DSO	IMO		
2.2	IMO proceeds with the settlement processing	Settlement processing	The IMO proceeds with the settlement processing. According to the level of service provision, penalties (reduction of agreed price/payment) may occur.	EXECUTE	IMO	IMO		
2.3	The FSP is notified on the final settlement	Settlement notification	The FSP is notified on the final settlement	REPORT	IMO	FSP		

5. Information exchanged

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

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I.E.01	Basic Participant Information	Register and basic information about the market participant such as username and password	
I.E.02	Market participant pre-qualification information	Contact information; Fiscal data; Access contract; bank details; power of representation; confidentiality agreement; declaration of non-collusion	
I.E.03	Market resource pre-qualification information	Market participants provide information on the resources they want to prequalify: Facility/resource name; Type of technology; Location; Market participant; etc.	
I.E.04	Technical resource pre-qualification information	Verification of the installed capacity to provide the service: Power; CUPS (Universal Supply Point Code acronym in Spanish); Maximum quantity; Response time, Etc	
I.E.05	Technical validation for pre-qualification	In case of the need of a technical validation for prequalification, the FSP receives the information on the when and how the test will be conducted: day; time; power to reduce/increase; duration of the test; etc.	
I.E.06	Metering data	Metering data from DER	
I.E.07	Generic attributes	Composed of generic parameters concerning the market session being requested. E.g.: • Auction identifier • Associated DSO • Product Type: Flexibility Product • Type of negotiation: Auction Area: Basic or aggregated.	
I.E.08	Product parameters	Composed of product parameters concerning the market session being requested. E.g.: 7. Service window: Selection of the required date and duration of the service o Start date/hour: 01/06/2021 o Duration: 3h o Opening time: 8:00 PM o Closing time: 10:00 PM 8. Availability: Selection of the capacity, the direction and the estimated hours of activation. o Capacity: 4MW	

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		o Direction: Upwards (up for generation, down for consumption) 9. Activation window (in case of activation product): Specific subperiod in an activation window when a particular DER could be activated and thus it must be available. Multiple sets of activation windows can be defined. E.g.: o Day: 01/06/2021 o Hour: 19h o Duration: 2h o Capacity to modify: 1MW o Direction: Upward 10. Local area: Selection of the trading area. Choice by postal code, connection point, lines… (to be determined). o Area: postal code 11. Activation Announcement: Time in advance that a DSO informs a DER that its activation is programmed confirmed. 12. Form of Remuneration: It establishes form of payment to winner DERs Two different terms are defined availability and activation (depending on the product). o Type of product: availability/activation o Availability/Activation cap price: X €/MW or X €/MWh	
I.E.09	List of pre-qualified units	List of pre-qualified units for a given market session	
I.E.10	List of qualified units (market, technical or consolidated)	List of qualified units for a given market session. The list can refer to the market qualification, technical qualification or the consolidated list.	
I.E.11	Bid	Composed of bidding information 3. General attributes • FSP identifier 4. Availability: Selection of the capacity, the direction and the estimated hours of activation. • Period of availability (multiple periods may be possible within the service window)	

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		• Price: for availability and/or activation Additional parameters (complex bids) may be considered (under discussion).	
I.E.12	Validate market results	Validated market results by either the IMO (market), the DSO (technical) or the consolidated market results.	
I.E.13	Scheduling of FSPs	Scheduling of FSPs	

6. Requirements (optional)

7. Common terms and definitions

8. Custom information (optional)

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A.3 SUC-ES-01: Long-term congestion management

SUC-ES-01 – Local Market Platform

Based on IEC 62559-2 edition 1

1. Description of the use case

1.1. Name of use case

Use case identification		
ID	***Area(s)/Domain(s)/Zone(s)***	***Name of use case***
SUC-ES-01	Local congestion management	Local Market Platform

1.2. Version management

Version management				
Version No.	***Date***	***Name of author(s)***	***Changes***	***Approval status***
0.1	21/06/2021	Leandro Lind		
1.0	21/04/2023	Beatriz Alonso	KPIs updated	

1.3. Scope and objectives of use case

Scope and objectives of use case	
Scope	This SUC describes the Local Market Platform, a system responsible for receiving the DSO needs on market sessions for flexibility procurement, the bids from FSPs, for the market clearing and for the communication of market results to different stakeholders.
Objective(s)	- Enable local flexibility procurement by DSOs - Open market sessions at the request of the DSO - Collect bids from market participants - Clear the local flexibility markets - Communicate market results to stakeholders
Related business case(s)	WECL-ES-01 and WECL-ES-02

1.4. Narrative of Use Case

Narrative of use case
Short description
This SUC describes the Local Market Platform, a system responsible for receiving the DSO needs on market sessions for flexibility procurement, the bids from FSPs, for the market clearing and for the communication of market results to different stakeholders. The market platform will be the main information exchange enabler and will also act as a Flexibility Resource Register, as proposed by the Active System Management (ASM) report.
Complete description

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The Local Market Platform will be operated by the Independent Market Operator, and will serve as the interface for the different market participants as well as for clearing the different market. This system use case starts with the request from the DSO for a market session. This request, as well as the rest of the SUC, are product agnostic, meaning that it applies to all products described in the two BUCs.

Three scenarios are defined for this SUC, namely (i) flexibility resource register, (ii) market request, (iii) market session.

Scenarios:

1. **Flexibility Resource Register:**

In this scenario, the FSP applicants will be able to request to be allowed to participate in market sessions, follow up the pre-qualification process, and update their information whenever needed. This scenario will also serve as a global register of flexibility resources to DSOs and to the IMO. These registers will provide information for the following scenarios (e.g. location, type of DER etc), and will be used in process such as the qualification and the settlement.

2. **Market Request:**

This scenario describes how the market platform will enable and handle a market session request by the DSO. It involves the interface in which the DSO may request a market session, the notification to the IMO, the validation process, the registration and the final notification to market participants. Within this scenario, differences may exist depending on the products that will be trades (e.g. long or short-term, availability or activation), which are highlighted in the step-by-step analysis.

3. **Market Session:**

The market session scenario describes the activities comprised between the notification of an open market session to the publication of market results. Therefore, it can be divided into three macro processes, namely the (i) qualification, (ii) the negotiation period, and (iii) the market clearing and results.

In this scenario, the Local Market Platform also interacts with the OneNet system by publishing the market results on a certain periodicity. Market results are collected and published onto the OneNet system every n hours or daily. The objective of this interaction is to make neighbouring SOs aware of activations in case those activations can impact in their operations (e.g. activations of units near the border between two SOs).

1.5. Key performance indicators (KPI)

Key performance indicators			
ID	***Name***	***Description***	***Reference to mentioned use case objectives***

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1	Cost effectiveness	Compare cost for flexibility with avoided traditional grid cost (Cost of the flexibility solution against traditional solution).	-Collect bids from market participants -Clear the local flexibility markets
2	ICT Cost	The term ICT cost comprises the communications and information technologies, including the software for the aggregation and market clearing process. Only those ICT costs that are directly related to the implementation of each coordination scheme will be considered.	-Enable local flexibility procurement by DSO -Open market sessions -Clear the local flexibility markets -Communicate market results
3	Available flexibility	The available power flexibility in a defined period (eg. per day) that can be allocated by the DSO at a specific grid segment, measured in MW. This in relation with the total amount of power in the specific grid segment in the same period.	-Enable local flexibility procurement by DSOs -Open market sessions
5	Power exchange deviation	Tracking error between a set-point requested by the SO and the measure.	-Clear the local flexibility markets
7	Volume of transactions (Power)	This indicator measures the volume of transactions in kW. This indicator will be used to measure the volume of transactions (cleared bids) during the examined period T for each product.	All
8	Number of transactions	This indicator measures the number of transactions. This indicator will be used to measure the number of offered and cleared bids for each product	All
12	Ease of access	Ease of access to the flexibility market for flexibility service providers, including accessibility, no redundant barriers to entry, user-friendliness.	All

1.6. Use case conditions

Use case conditions
Assumptions
The DSO is allowed to use flexibility solutions to defer/eliminate traditional capital investments where they are appropriate and cost-effective and to use flexibility solutions to secure or restore the network following an expected or unexpected failure if they are appropriate and cost-effective. It is assumed that settlement conditions are well defined and clearly state eventual needs for compensations and/or financial adjustments among affected parties in the flexibility provision process (e.g. BRPs, BSPs, Aggregators).
Prerequisites
Communication infrastructure between DSOs, FSPs, IMO and the Market Platform should be in place FSP engagement

1.7. Further information to the use case for classification/mapping

Classification information
Relation to other use cases

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WECL-ES-01; WECL-ES-02
Level of depth
Generic
Prioritisation
High priority
Generic, regional or national relation
National?
Nature of the use case
System Use Case
Further keywords for classification
Local Market Platform, Local congestion management

2. Diagrams of use case

Diagram(s) of use case

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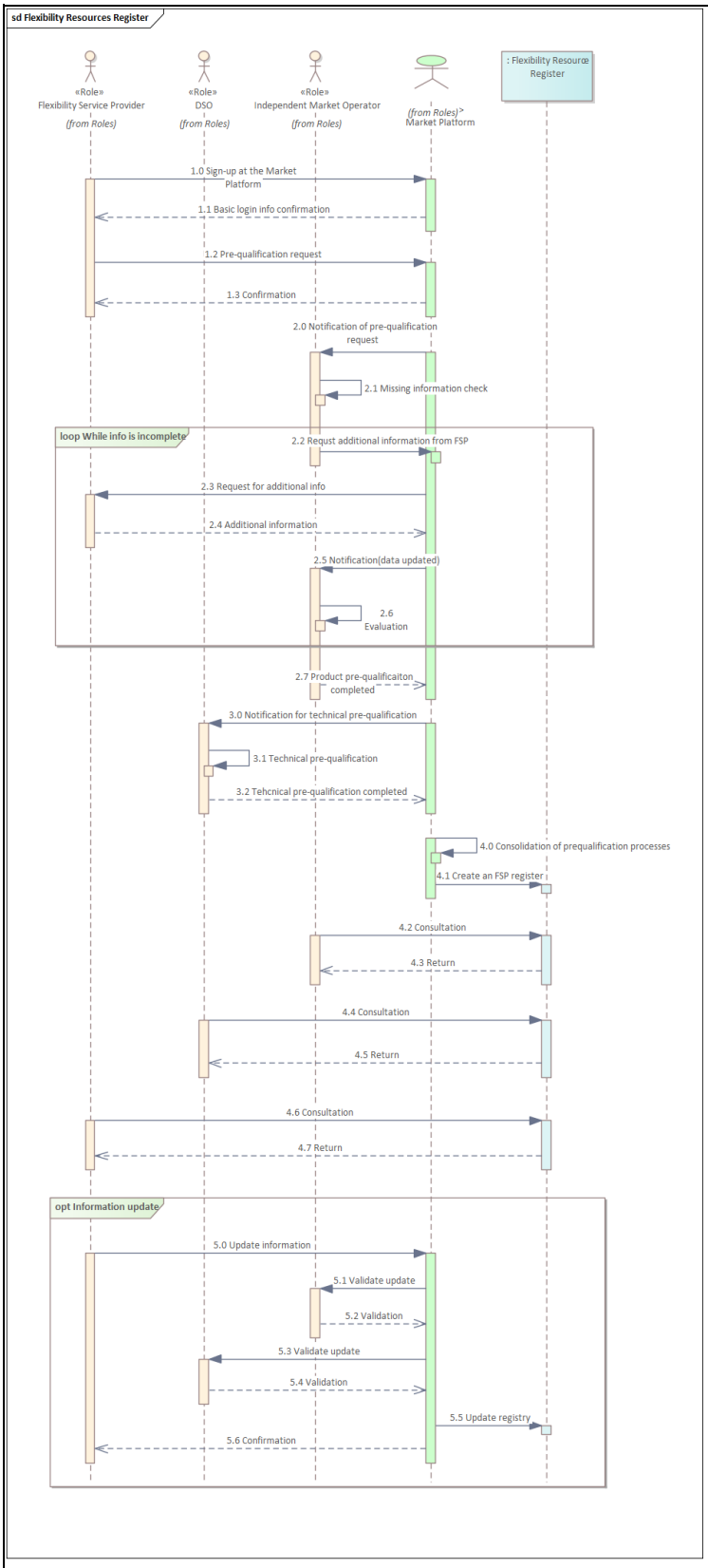

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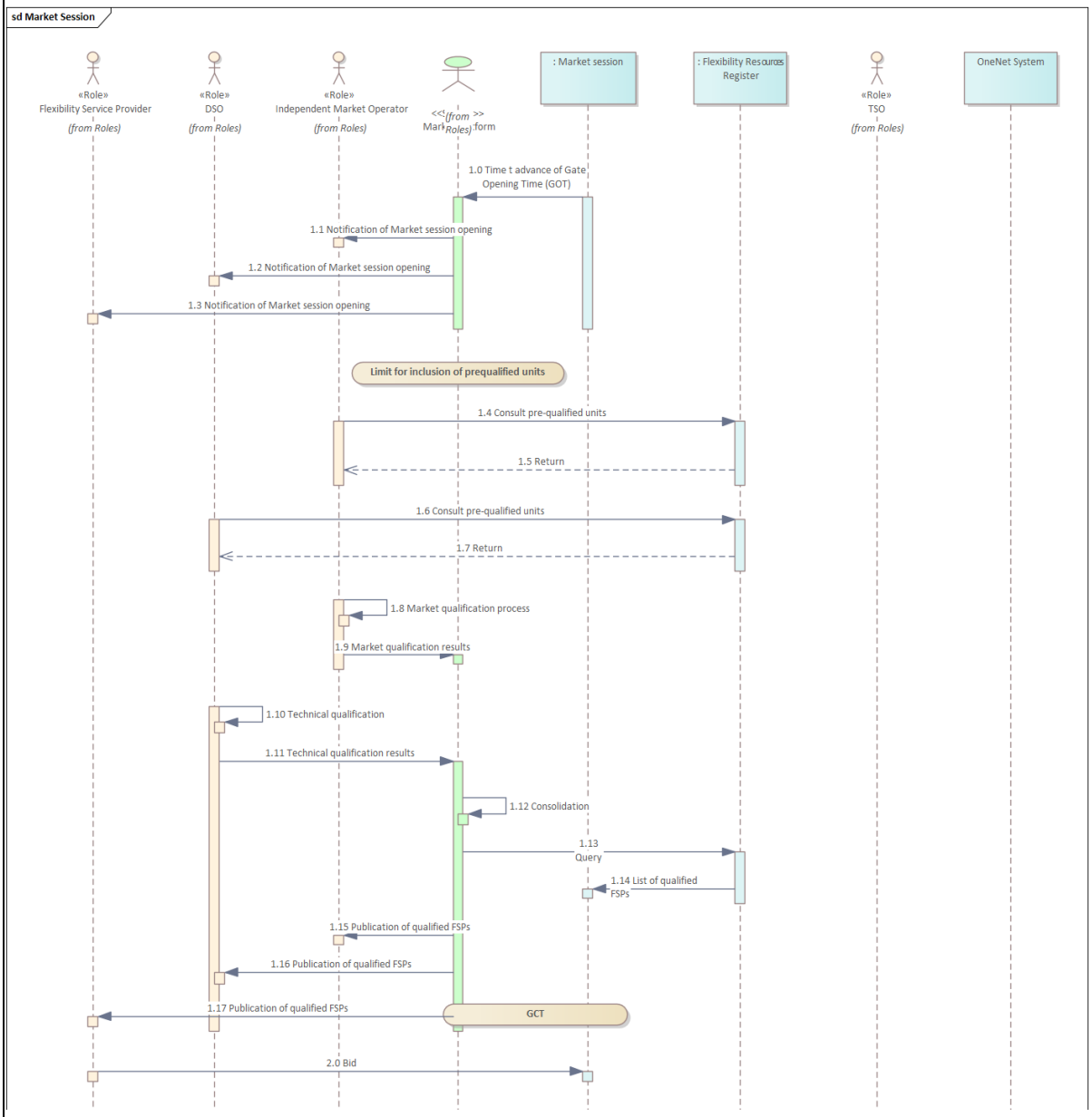
Part 1



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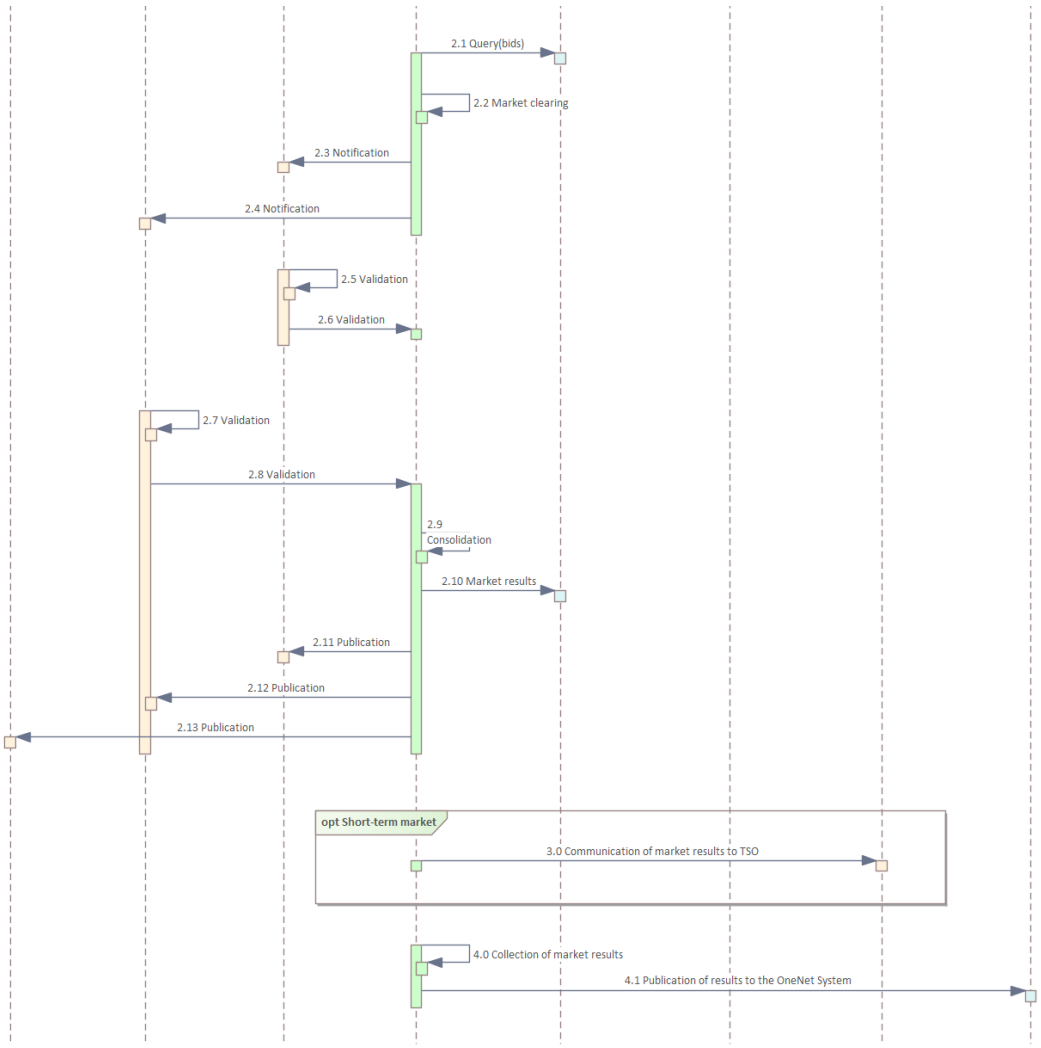
Part 2



3. Technical details

3.1. Actors

Actors			
Grouping (e.g. domains, zones)		***Group description***	
Actor name	***Actor type***	***Actor description***	***Further information specific to this use case***

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Market Platform	System	System designed to act as the flexibility resources register, the enabler for information exchange among market participants, and to clear market sessions	
Distribution System Operator (DSO)	Role	According to the Article 2.6 of the Directive: "a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution 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 distribution of electricity". Moreover, the DSO is responsible for connection of all grid users at the distribution level.	
Independent Market Operator (IMO)	Role	Responsible for calling, clearing, communicating results and possibly settling the provision of distributed flexibility. This role can be taken by an independent market operator, an existing one (e.g. a NEMO), or a system operator.	
Flexibility Service Provider (FSP)	Role	Generic role which links the role customer and its possibility to provide flexibility to the roles market and grid; generic role that could be taken by many stakeholders, such as an aggregator or individual distributed energy resources.	
Transmission System Operator (TSO)	Role	According to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "a natural or legal person 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". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.	
OneNet System	System	Pan-European information exchange proposed by the OneNet project.	

3.2. References

CEDEC, EDSO, ENTSO-E, Eurelectric, and GEODE, “TSO-DSO Report: An Integrated Approach to Active System Management,” 2019. Accessed: Jul. 19, 2019. [Online]. Available: https://www.entsoe.eu/news/2019/04/16/a-toolbox-for-tsos-and-dsos-to-make-use-of-new-system-and-grid-services/

4. Step by step analysis of use case

4.1. Overview of scenarios

Scenario conditions						
No.	***Scenario name***	***Scenario description***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Flexibility Resource Register	Register of FSPs able to provide the different flexibility products. Includes the information exchange during the pre-qualification process, and registration once it is	Market Platform	The reception of a pre-qualification request by an applicant FSP	The Market Platform should be up and running. Necessary communications with DSOs, FSPs and IMO should also be operational.	The FSP has a register in the market platform containing the necessary information requested during the

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		finished, and the maintenance of the register for the period in which the FSP is active.				pre-qualification process
2	Market Request	This scenario describes how the market platform will enable and handle a market session request by the DSO.	Market Platform	A market session request is registered in the platform	The Market Platform should be up and running. Necessary communications with DSO and IMO should also be operational.	A market session is validated, registered and communicated to market participants
3	Market Session	The market session scenario describes the activities comprised between the notification of an open market session to the publication of market results.	Market Platform	The Gate Opening Time of a market session.	A market session has been created. The market platform is up and running.	A market session is cleared and results are communicated to market participants.

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4.2. Steps - Scenarios

Flexibility Resource Register

Scenario #1 description

Register of FSPs able to provide the different flexibility products. Includes the information exchange during the pre-qualification process, and registration once it is finished, and the maintenance of the register for the period in which the FSP is active.

Scenario step by step analysis

Scenario name	Flexibility Resource Register

Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	FSP sign-up to the LMP	Sign-up at the Market Platform	The FSP opens the Local Market Platform front-end and signs up	CREATE	FSP	LMP	I.E.01	
1.1	LMP validates new account	Basic login info confirmation	The FSP receives a confirmation of the creation of new account. Email/phone validations may be included	REPORT	LMP	FSP	I.E.01	
1.2	FSP requests to be pre-qualified	Pre-qualification request	The FSP opens the Local Market Platform front-end, signs in, and requests to have its resources pre-qualified.	CREATE	FSP	LMP	I.E.02 I.E.03 I.E.04	
1.3	LMP sends a confirmation that the	Confirmation	LMP sends a confirmation that the pre-qualification request was made	REPORT	LMP	FSP		

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	pre-qualification request was made							
2.0	LMP notifies the IMO that a pre-qualification was requested	Notification of pre-qualification request	The IMO is informed about the request for a pre-qualification.	REPORT	LMP	IMO		
2.1	IMO checks if information is missing	Missing information check	Process also defined in step 1.1 of the BUCs WECL-ES-01 and WECL-ES-02.	EXECUTE	IMO	IMO		
2.2	IMO registers at the LMP that additional information is necessary	Request additional information from FSP	IMO registers at the LMP that additional information is necessary	CREATE	IMO	LMP		
2.3	LMP notifies FSP that additional information is required	Request for additional info	LMP notifies FSP that additional information is required.	REPORT	LMP	FSP		
2.4	FSP provides the requested information	Additional information	FSP login to the platform and provides the requested information	CHANGE	FSP	LMP		
2.5	LMP notifies the IMO that the data on the pre-qualification request was updated	Notification (data update)	LMP notifies the IMO that the data on the prequalification request was updated	REPORT	LMP	IMO		
2.6	IMO evaluates if pre-qualification data is complete	Evaluation	IMO checks if pre-qualification data is complete. If pre-qualification request is still incomplete, GOTO step 2.2. If information is complete, IMO concludes the product pre-qualification.	EXECUTE	IMO	IMO		

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2.7	IMO registers the successful resource pre-qualification to the LMP	Product pre-qualification completed	IMO registers the successful resources pre-qualification to the LMP	CREATE	IMO	LMP		
3.0	The LMP informs the DSO that a technical pre-qualification was requested	Notification for technical pre-qualification	The LMP informs the DSO that a technical pre-qualification was requested	REPORT	LMP	DSO		
3.1	The DSO conducts the technical pre-qualification process	Technical pre-qualification	This step is defined in steps 2.0 to 2.6 of the BUCs WECL-ES-01 and WECL-ES-02.	EXECUTE	DSO	DSO,FSP		
3.2	DSO concludes technical pre-qualification and registers the information into the LMP	Technical pre-qualification concluded	The DSO concludes technical pre-qualification and registers the information into the LMP	CREATE	DSO	LMP		
4.0	The LMP automatically consolidates the pre-qualification results	Consolidation of pre-qualification results	The LMP automatically consolidates the pre-qualification results	EXECUTE	LMP	LMP		
4.1	The LMP creates an FSP register on the Flexibility Resources Register	Create an FSP register	The LMP creates an FSP register on the Flexibility Resources Register	CREATE	LMP	LMP: Flexibility Resources Register		
4.2; 4.4; 4.6;	IMO, DSO and FSP are able to consult the register at the Flexibility Resources Register	Consultation	IMO, DSO and FSP are able to consult the register at the Flexibility Resources Register	GET	IMO; DSO; FSP	LMP: Flexibility Resources Register		

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4.3; 4.5; 4.7	The LMP returns the consultation	Return	The LMP returns the consultation	REPORT	LMP: Flexibility Resources Register	IMO; DSO; FSP		
5.0;	The FSP updates information	Update information	The FSP updates information	CHANGE	FSP	LMP		
5.1; 5.2; 5.3; 5.4	The IMO and the DSO validate the update	Update validation	The IMO and the DSO validate the update	EXECUTE; REPORT	IMO; DSO	LMP		
5.5	The LMP updates the Flexibility registry	Update registry	The LMP updates the Flexibility registry	REPORT	LMP	LMP: Flexibility Resources Register		
5.6	The LMP confirms the update	Confirmation	The LMP confirms the update	REPORT	LMP	FSP		

Market Request

Scenario #2 description

This scenario describes how the market platform will enable and handle a market session request by the DSO.

Scenario step by step analysis

Scenario	
Scenario name	Market Request

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Step No	Event	Name of process/activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged (IDs)	Requirement, R-IDs
1.0	The DSO requests the creation of a Market Session	Market session request	The DSO requests the creation of a Market Session	CREATE	DSO	LMP	I.E.05; I.E.06	
1.1	The LMP sends a confirmation that the market session was requested	Confirmation(request)	The LMP sends a confirmation that the market session was requested	REPORT	LMP	DSO		
1.2	The IMO is notified that a market session was requested	Notification (market request)	The IMO is notified that a market session was requested (e.g. by email)	REPORT	LMP	IMO		
1.3	The IMO evaluates if the requested market session is valid	Evaluation	The IMO evaluates if the requested market session is valid. This evaluation is, in principle, automatic	EXECUTE	IMO	IMO		
1.4	The IMO may consult the Flexible Resources Registry in order to evaluate the market session request	Consultation	The IMO may consult the Flexible Resources Registry in order to evaluate the market session request. This consultation is optional, and done in case the evaluation has to be carried out manually	GET	IMO	LMP: Flexibility Resources Registry		
1.5	The LMP returns the consultation	Return	The LMP returns the consultation	REPORT	LMP	IMO		
1.6	The IMO validates the market session and registers it into the LMP	Market session validation and defined in a date of the auction calendar (previously defined by the IMO)	The IMO validates the market session and registers it into the LMP	EXCUTE; CREATE	IMO	LMP		

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1.7	A new market session is created within the LMP	Market session creation	A new market session is created within the LMP	CREATE	LMP	: Market Session		
1.8	The LMP confirms to the IMO that a Market Session was created	Confirmation	The LMP confirms to the IMO that a Market Session was created	REPORT	LMP	IMO		
1.9	The LMP confirms to the DSO that a Market Session was created	Confirmation	The LMP confirms to the DSO that a Market Session was created	REPORT	LMP	DSO		

Market Session

Scenario #3 description

The market session scenario describes the activities comprised between the notification of an open market session to the publication of market results.

Scenario step by step analysis

Scenario								
Scenario name		Market Session						
Step No	***Event***	***Name of process/activity***	***Description of process/activity***	***Service***	***Information producer (actor)***	***Information receiver (actor)***	***Information exchanged (IDs)***	***Requirement, R-IDs***
1.0	Market session becomes active	Hours in advance of Gate Opening Time (GOT)	After a Market Session is created, it will become active at a certain time t before the Gate Opening Time. After it becomes active, stakeholders are notified of an upcoming Market Session. The time	TIMER	LMP: Market Session	LMP		

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			t is defined according to the product being traded. In case of long-term markets, it may mean weeks/months/years in advance, while for short-term markets it may be defined as minutes or hours in advance.					
1.1; 1.2: 1.3	IMO, DSO and FSPs are notified on the opening of a Market Session	Market session opening	IMO, DSO and FSPs are notified on the opening of a Market Session	REPORT	LMP	IMO; DSO; FSP		
N/A	Limit for the inclusion of prequalified units	Limit for inclusion of prequalified units	This marks the limit for inclusion of prequalified units. This is especially relevant for the long-term markets, which could be open years in advance. FSPs may still be allowed to request and conclude their prequalification processes up to this point. The prequalification process is defined in detail on the associated BUCs	TIMER	N/A	N/A		
1.4; 1.6	The IMO and the DSO consult the Flexibility Resources Register	Consult pre-qualified units	The IMO and the DSO consult the Flexibility Resources Register. This consultation aims at retrieving the pre-qualified FSPs and starting the qualification processes. This consultation may be done automatically	GET	IMO; DSO	LMP: Flexibility Resources Register	I.E.07	
1.5; 1.7	The Flexibility Resources Register returns the consultation	Return	The Flexibility Resources Register returns the consultation	REPORT	LMP: Flexibility Resources Register	IMO; DSO	I.E.07	
1.8	The IMO executes the market qualification process	Market qualification process	The IMO opens the market qualification process. This process is also described in steps 2.2 and 2.3 of the BUCs.	EXECUTE	IMO	IMO		

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1.9	The IMO registers into the LMP the results of the market qualification	Market qualification results	The IMO registers into the LMP the results of the market qualification	CREATE	IMO	LMP	I.E.08	
1.10	The DSO executes the Technical qualification process	Technical qualification	The DSO runs the Technical qualification process. This process is also described in steps 2.4 and 2.5 of the BUCs.	EXECUTE	DSO	DSO		
1.11	The DSO registers into the LMP the results of the technical qualification	Market qualification results	The DSO registers into the LMP the results of the technical qualification	CREATE	DSO	LMP	I.E.08	
1.12	The LMP consolidates the results of the qualification processes	Consolidation	The LMP consolidates the results of the qualification processes received from DSO and IMO. This process is automatic	EXECUTE	LMP	LMP		
1.13; 1.14	The LMP creates a list of qualified FSPs for the Market Session	Query; List of qualified FSPs	The LMP creates a list of qualified FSPs for the Market Session	GET; CREATE	LMP	: Flexibility Resources Register; : Market Session	I.E.08	
1.15; 1.16: 1.17	The LMP publishes the qualified FSPs for the Market Session	Publication of qualified FSPs	The LMP publishes the qualified FSPs for the Market Session	REPORT	LMP	IMO; DSO; FSP		

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2.0	FPSs enter bids for the Market Session	Bid	FPSs enter bids for the Market Session	CREATE	FSP	LMP: Market Session	I.E.09	
2.1	The LMP gets all bids submitted to the Market Session	Query(bids)	After the Gate Closure Time, the LMP gets all bids submitted to the Market Session	GET	LMP	LMP: Market Session		
2.2	The LMP clears the Market Session	Market Clearing	The LMP clears the Market Session	EXECUTE	LMP	LMP		
2.3; 2.4	IMO and DSO are notified on the preliminary market results	Notification	IMO and DSO are notified on the preliminary market results.	REPORT	LMP	IMO; DSO		
2.5: 2.6	The IMO validates the market results and confirms it on the LMP	Validation	The IMO validates the market results and confirms it on the LMP	EXECUTE; REPORT	IMO	LMP	I.E.10	
2.7; 2.8	The DSO validates the market results and confirms it on the LMP	Validation	The DSO validates the market results and confirms it on the LMP	EXECUTE; REPORT	DSO	LMP	I.E.10	
2.9	The LMP consolidated the validations of both IMO and DSO	Consolidation	The LMP consolidated the validations of both IMO and DSO	EXECUTE	LMP	LMP	I.E.10	
2.10	The LMP register to the Market Session the	Market results	The LMP register to the Market Session the consolidated market results	CREATE	LMP	LMP: Market Session	I.E.10	

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	consolidated market results							
2.11; 2.12; 2.13	The LMP publishes the market results. IMO, DSO and relevant FSPs are notified	Publication	The LMP publishes the market results. IMO, DSO and relevant FSPs are notified	REPORT	LMP	IMO; DSO; FSP	I.E.10	
3.0	The Local Market Platform sends short-term market results to the TSO	Communication of market results to TSO	The Local Market Platform sends short-term market results to the TSO.	REPORT	LMP	TSO	I.E.10	
4.0	The LMP collects certain number of market results before sending to the OneNet System	Collection of Market results	The LMP collects certain number of market results before sending to the OneNet System	TIMER; EXECUTE	LMP	LMP	I.E.10	
4.1	The LMP sends the collected market results to the OneNet system	Publication of results to the OneNet system	The LMP sends the collected market results to the OneNet system to be available for neighbouring SOs	REPORT	LMP	OneNet System	I.E.10	

5. Information exchanged

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

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I.E.01	Basic Participant Information	Register and basic information about the market participant such as username and password	
I.E.02	Market participant pre-qualification information	Contact information; Fiscal data; Access contract; bank details; power of representation; confidentiality agreement; declaration of non-collusion	
I.E.03	Market resource pre-qualification information	Market participants provide information on the resources they want to prequalify: Facility/resource name; Type of technology; Location; Market participant; etc.	
I.E.04	Technical resource pre-qualification information	Verification of the installed capacity to provide the service: Power; CUPS (Universal Supply Point Code acronym in Spanish); Maximum quantity; Response time, Etc	
I.E.05	Generic attributes	Composed of generic parameters concerning the market session being requested. E.g.: • Auction identifier • Associated DSO • Product Type: Flexibility Product • Type of negotiation: Auction Area: Basic or aggregated.	
I.E.06	Product parameters	Composed of product parameters concerning the market session being requested. E.g.: 13. Service window: Selection of the required date and duration of the service o Start date: 01/06/2021 o Duration: 2 months o Selection of days: M, T, W, T, F, S and S. o Opening time: 8:00 PM o Closing time: 10:00 PM 14. Availability: Selection of the capacity, the direction and the estimated hours of activation. o Capacity: 4MW o Direction: Upwards (up for generation, down for consumption) o Estimated hours of activation: 120h	

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		15. Activation window (in case of activation product): Specific subperiod in an activation window when a particular DER could be activated and thus it must be available. Multiple sets of activation windows can be defined. E.g.: o Day: 01/06/2021 o Hour: 19h o Duration: 2h o Capacity to modify: 1MW o Direction: Upward 16. Local area: Selection of the trading area. Choice by postal code, connection point, lines… (to be determined). o Area: postal code 17. Activation Announcement: Time in advance that a DSO informs a DER that its activation is programmed confirmed. 18. Form of Remuneration: It establishes form of payment to winner DERs Two different terms are defined availability and activation (depending on the product). o Type of product: availability/activation Availability/Activation cap price: X €/MW or X €/MWh	
I.E.07	List of pre-qualified units	List of pre-qualified units for a given market session	
I.E.08	List of qualified units (market, technical or consolidated)	List of qualified units for a given market session. The list can refer to the market qualification, technical qualification or the consolidated list.	
I.E.09	Bid	Composed of bidding information 5. General attributes • FSP identifier 6. Availability: Selection of the capacity, the direction and the estimated hours of activation. • Period of availability (multiple periods may be possible within the service window) • Price: for availability and/or activation	

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		Additional parameters (complex bids) may be considered (under discussion).	
I.E.10	Validate market results	Validated market results by either the IMO (market), the DSO (technical) or the consolidated market results.	

6. Requirements (optional)

7. Common terms and definitions

8. Custom information (optional)

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A.4 KPIs description

1 Cost-effectiveness

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H03
	2. KPI Demo ID	ES_BUC_KPI_01; ES_SUC_KPI_01
	3. Name	Cost-effectiveness
	4. KPI domain	Economic
	5. KPI category	Economic
	6. Description	Compare the cost for flexibility with avoided traditional grid cost (Cost of the flexibility solution against traditional solution). The cost of flexibility should be less than the avoided traditional solution cost to be effective (KPI <1) The avoided cost needs to be converted into a €/MWh Year basis and compare with the flexibility solution services for the time it will be contracted. To calculate the avoided cost, several factors need to be considered as deferred capital cost, losses, O&M costs...
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02; WECL-ES-SUC-01
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	UFD; OMIE; i-DE
Calculation information	**10. Formula**	$Cost_{effectiveness} = (1 - \frac{Cost_{flex}}{Cost_{Sub}}) \cdot 100$
	11. Variables	$Cost_{effectiveness}$: Cost effectiveness (%) $Cost_{Sub}$: Avoided traditional solution cost (€/MWh) $Cost_{flex}$: Cost of flexibility (€/MWh)
	12. Unit of measurement	%
	13. KPI baseline explanation	The KPI baseline is equal to 100 for each market flexibility request or location. That will be equivalent to choose the traditional solution against flexibility as there is no effectiveness. In some cases, there will be a set of KPIs for each individual location to compare different flexibility services solution against same traditional solution for each market flexibility request. It will be kept the lowest one for each location as reference because it will be the selected solution.
	14. KPI baseline source	It is equal to 100 (equivalent to flexibility services= avoided cost)
	15. Baseline responsible	It is equal to 100. UFD; i-DE will define traditional solution in each selected tested location to compare with flexibility services solution.
	16. KPI target value	<100

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	17. Calculation Methodology	1. Calculate avoided traditional solution cost (€/year) considering values that change on whether you use flexibility or the traditional solution. For example: • Electric system benefits: o Avoided distribution capacity infrastructure: the benefit from deferring the cost of the traditional solution o Avoided O&M cost: difference in O&M cost between the two solutions o Avoided distribution losses: difference in electric losses between the two solutions o ... • Reliability/Resiliency benefits o Net avoided restoration costs: avoided costs of restoring power during outages o Net avoided outage cost: avoided cost for reduction in frequency and duration of outages o ⋯ • Other: o Net avoided CO2: avoided CO2 for reduction in system load levels o ⋯ 2. Convert the avoided traditional cost (€/year) into availability and utilisation rates (€ /MWh) based on site specific expected availability and utilisation hours

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2 ICT costs

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H04
	2. KPI Demo ID	ES_BUC_KPI_02; ES_SUC_KPI_02
	3. Name	ICT costs
	4. KPI domain	Economic
	5. KPI category	Economic
	6. Description	The term ICT cost comprises the information and communication technologies necessaries for DSO-MO-FSP coordination through platforms to develop new local markets. Summation of ICT costs that are directly related to the implementation of new local markets. The term implementation is used to refer to the work in designing, specifying, coding, testing, validating and documenting software. It will be one for the Spanish demo including OMIE, UFD and i-DE ICT cost.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02; WECL-ES-SUC-01
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE; UFD; i-DE
Calculation information	**10. Formula**	$ICT_{cost} = \sum_{i=1}^{N_c} c_i$
	11. Variables	ICT_{cost}: cost of ICT (€) c_i: generic ith cost directly related new local market implementation (€) Nc: overall number of cost items
	12. Unit of measurement	€
	13. KPI baseline explanation	0
	14. KPI baseline source	N/A
	15. Baseline responsible	N/A
	16. KPI target value	>0
	17. Calculation Methodology	To identify ICT development for the implementation of new local markets for each of the participants and to summarize them

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3 Available flexibility

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H14A
	2. KPI Demo ID	ES_BUC_KPI_03; ES_SUC_KPI_03
	3. Name	Available flexibility
	4. KPI domain	Technical
	5. KPI category	Congestion management performance
	6. Description	Flexible power that can be used for congestion management at a specific grid segment, i.e., the available power flexibility in a defined period (e.g., per day) that can be allocated by the DSO at a specific grid segment. It relates to the total amount of power in the specific grid segment in the same period. It is measured in MW. One KPI for each test. The term power is used to refer to measure demand in the area in reporting time at the specific grid location.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02; WECL-ES-SUC-01
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	UFD; i-DE
Calculation information	**10. Formula**	$Flexibility_{\%} = \frac{\sum P_{Available_{Flexibility}}}{\sum P_{Total_{in_{Area}}}} \cdot 100$
	11. Variables	$Flexibility_{\%}$: Percentage of available flexible power with respect to the total demand at a specific grid segment in reporting period (%) $\sum P_{Available_{Flexibility}}$: Power in MW of available flexibility at a specific grid segment in reporting period (MW). $\sum P_{Total_{in_{Area}}}$: Total power demand in MW at DEMO grid segment (MW)
	12. Unit of measurement	%
	13. KPI baseline explanation	N/A (new local markets)
	14. KPI baseline source	N/A (new local markets)
	15. Baseline responsible	N/A
	16. KPI target value	>0
	17. Calculation Methodology	Define the affected specific area to obtain the power to compare with the flexibility capacity

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4 Error of load forecast calculated T hour in advance

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H20B
	2. KPI Demo ID	ES_BUC_KPI_04
	3. Name	Error of load forecast calculated T hour in advance
	4. KPI domain	Technical
	5. KPI category	Data processing performance
	6. Description	Error of load forecast calculated T hour in advance. One KPI for each demo test. Short- or long-term hours in advance, to be specified for each test.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	UFD; i-DE
Calculation information	**10. Formula**	$Load_{FA_{24h}} = \frac{1}{N}\left(\sum_{t=1}^{N}\left\lvert\frac{FC_{load,t} - RL_{load,t}}{RL_{load,t}}\right\rvert\right)\cdot 100$
	11. Variables	$Load_{FA_{T,h}}$: Error of load forecast calculated T hour in advance (%) FC_{load} : Load estimated T hours in advance (MW) RL_{load} : Real load (MW) N: Number of available data points
	12. Unit of measurement	%
	13. KPI baseline explanation	The KPI baseline is equal to 0 for each market flexibility request or location. That will be equivalent to $FC_{load}=RL_{load}$
	14. KPI baseline source	Distribution planning forecasting methodology
	15. Baseline responsible	UFD; i-DE
	16. KPI target value	as close to “0” as possible
	17. Calculation Methodology	Historical data/ Distribution planning forecasting methodology

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5 Power exchange deviation

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H23A
	2. KPI Demo ID	ES_BUC_KPI_05; ES_SUC_KPI_04
	3. Name	Power exchange deviation
	4. KPI domain	Technical
	5. KPI category	Congestion management performance
	6. Description	Tracking error between a set-point requested by the SO and the measure Deviation between accepted and actual activated flexibility power. There will be one KPI for each test which implies energy deliver to check that the service has been delivered as contracted. For measurement of flexibility a baseline has to be previously defined, to which the actual metered data of the FSP can be compared too. The baseline is an estimation of what the consumption/production would have been if no flexibility activation had been triggered.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02; WECL-ES-SUC-01
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE; UFD; i-DE
Calculation information	**10. Formula**	$P_{Deviation} = \frac{\lvert P_{accepted} - P_{activacted} \rvert}{P_{accepted}} \cdot 100$
	11. Variables	$P_{Deviation}$: Power exchange deviation (%) $P_{accepted}$: accepted (contracted) power (kW) $P_{activacted}$: activated flexibility power (kW)
	12. Unit of measurement	%
	13. KPI baseline explanation	P accepted (one for each test)
	14. KPI baseline source	Flexibility provider agreement done in Market platform
	15. Baseline responsible	UFD; OMIE; i-DE
	16. KPI target value	<35% Otherwise will mean failed service and no payment corresponds. Potential end of the contract
	17. Calculation Methodology	1. Define baseline 2. Collect metered data 3. Calculate activated flexibility power 4. Compare with accepted/contracted power

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6 Asset load profile variation

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H13A
	2. KPI Demo ID	ES_BUC_KPI_06
	3. Name	Asset load profile variation
	4. KPI domain	Technical
	5. KPI category	Congestion management performance
	6. Description	This indicator measures the percentage decrease of load demand in the requested asset by a flexibility provider resource. As asset, the distribution electric facility where the congestion problem needs to be solved is considered.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	UFD; i-DE
Calculation information	**10. Formula**	$CR = \frac{AL_{initial} - AL_{final}}{AL_{initial}} \cdot 100$
	11. Variables	CR: Congestion reduction (%) $AL_{initial}$: asset load before delivering flexibility (initial asset load (kW)) AL_{final}: asset load a during delivery of flexibility (final asset load (kW))
	12. Unit of measurement	%
	13. KPI baseline explanation	Initial asset load before flexibility activation
	14. KPI baseline source	Grid information
	15. Baseline responsible	Distribution operators: UFD; i-DE
	16. KPI target value	<100 but each problem will have a different target depending on how much the asset is overloaded over limit thermal conditions
	17. Calculation Methodology	1) Collect asset load before flexibility activation; 2) Collect asset load during flexibility activation; 3) Compare

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7 Volume of transactions (Power)

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H09A
	2. KPI Demo ID	ES_BUC_KPI_07; ES_SUC_KPI_05
	3. Name	Volume of transactions (Power)
	4. KPI domain	Technical
	5. KPI category	Market performance
	6. Description	This indicator measures the volume of transactions in kW. This indicator will be used to measure the volume of transactions (cleared bids) during the examined period T for each product. This indicator will give a measure of power magnitude demo range.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02; WECL-ES-SUC-01
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE
Calculation information	**10. Formula**	$VT_P = \sum_T \sum_I P_{i,t}$
	11. Variables	VT_P: Volume of transaction considering active power (kW) $P_{i,t}$: Volume offered or cleared capacity by the i-th flexible resource at time t (kW) I: Set of flexible resources. T: Examined period.
	12. Unit of measurement	kW
	13. KPI baseline explanation	0 (no volume of transactions)
	14. KPI baseline source	N/A
	15. Baseline responsible	N/A
	16. KPI target value	>0
	17. Calculation Methodology	Collect platform transaction information

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8 Number of transactions

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H07
	2. KPI Demo ID	ES_BUC_KPI_09; ES_SUC_KPI_06
	3. Name	Number of transactions
	4. KPI domain	Technical
	5. KPI category	Market performance
	6. Description	This indicator measures the number of transactions. This indicator will be used to measure the number of offered and cleared bids for each product. This indicator will give a measure of demo magnitude by summing transactions.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02; WECL-ES-SUC-01
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE
Calculation information	**10. Formula**	$N_T = \sum_T n_{Bids,t}$
	11. Variables	$n_{Bids,t}$: number of offered or cleared bids at time t T: examined period
	12. Unit of measurement	# (of transactions)
	13. KPI baseline explanation	0
	14. KPI baseline source	N/A
	15. Baseline responsible	N/A
	16. KPI target value	>0
	17. Calculation Methodology	Collect platform transaction information

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9 Number of products per demo

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H11
	2. KPI Demo ID	ES_BUC_KPI_09
	3. Name	Number of products per demo
	4. KPI domain	Technical
	5. KPI category	Market performance
	6. Description	This indicator measures the percentage of products tested in the demos with respect to the number of products initially targeted by the demos. 1 KPI for the Spanish demo to evaluate if all selected products have been tested. Three products have been targeted by the Spanish demo for congestion management service: • Corrective local active • Predictive short-term local active • Predictive long-term local active
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	UFD; i-DE
Calculation information	**10. Formula**	$NPD = \frac{nP_{tested}}{nP_{targeted}} \cdot 100$
	11. Variables	NPD: Number of products per demo (%) nP_{tested}: number of products tested in the BUC. $nP_{targeted}$: number of products initially targeted for the BUC.
	12. Unit of measurement	%
	13. KPI baseline explanation	• Corrective local active (WECL-ES-02) • Predictive short-term local active (WECL-ES-02) • Predictive long-term local active (WECL-ES-01)
	14. KPI baseline source	Spanish demo BUC definition
	15. Baseline responsible	Spanish demo
	16. KPI target value	100%
	17. Calculation Methodology	N/A

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10 Active participation

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H02
	2. KPI Demo ID	ES_BUC_KPI_10
	3. Name	Active participation
	4. KPI domain	Social
	5. KPI category	General descriptive
	6. Description	This indicator measures the percentage of customers actively participating in the demo with respect to the total customers that accepted the participation. This indicator will be used to evaluate the customer engagement plan. 1 KPIs for the whole Spanish demo.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE; UFD; i-DE
Calculation information	**10. Formula**	$R = \frac{N_{active}}{N_{accept}} \cdot 100$
	11. Variables	R: Active participation (%) N_{active}: Customers actively participating in the demo N_{accept}: Customers accepted to participate in the demo.
	12. Unit of measurement	%
	13. KPI baseline explanation	N accept will include currently accepted customers plus contracted by cascading funds
	14. KPI baseline source	UFD; i-DE
	15. Baseline responsible	UFD; i-DE
	16. KPI target value	100%
	17. Calculation Methodology	Compare accepted with active customers at the end of demos run

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11 Number of FSPs

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H01
	2. KPI Demo ID	ES_BUC_KPI_11
	3. Name	Number of FSPs
	4. KPI domain	Social
	5. KPI category	General descriptive
	6. Description	This BUC aims to decrease the entry barriers for flexibility provision by simplifying the process for flexibility service providers. Overall progress of this aim can be measured by the number of FSP joining the platform. 1 KPIs for the whole Spanish demo.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE; UFD; i-DE
Calculation information	**10. Formula**	N_{FSP}
	11. Variables	N_{FSP}: Number of FSPs
	12. Unit of measurement	#
	13. KPI baseline explanation	0, no participation
	14. KPI baseline source	N/A
	15. Baseline responsible	N/A
	16. KPI target value	As maximum as possible
	17. Calculation Methodology	Count

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12 Ease of access

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H06
	2. KPI Demo ID	ES_BUC_KPI_12
	3. Name	Ease of access
	4. KPI domain	Social
	5. KPI category	General descriptive
	6. Description	Ease of access to the flexibility market for flexibility service providers, including accessibility, no redundant barriers to entry, user-friendliness. 1 KPIs for the whole Spanish demo.
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE; UFD; i-DE
Calculation information	**10. Formula**	Based on a post-demonstration surve
	11. Variables	Questionnaire
	12. Unit of measurement	Responses
	13. KPI baseline explanation	N/A
	14. KPI baseline source	-
	15. Baseline responsible	Survey responsible
	16. KPI target value	N/A
	17. Calculation Methodology	Survey

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13 Number of avoided technical restrictions (congestions)

	KPI definition template (Demo KPIs)	
General Information	**1. KPI ID**	KPI_H012
	2. KPI Demo ID	ES_BUC_KPI_13
	3. Name	Number of avoided technical restrictions (congestions/voltage violations)
	4. KPI domain	Technical
	5. KPI category	General descriptive
	6. Description	Avoided congestions thanks to the measures implemented in the demo
	7. Related UC(s)	WECL-ES-BUC-01; WECL-ES-BUC-02
	8. Link with other projects	Harmonized KPI
	9. KPI responsible	OMIE; UFD; i-DE
Calculation information	**10. Formula**	$ATR\% = \frac{N_{TRFlex}}{N_{TR}} \cdot 100$
	11. Variables	$ATR\%$: Share of avoided technical restrictions (congestions/voltage violations) (%) N_{TR}: Total number of expected technical restrictions N_{TRFlex}: Total number of technical restrictions solved through activation of flexibility services
	12. Unit of measurement	Test results
	13. KPI baseline explanation	N/A
	14. KPI baseline source	-
	15. Baseline responsible	-
	16. KPI target value	100%
	17. Calculation Methodology	Test results for simulated congestions at the selected demos areas

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