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User centric charging infrastructure for electric vehicles — Charging stations of the future — Stations models considering users' expectations

CCMC will prepare and attach the official title page.

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European foreword

This CEN Workshop Agreement has been developed in accordance with the CEN-CENELEC Guide 29 "CEN/CENELEC Workshop Agreements – A rapid prototyping to standardization" and with the relevant provisions of CEN/CENELEC Internal Regulations - Part 2. It was approved by a Workshop of representatives of interested parties on YYYY-MM-DD, the constitution of which was supported by CEN following the public call for participation made on YYYY-MM-DD. However, this CEN Workshop Agreement does not necessarily include all relevant stakeholders.

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Introduction

This document presents results generated in the USER-CHI project, a research and innovation project funded under European Union's program Horizon 2020, aimed at unlocking the massive potential of electromobility in Europe, from a user-centric perspective.

Following a user driven innovation approach, the project performed a deep qualitative and quantitative research of charging needs, demands and requirements of citizens and users in six different European countries: Norway, Finland, Hungary, Germany, Italy and Spain. As a result of this research work, subjective perception of charging options, decision influences and acceptance barriers have been analysed to define the innovative features and value-added services needed and expected in the next generation of future charging stations.

This CWA presents the four different stations envisaged by the project team to fulfil the needs and expectations of EV (Electric Vehicle) users (including LEVs, Light Electric Vehicles), according to the results obtained in the user research.

When considering the key aspects related to the charging process of an EV, the number of chargers and the availability of a dense charging infrastructure emerge as a critical aspect. Consequently, the quantity is important, but also qualitative aspects related to end user satisfaction. The charging stations models presented in this document also aim to cover qualitative aspects, such as:

- Better availability of charging facilities.
- Energy saving and greener environment.
- Standardization of core components.
- Ubiquitous and environmentally friendly.
- Diversified charging modes.
- Digital and intelligent charging.
- Tighter control for safety and privacy protection.
- Charging infrastructure is a node for multi-network convergence.

Besides software solutions offered by the OCPI protocol allowing for V2G and load balancing, alternative hardware-based solutions are also in development or already available. Alternative solutions comprise, amongst others, autonomous connection devices (ACD), AVP-guided parking systems, and inductive and conductive charging solutions. With connection options to all available sides of the vehicle.

1 Scope

This CWA provides guidelines for the stations of the future to fulfil the needs and expectations of Electric Vehicle (EV) users. This document includes design features for the charging stations that electromobility users demand, and recommendations for its successful deployment.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

4 User requirements and expectations

4.1 General

Plug-in hybrid electric vehicles became the most popular type of passenger electric vehicles in the European Union in November 2020. This technological transition is supporting today the development of electromobility, but to foster a widespread use of electromobility, it is necessary to provide an appropriate charging infrastructure.

This document focuses on the definition of the charging stations that not only EVs and LEVs require, but also fulfil the needs and expectations of the end users. To achieve this, a qualitative and quantitative user research following the user experience principles has been performed, achieving a deep knowledge of EV drivers' charging preferences and patterns in order to increase their acceptance. As a result of this research, three categories of requirements have been identified:

A) Must-be requirements:

- Availability of a dense charging point network in cities and in highways, including promoting the installation of charging points at drivers' home and in public parking lots. For professional drivers the city charging network is critical, while for private drivers the most critical point is charging when they arrive home, in private chargers or public chargers.
- A procedure for booking a charging point that ensures its availability when the driver arrives.

B) Incremental gain requirements:

- Charging point status: occupied-unoccupied-in maintenance, blocked, charging, or reserved.
- Standardization of technical components and signalization.
- Paying with credit cards; contactless payment.
- Employing app utilities without subscription.
- Increase the amount of fast charging points; fast charge in highways.
- Automatic user detection in the charging point.
- Interoperability among charging points, at European level.
- A unique application for routing, booking and paying; pre-booking.

C) Desirable requirements:

- Additional services to perform activities when charging the battery. Two aspects are differentiated:

- Services at the urban charging points, like shopping malls or mobility hubs.
- Services at charging points on route, in long range trips.

- Monitoring utilities like remaining charging time, percentage of charge in real time, power limitation to obtain a lower price, different criteria for fixing fees, or service interruption alarm, are interesting features for managing the waiting time when charging.
- Sustainability: users perceive electromobility as sustainable, and this value must be present in all the charging process.

These requirements are related to the charging process of an EV and should be included in a charging station aimed to achieve end users' expectations. Taking these requirements as entry requisites of a development process, four different concepts of stations of the future are defined:

- Intermodal station,
- Highway station,
- LEV chargers, and
- Urban station.

The main features related to each concept are presented in Table 1, organized in three categories:

- Technologies: this category refer to the main technological solutions to be included in the facilities of the concept design.
- Services / Users demands: this category refers to the services that end users are expecting to find, in order to cover their main demands.
- Location: this category refers to places that are likely to host an Intermodal station, with the described characteristics.

		Technologies	Services / User demands	Location
Intermodal station	Electric cars – eBikes – eScooters – Public transport	• Chargers for LEVs • Shared electric scooters (eScooters), electric-assist bicycles (eBikes) and electric mopeds. • Slow chargers. Low power chargers (AC, DC, Inductive charging) • Fast chargers (DC) • (a)EVSE[1] • Pay for charging (not parking), interchangeable payment method (credit cards; contactless payment; subscription, cash, …) • Rental and shared vehicle area	• Standard and fast chargers • Inductive charging for EVs + Maintenance + Parking lot • Chargers for LEVs • Intermodal ticketing point • Cafeteria • Toilets • Lockers & Courier service • Coworking & resting area	• Nature integrated • Anti-theft / safe zona • Railway station, city accesses, university campuses • Big space is required
Urban station	Electric cars – eBikes – eScooters - Electric vans	• Slow chargers (AC, DC) • Fast chargers (DC) • (a)EVSE • Parking & Charging booking	• Parking & Charging service for LEVs and EVs • Lockers & Courier service • Logistics	• City Center • Neighborhood • Shopping area

[1] Automated (a) or manually operated Electric Vehicle Supply Equipment consisting of a single charger or combination of charger and automation connecting facility, allowing for conductive (AC & DC) or inductive charging.

		• Restricted access • Interchangeable payment method (credit cards; contactless payment; subscription, cash, …)	• Short stays • Loading/Unloading area	
Highway station	Electric cars – Electric vans	• Fast chargers (DC) • Charging booking • (a)EVSE	• Interchangeable payment method (credit cards; contactless payment; subscription, cash, …) • Cafeteria • Toilets • Coworking & resting area • Vehicle maintenance • Playground / Physical activity	• Highway
LEV chargers	eBikes – eSccoters – eMopeds	• Photovoltaic panels connected to grid • Modularity • Battery storage cabinets / Battery swapping • AC chargers • Charging booking	• Secure parking • Vertical parking • Interchangeable payment method (credit cards; contactless payment; subscription, cash, …)	• Chargers in urban furniture, street lights and benches • Bus canopies, underground • University campus

Table 1: Main features of the Stations of the Future, organized in three topics

5 Business models

5.1 General

The growth of population mobility and an increased concern on climate change and energy independence have boosted interest in electric vehicles (EVs) as one way to address these challenges. The expansion of the public charging infrastructure network is a strategic component for promoting EVs, and with them dropping GHG emissions imputable to conventional cars and improving the local environment in terms of air pollution decrease.

To stay up-to-date with growing demand and address range-anxiety issues, charging infrastructure is required, mainly close to public transport hubs, at destination points, and along highways. Additionally, to adequately profit from the flexibility of EVs while facilitating the stability of the energy system, the infrastructure should be deployed in combination with grid edge technologies – such as decentralised generation, storage, microgrids and smart buildings – and integrated into smart grids.

As the share of kilometres driven by EVs rises, urban mobility emissions will gradually reduce. Moreover, electrification combined with a clean energy mix and optimised charging patterns will further decrease emissions and enhance air quality to ameliorate the ecological footprint.

Finally, smart-charging services will reduce charging costs, while they can create new revenue streams in the energy markets for Charge Point Operators (CPOs) and E-Mobility Service Providers (EMSPs) able to provide ancillary services.

For these reasons different areas of impact have to be considered and in all the cases with a focus on the project partner cities that have expressed interest in the specific business model case. Business cases have to be calibrated considering variables such as scalability of the infrastructure, demand and market management programs, environmental context, presence or not of relevant e-Mobility operators, etc.

Traditional business models are developed with profit as the overarching aim. Sustainable Business Models (SBMs) aim to broaden the definition of value creation by integrating social and environmental performance dimensions besides the primary fabric of business. SBMs are thus defined in terms of their ability to internalise these three sustainability dimensions into the core of business.

Social and environmental values are desirable from a collective point of view. Still, it is often unclear how private organisations can capture this type of value while preserving economic sustainability. This is a

relevant question mark that has to be taken into high consideration for the business modelling generation process of (a)EVSE

Therefore, business models should be analysed and defined considering different environmental scenarios and adopting a multi-stakeholder approach, specifying for each demo city interested in the BM: the market characteristics, market trends, market limits and constraints, target clients and their profile, market size and business opportunities to make them viable, attractive, and economically sustainable.

For the purpose of this document seven business models related to the charging process of EVs have been defined:

- BM1 - Logistics Hubs
- BM2 - Citizens e-mobility stations
- BM3 - City Centre (park & charge)
- BM4 – E-trucks
- BM5 – E-taxi stops
- BM6 - Special events
- BM7 – Mobile Charging Stations

The main features of the business models are melted employing the well-known CANVAS business model developed by Osterwalder[2]. The most relevant features of the business model related to each conceptual station are presented in a new reduced format, including four topics:

- The Business, bringing together the upper left side of the business model chart (Key Partners, Key Activities and Key Resources).
- The Market, bringing together the upper right side of the business model chart (Customer Segments, Customer Relationship and Channels).
- The flow, bringing together the lower boxes of the business model chart (Revenue Streams and Costs Structure).
- The Value, the central part of the chart, presented as it appears in the business model chart.

5.2 BM1 - Logistics Hubs

The digitalisation and electrification of logistics is one of the top treated topics in relation to the environmental impacts of transport, especially in the recent years with the growing of international logistics demand due to e-commerce business. The subject involves all the three main sectors characterising the business: supply, storage, and last mile distribution.

In this operational and market context, *Logistics Hubs* represents a business case proposing recharging services addressed to logistics or mobility operators working in (or accessing to a) shared infrastructure.

The following table represents the CANVAS of the identified business model.

[2] Osterwalder, A., Pigneur, Y., Business Model Generation, John Wiley & Sons Inc, 2010

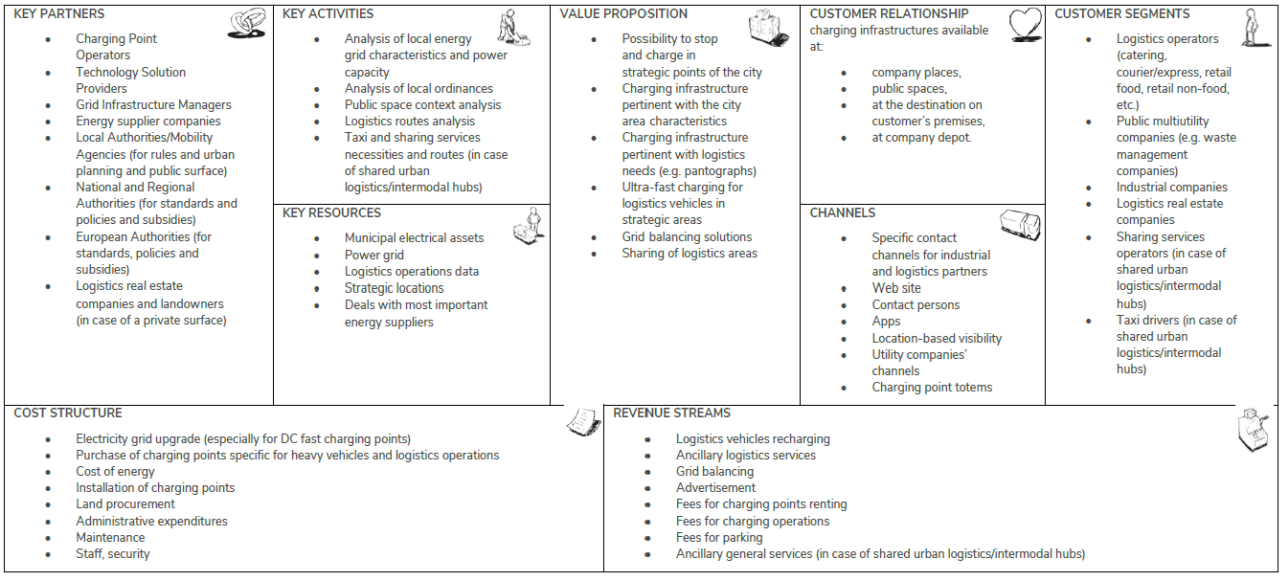

Figure 1: Logistics Hubs CANVAS.

5.3 BM2 - Citizens e-mobility stations

Mobility stations aim to provide the most suitable means of transport at any time and any place in order to reduce private vehicle ownership of residents and customers. They combine and provide different transport modalities in a unique hub.

The concept is to find in the same location several mobility technologies (car-sharing both stationary and free-floating, scooters, normal bikes and cargo bikes) connected with public transport and ancillary services (e.g. Wi-Fi, toilettes, cafeteria, or bike repairing).

In the most sophisticated and advanced mobility hub, these services can include electromobility: different zero-emission and shared transport modes available and linked together in a network.

In this operational and market context, *Citizens e-mobility stations* represents a business case addressing e-Mobility Stations and proposing recharging services addressed to e-drivers (private or professional), to logistics and/or mobility operators working in (or accessing to a) mobility hub.

The following table represents the CANVAS of the identified business model.

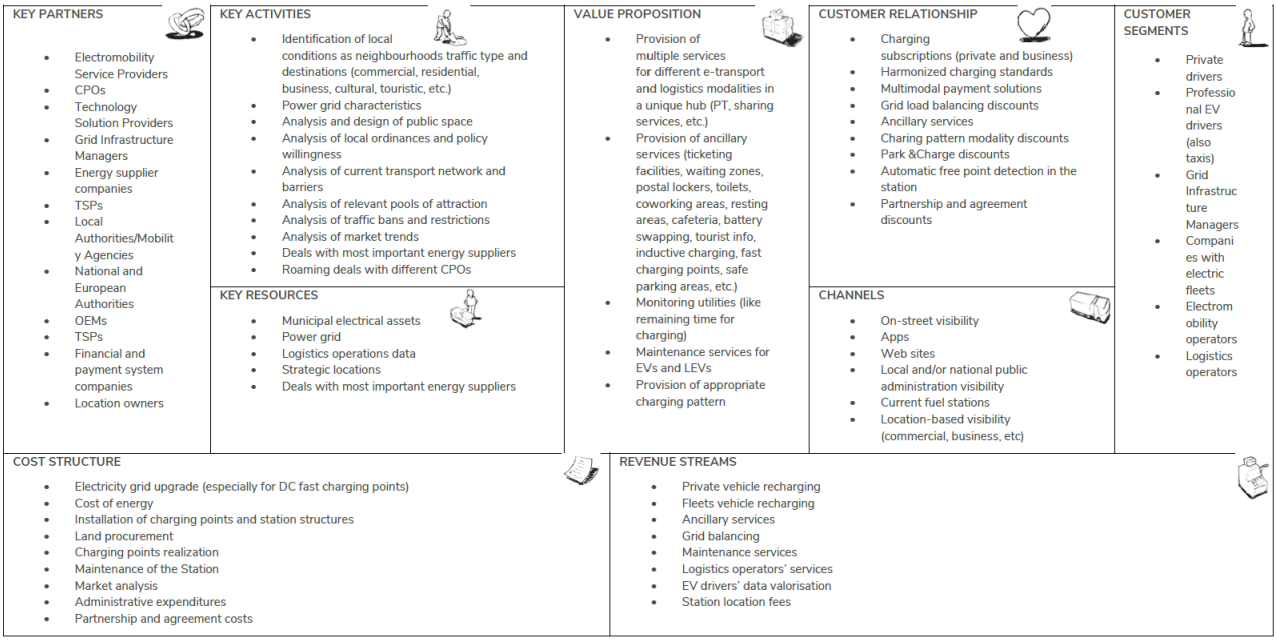

Figure 2: Citizens e-Mobility Stations CANVAS.

5.4 BM3 - City Centre (park & charge)

To increase the EV drivers' satisfaction level concerning the current public charging infrastructures, different actions can be undertaken, among which, for example: allowing e- drivers to find out where they can charge easily, simplifying the EV charging buying process, supporting EV drivers in being involved with local EV communities, or disseminating the utility or city programs concerning EV charge points.

To accelerate the DC fast charging deployment, two are the point to follow first: to develop infrastructure for intercity travels where drivers, travelling between cities, do not have time to spend for charging the vehicle; to focus on drivers who do not have access to home or work charging.

In this operational and market context *City Centre (park & charge)* represents a business case addressing park & charge and proposing recharging services addressed to citizens and e-drivers travelling within the urban context with electric vehicles.

The following table represents the CANVAS of the identified business model.

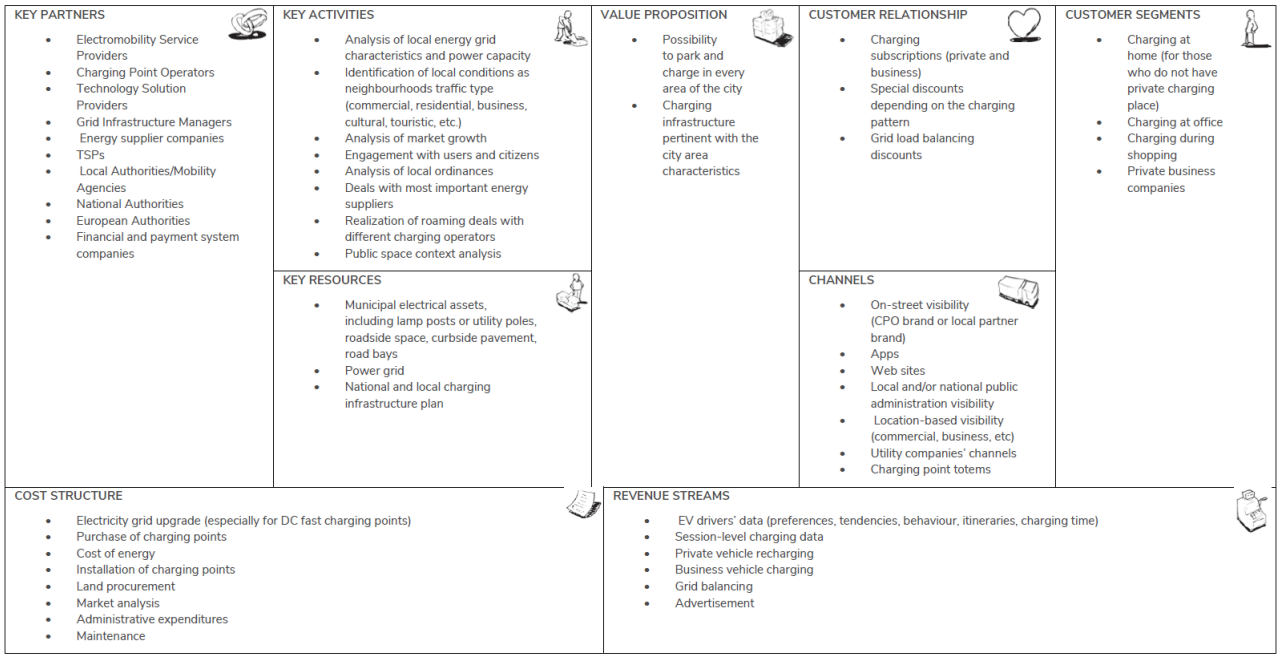

Figure 3: City Centre (park & charge) CANVAS.

5.5 BM4 – E-trucks

Diesel power is still king in trucking and will be it for a long time. But both public administrations and industry leaders show a huge pull and interest in market electrification.

In recent years, the exploration of near-silent, low-maintenance, battery-powered trucks and the related infrastructure is a consistent theme in logistics. The number of electric delivery trucks and vans presented and announced by manufacturers gives the impression that finally, the sector is getting to a tipping point.

In this operational and market context *E-trucks* represents a business case addressing e-truck sector and proposing recharging services addressed to transport and mobility operators working with electric light and heavy logistics vehicles.

The following table represents the CANVAS of the identified business model.

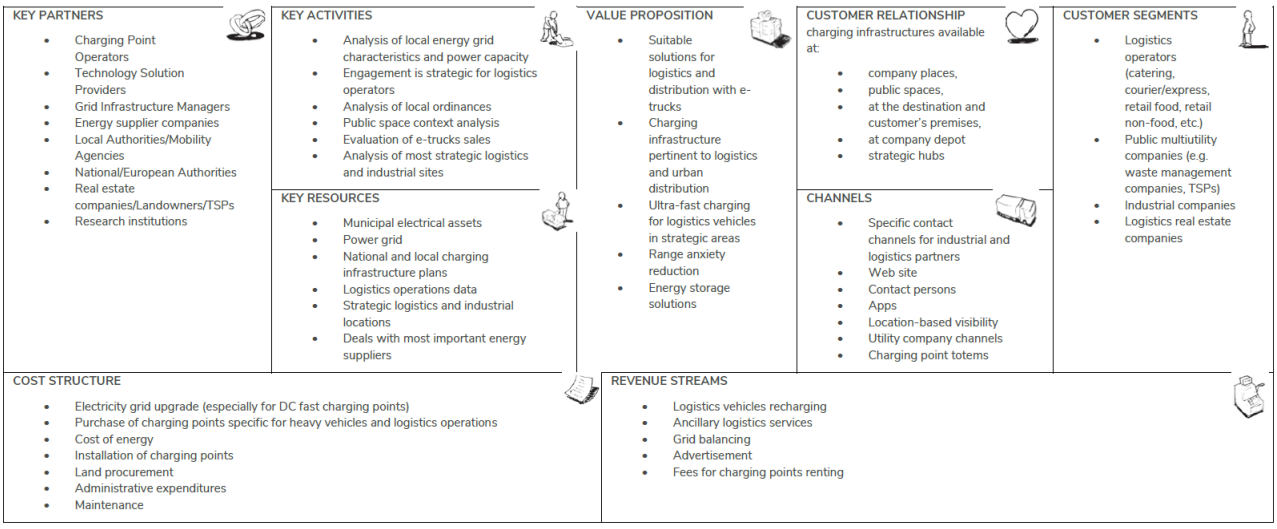

Figure 4: E-trucks CANVAS.

5.6 BM5 – E-taxi stops

There are different characteristics of the electric powertrain, if compared to the Internal Combustion Engine Vehicles (ICEVs), that seem particularly attractive for the urban environments: zero tailpipe emissions, higher energy efficiency and silent operations. For this reason, in recent years, many countries have laid out plans to ban or severely limit access to ICEVs (especially diesel vehicles) in urban areas in the coming years.

This mindset shift, combined with the constantly decreasing cost of batteries and an increased supply of Battery Electric Vehicles (BEVs) in previously underserved vehicle classes, is paving the way for a fast transition towards zero-emission vehicles such as BEVs. In this framework, organisations with large vehicle fleets that are intensively used, such as taxi companies, could be important players in the transition towards cleaner means of transport. This concerns not only taxi vehicles, but also their management systems, which are an important part of the sustainable urban transport ecosystem.

In this operational and market context *E-taxi stops* represents a business case addressing e-taxis and proposing recharging services addressed to their operational necessities.

The following table represents the CANVAS of the identified business model.

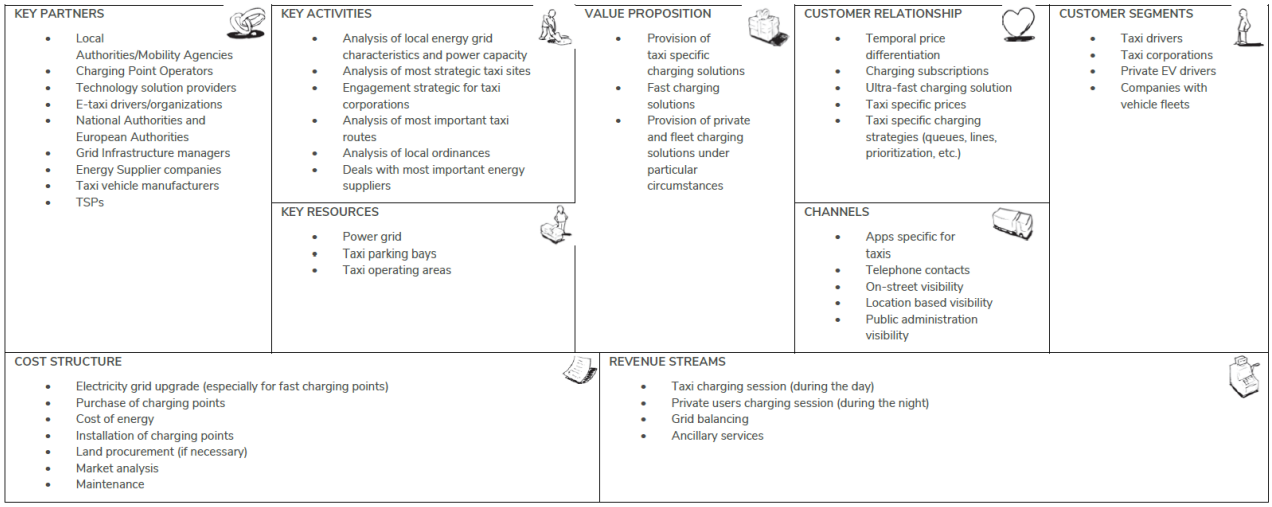

Figure 5: E-taxi stops CANVAS.

5.7 BM6 - Special events

Electric vehicle (EV) numbers are growing at an exponential pace and are pushing the market and business necessities to find out different solutions for providing necessary energies to all potential situations, either normal or special ones, such as out of routine regimes like emergency cases, or occasional events (e.g. sport and fair events, conferences, or congresses).

The growth of the market and the evolution in EV technology are moving to a new face of the "range anxiety" that characterizes electric drivers: the ability to find a way to charge up when the planned route does not go exactly according to the plans22. The new pivotal question is no more oriented to vehicle abilities and characteristics but around the lack of infrastructure and its ability to provide services on all occasions of moving, daily or extraordinary.

With extraordinary circumstances, it is not meant only emergencies or catastrophes, but also events out of normal and daily utilization of electric vehicles.

In this operational and market context *Special events* represents a business case addressing singular events and proposing recharging services for e-drivers travelling during extraordinary situations.

The following table represents the CANVAS of the identified business model.

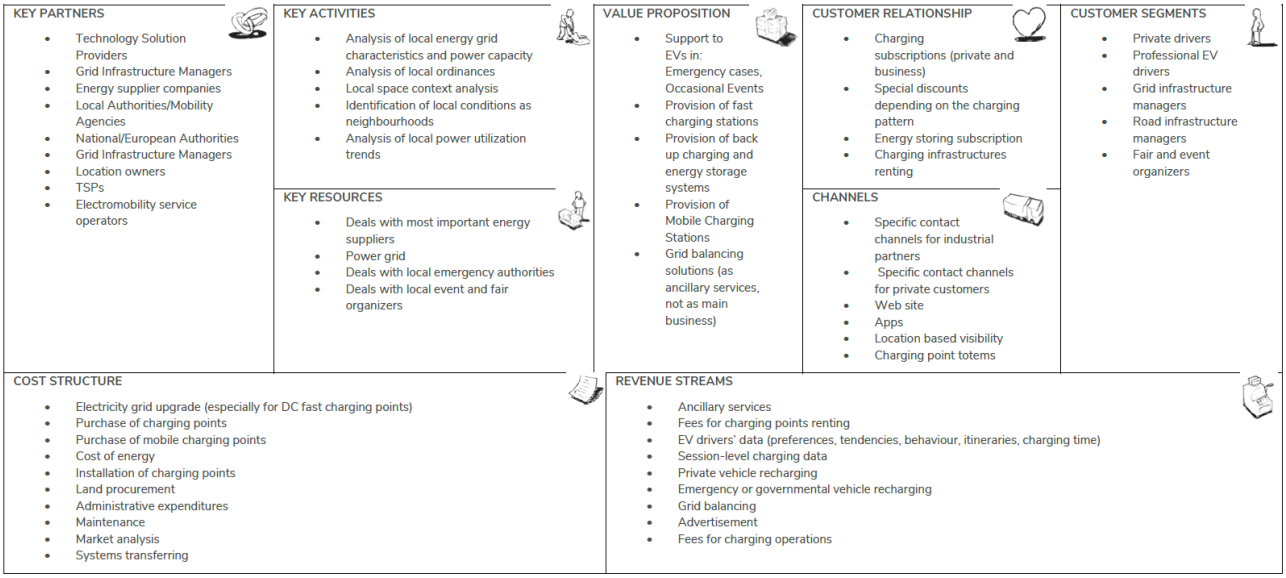

Figure 6: Special events CANVAS.

5.8 BM7 – Mobile Charging Stations

Electric vehicles (EVs) adoption and charging infrastructure implementation are not growing in a parallel way. If there is a remarkable growing of the EV market share, the related necessary recharging infrastructure is not growing with the same pace. There are still gaps – places without chargers that could be served if EV charging was available.

Today battery swapping and wireless charging lanes are only occasionally utilized. Consequently, to date, the most promising solution is the Mobile Charging Stations (MCSs), an option that can serve EV charging in a portable, flexible, and put-on wheels manner.

The ability of MCSs to provide charging services without time and location constraints could give them a prominent role to accelerate EV penetration.

In this operational and market context *Mobile Charging Stations* represents a business case addressing portable charging stations and proposing recharging solutions for exploiting the potentialities and benefits derived by using MCSs.

The following table represents the CANVAS of the identified business model.

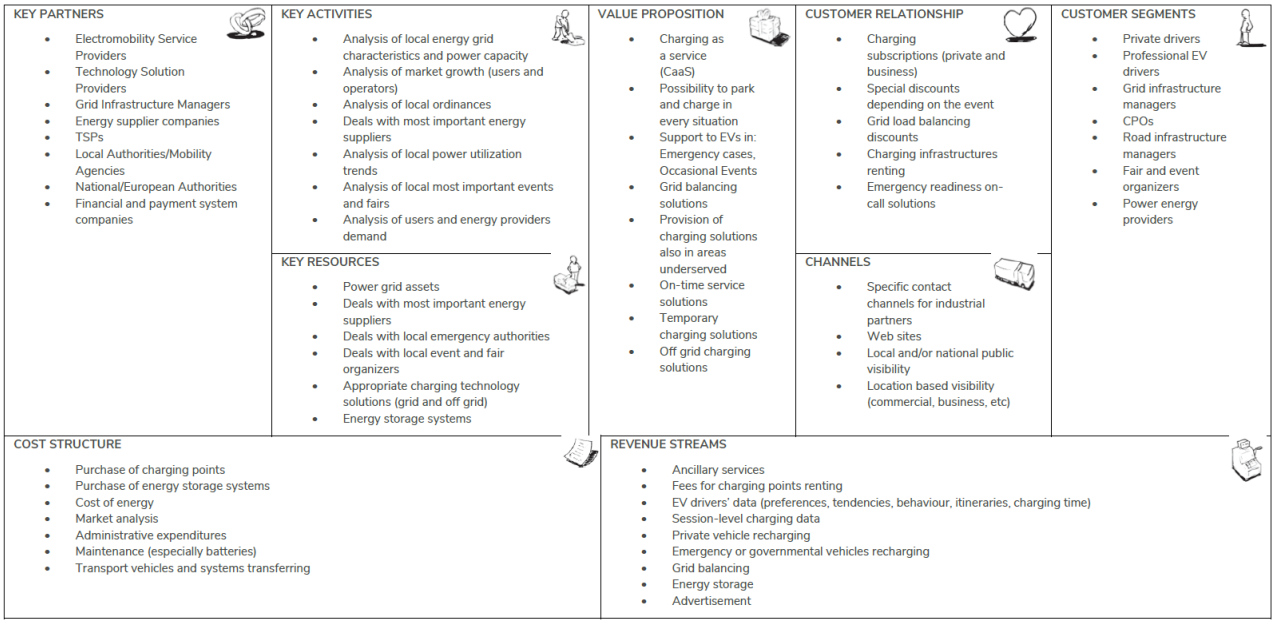

Figure 7: Mobile Charging Stations CANVAS.

6 Intermodal station of the future

6.1 The sketch

This sketch presents a charging station to support multimodal mobility in the cities. The concept combines different transport modes (communal and particular, public and private), in a big facility.

The concept design for the intermodal station should provide the flowing services that electric cars, eBikes, eScooter and public transport users' demand:

- Standard and fast chargers
- Inductive charging for EVs, vehicle maintenance and parking lot
- Chargers for LEVs
- Intermodal ticketing point
- Cafeteria
- Toilets
- Lockers and courier service
- Coworking and resting area

The following picture shows and example of the concept design for the intermodal station.

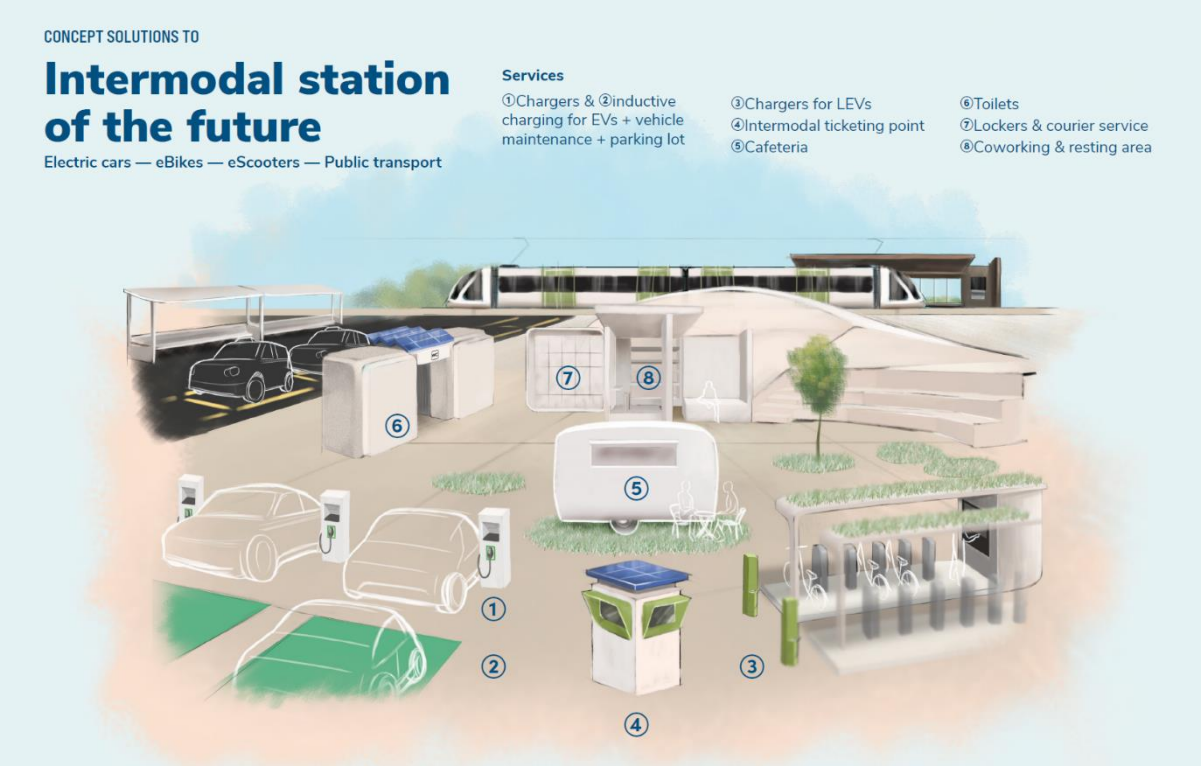

Figure 8: Concept design for the Intermodal station.

6.2 The main features

According to stations' main features presented in Table 1 the following technologies should be included in the intermodal station concept design:

- Chargers for LEVs
- Shared electric scooters (eScooters), electric-assist bicycles (eBikes) and electric mopeds.
- Slow chargers. Low power chargers (AC, DC, Inductive charging)
- V2G abling technologies
- (a)EVSE
- Fast chargers (DC)
- Pay for charging (not parking), interchangeable payment method (credit cards; contactless payment; subscription, cash, …)
- Rental and shared vehicle area

The intermodal station's locations require a big space. The location where the station should be installed in an anti-theft and safe zona and be integrated with the nature. The intermodal station should be located close to railway stations, city accesses and university campuses.

The following figure shows the main features of the intermodal station grouped in the three categories.

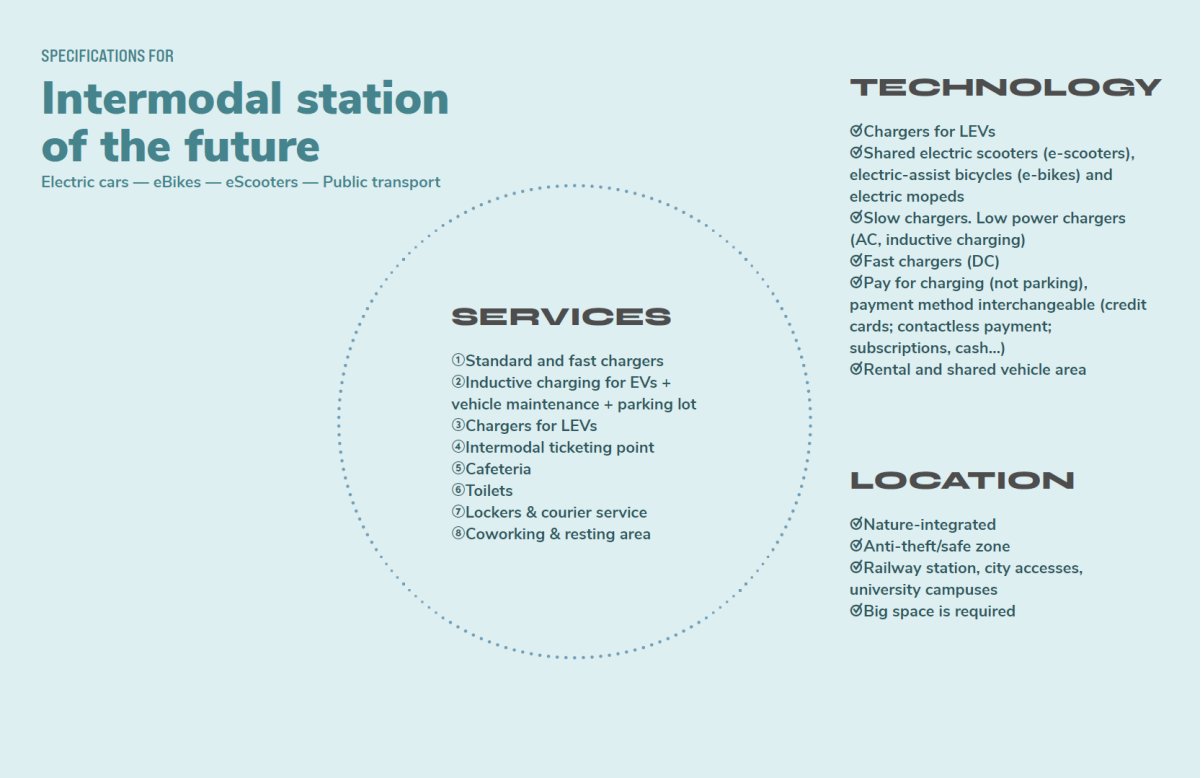

Figure 9: Main features of the Intermodal station.

6.3 The business model

According to the seven business models related to the charging process of EVs defined, the concept design of the Intermodal station does not match exactly with one of these business models, but the concept is related, at a different level, with various of these models.

From the business model point of view, the Intermodal station of the future is a logistic hub, a station hosting different transport modes, a station offering services of park&charge and taxi. For this reason, a combination of several business is applicable.

- BM1 – Logistics Hubs.
- BM2 – Citizen e-Mobility Station.
- BM3 – City Centre (Park&Charge).
- BM5 – e-Taxi Stops.

The following figure represents the CANVAS of the business model for the Intermodal station highlighting the most relevant aspects.

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENTS
Electromobility Service Providers CPOs Technology Solution Providers Grid Infrastructure Managers Energy supplier companies TSPs Local Authorities/Mobility Agencies National and European Authorities OEMs Financial and payment system companies Taxi corporations Taxi vehicle manufacturers	Analysis of relevant pools of attraction Power grid characteristics Analysis and design of public space Analysis of local ordinances and policy willingness Analysis of current transport network and barriers Analysis of market trends Deals with most important energy suppliers Roaming deals with different CPOs **KEY RESOURCES** Municipal electrical assets Logistics operations data Strategic locations National and local charging infrastructure plan	**(SERVICES)** To stop and charge in strategic intermodal locations Standard, fast, and ultra fast chargers Inductive charging Battery swap Vehicles maintenance Parking lots Pay for charging (not parking) Rental and shared mobility services Chargers for LEVs Intermodal ticketing Cafeteria Toilets Lockers, courier and logistics services Sharing of logistics areas Coworking & resting areas Grid balancing solutions Energy storage solutions	Different payment solutions Charging subscriptions Parking&charging booking Harmonized charging standards Providers roaming solutions Park&charge discounts Automatic free point detection Taxi parking&charging points Logistics parking&charging points PT parking and charging areas Provision of private and fleet charging solutions Grid load balancing discounts **CHANNELS** Specific channels for industrial and logistics Strategic transport location visibility Apps Web sites Local and/or national public administration visibility Utility companies' channels	Private drivers Professional EV drivers (also taxis) PT companies Sharing mobility providers Electromobility providers Logistics operators

COST STRUCTURE	REVEUE STREAMS
Electricity grid upgrade (especially for DC fast charging points if needed in the intermodal point) Charing point hardware Charging point installation Cost of energy Land setting and adaptation Location analysis Administrative expenditures Maintenance	Logistics vehicles recharging Private vehicles recharging Business vehicles charging Fees for parking Maintenance services Ancillary general services Ancillary logistics services Grid balancing Advertisement EV drivers' data (preferences, tendencies, behaviour, itineraries, charging time)

Figure 10: Most relevant features of the combined BMs, considered in the Intermodal station concept.

6.3.1 Business

The business represented in the upper left side of the CANVAS business model is composed by the key partners, activities and resources.

The key partners of the intermodal station are electromobility service providers, CPOs, grid infrastructure managers and energy supplier companies.

The main activities and resources of the intermodal station are power grid characteristics, deals with most important energy suppliers, roaming deals with different CPOs and strategic locations.

6.3.2 Market

The market represented in the upper right side of the business model chart is composed by the customer segments and relationship and the channels.

The market of the intermodal station is segmented in private drivers, PT companies, electromobility providers and logistics operators.

The most used channel of the intermodal station is through Apps and the harmonized charging standards and providers roaming solutions are the basics of customer relationship.

6.3.3 Flow

The flow represented in the lower boxes of the business model chart is composed by the revenue streams and the costs' structure.

The electricity grid upgrade, the charging point installation, the land setting and adaptation and the maintenance are the main costs' structure of the intermodal station.

The main sources of income of the intermodal station come from private vehicles recharging, business vehicles charging, maintenance services, ancillary general services, ancillary logistics services and the EV drivers' data.

6.3.4 Value

The value is represented in the central part of the CANVAS business model.

The main value that the intermodal station provides is to stop and charge in strategic intermodal locations, standard, fast, and ultra-fast chargers, vehicles maintenance, rental and shared mobility services, intermodal ticketing, lockers, courier and logistics services, sharing of logistics areas, coworking & resting areas, grid balancing solutions and energy storage solutions.

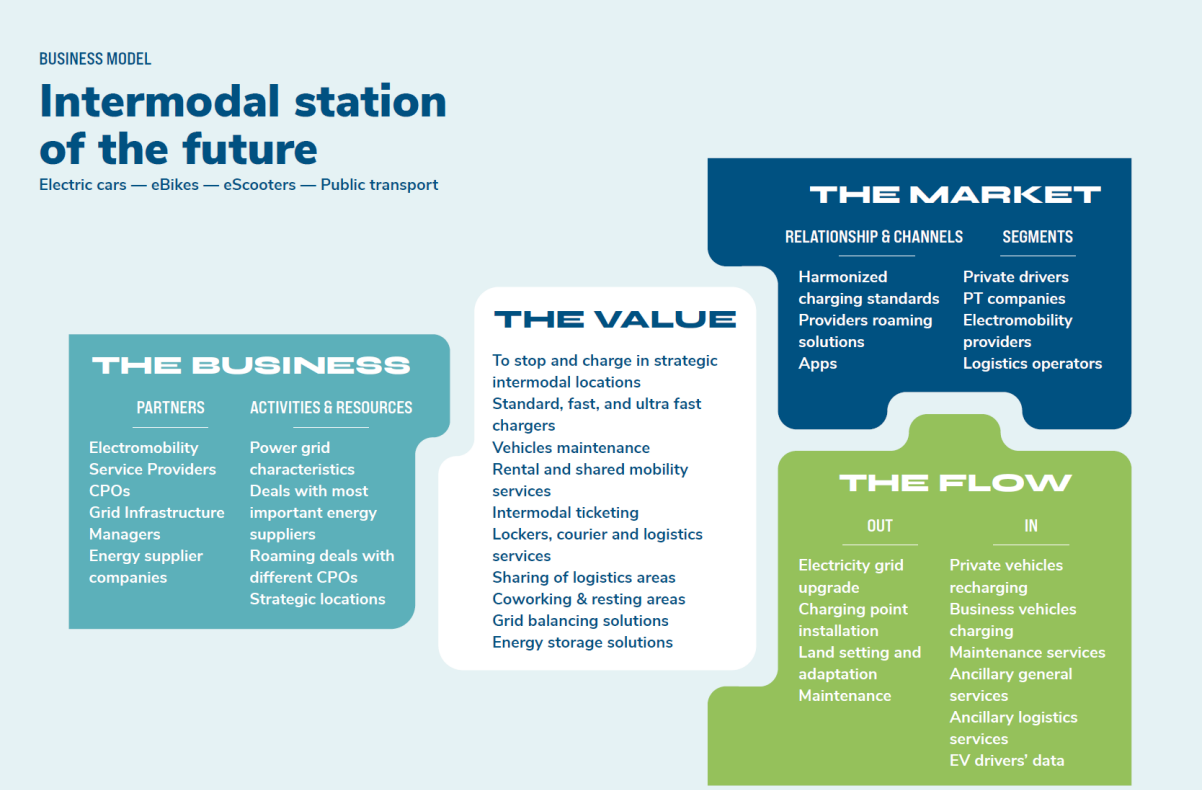

Figure 11: Business model related to Intermodal station.

7 Urban station of the future

7.1 The Sketch

This sketch presents a charging station adapted to the requirements of a city centre: adaptation to existing infrastructures and space optimization. The concept combines charging and parking services, addressed to end users and logistics professionals.

The concept design for the for the urban station should include the flowing services that electric cars, eBikes, eScooter and electric vans users' demand:

- Parking and charging (ultrafast) for LEVs
- Parking and charging for EVs
- Lockers and courier service
- Logistics
- Loading and unloading area
- Restricted access: retractable bollards (pre-registered users)

The following picture shows and example of the concept design for the urban station.

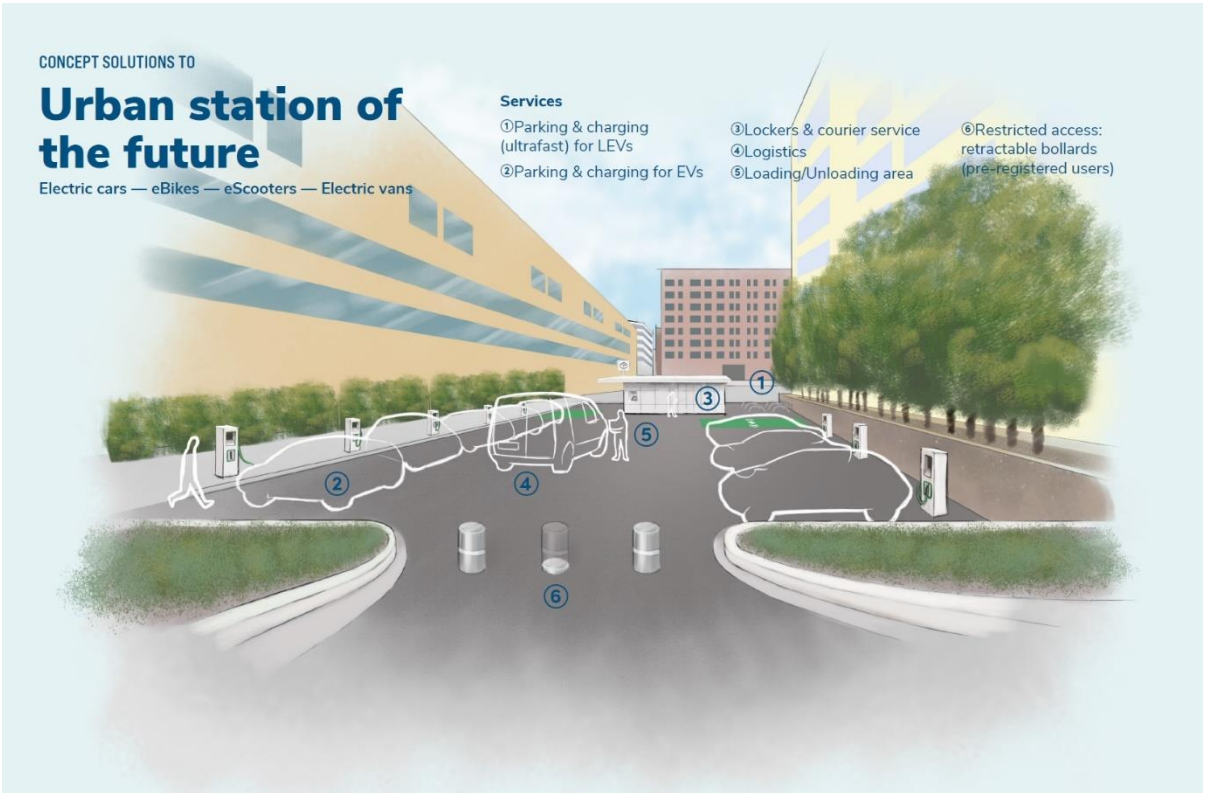

Figure 12: Concept design for the Urban Station.

According to stations' main features presented in Table 1 the following technologies should be included in the urban station concept design:

- Slow chargers (AC, DC)
- Fast chargers (DC)
- Parking and charging booking
- (a)EVSE
- Restricted access
- Pay for charging (not parking), payment method interchangeable (credit cards; contactless payment; subscriptions, cash…)

The urban station should be located close to the city centre, neighbourhoods and shopping areas.

The following figure shows the main features of the urban station grouped in the three categories.

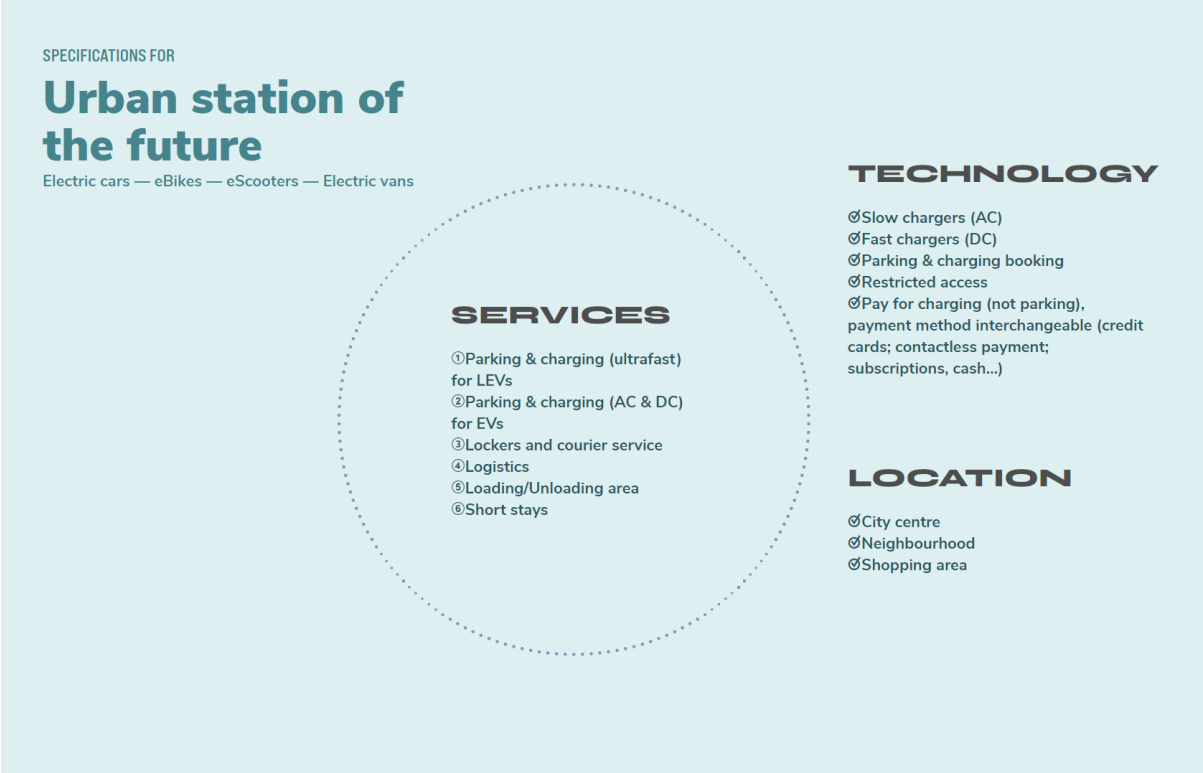

Figure 13: Main features of the Urban station.

According to the seven business models related to the charging process of EVs defined, the concept design of the Urban station does not match exactly with one of these business models, but the concept is related, at a different level, with various of these models.

From the business model point of view, the Urban station of the future is a logistic hub and a station offering services of park&charge and taxi. For this reason, a combination of several business is applicable.

- BM1 – Logistics Hubs.
- BM3 – City Centre (Park&Charge).
- BM5 – e-Taxi Stops.

The following figure represents the CANVAS of the business model for the Urban Station highlighting the most relevant aspects.

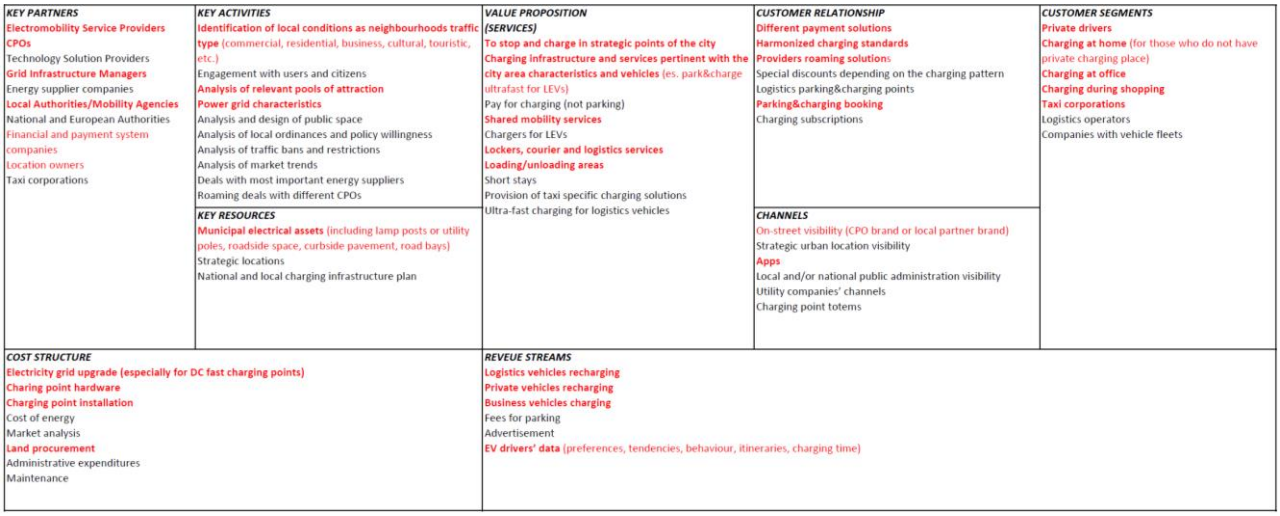

Figure 14: Most relevant features of the combined BMs, considered in the Urban station concept.

7.1.1 Business

The business represented in the upper left side of the CANVAS business model is composed by the key partners, activities and resources.

The key partners of the urban station are electromobility service providers, CPOs, grid infrastructure managers, local authorities and mobility agencies.

The main activities and resources of the urban station are identification of local conditions as neighbourhoods traffic type, analysis of relevant pools of attraction, power grid characteristics and municipal electrical assets.

7.1.2 Market

The market represented in the upper right side of the business model chart is composed by the customer segments and relationship and the channels.

The market of the urban station is segmented in private drivers, charging at home, charging at office, charging during shopping and taxi corporations.

The most used channel of the urban station is through Apps and the different payment solutions, harmonized charging standards, providers roaming solutions and parking and charging booking are the basics of customer relationship.

7.1.3 Flow

The flow represented in the lower boxes of the business model chart is composed by the revenue streams and the costs' structure.

The electricity grid upgrade, the charging point installation and hardware and the land procurement are the main costs' structure of the urban station.

The main sources of income of the urban station come from logistics and private vehicles recharging, business vehicles charging and EV drivers' data.

7.1.4 Value

The value is represented in the central part of the CANVAS business model.

The main value that the urban station provides is to stop and charge in strategic locations in the city, charging infrastructure and services tailored to cities' features and to different vehicle models, shared mobility services lockers, courier and logistics services and loading and unloading areas.

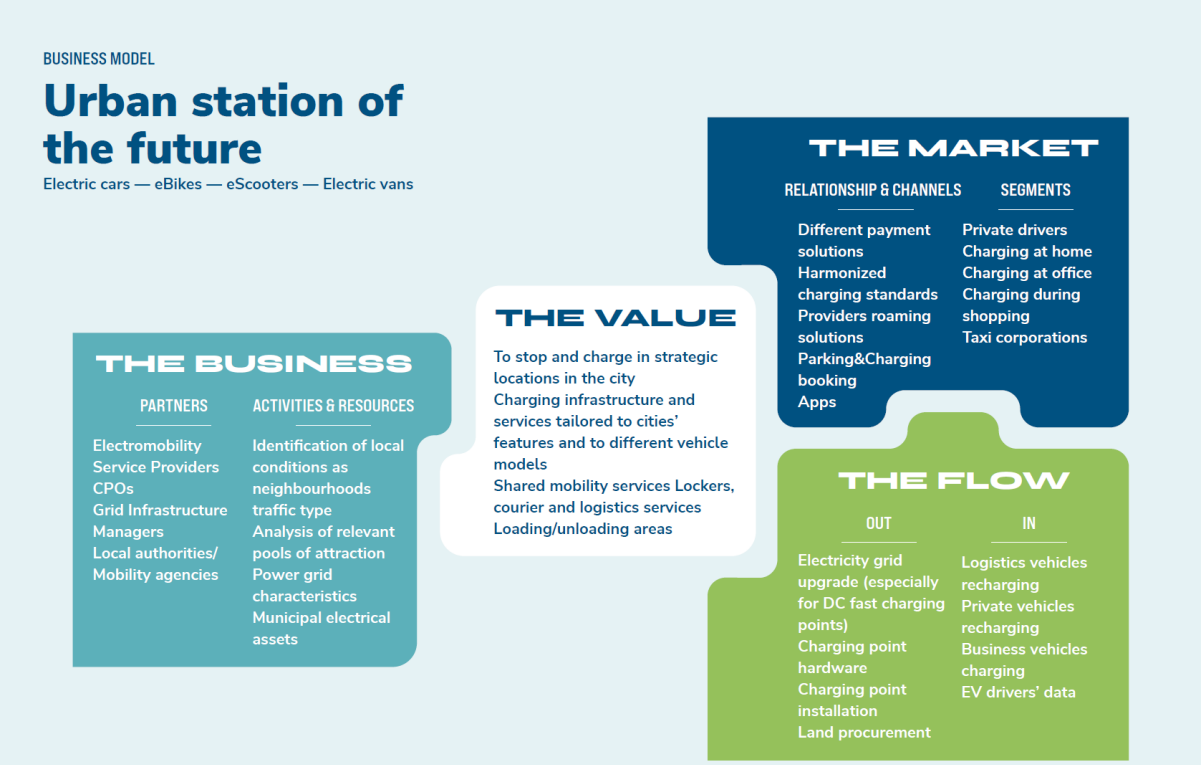

Figure 15: Business model related to the Urban station.

8 Highway station

8.1 The sketch

This sketch presents a charging station to support the electromobility in the long range. The concept goes deeper in the idea of supplying different services to travellers who book a EV charge in a planned trip.

The concept design for the for the highway station should provide the flowing services that electric cars and electric vans users' demand:

- Fast chargers and parking lot
- Vehicle maintenance
- Shops
- Fitness/Playground zone
- Cafeteria
- Toilets
- Playground
- Coworking and resting area

The following picture shows and example of the concept design for the highway station.

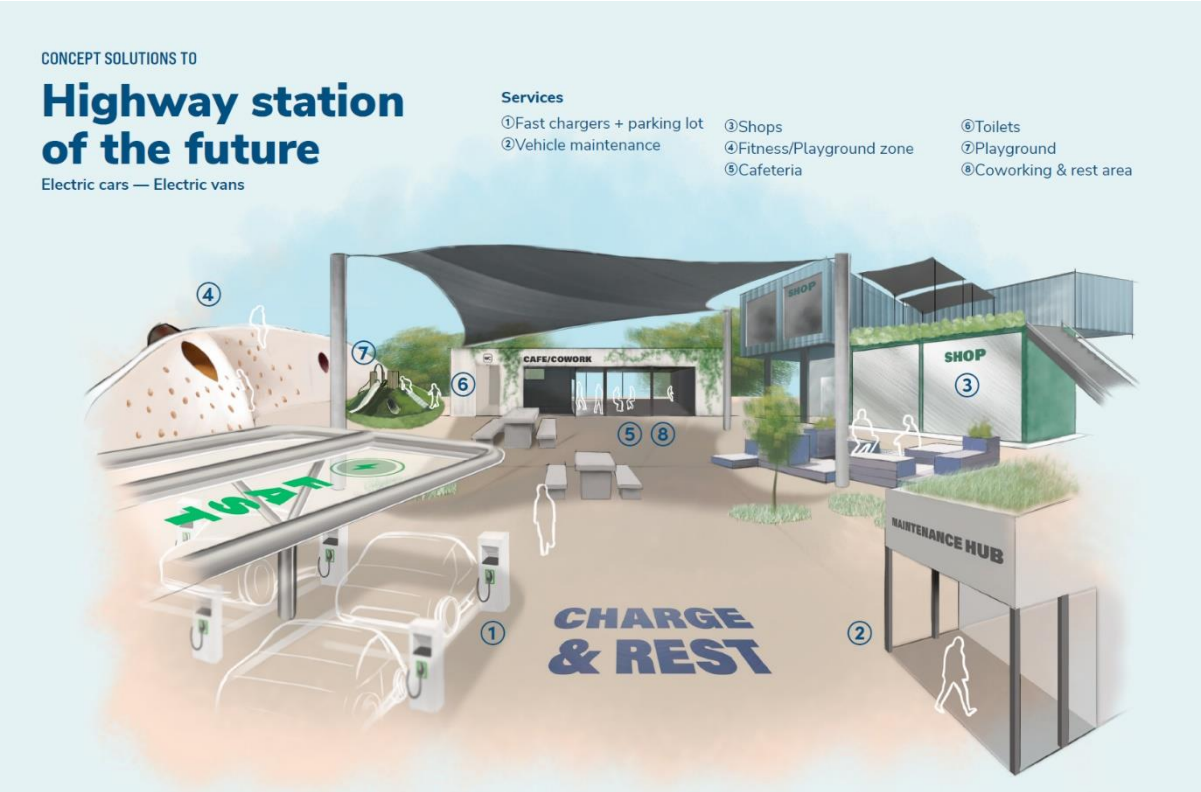

Figure 16: Concept design for the Highway station.

8.2 The main features

According to stations' main features presented in Table 1 the following technologies should be included in the highway station concept design:

- Fast chargers (DC)
- Booking of chargers
- (a)EVSE

The highway station locations require a big space. The location of the station should be integrated with the nature. The highway station should be located close to highways.

The following figure shows the main features of the highway station grouped in the three categories.

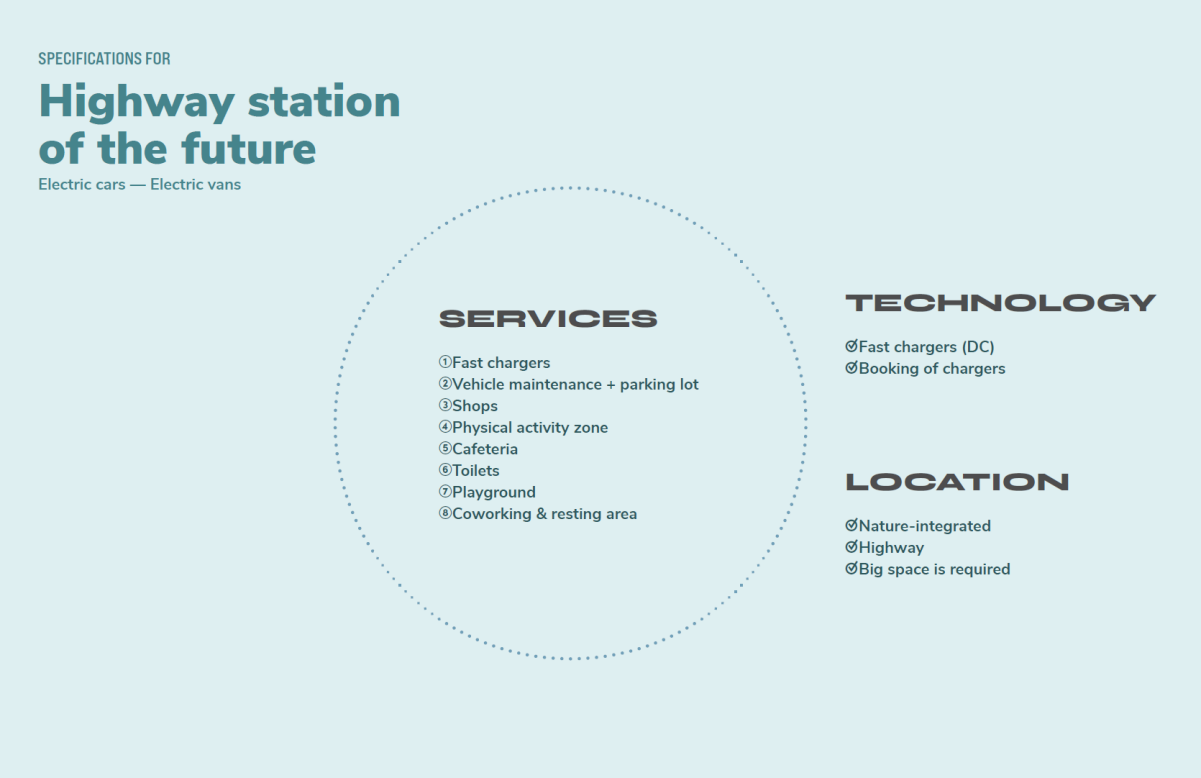

Figure 17: Main features of the Highway station.

8.3 The business model

According to the seven business models related to the charging process of EVs defined, the concept design of the Highway station does not match exactly with one of these business models, but the concept is related, at a different level, with various of these models.

From the business model point of view, the Highway station of the future is a station including additional services, a station for e-trucks, a station that is equipped with facilities to face special events (e.g. extreme climate episodes), and a station including services of mobile chargers. For this reason, a combination of several business is applicable.

- BM2 – Citizen e Mobility Station.
- BM4 – e-Trucks.
- BM6 – Special Events.
- BM7 – Mobile Charging Stations.

The following figure represents the CANVAS of the business model highlighting the most relevant aspects.

<table>
<tr>
<td rowspan="2">KEY PARTNERS
Highway operators and concessionaries
CPOs
Technology Solution Providers
Grid Infrastructure Managers
Energy supplier companies
National and European Authorities
OEMs
Financial and payment system companies</td>
<td>KEY ACTIVITIES
Analysis of relevant pools of attraction
Power grid characteristics
Analysis and design of public space
Analysis of national ordinances and policy willingness
Analysis of current traffic network and barriers
Analysis of market trends
Deals with most important energy suppliers
Deals with highway administrations and operators
Roaming deals with different CPOs</td>
<td rowspan="2">VALUE PROPOSITION
(SERVICES)
To stop and charge in strategic highway locations
Fast and ultra fast chargers
Parking lots
Multiple ancillary services for different e-transport modalities (battery swaping, vehicles maintenance, playgroud, physical activity zones, cafeteria, toilets, etc.)
Sharing of logistics areas
Coworking & resting areas
Grid balancing solutions
Energy storage solutions
Support to EVs in emergency and occasional situations
Provision of Mobile Charging stations</td>
<td>CUSTOMER RELATIONSHIP
Different payment solutions
Charging subscriptions (private and business)
Booking of chargers
Harmonized charging standards
Providers roaming solutions
Automatic free point detection
Trucks parking&charging points
Provision of private and fleet charging solutions
Grid load balancing discounts</td>
<td rowspan="2">CUSTOMER SEGMENTS
Private drivers
Professional EV drivers
Logistics operators
Industrial companies</td>
</tr>
<tr>
<td>KEY RESOURCES
National electrical assets
Engagement strategic for logistics operators (visibility)
Drivers traffic data
Logistics operations data
Strategic locations
National charging infrastructure plan</td>
<td>CHANNELS
Specific channels for industrial and logistics
Strategic transport location visibility
Apps
Web sites
National public administration visibility
Utility companies' channels
Highway administrations and operators visibility</td>
</tr>
<tr>
<td colspan="2">COST STRUCTURE
Electricity grid upgrade (especially for DC fast charging points if needed in the intermodal point)
Charing point hardware (specific for heavy vehicles)
Charging point installation
Cost of energy
Land setting and adaptation
Location analysis and procurement
Administrative expenditures
Maintenance
Staff, security</td>
<td colspan="3">REVEUE STREAMS
Logistics vehicles recharging
Private vehicles recharging
Business vehicles charging
Emergency situation services
Maintenance services
Ancillary general services
Grid balancing
Advertisement
EV drivers' data (preferences, tendencies, behaviour, itineraries, charging time)</td>
</tr>
</table>

Figure 18: Most relevant features of the combined BMs, considered in the Highway station concept.

8.3.1 Business

The business represented in the upper left side of the CANVAS business model is composed by the key partners, activities and resources.

The key partners of the highway station are highway operators and concessionaries, CPOs and grid infrastructure managers.

The main activities and resources of the highway station are analysis of relevant pools of attraction, power grid characteristics, roaming deals with different CPOs and national electrical assets.

8.3.2 Market

The market represented in the upper right side of the business model chart is composed by the customer segments and relationship and the channels.

The market of the highway station is segmented in private drivers, professional EV drivers and logistics operators.

The most used channel of the highway station is through the highway administrations and operators' visibility and the booking of chargers, providers roaming solutions and parking and charging points for trucks are the basics of customer relationship.

8.3.3 Flow

The flow represented in the lower boxes of the business model chart is composed by the revenue streams and the costs' structure.

The electricity grid upgrade, the charging point hardware, the maintenance, the staff and the security are the main costs' structure of the highway station.

The main sources of income of the highway station come from logistics and private vehicles recharging, business vehicles charging, ancillary general services and the EV drivers' data.

8.3.4 Value

The value is represented in the central part of the CANVAS business model.

The main value that the highway station provides is to stop and charge in strategic highway locations, fast and ultra-fast chargers, multiple ancillary services for different e-transport modalities, grid balancing solutions, energy storage solutions, emergency and ad-hoc support for EVs and provision of mobile charging stations.

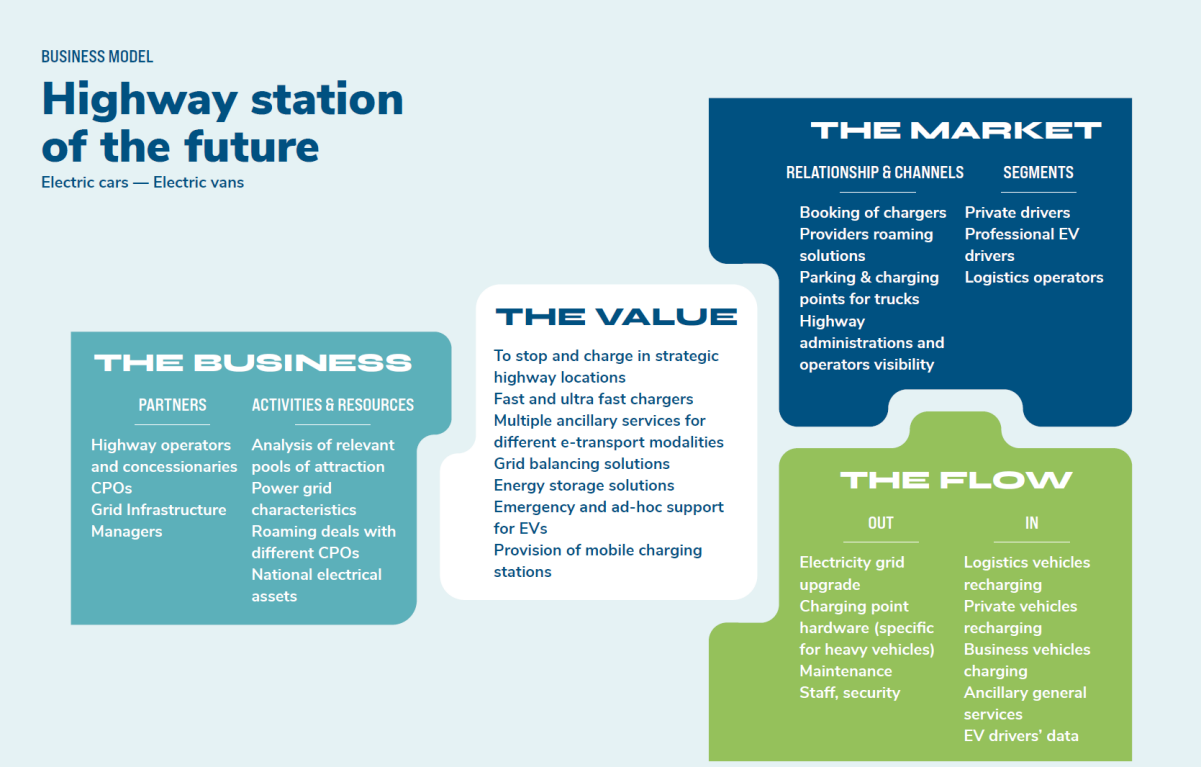

Figure 19: Business model of the Highway station.

9 LEV chargers of the future

9.1 The sketch

This sketch presents a charging station to support the active, multimodal and sustainable mobility. The concept combines the communal public transport with the particular transport, employing LEVs.

The concept design for the for the LEV chargers should provide the flowing services that eBikes and eScooter users' demand:

- Shelter and charger modules in underground stations
- Solar powered chargers in streetlamps in university campuses, parks...
- Solar powered chargers integrated in bus canopies, with vertical parking of LEVs

The following picture shows and example of the concept design for the LEV chargers.

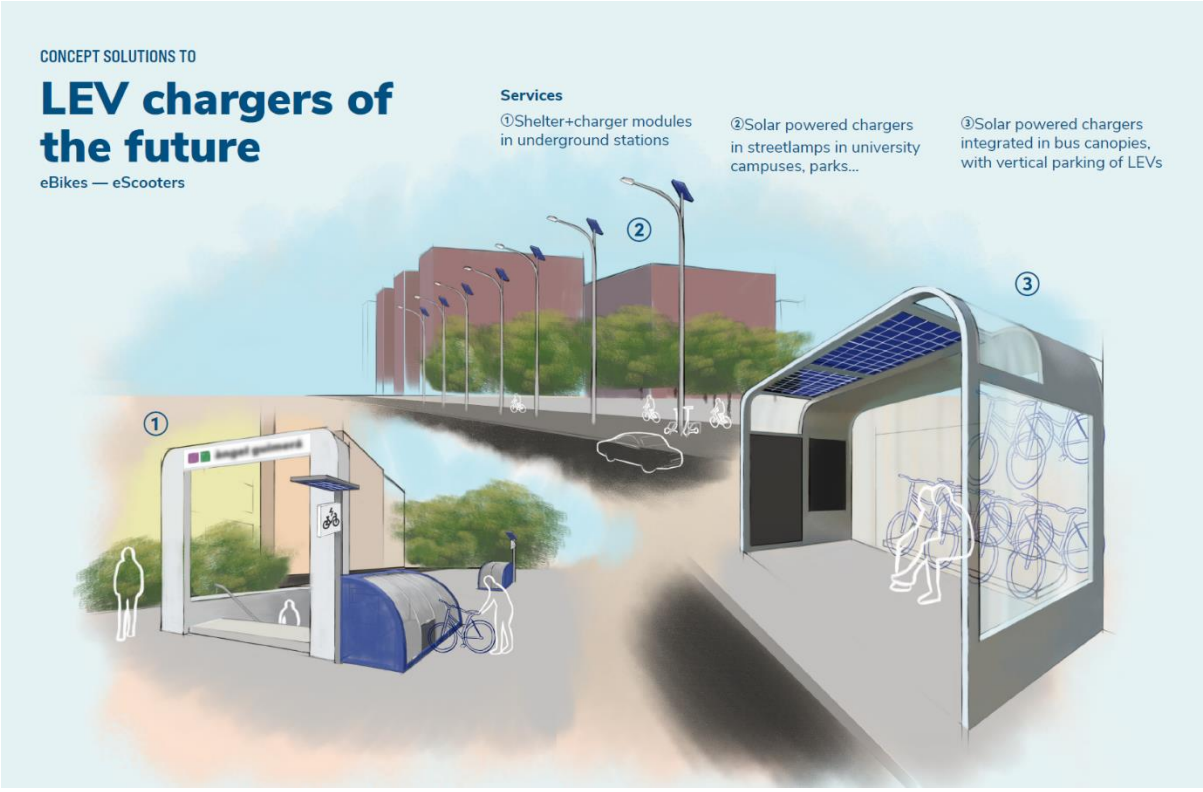

Figure 20: Concept design of the LEV chargers.

9.2 The main features

According to stations' main features presented in Table 1 the following technologies should be included in the LEV chargers concept design:

- Photovoltaic panels connected to grid
- Modularity
- Battery storage cabinets
- Battery swaping
- AC chargers
- Charging booking

The LEV chargers should be located close to university campuses and be integrated into bus canopies or underground stations.

Chargers should be installed in urban furniture, streetlamps and benches.

The following figure shows the main features of the LEVs chargers grouped in the three categories.

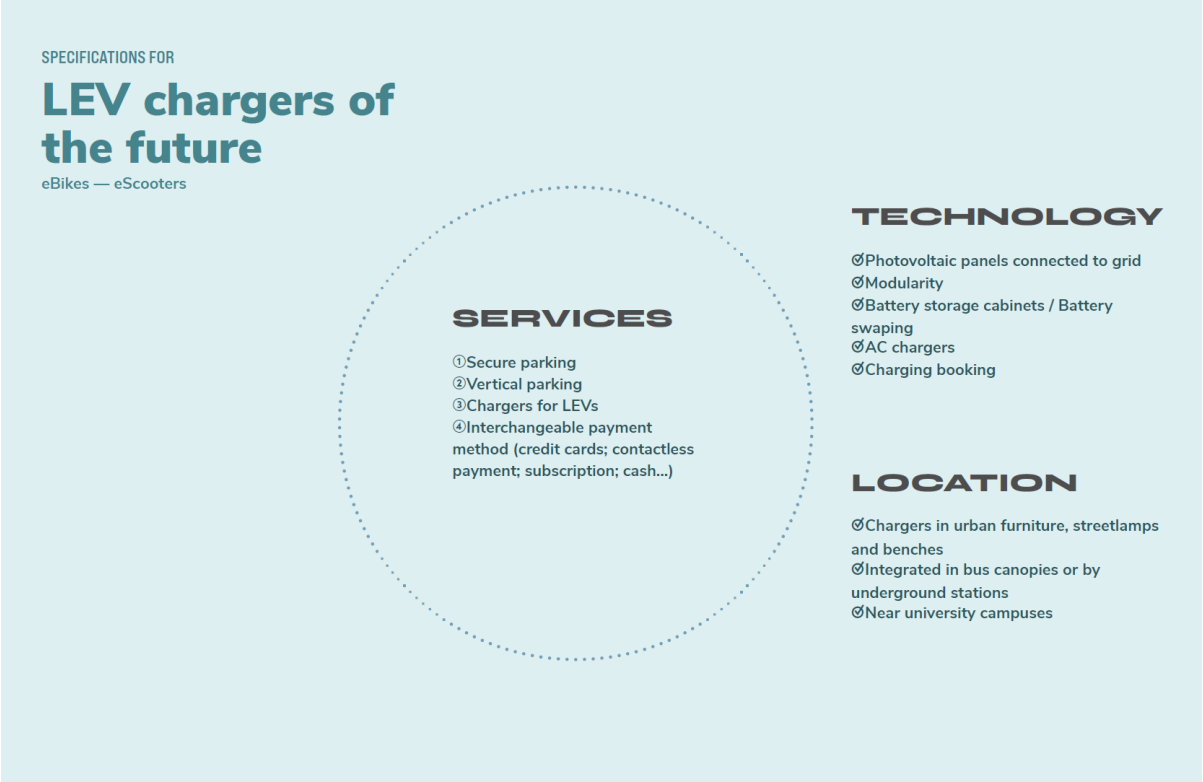

Figure 21: Main features of the LEV chargers.

9.3 The business model

According to the seven business models related to the charging process of EVs defined, the concept design of the LEV chargers does not match exactly with one of these business models, but the concept is related, at a different level, with various of these models.

From the business model point of view, the LEV chargers of the future is a station including intermodal mobility and services of park&charge. For this reason, a combination of several business is applicable

- BM2 – Citizen e Mobility Station.
- BM3 – City Centre (Park&Charge).

The following figure represents the CANVAS of the business model for the LEV chargers highlighting the most relevant aspects.

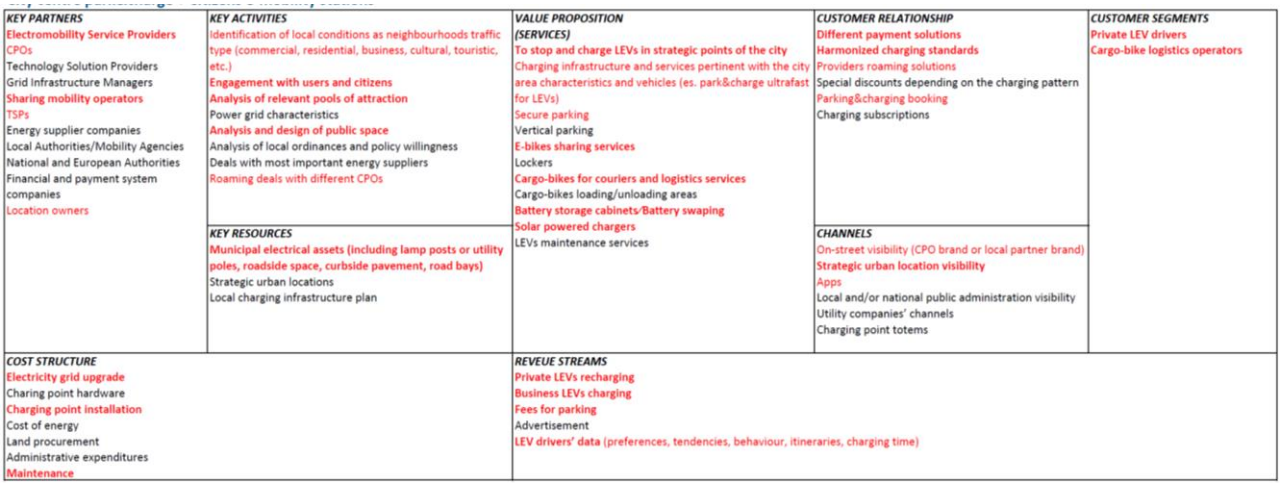

Figure 22: Most relevant features of the combined BMs, considered in the LEV chargers concept

9.3.1 Business

The business represented in the upper left side of the CANVAS business model is composed by the key partners, activities and resources.

The key partners of LEV chargers are electromobility service providers, CPOs, sharing mobility operators and location owners.

The main activities and resources of LEV chargers are engagement with users and citizens, analysis of relevant pools of attraction, analysis and design of public space and municipal electrical assets.

9.3.2 Market

The market represented in the upper right side of the business model chart is composed by the customer segments and relationship and the channels.

The market of the LEV chargers is segmented in private LEV drivers and cargo-bike logistics operators.

The most used channel of the LEV chargers is through Apps and the different payment solutions, harmonized charging standards, providers roaming solutions and strategic urban location visibility are the basics of customer relationship.

9.3.3 Flow

The flow represented in the lower boxes of the business model chart is composed by the revenue streams and the costs' structure.

The electricity grid upgrade, the charging point installation and the maintenance are the main costs' structure of the LEV chargers.

The main sources of income of the LEV chargers come from private LVEs recharging, business LVEs charging, fees for parking and LEV drivers' data.

9.3.4 Value

The value is represented in the central part of the CANVAS business model.

The main value that the LEV chargers provide is to stop and charge LVEs in strategic locations in the city, charging infrastructure and services tailored to cities specific features and to different vehicle models, secure parking, eBikes sharing services, cargo-bikes for couriers and logistics services, loading and unloading areas, battery storage cabinets, battery swapping and solar powered chargers.

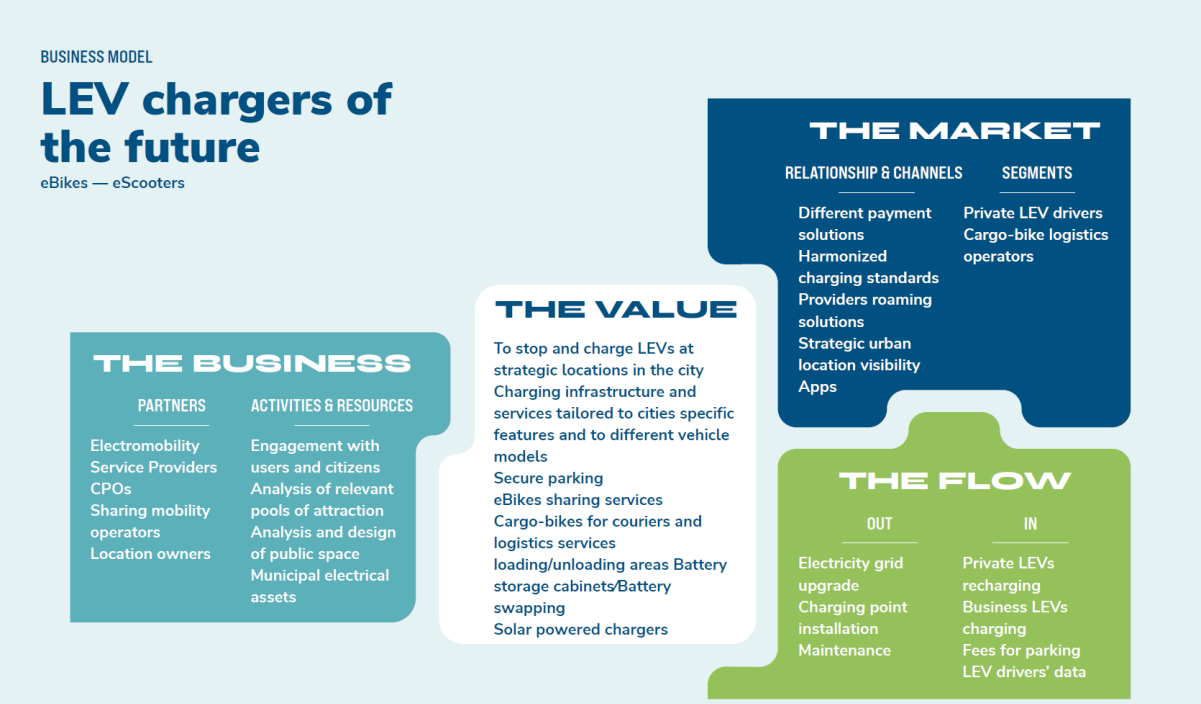

Figure 23: Business model of the LEV chargers.

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