Begonia

USE CASE 8:

Cross-border virtual communities of RESs and CLs

This project has received funding from the European Commission under grant agreement N°101133306.

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Use case identification

Table 1. Identification of use case 8.

ID	Name of Use Case	Geographical scope	Cross-sector domains			Interoperability layers
			Electric	Mobility	Data	
BEG.08	Cross-border virtual communities of RESs and CLs	☒ Local ☒ Regional ☒ National ☒ Cross-border ☐ Outermost	☒ Customer ☒ DER ☒ Distribution ☐ Transmission ☐ Generation	☐ Customer information ☒ Vehicle ☐ Energy station ☒ Infrastructure ☐ Traffic and logistic	☒ Edge ☒ Fog ☒ Cloud	☒ Component ☒ Communication ☒ Information ☒ Function ☒ Business

The scope and objectives of the use case

Table 2. Scope and objectives of use case 8.

Scope and Objectives of the Use Case	
Scope	This use case aims to propose a cross-border platform for creating a virtual community of RESs and CLs such as EV charging stations, batteries, and HVAC systems to facilitate green transition. Through this platform, CLs on the demand side are involved in automated power trading with RESs with agreed prices. The excess production of RESs or the extra demand of the CLs that are not settled in the platform should be sold or purchased in the day-ahead and intraday markets, respectively. Hence, the whole platform can participate in the electricity market as a single market player. The platform will also allow EV owners to find the charging points that are members of this platform and charge their EVs with green energy.
Objective	The main goals of the use case are as follows: • One of the main objectives of this use case is to facilitate the engagement of end-users in green transition and incentivize them to have an active role in increasing the share of RESs, • Another objective is to reduce the uncertainties caused by RESs by aggregating them and utilizing the flexibility of CLs, • The platform can create a market environment for trading the power of RESs, • Utilizing the method reduces the number of market players and consequently the complexities of running electricity markets, • Aggregating the RESs and CLs reduces the need for balancing reserve and consequently operation costs, • The platform provides a tool for EV owners to charge their cars with RESs at competitive prices.
Reference country(ies)	Denmark, Sweden
Related Business Case	Renewable energy operation, demand side management, Charging station management

Possible stakeholders	RESs, charging stations, and HVAC load owners. Facilities with CLs, EV owners

Narrative of the use case

The EU aims to be climate-neutral by 2050. This means a significant increase in RES investment. Despite the benefits of RESs, their output power is uncertain and this makes it difficult to bid their output power in electricity markets. Additionally, the imbalances that are caused by RESs can create reliability and stability issues for the grid and financial losses for RESs. In general, there are two main solutions for this issue, 1) aggregating RESs as a single unit and participating in the electricity markets, and 2) joining RESs with CLs to damp their output power fluctuations and increase their predictability.

The proposed use case aims to achieve both objectives by developing a platform that is capable of registering different types of RESs, e.g., PV and wind, and different types of CLs such as charging points of EVs, batteries, and HVAC systems. Charging stations are chosen due to the high electricity demand and the flexibility they can provide in charging the EVs. HVAC systems consume approximately 40% of total building energy and are equipped with energy management systems which makes them controllable.

The platform has different advantages. First, it can be a useful tool for people who are interested in green energies and would like to be supplied by RESs. So, it can facilitate social engagement in green transition. From the technical point of view, joining the RES and loads can decrease the unpredictability of RESs. This reduces the challenges for operating electricity markets and also reduces the need for balancing reserves.

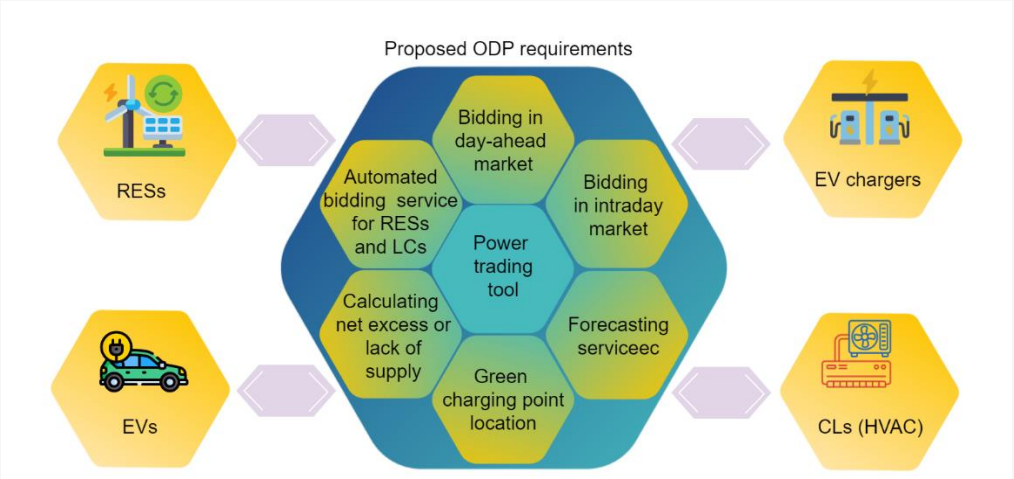

Figure 1. The framework of the use case 8.

RESs predict their output power and CLs predict their consumption for the next day. The bids and offers are submitted to the power trading tool and settled. The excess production or demand is calculated and submitted to the day-ahead market. Close to real-time, the forecasts and values of traded powers are updated accordingly, and the updates in the excess production or demand are settled in the intraday market. The power trading tool can use different mechanisms for trading power such as the pool-co approach or P2P trading.

The platform is designed in such a way that the maximum flexibility potential of the CLs is used to minimize the excess production or demand. After closing the intraday market, the sudden changes in the RESs and deviations from the scheduled powers are tried to be balanced using the flexibility of loads. It should be noted that all CLs should be equipped with optimal controllers and energy management units that satisfy their operational constraints. EVs can use the database of the platform to know which charging stations are supplied by green energy and their prices.

Advanced AI-driven methods are required for developing forecast tools for RESs, EV charging stations, and HVACs. Additionally, AI-based approaches should be used for automated power bidding. Both of these tools can be provided by the platform as services taking into account the owners' preferences. To assess the commitment of the market players in producing or consuming the scheduled power and providing the forecast services it is necessary to record the data at customers' nodes and send them to a database in the platform. Since transmission and distribution system tariffs should be considered in the cost, agreements with TSOs and DSOs are required to include those costs in the customers' final prices.

Diagram of the use case

The diagram of the use case 8 is presented in Figure 2. Actors' actions and scenarios' descriptions are presented in Table 3 and Table 4, respectively.

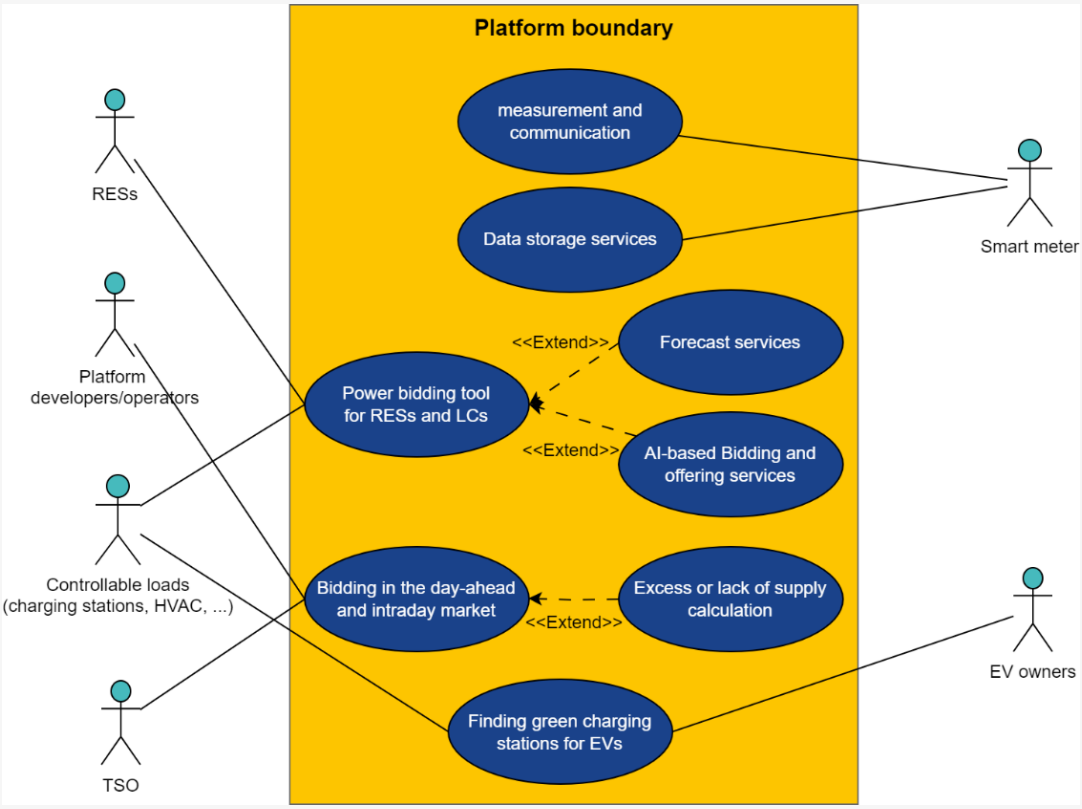

Figure 2. The diagram of the use case 8.

Actors of the use case

Table 3. Description of the actions of use case 8 actors.

Actor Name	Actor Type	Actor description	Actions	Standards
Smart meter	System	A device that is capable of recording and communicating data with databases	Smart meters record data from devices and RESs and send them to data storage to be used for forecasting and other services.	No
RESs	System	RESs such as wind and solar power	RESs use forecast results and bidding in P2P trading with CLs.	No
CLs	Role	CLs are referred to the devices with manageable energy consumption.	CLs use forecast results and offer in power trading with RESs.	
EV owners	Role	The owners of the EVs	Use ODP to find charging stations supplied with green energy.	No
Platform developers/ operators	Role	Persons or companies that are responsible for maintaining and running sdervices in the ODP	They use services that calculate net excess or lack of supply in the ODP portfolio and participate in the day-ahead or intraday markets to balance the portfolio.	No
TSO	Role	An entity 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.	TSO receives bids and offers from the ODP.	No

Scenarios

Table 4. Description of use case 8 scenarios.

S.No	Scenario Name	Triggering Event	Scenario Description	Primary Actor
BEG.11.S1	measurement and communication	Continuous, in specific time intervals	Parameters of the devices and RESs are measured and communicated with ODP	Smart meters
BEG.11.S2	Data storage services	When new data is received	Data is received from smart meters, processed and saved	Smart meters
BEG.11.S3	power trading tool for RESs and CLs	Continuous, in specific time intervals	A tool that receives bids and offers of RESs and CLs and determines accepted bids using a market mechanism	RESs and CLs

BEG.11.S4	Forecast services	Submitting a bid or offer is required	A service that uses historical data of RESs and CLs to predict their output power and consumption, respectively.	RESs and CLs
BEG.11.S5	AI-based Bidding and offering services	Submitting a bid or offer for power trading is required	Using the forecast results, RESs and CLs use this tool to submit bids and offers for trading power in the ODP	RESs and CLs
BEG.11.S6	Bidding in the day-ahead and intraday market	Dayahead or intraday market opens	The net excess or lack of supply in ODP is submitted to the day-ahead and intraday markets	Platform developers/ operators
BEG.11.S7	Excess or lack of supply calculation	Submitting a bid or offer to day-ahead or intraday markets is required	Calculating the unsettled powers in the ODP portfolio	Platform developers/ operators
BEG.11.S8	Finding green charging stations for EVs	EV owners looking for green charging stations	The EV owners can have access to the platform for example through a mobile app and find the location of charging stations supplied by green energy.	EV owners

Policy and digitalisation needs

Table 5. Description of use case 8 policy and digitalisation needs.

Policy needs	• As end-users are one of the core elements in developing the grid's digital twins, end-users should be ensured that the privacy of their data is preserved. Policies should be in place to guarantee that user data is securely stored and only used for its intended purposes. • In case the platform is used by different states, the policies for storing data in different member states should be considered.
Digitalisation needs	• Interoperability between different elements of the platform.