Begonia

USE CASE 3:

Cross-border charging coordination and traffic management of ETs

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Use case identification

Table 1. Identification of use case 3.

ID	Name of Use Case	Geographical scope	Cross-sector domains			Interoperability layers
			Electric	Mobility	Data	
BEG.03	Cross-border charging coordination and traffic management of ETs	☐ 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 2.

Scope and Objectives of the Use Case	
Scope	This use case proposes an ODP for charging coordination and route planning of ETs. The aim is to provide optimal charging service, reduce traffic issues, and mitigate the grid issues caused by charging a large number of ETs. The main property of the ETs that makes them different from private EVs is the predetermined destinations which makes the coordination and scheduling for charging more precise and reliable. Different companies can connect the platform, allow different levels of access to their ETs' charging data, charging points, and driving destinations, and receive the best route planning and charging services. The platform can also analyze the need for grid investments in areas with a large number of ET charging points to ensure quality of service for ETs and grid reliability.
Objective	The main objectives of the use case are as follows: • Proposing an ODP for facilitating the charging coordination of ETs considering distribution grid limitations, • Managing traffic and reducing waiting time for charging ETs in charging stations, • Fair sharing of charging capability among different companies taking into account the number of ETs and minimum charging requirements of ETs, truck routes, and available cross-border charging stations, • Providing adaptive charging strategies for companies based on the level of access provided to data, • Developing tools for evaluating different planning solutions for increasing the charging capability of the areas with high penetration of ET charging stations and finding the most optimal solutions, • Utilizing the flexibility of aggregated charging stations for providing ancillary services for power systems.
Reference country(ies)	Denmark, Germany, Sweden, Norway, and Finland
Related Business Case	ETs' charging coordination, Traffic management, grid services

Possible stakeholders	Logistics companies, ET owners, TSO, DSO, Charging stations

Narrative of the use case

Transportation is the fastest-growing source of emissions worldwide and now accounts for 14 percent of GHG emissions. In this regard, achieving the long-term transition to a low-carbon European economy requires special attention to the electrification of the transport sector. Among different types of transportation systems, medium and heavy trucks are the sources of 22% of GHG emissions. The transition toward truck electrification has already started and logistics and transport companies are planning to replace traditional trucks with ETs. While there are currently more than 4,000 ETs on the road, this number will reach 600,000 ETs in 2030, comprising 50% of new registered trucks. ETs have characteristics that make them different from private EVs. The size of the battery of the ETs is much bigger than EVs and more importantly, the daily destination of the ETs is usually known which makes it possible to easier calculate the required energy and plan for charging.

Large-scale integration of ETs raises several challenges. The necessity to charge the ETs may lead to heavy traffic on the roads close to charging stations and long waiting times in queues to connect to the charging point. Additionally, since these ETs normally belong to companies, and in some cases, several companies in industrial parks may start using ETs, soon, we will be faced with areas in the distribution grids with very high penetration of ETs charging stations. An example of these areas is in Børup in Denmark which is a main transit route from Germany to Denmark, Sweden, Norway, and Finland. This area is in the intersection of two motorways and many companies such as PostNord, Blue Water Shipping, DHL, Arla Foods Taulov, DANX, and Danske Fragmænd have terminals in this area. It is estimated that these companies own more than 7000 trucks excluding the passing trucks. Some of these companies like PostNord have already started installing charging stations and planning to upgrade their fleet by 2026 to ETs. This area in Denmark is already a growing concern for the local DSOs which struggle with grid expansion, and for the Danish TSO to increase the capacity in that region using renewables. In this case, the transport sector is causing additional stress on the energy sector, which may lead to stability issues and power cuts.

To overcome these issues, in this use case, an ODP is proposed that can provide charging coordination and route scheduling services for ETs, propose investment solutions for increasing the charging capacity of the charging stations, and estimate aggregated flexibility in charging stations and offer it to the DSO or TSO as a flexibility service. The main requirements of the ODP users and the specifications of the ODP are illustrated in Figure 1.

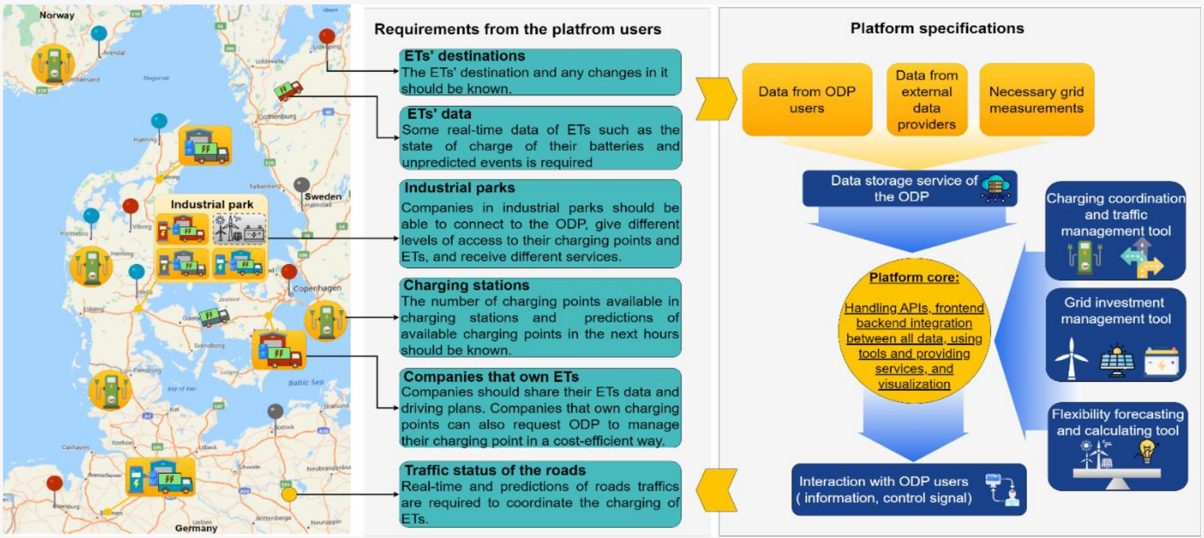

Figure 1. Illustration of the requirements from platform users and the specifications of the platform.

The platform should include private ETs or groups of ETs that belong to companies. The information regarding the destination of ETs, and the characteristics of the ETs such as their location, battery size, and SOC of the batteries should be reported to the ODP. The platform should also be capable of including both private charging stations and charging stations that belong to ET-owner companies and provide charging coordination based on the level of access to the information that is determined by the charging station owners. The platform should also provide charging coordination services for industrial parks with several companies. The companies can give access to the detailed charging requirements of each one of their ETs or the aggregated required energy for a period and receive a charging schedule for each ET or assigned hourly energy consumption capacity for a period, respectively. The assignment of the energy for charging ETs of different companies should be done considering grid limitations and minimum charging requirements of each ET, different options for ETs on the way to their destinations, the road traffic, and the timetable for delivering the goods. To use the charging points on the route, the platform should also allow the ETs to book charging stations in advance to reduce the waiting time in queues. Since the number of charging stations is limited, the charging point assignment to ETs can cause road traffic. The platform should perform the charging coordination and route planning for ETs such that the impact on road traffic is minimized. The ET owners should also be able to interact with ODP using mobile apps or any other tools to report sudden changes in the driving route or events such as accidents to reschedule the programs.

As another tool for the ODP, the ODP can also receive information about charging stations and ETs in the industrial parks with several companies and grid limitations and analyze different solutions for increasing the charging capacity of the charging stations or industrial parks to cover the maximum number of ETs. These solutions can be a) grid reinforcement programs, b) installing new renewable distributed generation resources e.g., PV panels and wind turbines, c) energy storage systems, and d) installing non-RESs such as combined heat and power (CHP) units. Furthermore, access to a large number of charging stations, information about ETs connected or scheduled to be connected to charging points, and other information about ETs allows the ODP to calculate the aggregated energy flexibility in the platform and offer it to DSO or TSO as a flexibility service.

Diagram of the use case

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

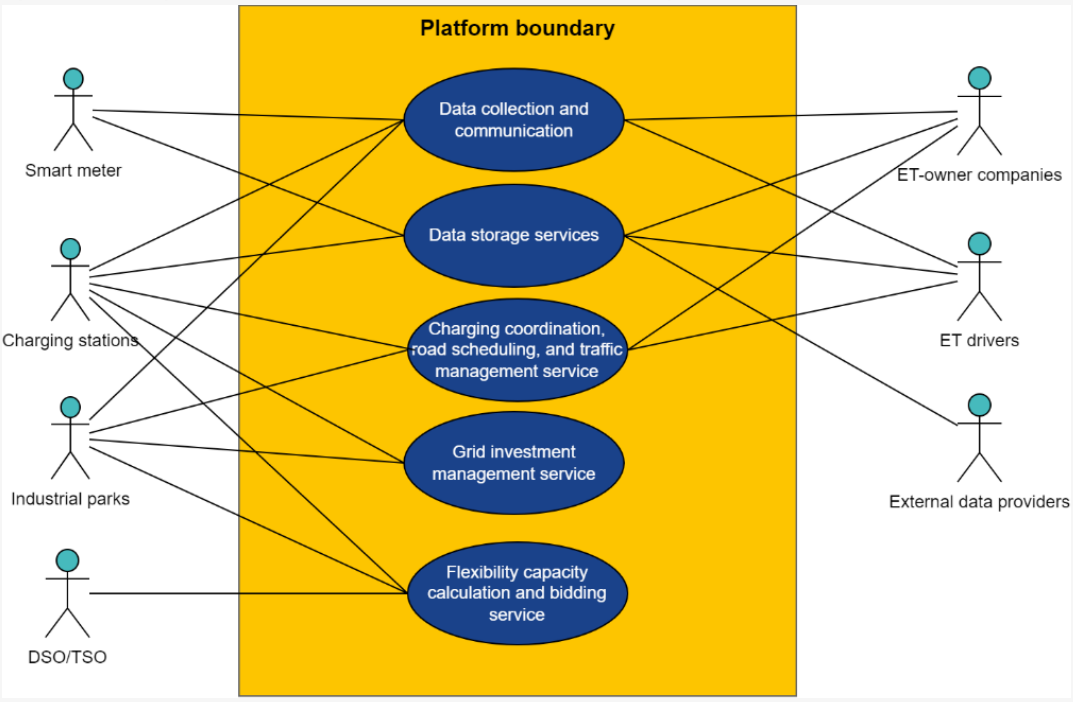

Figure 2. Diagram of the use case 3.

Actors of the use case

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

Actor Name	Actor Type	Actor description	Actions	Standards
Smart meters (volt, current, power factor, watt, and power quality meters)	System	A smart meter is a digital device that measures and records energy consumption in real-time.	Smart meters collect the data from the grid, charging stations, and ETs and communicate it with the data storage.	No
Charging stations	Role	A charging station (CS) is physical equipment consisting of one or more charging station controllers and one or more electric vehicle supply equipments managing the energy transfer to and from EVs.	Communicate the data on the availability of charging points with the ODP and receive control signals for chargers or booking a charging point for an ET. Charging stations can also request for analyzing the	No

			investment solutions for increasing charging capacity	
ET owner companies	Role	Logistics companies that own ETs are responsible for managing their fleet's charging needs and schedules.	Communicate the data of their ETs, their destinations, and timetables, and the data of charging points (if available) with ODP. Perform the calculations needed by ODP such as minimum energy needed for a period. Agree on the level of access to the data and coordination of the charging points with ODP. Receiving control signals from the ODP	No
ET drivers	Role	Drivers of the ETs are responsible for operating the vehicles and reporting real-time conditions.	ET drivers can send information about sudden events such as accidents to the ODP. The ODP helps the ETs to book a charging point and receive route-scheduling services.	No
Industrial parks	Role	An area of land developed as a site for factories and other industrial businesses; an industrial estate.	In addition to the charging coordination and route scheduling services, industrial parks can receive power investment solutions for increasing the charging capacity of the area and reducing the stability issues of the grid.	No
DSO/TSO	Role	DSO is responsible for ensuring the maintenance of and, if necessary, developing the distribution system in a given area, where applicable, and ensuring the long-term ability of the system to meet electricity demands. TSO is responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet electricity demands.	ODP can participate in the balancing market and provide balancing services for TSO. Additionally, if DSO is willing to use flexibility solutions, it can use the flexibility offered by ODP to solve distribution grid issues.	No
External data providers	Role	Data providers are research institutes, industry associations, and sometimes different consultancy companies which are paid by different companies to supply data	Required data for ODP services such as electricity price is received from external data providers.	No

Scenarios

Table 4. Description of use case 3 scenarios.

S.No	Scenario Name	Triggering Event	Scenario Description	Primary Actor
BEG.03.S1	Data collection and communication	Continuous	The parameters of the charging stations, ETs, industrial parks, and distribution grid are measured and sent to the data storage.	Smart meters, ET-owner companies, charging stations, ET drivers, industrial parks
BEG.03.S2	Data storage services	New data is received	All the static and dynamic data sent from ODP users are saved and processed in the data storage.	Smart meters, ET-owner companies, charging stations, ET drivers, industrial parks
BEG.03.S3	Charging coordination, road scheduling, and traffic management service	Any update on the status of ETs and charging stations	Based on the most recent information, the ETs charging coordination is performed taking into account the ETs' preferences, road traffic status, and distribution grid limitations.	ET-owner companies, charging stations, ET drivers, industrial parks
BEG.03.S4	Grid investment management service	Request received from industrial parks or charging stations	The ODP analyzes the required energy of the area using historical data, considers different properties of the area such as geographical conditions and the investors' preferences, and determines the type and size of the technologies that can be used to increase the charging capacity.	Charging stations, industrial parks
BEG.03.S5	Flexibility capacity calculation and bidding service	Continuous in specific time intervals	Considering the regulations of flexibility procurement and the data received from charging points and users, the available flexibility of the system is calculated and offered to the existing ancillary service markets.	Charging stations (private or charging points of companies)

Policy and digitalisation needs

Table 5. Description of use case 3 policy and digitalisation needs.

Policy needs	The main policy concerns for this use case are about data sharing. • Regulations are required to allow data sharing among member states. • Regulations are needed to facilitate the participation of ODP and charging stations in providing grid services, • There are concerns about if the companies are willing to share their internal data such as their required charging energy, the charging status of their ETs, and the daily route of their ETs.
Digitalisation needs	• The platform should have access to real-time and historical data on the grid, companies, charging stations, • The companies should have tools for estimating the required energy for ETs for the next day,

	• The platform should be able to apply its decisions to charging stations with different technologies.