



# Stations of the Future: a study on EV charging stations considering users' requirements and expectations

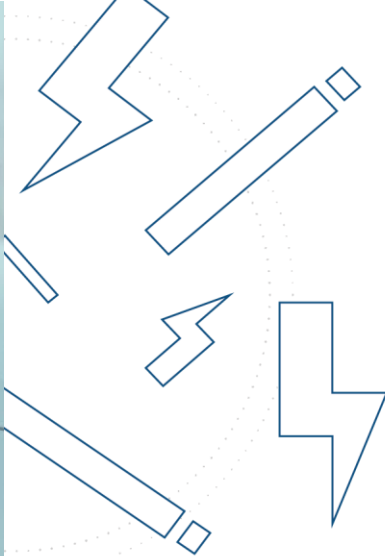
APRIL 18<sup>TH</sup>, 2024



# STATIONS OF THE FUTURE

USER-CHI

Charging your e-mobility future



**USER-CHI**  
CHARGING YOUR E-MOBILITY FUTURE



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [875187]



# Introduction

USER-CHI is a research and innovation project, 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.

## STATIONS OF THE FUTURE

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

# Highlights



*THE UPCOMING SCENARIO IN MOBILITY IS*

## **ELECTROMOBILITY**

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, we need to provide appropriate charging infrastructure.

# The Context

## Electromobility and the USER-CHI project

## HOW MANY CHARGERS DO WE NEED? AND WHAT TYPE?

Although amount of chargers is quite different between Norway and Germany-Spain, Norwegians consider that the charging infrastructure is still an unsolved issue. This suggests that even in Norway the charging infrastructure has not overcome the required critical threshold, or perhaps there is something else...

### NUMBER OF EV CHARGE INFRASTRUCTURE PER POPULATION

	GERMANY	NORWAY	SPAIN
<b>Tesla Supercharger</b>	1/1.000.000	1/70.000	1/700.000
<b>Tesla Dest Charger</b>	1/100.000	1/37.000	1/100.000
<b>Charging Point</b>	1/10.000	1/2.000	1/9.000
<b>Connector</b>	1/4.500	1/900	1/3.400

## ELECTROMOBILITY IS ONLY A QUANTITATIVE PROBLEM, OR QUALITATIVE ASPECTS ALSO MATTER?

### TRENDS IN EVs

- 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

### OUR AIM

In order to achieve the project aims, USER-CHI is focused in defining the charging infrastructures for EVs and LEVs that create value for customers, the industry and the society.

# How do we boost electromobility?

## It's a matter of quantity, but the qualitative matters

## ACCORDING TO OUR RESEARCH, CAR ELECTROMOBILITY HAS REQUIREMENTS:

### 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.

### 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.



### DESIRABLE REQUIREMENTS

- Additional services to perform activities when charging the battery. We could differentiate between:
  - Services at urban charging points, like shopping malls or mobility hubs.
  - Services at the 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.

# What did we find out?

## There are basic drivers, valuable requirements and desirable features

## AND WHAT ABOUT LEVs IN ELECTROMOBILITY?

### INCREMENTAL GAIN REQUIREMENTS (FOR LEVs)

- Specific free charging points for LEVs in urban areas.
- Lighter e-Bikes (they are currently heavier than conventional bikes).
- Safer e-Scooters.



## AND WHAT ABOUT THE GENDER ISSUES?

### What differences do they make in electromobility?

Based on our research, women tend to park in private parking. On the other hand, women would like to have more charging points at home. Both results could be related to security reasons as the risk of sexual harassment is higher for women in public spaces. From the gender perspective, there are two different dominant patterns and needs associated. This should be addressed when planning charging stations in the future.

Does everybody need the same?

LEVs have specific requirements. And women have a different experience ...

		Technologies	Services / User demands	Location
<b>Intermodal Station</b>	Electric cars – eBikes – eScooters – Public transport	<ul style="list-style-type: none"> <li>Chargers for LEVs</li> <li>Shared electric scooters (eScooters), electric-assist bicycles (eBikes) and electric mopeds.</li> <li>Slow chargers. Low power chargers (AC, Inductive charging)</li> <li>Fast chargers (DC)</li> <li>Pay for charging (not parking), interchangeable payment method (credit cards; contactless payment; subscription, cash, ...)</li> <li>Rental and shared vehicle area</li> </ul>	<ul style="list-style-type: none"> <li>Standard and fast chargers</li> <li>Inductive charging for EVs + Maintenance + Parking lot</li> <li>Chargers for LEVs</li> <li>Intermodal ticketing point</li> <li>Cafeteria</li> <li>Toilets</li> <li>Lockers &amp; Courier service</li> <li>Coworking &amp; resting area</li> </ul>	<ul style="list-style-type: none"> <li>Nature integrated</li> <li>Anti-theft / safe zona</li> <li>Railway station, city accesses, university campuses</li> <li>Big space is required</li> </ul>
<b>Urban Station</b>	Electric cars – eBikes – eScooters - Electric vans	<ul style="list-style-type: none"> <li>Slow chargers (AC)</li> <li>Fast chargers (DC)</li> <li>Parking &amp; Charging booking</li> <li>Restricted access</li> <li>Interchangeable payment method (credit cards; contactless payment; subscription, cash, ...)</li> </ul>	<ul style="list-style-type: none"> <li>Parking &amp; Charging service for LEVs and EVs</li> <li>Lockers &amp; Courier service</li> <li>Logistics</li> <li>Short stays</li> <li>Loading/Unloading area</li> </ul>	<ul style="list-style-type: none"> <li>City Center</li> <li>Neighborhood</li> <li>Shopping area</li> </ul>
<b>Highway Station</b>	Electric cars – Electric vans	<ul style="list-style-type: none"> <li>Fast chargers (DC)</li> <li>Charging booking</li> </ul>	<ul style="list-style-type: none"> <li>Interchangeable payment method (credit cards; contactless payment; subscription, cash, ...)</li> <li>Cafeteria</li> <li>Toilets</li> <li>Coworking &amp; resting area</li> <li>Vehicle maintenance</li> <li>Playground / Physical activity</li> </ul>	<ul style="list-style-type: none"> <li>Highway</li> </ul>
<b>LEV Station</b>	eBikes – eScooters – eMopeds	<ul style="list-style-type: none"> <li>Photovoltaic panels connected to grid</li> <li>Modularity</li> <li>Battery storage cabinets / Battery swapping</li> <li>AC chargers</li> <li>Charging booking</li> </ul>	<ul style="list-style-type: none"> <li>Secure parking</li> <li>Vertical parking</li> <li>Interchangeable payment method (credit cards; contactless payment; subscription, cash, ...)</li> </ul>	<ul style="list-style-type: none"> <li>Chargers in urban furniture, street lights and benches</li> <li>Bus canopies, underground</li> <li>University campus</li> </ul>

# According to the users' demands, FOUR different stations:

- The Long and the Short range
- Peri-urban areas and city centre
- Public Transport and active mobility

## Intermodal station of the future

Citizens e-mobility stations + Logistics Hubs + E-taxi stops + City centre park&charge



Before introducing our concept designs ...

... a little explanation about how we tackled the business models definition

Date: 31/01/2022  
Author(s): Gabriele Pistilli, Fabio Cartolano





CONCEPT SOLUTIONS TO

# Intermodal station of the future

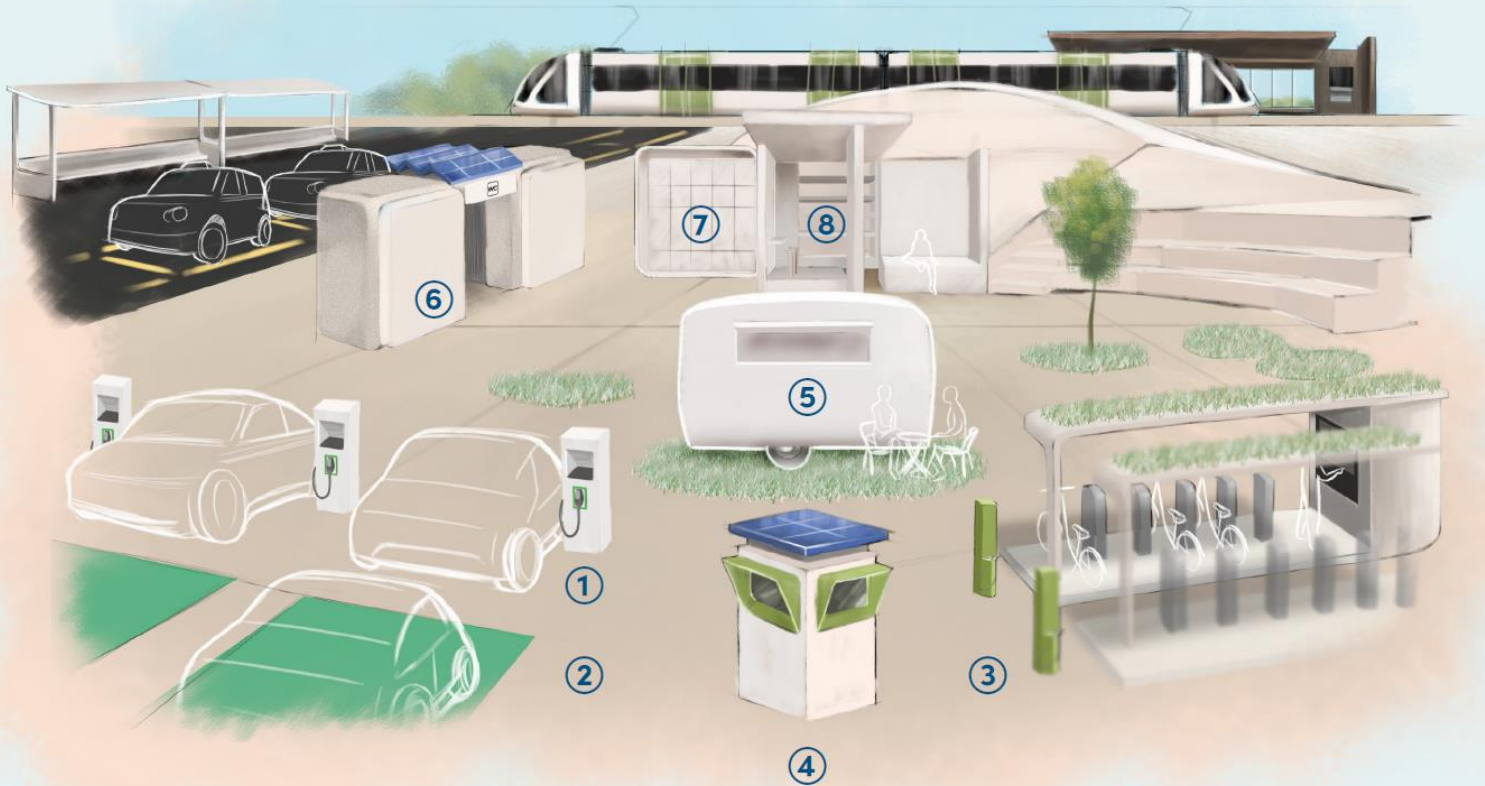
Electric cars — eBikes — eScooters — Public transport

## Services

①Chargers & ②inductive charging for EVs + vehicle maintenance + parking lot

③Chargers for LEVs  
④Intermodal ticketing point  
⑤Cafeteria

⑥Toilets  
⑦Lockers & courier service  
⑧Coworking & resting area



USER-CHI — Stations of the Future

## The Intermodal Station of the Future

A station to  
support the  
multimodal  
mobility

# Intermodal station of the future

Electric cars — eBikes — eScooters — Public transport

## SERVICES

- ① Standard and fast chargers
- ② Inductive charging for EVs + vehicle maintenance + parking lot
- ③ Chargers for LEVs
- ④ Intermodal ticketing point
- ⑤ Cafeteria
- ⑥ Toilets
- ⑦ Lockers & courier service
- ⑧ Coworking & resting area

## TECHNOLOGY

- ∅ Chargers for LEVs
- ∅ Shared electric scooters (e-scooters), electric-assist bicycles (e-bikes) and electric mopeds
- ∅ Slow chargers. Low power chargers (AC, inductive charging)
- ∅ Fast chargers (DC)
- ∅ Pay for charging (not parking), payment method interchangeable (credit cards; contactless payment; subscriptions, cash...)
- ∅ Rental and shared vehicle area

## LOCATION

- ∅ Nature-integrated
- ∅ Anti-theft/safe zone
- ∅ Railway station, city accesses, university campuses
- ∅ Big space is required

# Intermodal Station main features

- Services
- Technology
- Location

# Intermodal station of the future

Electric cars — eBikes — eScooters — Public transport

## Intermodal Station business model

- Citizens e-mobility
- Logistics Hubs
- e-Taxi stops
- CC park&charge

### THE BUSINESS

PARTNERS	ACTIVITIES & RESOURCES
Electromobility Service Providers CPOs Grid Infrastructure Managers Energy supplier companies	Power grid characteristics Deals with most important energy suppliers Roaming deals with different CPOs Strategic locations

### THE VALUE

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
- Energy storage solutions

### THE MARKET

RELATIONSHIP & CHANNELS	SEGMENTS
Harmonized charging standards Providers roaming solutions Apps	Private drivers PT companies Electromobility providers Logistics operators

### THE FLOW

OUT	IN
Electricity grid upgrade Charging point installation Land setting and adaptation Maintenance	Private vehicles recharging Business vehicles charging Maintenance services Ancillary general services Ancillary logistics services EV drivers' data

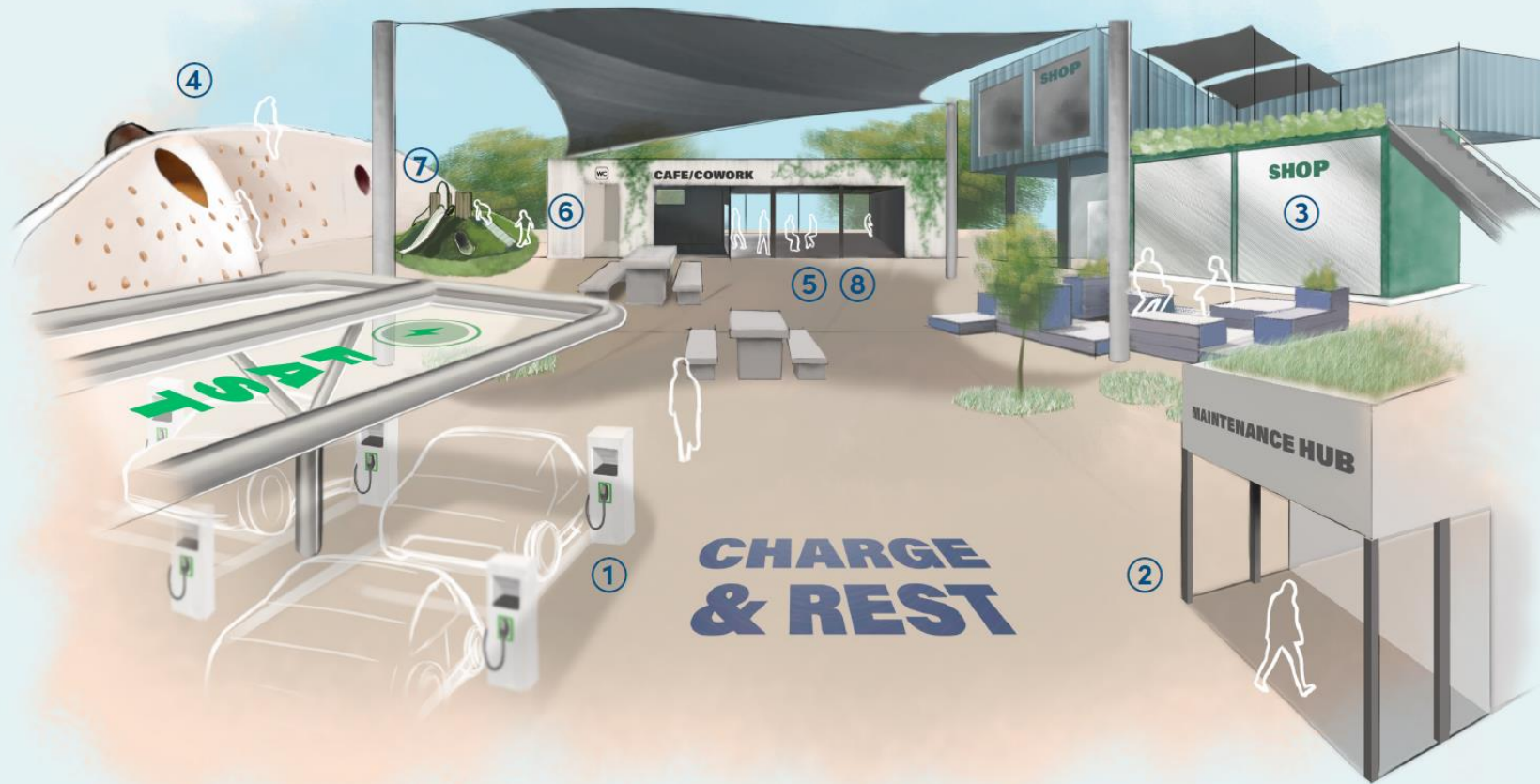
CONCEPT SOLUTIONS TO

# Highway station of the future

Electric cars — Electric vans

## Services

- ① Fast chargers + parking lot
- ② Vehicle maintenance
- ③ Shops
- ④ Fitness/Playground zone
- ⑤ Cafeteria
- ⑥ Toilets
- ⑦ Playground
- ⑧ Coworking & rest area



USER-CHI — Stations of the Future

## The Highway Station of the Future

A station to support the long range electromobility

SPECIFICATIONS FOR

# Highway station of the future

Electric cars — Electric vans

## SERVICES

- ① Fast chargers
- ② Vehicle maintenance + parking lot
- ③ Shops
- ④ Physical activity zone
- ⑤ Cafeteria
- ⑥ Toilets
- ⑦ Playground
- ⑧ Coworking & resting area

## TECHNOLOGY

- ✔ Fast chargers (DC)
- ✔ Booking of chargers

## LOCATION

- ✔ Nature-integrated
- ✔ Highway
- ✔ Big space is required

## Highway Station main features

- Services
- Technology
- Location

# Highway station of the future

Electric cars — Electric vans

## THE BUSINESS

### PARTNERS

Highway operators and concessionaries  
CPOs  
Grid Infrastructure Managers

### ACTIVITIES & RESOURCES

Analysis of relevant pools of attraction  
Power grid characteristics  
Roaming deals with different CPOs  
National electrical assets

## THE VALUE

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  
Provision of mobile charging stations

## THE MARKET

### RELATIONSHIP & CHANNELS

Booking of chargers  
Providers roaming solutions  
Parking & charging points for trucks  
Highway administrations and operators visibility

### SEGMENTS

Private drivers  
Professional EV drivers  
Logistics operators

## THE FLOW

### OUT

Electricity grid upgrade  
Charging point hardware (specific for heavy vehicles)  
Maintenance  
Staff, security

### IN

Logistics vehicles recharging  
Private vehicles recharging  
Business vehicles charging  
Ancillary general services  
EV drivers' data

# Intermodal Station business model

- Citizens e-mobility
- Special Events
- e-Trucks
- Mobile charging

CONCEPT SOLUTIONS TO

# LEV chargers of the future

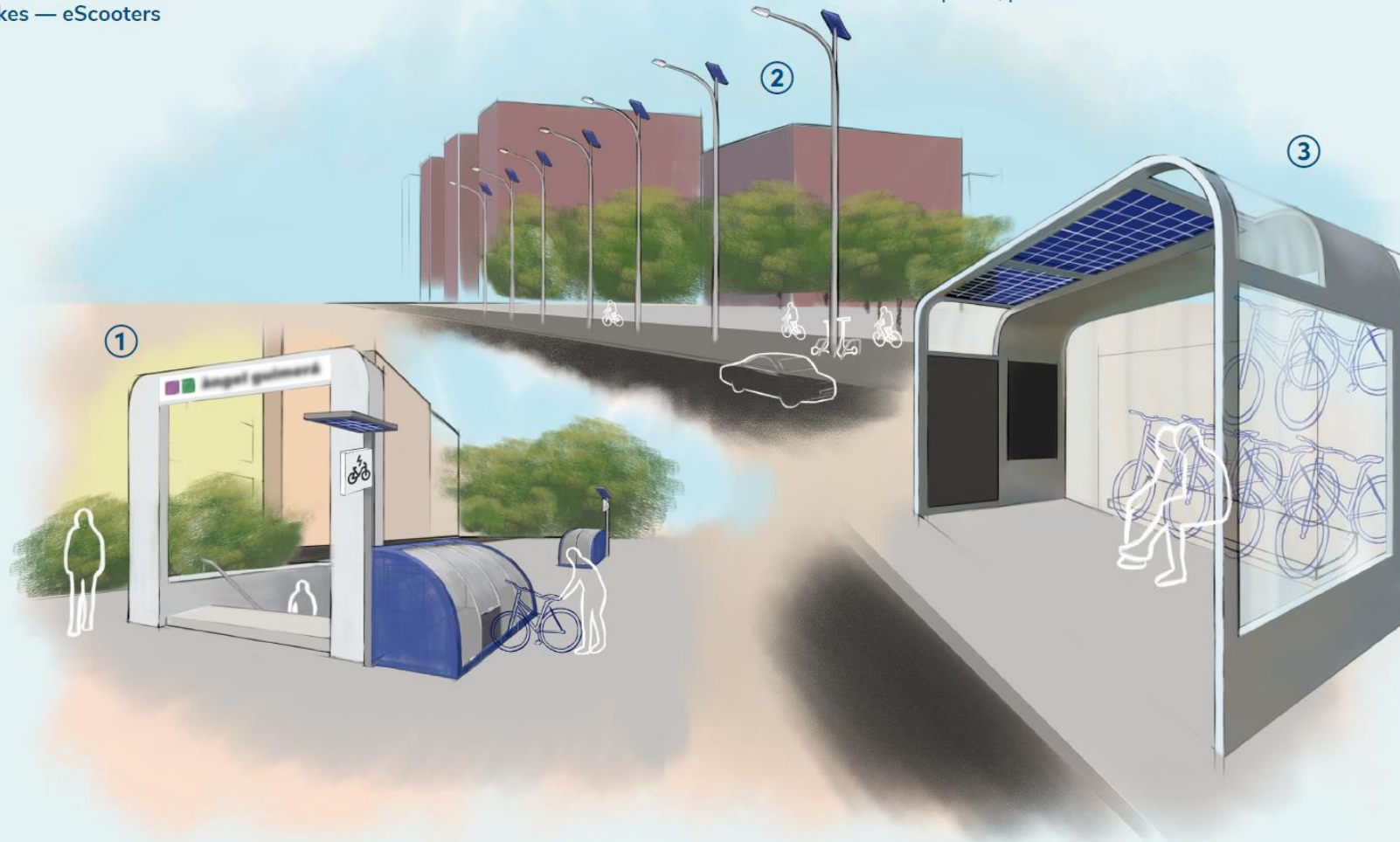
eBikes — eScooters

## Services

① Shelter+charger modules in underground stations

② Solar powered chargers in streetlamps in university campuses, parks...

③ Solar powered chargers integrated in bus canopies, with vertical parking of LEVs



USER-CHI — Stations of the Future

## The LEV chargers of the Future

A station to support the active, multimodal and sustainable mobility

# LEV chargers of the future

eBikes — eScooters

## SERVICES

- ① Secure parking
- ② Vertical parking
- ③ Chargers for LEVs
- ④ Interchangeable payment method (credit cards; contactless payment; subscription; cash...)

## TECHNOLOGY

- ☑ Photovoltaic panels connected to grid
- ☑ Modularity
- ☑ Battery storage cabinets / Battery swapping
- ☑ AC chargers
- ☑ Charging booking

## LOCATION

- ☑ Chargers in urban furniture, streetlamps and benches
- ☑ Integrated in bus canopies or by underground stations
- ☑ Near university campuses

# LEV chargers main features

- Services
- Technology
- Location



BUSINESS MODEL

# LEV chargers of the future

eBikes — eScooters

## LEV chargers business model

- Citizens e-mobility
- CC park&charge

### THE BUSINESS

**PARTNERS**

Electromobility Service Providers  
CPOs  
Sharing mobility operators  
Location owners

**ACTIVITIES & RESOURCES**

Engagement with users and citizens  
Analysis of relevant pools of attraction  
Analysis and design of public space  
Municipal electrical assets

### THE VALUE

To stop and charge LEVs at 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/unloading areas  
Battery storage cabinets/Battery swapping  
Solar powered chargers

### THE MARKET

**RELATIONSHIP & CHANNELS**

Different payment solutions  
Harmonized charging standards  
Providers roaming solutions  
Strategic urban location visibility  
Apps

**SEGMENTS**

Private LEV drivers  
Cargo-bike logistics operators

### THE FLOW

**OUT**

Electricity grid upgrade  
Charging point installation  
Maintenance

**IN**

Private LEVs recharging  
Business LEVs charging  
Fees for parking  
LEV drivers' data

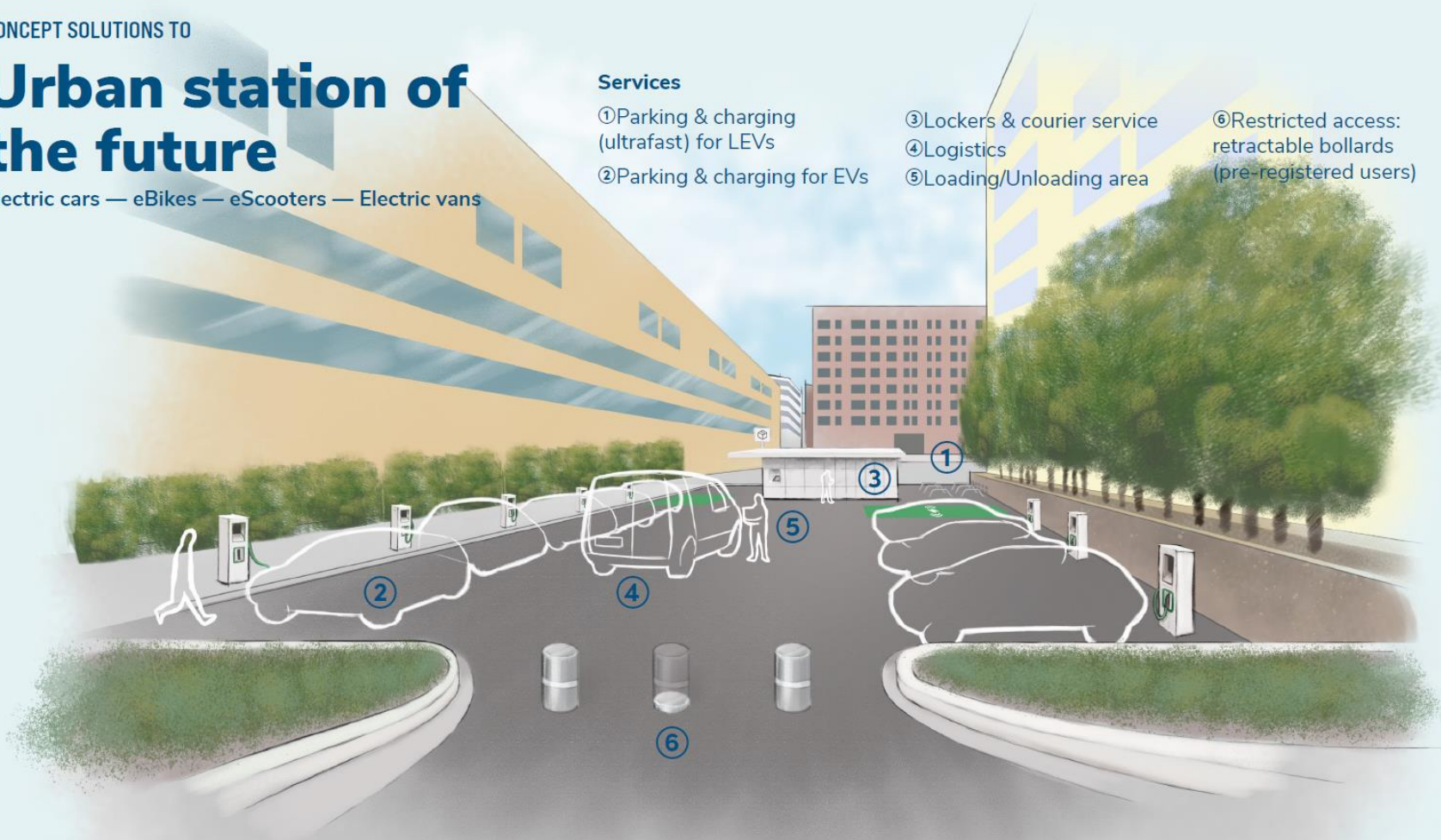
CONCEPT SOLUTIONS TO

# Urban station of the future

Electric cars — eBikes — eScooters — Electric vans

## Services

- ① Parking & charging (ultrafast) for LEVs
- ② Parking & charging for EVs
- ③ Lockers & courier service
- ④ Logistics
- ⑤ Loading/Unloading area
- ⑥ Restricted access: retractable bollards (pre-registered users)



## The Urban Station of the Future

A station to support the new mobility in the cities

SPECIFICATIONS FOR

# Urban station of the future

Electric cars — eBikes — eScooters — Electric vans

## SERVICES

- ① Parking & charging (ultrafast) for LEVs
- ② Parking & charging (AC & DC) for EVs
- ③ Lockers and courier service
- ④ Logistics
- ⑤ Loading/Unloading area
- ⑥ Short stays

## TECHNOLOGY

- ☑ Slow chargers (AC)
- ☑ Fast chargers (DC)
- ☑ Parking & charging booking
- ☑ Restricted access
- ☑ Pay for charging (not parking), payment method interchangeable (credit cards; contactless payment; subscriptions, cash...)

## LOCATION

- ☑ City centre
- ☑ Neighbourhood
- ☑ Shopping area

# Urban Station main features

- Services
- Technology
- Location

# Urban station of the future

Electric cars — eBikes — eScooters — Electric vans

## THE BUSINESS

### PARTNERS

Electromobility Service Providers  
CPOs  
Grid Infrastructure Managers  
Local authorities/  
Mobility agencies

### ACTIVITIES & RESOURCES

Identification of local conditions as neighbourhoods traffic type  
Analysis of relevant pools of attraction  
Power grid characteristics  
Municipal electrical assets

## THE VALUE

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  
Loading/unloading areas

## THE MARKET

### RELATIONSHIP & CHANNELS

Different payment solutions  
Harmonized charging standards  
Providers roaming solutions  
Parking&Charging booking  
Apps

### SEGMENTS

Private drivers  
Charging at home  
Charging at office  
Charging during shopping  
Taxi corporations

## THE FLOW

### OUT

Electricity grid upgrade (especially for DC fast charging points)  
Charging point hardware  
Charging point installation  
Land procurement

### IN

Logistics vehicles recharging  
Private vehicles recharging  
Business vehicles charging  
EV drivers' data

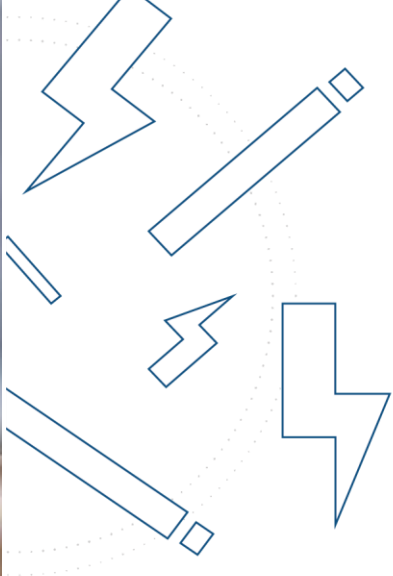
# Urban Station business model

- Logistics Hubs
- e-Taxi stops
- CC park&charge

## Some conclusions

- A Handbook to promote electromobility, based on user needs and expectations regarding the charging process of EVs.
- Our concepts aim to be a reference to support electromobility actors to implement the facilities their cities need to boost a more sustainable and active mobility.  
CWA18090 2024
- The Handbook relates every concept to different business models that have been defined and assessed with relevant European cities.
- A *CEN Workshop Agreement (CWA)* have been produced, with the aim of disseminating these results among the mobility industry (CWA18090 2024)

STATIONS  
OF THE  
FUTURE



# THANK YOU!

ANY QUESTIONS OR COMMENTS?

## CONNECT WITH US:

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[Download the Handbook here](#)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [875187]