D8.8 BUSINESS MODEL VALIDATION RESULTS (I)

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Abstract

The Deliverable 8.8 outlines in a first release the elements driving and characterising the electromobility market in seven different Business Models (BMs): BM1 – Logistics hubs; BM2 – Citizens e-Mobility Stations; BM3 –City centre (park & charge); BM4 – E-trucks; BM5 – E-taxis stops; BM6 – Special events; BM7 – Mobile charging stations. Different areas of impact have been 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 been 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. In this framework, a preliminary analysis of the business models has been drafted and will be completed in D8.9 (M36) with a more precise validation of the proposed project solutions and to indicate whether the USER-CHI business models are viable, attractive, and economically sustainable also after the project end.

Keywords

Business modelling, Value proposition, Pricing, Demand Management, Product Management, Business Analysis, Economic Sustainability.

Copyright statement

Executive summary

The purpose of this document is to provide a first analysis of the seven business models considered in project objective O5, to co-design and demonstrate novel and sustainable business and market alternatives to foster investments and enable replication in the electromobility sector. The business models will 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. For every city interested in the specific business model, based on the results of several workshops conducted with the local project partners, the local value proposition will also be defined, the solutions planned (coming from the USER CHI products), the related user needs and the solution benefits expected from the local projects and programs. Finally, for each USER-CHI business model, a CANVAS management template is reported illustrating the key partners, activities, resources, the value proposition, the customer segments, the business channels, the cost structure, and the revenue streams.

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1. Introduction

The purpose of this document is to provide a first analysis of the seven business models considered in project objective O5, to co-design and demonstrate novel and sustainable business and market alternatives to foster investments and enable replication in the electromobility sector. The seven Business Models (BMs) are: BM1 – Logistics hubs; BM2 – Citizens e-Mobility Stations; BM3 –City centre (park & charge); BM4 – E-trucks; BM5 – E-taxis stops; BM6 – Special events; BM7 – Mobile charging stations. The business models will 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. In this framework, a preliminary analysis of the business models has been drafted and will be completed in D8.9 (M36) with a more precise validation of the proposed project solutions and to indicate whether the USER-CHI business models are viable, attractive, and economically sustainable also after the project end.

1.1 Document structure

The Deliverable 8.8 reports the business modelling analysis conducted for all the USERC-CHI specific cases and outlines the preliminary business models developed in each demo site utilising the products realised in the project.

The document is structured as follows:

- Chapter 1 is the present introductory section.
- Chapter 2 describes the business model generation process adopted during the analysis
- Chapter 3 presents business models developed per each USER-CHI specific case
- Chapter 4 reports the final considerations and conclusions about the present preliminary deliverable and anticipations of the following conclusive one (D8.9).

1.2 Background

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 – by, for instance, implementing dynamic charging pricing – 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.

2. Business model generation process

This section describes the methodology and the process used to generate USER CHI business models reported in the next section following the methodology proposed by Osterwalder and Pigneur[1].

2.1 Guidelines

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 Electric Vehicle Supply Equipment (EVSE) and related solutions proposed as products of USER CHI. As a matter of fact, they refer to a market with limited maturity and whose overall context (the expected large uptake of electromobility) is expected to be highly influenced by public interventions (both funding for research and

[1] Alexander Osterwalder and Yves Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers and Challengers (Hoboken, New Jersey: John Wiley and Sons, Inc., 2010)

developments and future regulations) for its high relevance in the transport domain. For this reason, the initial stages of the business modelling generation process described in this section propose a detailed identification of both public and private values linked to product or services to be offered. This is a preliminary step leading to the subsequent iterative process of business modelling generation, whose main goal is to support USER CHI consortium partners in:

- Refining, describing and communicating the project value propositions to their customers and all other stakeholders along with the development process that is in progress;
- Identifying how to create and deliver the related values;
- Elaborate strategies and define actions for capturing economic value while addressing social and environmental dimensions considered crucial by the overall market context.

2.2 Step 1: creating a proposed vision for USER-CHI services

The initial step of the business modelling process adopted in USER CHI was to outline a unified vision of delivered services and to identify common characteristics facilitating the definition of concrete value propositions. This process has been articulated in the following activities:

1. **Strategic activities**, i.e. creating adaptable, long-term visions that acknowledge the complexities of societal problems. Visions are desired future states based on current sustainability problems shared by collectives. Visions have been investigated during the workshops held with project stakeholders by capturing long-term plans envisioned in their organisations.

2. **Tactical activities** linking individual actor strategies to the shared long-term visions created via strategic activities, aiming to overcome short-termism within different societal sectors. This activity was carried out by harmonising different stakeholders' visions and focusing on medium-short term plans dealing with politics, business or societal goals in each organisation.

3. **Operational activities** aim to link everyday activities, such as innovative experiments, to long-term visions, broader policies, and change agendas. Innovations can occur in several dimensions – in terms of new goods and services such as EVSE and were investigated by linking actors' plans with USER-CHI products (summarised in section 4.1).

4. **Reflexive activities** include the ongoing monitoring, assessment and evaluation of experimental policies and practices to revise overarching visions and plans where

necessary. Assessments and evaluations, when shared and disseminated effectively, can also lead to broader changes outside the system in question. This step will be continued during the next period and will be included in the final version of Business models (D8.9 Business model validation results).

2.3 Step 2: identify and map ecosystem actors

This step identifies the ecosystem actors that are critical to the delivery of USER-CHI products (i.e. the value chain). This has been done by sketching a hypothetical business model and identifying subjects that are fundamental to the delivery of a service, in addition to any other ecosystem members that are critical to value creation, distribution and capture.
Hypothetical business models were sketched from a service-operator perspective (be they public administrations or private entities) by analysing their potential "pain relievers" or "gain creators", therefore moving from identified problems to potential improvement aspects; finally leading to identify and design the value proposition.

2.4 Step 3: a methodology for developing sustainable business models

The methodology used for the present business modelling generation process refers to the business model CANVAS, introduced by Alexander Osterwalder[2]. It supports a creative and qualitative process that can involve relevant actors and delivers a visual overview of the mechanisms of the proposed business.

[2] Alexander Osterwalder and Yves Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers and Challengers (Hoboken, New Jersey: John Wiley and Sons, Inc., 2010)

The canvas describes the structure of business models and how they create, deliver and capture value. The CANVAS (see Figure 1) comprises nine building blocks: a value proposition (a product or service that is offered to customers), customer interfaces (segment identification and related relationships) and distribution channels, a financial model (cost and revenue structure that distributes benefits across business model stakeholders), key partners, resources and activities.

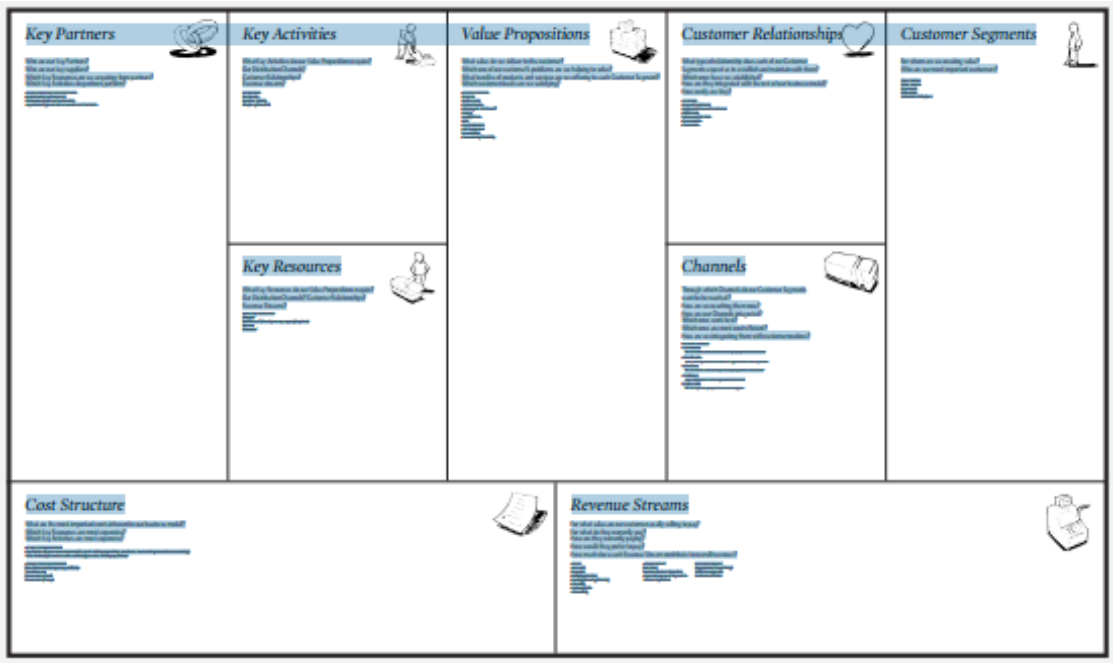

Figure 1: Business model CANVAS

Moving from a general overview of the electromobility landscape with its current trends, the business models reported in the next section have been elaborated with an iterative process depicted in Figure 2, where initial assumptions (aimed at identifying the value chain and values per each actor) were modelled in a design experiment (sketching the value propositions and the overall business model) and then submitted for validation tests to potential customers/stakeholders in dedicated workshops, in order to gain relevant insights and recommendations.

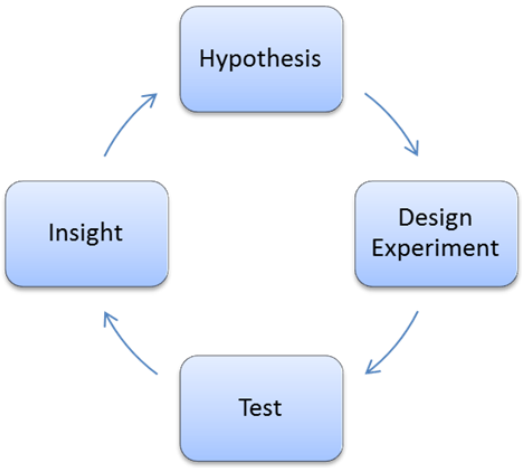

Figure 2: Iterative business modelling process

2.5 Step 4: identifying and engaging key stakeholders

During the workshops, key stakeholders were identified by considering the whole ecosystem for each demo site and each business case. Stakeholders are not directly involved in delivering the value proposition but somehow identified in the value chain because they have an advantage from the success of the business case. They may be transport operators, logistics service providers, facility managers, energy supplier companies, national/European authorities, financial entities, etc. The engaging process was considered as a key step for capturing support from these subjects that will be fundamental for the success of the business model because of their capacity to attract, influence or aggregate potential customers or to provide knowledge and assistance in the operational phases for infrastructure, legal, and financial services.

2.6 Step 5: service design considerations

This step relates to additional considerations facilitating the uptake of business models. In the start-up phase a new service may be adopted by enthusiastic innovators (a very limited number of customers) but next steps to engage the so-called early innovator and later the early majority (usually identified as “crossing the chasm”) are the most critical and often need to be supported or incentivised considering how to design the service with regards to pricing models, subscription schemes, nudging or maybe gamification. Some of these features are sketched in the business models proposed in the next section; they will be further investigated in the next project period and reported in D8.9 Business model validation results.

3. USER-CHI business models

This section will report the results of the first iteration analysis conducted about the seven Business Models (BM) considered in the project objective O5: (BMs): BM1 – Logistics hubs; BM2 – Citizens e-Mobility Stations; BM3 –City centre (park & charge); BM4 – E-trucks; BM5 – E-taxis stops; BM6 – Special events; BM7 – Mobile charging stations. For each BM, specific focuses are reported on the project cities that expressed interest in the business case (Table 1) and CANVAS templates describing the structure of business models.

Table 1: Cities - Business models matrix

	BARCELONA	BERLIN	BUDAPEST	TURKU	ROME
BM1 – Logistics hubs	X				
BM2 – Citizens e-Mobility Stations		X	X		X
BM3 – City centre (park & charge)		X			
BM4 – E-trucks				X	
BM5 – E-taxis stops	X			X	
BM6 – Special events			X	X	X
BM7 – Mobile charging stations					X

Before describing the business analysis results, a recap of the USER-CHI products associated with the local use cases is reported.

3.1 USER-CHI products in a nutshell

With the aim to achieve its strategic challenges and objectives, USER-CHI will generate a wide-ranging set of solutions comprehending all aspects of a massive deployment of electric vehicles. The following table summarises the main characteristics of USER-CHI products to be implemented and then associated in the different use cases of the pilot sites.

Table 2: USER-CHI products to be implemented in the Pilot Sites

Product	Short description
CLICK – Charging Location and Holistic Planning Kit	CLICK will be conceived as an easy-to-use question-and-answer online tool for the top-down location planning for charging infrastructure. The main objectives rely in the optimisation of the location and planning of

	new charging infrastructure in cities and TEN-T corridors, matching the users' needs, preferences, and habits, with the existing charging technologies and typologies available in the market.
INCAR – Interoperability, Charging and Parking Platform	INCAR will consist of a platform able to offer customised solutions to different end-users to satisfy their needs and so improve the customer experience. Its offer includes a set of innovative integrated EV-related services such as (i) interoperability and roaming to access EVSEs, (ii) booking features of parking slots and charging stations avoiding waiting times and increasing the usage of existing infrastructure (park & charge combined service), (iii) real-time information about publicly accessible EVSEs, (iv) searching and routing to EVSEs, and (v) integration with route planning of EV fleets.
SMAC – Smart Charging Tool	SMAC will provide users with a platform offering smart grid integration services for slow, medium, fast, and ultrafast charging. This will be complemented by a set of high-value services for EV drivers, such as maximising Renewable Energy Sources (RES) electricity supply and competitive charging prices.
INSOC – Integrated Solar-DC charging for LEVs	INSOC will include a software and hardware combined solution to satisfy LEVs (e-bikes, e-scooters, etc) charging needs, by also integrating on-site production of RES and theft-proof parking.
INDUCAR – Inductive Charging for e-Cars	INDUCAR will foresee an inductive charging solution to deliver a high level of automated power transfer. This will allow offering a very advantageous charging experience to the user (e.g. avoiding manual handling of cables).

3.2 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 does not involve only local industries but all the three main sectors characterising the business: supply, storage, and last mile distribution.

At a global level, the digitalisation of the supply chain should imply for the sector a value of about 4 billion dollars by 2025[3], moving funds and investments coming from the three main sector players: e-commerce sellers, real-estate firms, and express couriers[4] .Investments directed not only to digitalisation of business, but also to improve the efficiency and electrification of local facilities and operational solutions.
The commitment has been focused especially for those segments of mobility which have the greatest potential for electrification, as urban logistics, promoting not only the acquisition of electric vehicles, but also the improvement of related infrastructures.

This care must be supported from both private entities and public authorities, with the aim to reduce the pollution footprint of mobility and logistics in urban areas. European, national, and local authorities have been promoting policies and projects for electrification of transport and delivery for many years[5]. All these commitments have been translated in plans to support the development of urban freight distribution and, consequently, also the related necessary cargo infrastructures.

Not only funds for the acquisition of new fleets and realisation of facilities, but also rules and incentives for facilitating the transition to new operating systems like harmonisation of rules, discounts or exemptions from congestion charges/tolls, access to priority lanes, access to pedestrian areas, consolidated services with the sharing of last mile using EVs, realization of pilot tests with infrastructures specific for e-urban logistics, promotion of last-mile distribution by bike, electric motorbikes, through micro-platforms, etc.

The implementation of operational strategies and solutions for zero-emission logistics raised different questions regarding the use of Battery Electric Vehicles (BEV). Most of them are related to the charging infrastructure required and apply to three sectors[6]:

- **Location and type of charging stations**. Ideal location for the business, necessary power capacity in relation to operational use.
- **Operational requirements.** In consideration of logistical segments, journey types and number of stops.

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[3] Logistica in Catalonia. Sector Snapshot. Catalonia Trade&Investment

[4] https://www.mhlnews.com/global-supply-chain/article/22051522/ecommerce-drives-the-demand-for-logistics-real-estate

[5] International Transport Forum - How Urban Delivery Vehicles can Boost Electric Mobility.

[6] Charging infrastructure for electric vehicles in city logistics. CE Delft, Amsterdam University of Applied Sciences

- **Charging strategy**. Battery swapping or classic power grid connection.

In the urban e-logistics field, the operating route is the main element influencing the charging strategies to implement. The most considered charging strategies are three:

- Overnight charging and performing the entire journey during the day without recharging.
- Overnight charging and performing the journey during the day considering, when necessary, the use of at least one charging station along the route.
- Overnight charging and recharge during stops at customer's premises and getting through the day in that way.

Basically, the type of locations for charging a logistics e-vehicle are four: the charging infrastructure available at companies, in the public space, at the destination on the customer's premises, and at the depot.

In general, the company own charging points at the depot are seen as cheapest way for charging, in consideration that the company is a bulk consumer of electricity and with a low rate. The highest-capacity charging stations (350 kW) are often necessary for a small proportion of companies. A lower-capacity charging station is usually sufficient for vehicles and less heavily laden journeys.

Regarding the convenience of implementing a complete fleet of logistics e-vehicles, for CE Delft, BEV trucks expected total costs should be at about the same level as for diesel vehicles in 2030, if the tax for both types of vehicles will remain at the same level and there will not be integrated new tax benefits for a BEV[7].

Together with the price for operating with electric vehicles, there are other relevant aspects that need to be clarified before expecting a wide commitment of e-logistics, both at urban and extra-urban level: reliability and resistance of necessary equipment, on-board AC-DC converter or DC charging stations, implementation of "smart charging" systems, upgrading of power grids, alternative charging modalities (pantographs, induction, etc.).

In this operational and market context USER CHI project elaborated a business case addressing Logistics Hubs and proposing recharging services addressed to logistics o mobility operators working in (or accessing to a) shared infrastructure. These Logistic Hubs for electric vehicles will be studied in Barcelona demo site and can help to maximise the productivity of the EV fleet.

Logistics Hubs within urban perimeters, such as sharing services hubs (for cars, vans, scooters, motorcycles, bikes, etc.), can offer easy charging, visibility in front of the customers, and less expensive logistic operations. The designed value proposition is therefore to equip such infrastructure with project tested solutions such as:

[7] Charging infrastructure for electric vehicles in city logistics. CE Delft, Amsterdam University of Applied Sciences

- INCAR for the implementation of a hub allowing Charging Point Operators (CPOs) management systems for roaming and extra-services through OCPI (Open Charge Point Interface) 2.2 communication
- SMAC for creating a software tool calculating the optimal charging profile (i.e. the amount of energy to provide) of the charging stations and for smart grid integration and demand management services for slow, medium, fast and ultrafast charging inside the logistics hubs.
- INDUCAR for the vehicles inductive charging during the time at the logistics hub.

The following table represents the CANVAS of the identified business model, a more detailed description of the "Logistics Hubs" business model alongside with the related market analysis is reported in **Annex 1 "Logistics Hubs business model analysis"**

3.2.1 CANVAS – Logistics Hubs

Table 3: Logistics Hubs CANVAS

KEY PARTNERS

- Charging Point Operators
- Technology Solution Providers
- Grid Infrastructure Managers
- Energy supplier companies
- Local Authorities/Mobility Agencies (for rules and urban planning and public surface)
- National and Regional Authorities (for standards and policies and subsidies)
- European Authorities (for standards, policies and subsidies)
- Logistics real estate companies and landowners (in case of a private surface)

KEY ACTIVITIES

- Analysis of local energy grid characteristics and power capacity
- Analysis of local ordinances
- Public space context analysis
- Logistics routes analysis
- Taxi and sharing services necessities and routes (in case of shared urban logistics/intermodal hubs)

KEY RESOURCES

- Municipal electrical assets
- Power grid
- Logistics operations data
- Strategic locations
- Deals with most important energy suppliers

VALUE PROPOSITION

- Possibility to stop and charge in strategic points of the city
- Charging infrastructure pertinent with the city area characteristics
- Charging infrastructure pertinent with logistics needs (e.g. pantographs)
- Ultra-fast charging for logistics vehicles in strategic areas
- Grid balancing solutions
- Sharing of logistics areas

CUSTOMER RELATIONSHIP

charging infrastructures available at:

- company places,
- public spaces,
- at the destination on customer's premises,
- at company depot.

CHANNELS

- Specific contact channels for industrial and logistics partners
- Web site
- Contact persons
- Apps
- Location-based visibility
- Utility companies' channels
- Charging point totems

CUSTOMER SEGMENTS

- Logistics operators (catering, courier/express, retail food, retail non-food, etc.)
- Public multiutility companies (e.g. waste management companies)
- Industrial companies
- Logistics real estate companies
- Sharing services operators (in case of shared urban logistics/intermodal hubs)
- Taxi drivers (in case of shared urban logistics/intermodal hubs)

COST STRUCTURE

- Electricity grid upgrade (especially for DC fast charging points)
- Purchase of charging points specific for heavy vehicles and logistics operations
- Cost of energy
- Installation of charging points
- Land procurement
- Administrative expenditures
- Maintenance
- Staff, security

REVENUE STREAMS

- Logistics vehicles recharging
- Ancillary logistics services
- Grid balancing
- Advertisement
- Fees for charging points renting
- Fees for charging operations
- Fees for parking
- Ancillary general services (in case of shared urban logistics/intermodal hubs)

3.3 BM2 - Citizens e-mobility stations

Basic concept behind the realization of Mobility Stations is the better use of public space, for a more efficient urban transport and space sharing[8]. The public space does not have to be seen only as a private parking for polluting cars but could be considered as access point for different public services, also mobility related.

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 (Wi-Fi, toilettes, cafeteria, bike repairing, etc.).

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.

The existing context, the transportation offers and the user needs can also influence layout and localization of such Mobility Stations. They can be as small as only two (e-)bikes at a street corner or they can contain a combination of e-(cargo)bikes, light electric vehicles (such as e-scooters and e-cargo bikes), even electric carsharing and/or public transport possibilities.

Other aspects that should be taken into consideration are: existing transportation networks and routes, network of cycling routes, limited traffic zones, points of attractions, electricity network, in order to overcome the issue of the physical barriers among transport modes and to solve the 'cluttering' of public space caused by the wide variety of shared services, bikes, cars and e-scooters, which are often indiscriminately parked on pavements and in pedestrianised areas[9].

Examples of places where such e-Mobility stations can be integrated are: on-street parking spaces, in between existing landscaped areas, dead space (negative aspect can be the low visibility or safety for potential users).

They can also support additional services such as city logistics which needs relief in an environment of constantly growing traffic, especially in city centres.

Concerning e-Mobility, innovative services that can be provided are: battery swapping, inductive charging, and fast charging solutions.

The continuous innovation progress, together with the proliferation of EV charging and the increasing competition will erode energy margins for CPOs, emphasising the need to deliver additional services. Given that the growth needs to be delivered with profitability, an alternative can be focusing on electric fleets deployment, especially with high-use vehicles. Nowadays, most of the public and alternative mobility services in urban areas have to operate with electric vehicles:

[8] https://www.eltis.org/SUMP2016

[9] https://www.eltis.org/discover/news/leuven-install-50-mobility-hubs-foster-multimodality

car/scooter/bike-sharing, public transport, taxis, etc. All these operative sectors imply a high use of vehicles that can generate revenues for mobility operator, maintenance operator and charging point operator.

For CPOs, having a large group of workplaces charging users provide a captive network to sell secondary services such as advertising, maintenance, etc. Moreover, once these spaces are fitted with a sophisticated offering, workplace charging could act as a balancing mechanism for the grid (especially in heavy industrial and power-intensive locations). All these energy-related services can create new sources of value for the customers as well as for energy and mobility service providers.

Finally, CPOs typically do not own the land where charging assets are installed. The important element is to figure out benefits for site owners. Operators have to understand what to offer to site owners, such as a fee or rental income, that will allow their business model to work and be profitable. In some cases, the site owner may not even expect any income, treating charging as a free service (as in the case of Wi-Fi) to attract footfall.

In this operational and market context, USER CHI project elaborated 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.

These e-Mobility Stations for electric vehicles will be studied in Berlin, Budapest and Rome demo sites and can help to maximise the productivity of any kind of e-Mobility solution.

E-Mobility Stations within different urban contexts can provide easy access to a wide set of charging solutions in every area of the city, and so can be able to offer multiple services for different e-transport and logistics modalities in a unique hub (PT, sharing services, etc.).

Furthermore, the possibility to attract a variety of e-Mobility subjects can open the business opportunities also to the provision of different ancillary services such as: ticketing facilities, waiting zones, postal lockers, toilets, coworking areas, resting areas, cafeteria, battery swapping, tourist info, inductive charging, fast charging points, safe parking areas, etc.

Based on these assumptions and to the objectives expressed by the USER CHI demo sites, the designed value proposition is therefore to equip these kinds of e-Mobility infrastructures with project tested solutions such as:

CLICK	
BERLIN	*For the top-down location planning of charging infrastructure*
ROME	*As demo web service that should be used by professionals and with the collaboration of ENEL X.*
BUDAPEST	*For supporting local urban mobility planners in defining the most suitable places to install new chargers*
INCAR	
BERLIN	

ROME	*For the implementation of a platform allowing a unique interoperability management system for roaming, charging, and routing to booked parking slots*
BUDAPEST	*For offering innovative services to both users with an EMSP contract and users without an EMSP contract, considering that the EMSP is participating in the INCAR platform*
INSOC	
ROME	*For building theft-proof parking for e-bike/e-kick scooter equipped with solar panels for renewable energy production (DC – Charging stations).*
BUDAPEST	*For Integrated Solar DC – Charging stations. INSCOC is considered interesting for e-bikes and also for e-scooters services. Budapest foresees to deploy two facilities characterized by a theft-proof parking for e-bike equipped with solar panels for renewable energy production.*
SMAC	
BERLIN	*For dynamically optimizing the power supplied to the charging points*
ROME	*For providing CPOs and EMSPs with a tool including smart grid integration services, RES electricity supply, reduction of grid impact and demand management features.*
BUDAPEST	*For calculating the optimal charging profile (amount of energy to provide) in the charging stations.*

The following table represents the CANVAS of the identified business model, a more detailed description of the "Citizens e-Mobility stations" business model alongside with the related market analysis is reported in **Annex 2 "Citizens e-Mobility stations business model analysis"**

3.3.1 CANVAS – Citizens e-Mobility stations

Table 4: Citizens e-Mobility Stations CANVAS

<table>
<tr>
<td rowspan="2">KEY PARTNERS 

Electromobility Service Providers
CPOs
Technology Solution Providers
Grid Infrastructure Managers
Energy supplier companies
TSPs
Local Authorities/Mobility Agencies
National and European Authorities
OEMs
TSPs
Financial and payment system companies
Location owners
</td>
<td>KEY ACTIVITIES 

Identification of local conditions as neighbourhoods traffic type and destinations (commercial, residential, business, cultural, touristic, etc.)
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 relevant pools of attraction
Analysis of traffic bans and restrictions
Analysis of market trends
Deals with most important energy suppliers
Roaming deals with different CPOs
</td>
<td rowspan="2">VALUE PROPOSITION 

Provision of multiple services for different e-transport and logistics modalities in a unique hub (PT, sharing services, etc.)
Provision of ancillary services (ticketing facilities, waiting zones, postal lockers, toilets, coworking areas, resting areas, cafeteria, battery swapping, tourist info, inductive charging, fast charging points, safe parking areas, etc.)
Monitoring utilities (like remaining time for charging)
Maintenance services for EVs and LEVs
Provision of appropriate charging pattern
</td>
<td>CUSTOMER RELATIONSHIP 

Charging subscriptions (private and business)
Harmonized charging standards
Multimodal payment solutions
Grid load balancing discounts
Ancillary services
Charing pattern modality discounts
Park &Charge discounts
Automatic free point detection in the station
Partnership and agreement discounts
</td>
<td rowspan="2">CUSTOMER SEGMENTS 

Private drivers
Professional EV drivers (also taxis)
Grid Infrastructure Managers
Companies with electric fleets
Electromobility operators
Logistics operators
</td>
</tr>
<tr>
<td>KEY RESOURCES 

Municipal electrical assets
Power grid
Logistics operations data
Strategic locations
Deals with most important energy suppliers
</td>
<td>CHANNELS 

On-street visibility
Apps
Web sites
Local and/or national public administration visibility
Current fuel stations
Location-based visibility (commercial, business, etc)
</td>
</tr>
<tr>
<td colspan="3">COST STRUCTURE 

Electricity grid upgrade (especially for DC fast charging points)
Cost of energy
Installation of charging points and station structures
Land procurement
Charging points realization
Maintenance of the Station
Market analysis
Administrative expenditures
Partnership and agreement costs
</td>
<td colspan="3">REVENUE STREAMS 

Private vehicle recharging
Fleets vehicle recharging
Ancillary services
Grid balancing
Maintenance services
Logistics operators' services
EV drivers' data valorisation
Station location fees
</td>
</tr>
</table>

3.4 BM3 - City Centre (park & charge)

In the field of electromobility, different aims and priorities between charging infrastructure needs and related policy goals are often barriers to market growth. During the early stages of the transition, when there is lower demand to support a private business case, governments often focus on building out basic spatial coverage of charging infrastructure. Many of these stations will likely face low utilization with limited numbers of electric vehicles on the road but are important for encouraging a greater range of confidence and promoting awareness of electric vehicles.

As the market grows, the demand for charging in urban areas and along major travel corridors will far outstrip the capabilities of the initial stations. At that point, planning for new public chargers will be based on ensuring sufficient charging capacity at the most popular locations. This typically leads to larger stations with more chargers per location. As charger utilization grows with electric vehicle adoption, the number of electric vehicles per charger increases, and this encourages more private investment in charging infrastructure.

For this transition to electromobility, city governments have often then a key leadership role. Their decisions in demographic, geographic, and infrastructural urban policies can, directly and indirectly, lead to the development of different charging infrastructure network solutions and, consequently, to the growth of the local electric vehicle market.

Municipalities can assume different roles in facilitating the implementation of electric charging urban solutions, adopting different policies to increase deployment. This can take the form of direct installation of charging, often in partnership with power companies or network operators, providing land for private installations, adjusting codes and zoning, offering subsidies, and streamlining permitting processes. City governments are increasingly leveraging their electrical assets, including lampposts or utility poles, to enable low-cost curbside charging, like in London, Berlin, Los Angeles, and Tokyo.

Utility companies, being often the direct expression of policy decisions but with a vision in market direction, are foremost to understand EVs market potentialities. They can be useful to express to people that when they get into electromobility, the “product” they buy is not a luxury, but rather an essential tool to complete daily activities: getting to work, going grocery shopping, visiting friends, and travelling to go see family. All of these are potential touchpoints for utilities and governments to connect with EV drivers and engage with them in new ways that are going to be leveraged[10].

Analysis of market growth, engagement with users and citizens, and collaboration of stakeholders are fundamental prerequisites for understanding kind, location, power capacity and plug-in type to install. These aspects are all components that categorize electric vehicle charging equipment.

[10] Beinot Marcoux – ChargeHub Central - 2020

Another important element to consider is the impact of vehicle charging on the electric grid and how this component puts downward pressure on electricity rates. This can be good for utilities and their ratepayers. However, public charging operators cannot make money unless the utility (or other stakeholders) support them, and regulators often approve this model: utilities and cities should get something in return[11].

In order to quantify this support, it is key to understand what kind of drivers live in cities and what their spaces are. Two main categories can be identified: urban, which would mean placement charging stations in a city network (urban road network), and rural, placement in a regional or national network (rural roads and highways)[12].

The analysis of kind of driver, their preferences, characteristics and data (especially at charging session-level) are precious and valuable elements to utilities and cities for both planning development of infrastructure and managing services to users. Therefore, as a best practice, some municipalities and utilities are requesting access to session-level charging data from charging operators in exchange for access to city-owned properties or support from the utility. Operators can also be asked by cities and utilities to fulfil particular performance indicators in order to keep on benefiting from access or support[13].

A right monitoring and forecast analysis can also support strategies to identify areas where the grid can potentially be more stressed by vehicle charging. In these cases, the adoption of smart parking and charging solutions can increase space efficiency and revenues for the CPO and MSP by mitigating overuse or high simultaneous demand.

Data reveals how among electric vehicle early adopters, most of the charging is done at home. In many places where people drive to work, workplace charging is the second-largest share of charging energy used. For drivers with reliable home or workplace charging, both AC and DC public charging may typically be used only for longer trips or in unusual circumstances. For those without home charging and those with high daily mileage, however, public charging is a critical precondition to use an e-vehicle.

Information related to EV drivers or telematics data care can change over time based on attributes of the mainstream market and technological improvements. Charging models must take such shifts into account in order to not base future policy solely on early adopters' behaviour. Ideally, regular updates with new data could be performed to gradually expand projections. Governments can also influence behaviour through broader transportation policy (e.g., congestion pricing, public transport, and private hire vehicle licensing), so it is important to align the analysis's assumptions on driving behaviour with other goals, such as parking reduction, modal shift, or development patterns.

To increase the EV drivers' satisfaction level concerning the current public charging infrastructures, different actions can be undertaken, among which, for example: allowing e-

[11] Beinot Marcoux – ChargeHub Central - 2020
[12] Optimal allocation of electric vehicle charging infrastructure in cities and regions. Joint Research Centre (JRC). European Commission
[13] Beinot Marcoux – ChargeHub Central - 2020

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, disseminating the utility or city programs concerning EV charge points, etc.

Finally, 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 USER CHI project elaborated a business case addressing City Centre (park & charge) and proposing recharging services addressed to citizens and e-drivers travelling within the urban context with electric vehicles. These solutions for drivers with e-vehicles in the urban context will be studied in Berlin demo site and can help to maximise the attractiveness and adoption of the EVs in the city.

Charging solutions within urban perimeters, for private drivers but also for electromobility service providers, can offer easy charging, visibility in front of the customers, and pertinent infrastructure depending on the area of the city, supporting in this way the customers in every situation of the day (at work as at home). The designed value proposition is therefore to equip such infrastructure with project tested solutions such as INCAR and CLICK. Both the USER-CHI tools that VMZ is developing in the city of Berlin, can lead to advantages in the framework of the city centre (park & charge).

- INCAR (in the demo led by Qwello and in the demo led by Gewobag) for the implementation of a platform allowing a unique interoperability management system for roaming, charging, and parking.
- CLICK (demo web service) for the top-down location planning of charging infrastructure.

The following table represents the CANVAS of the identified business model, a more detailed description of the “City Centre (park & charge)” business model alongside with the related market analysis is reported in **Annex 3 “City Centre (park & charge)” business model analysis”.**

3.4.1 CANVAS – City centre (park & charge)

Table 5: City Centre (park & charge) CANVAS

<table>
<tr>
<td rowspan="2">KEY PARTNERS
Electromobility Service Providers
Charging Point Operators
Technology Solution Providers
Grid Infrastructure Managers
Energy supplier companies
TSPs
Local Authorities/Mobility Agencies
National Authorities
European Authorities
Financial and payment system companies</td>
<td>KEY ACTIVITIES
Analysis of local energy grid characteristics and power capacity
Identification of local conditions as neighbourhoods traffic type (commercial, residential, business, cultural, touristic, etc.)
Analysis of market growth
Engagement with users and citizens
Analysis of local ordinances
Deals with most important energy suppliers
Realization of roaming deals with different charging operators
Public space context analysis</td>
<td rowspan="2">VALUE PROPOSITION
Possibility to park and charge in every area of the city
Charging infrastructure pertinent with the city area characteristics</td>
<td>CUSTOMER RELATIONSHIP
Charging subscriptions (private and business)
Special discounts depending on the charging pattern
Grid load balancing discounts</td>
<td rowspan="2">CUSTOMER SEGMENTS
Charging at home (for those who do not have private charging place)
Charging at office
Charging during shopping
Private business companies</td>
</tr>
<tr>
<td>KEY RESOURCES
Municipal electrical assets, including lamp posts or utility poles, roadside space, curbside pavement, road bays
Power grid
National and local charging infrastructure plan</td>
<td>CHANNELS
On-street visibility (CPO brand or local partner brand)
Apps
Web sites
Local and/or national public administration visibility
Location-based visibility (commercial, business, etc)
Utility companies’ channels
Charging point totems</td>
</tr>
<tr>
<td colspan="3">COST STRUCTURE
Electricity grid upgrade (especially for DC fast charging points)
Purchase of charging points
Cost of energy
Installation of charging points
Land procurement
Market analysis
Administrative expenditures
Maintenance</td>
<td colspan="3">REVENUE STREAMS
EV drivers’ data (preferences, tendencies, behaviour, itineraries, charging time)
Session-level charging data
Private vehicle recharging
Business vehicle charging
Grid balancing
Advertisement</td>
</tr>
</table>

3.5 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 the EU, the Commission is leading companies' awareness for bringing together measures compelling truck-makers to produce and sell zero-emission vehicles.

Different companies (both producers and logistics operators) are inviting policymakers and negotiators to promote strong legislation on truck CO_2 emission standards.

This is the direction where the market, together with demand, is going. Indeed, some electric trucks are already here. Big, medium and small companies specialise in providing new and alternative solutions aiming at electric and zero emissions road transport and logistics.

Some electric general lorries prototypes have been designed or produced by small manufacturers since the 2000s. Often they were the simple conversion of diesel units. While trials with different important companies in real-world conditions, for several months or more, have already been conducted from 2010. In 2019, Renault, Volvo, and MAN began the first series production of heavy-duty lorries.

While in the USA, the market is heavily developing both by small and big players. Some of them have developed only chassis for electric vehicles able to be fitted with proper glider kits. Freightliner, the North American branch of Daimler Trucks, has just started to test its eM2 Class 6 van and its heavy-duty semi-trailer e-Cascadia with important logistics partners such as Penske[14] and NFI[15].

If the EU wants to be in line with its Green Deal objective of climate neutrality by mid-century, diesel and natural gas truck sales must be phased out between 2035 and 2040 at the latest.

To achieve this level of decarbonisation, several legislative and policy changes are necessary to accelerate both the production supply of e-trucks and to deploy charging infrastructure at the depot (overnight charging), at the intermediate/distribution centres (destination charging) and at publicly accessible locations (public charging). To achieve these objectives, policymakers need to bring about a comprehensive strategy to rapidly electrify all steps.

[14] https://www.truckinginfo.com/321715/daimler-delivers-electric-em2-truck-to-penske-truck-leasing

[15] https://insideevs.com/news/366608/nfi-penske-first-two-freightliner-ecascadia/

There are two main branches of action in consideration of the different existing kinds of truck and lorry: urban contexts vehicles and long-haul vehicles. Looking at how technology and innovation are moving forward, electric lorries are penetrating first within the urban environment.

Distribution vans and waste collection trucks are two examples of vehicles operating in the urban context that can excellently be fitted with electric solutions. Most of their time is spent stopping, starting, or idling, and this is a perfect driving pattern where an electric engine can be more efficient than an internal combustion engine.

Half of the EU's total truck activity (in tonnes-km, a good proxy for CO2 emissions) is driven over distances of less than 300 km[16]. These trips with present technology could be covered without problems by electric trucks through new models currently on to the market with about 300 km range (enough to cover nine trips out of ten). Furthermore, it is expected that in the next years the range of the electric trucks available will swiftly increase to 500 km, covering about two-thirds of kilometres and 19 trips out of 20.

On the demand side, the adoption of electric freight vehicles depends mainly on the total cost of ownership, better driver comfort, much lower noise levels (eight times lower according to Renault Trucks), reduced congestion, and air quality benefits in cities.

Transport&Environment foresees that with the present number of freight vehicles in Europe and the present standard of utilization, it could be enough to supply depot plants with recharging systems of 30 kW of power delivered overnight for each truck. However, in reality, the needs will vary greatly from one truck to another: a large share of small and medium electric trucks could charge with tri-phase AC chargers of 11 or 22 kW overnight. On the other hand, larger heavy trucks with larger batteries need up to 80 kW overnight charging.

Finally, in the early market phase, where most trucks will need to come back to the depot, public charging could be used as a necessary safety net, allowing a top-up of the battery when operations require a bit more range.

In reality, as previously anticipated, there are already truck makers delivering heavy-duty vehicles but, in most cases, only to specific customers and only for testing phases (e.g. Freightliner with e-Cascadia for Penske and NFI).

Experts expect that values will grow in the next years, but still limited to small and medium duty trucks and with exceptions for big players such as Amazon, DPD, UPS, etc., with greater capacity to tackle trials and accept challenges for new business sectors and opportunities.

In any case, the trucks' sector is an industry that has to get used to the technology before it really takes off, so this is not going to be a giant breakout in next future.

One of the most reported problems that truck manufacturers have to tackle in the realization of e-vehicles includes overcoming range anxiety and the fear of being stranded if the charge runs out. Even if a charger is available, all the operation cases can take hours. A business relying on electricity powering its trucks risks missing deliveries and losing money.

[16] Recharge EU trucks: time to act! – Transport&Environment

For now, the use of gas or diesel with some electric boost in a hybrid combination is gaining more traction.

Next to the realization of vehicles able to range longer distances, another aspect is the growth of reliable charging infrastructure. Substantial investment will be needed in public charging infrastructure to serve the growing electric market. Analysis conducted by T&E reveals that annual investments in Europe for the deployment of all charge points (depot, destination and public, including equipment, installation, and grid upgrades) would increase up to about 1.4 - 2.7 billion euros in 2025 and up to 11 - 18 billion in 2030.

Most of the troubles related to developing e-vehicles are related to battery costs. This problem has been deeply tackled in the last years, with technological progress and consequent dropping of prices (from 1,183 $/kWh in 2010 to 156$/kWh in 2019, an 87% drop in 9 years). Progresses that increased the energy and power density of batteries and allowed electric trucks to be more competitive than diesel in recent years[17].

A solution for fast and competitive recharging of electric trucks are the so-called "mega chargers" (also called HPCCV or High-Power Charging for Commercial Vehicles). These are specific sites that could be placed along the main highways and at truck rest areas and natural stops on the roads. Truck drivers are mandated to take a 45-minute break every 4.5 hours[18], and this time period could be used to recharge the truck batteries. The power requirements for electric truck chargers, particularly High-Power Charging for Commercial Vehicles (HPCCVs), can be significant and might need grid upgrades in many cases.

For this reason, grid and electric truck operators need to cooperate on planning new and smart infrastructure to reduce network and installation costs by optimising location strategy for HPCCVs in particular. The planning of HPCCVs needs to take into account the pre-existing grid infrastructure, including the location of high or medium voltage lines, which would help reduce the distance over which the new grid has to be deployed[19].

Considerations must also be given to combine grid upgrade works with "future-ready" infrastructure implementation plans (for example, preparing the grid capacity for electric vehicles).

Support and subsidies by public authorities can drive the adoption and realization of e-trucks. The objective is to improve technological maturity, better cost-effectiveness, and better air quality within and outside urban areas. In Europe, electric trucks are being embraced by all major truck makers as an answer for the newly adopted heavy-duty vehicle CO2 emission standards (15% average emission reduction by 2025 and 30% by 2030 compared to 2019 levels)[20], and can benefit from the new community rules as the one that allows an additional maximum permissible

[17] Recharge EU trucks: time to act! – Transport&Environment
[18] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006R0561
[19] https://insideevs.com/news/372749/charin-hpccv-over-2-mw-power/
[20] Recharge EU trucks: time to act! – Transport&Environment

weight for vehicles (two tons more for zero-emission trucks) and from the a new incentive mechanism just introduced for zero- and low-emission vehicles.

In this operational and market context USER CHI project elaborated 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.

These operational and business solutions analysed for electric trucks will be studied in Turku demo site and can help to maximise the productivity and adoption of e-logistics fleets.

Charging solutions will be provided, within and outside the urban perimeters, for logistics operators but also for e-commerce sellers, freight real-estate firms, and express couriers, that can find every time suitable solutions for their business operated with e-trucks (resistant infrastructure, fast charging systems, energy storage solutions, range anxiety calming, etc.). The designed value proposition is therefore to implement such solutions with the project tested products such as:

- CLICK planning toolkit in the framework of the electromobility master plan that will foresee both quick chargers and standard chargers suitable also for logistics purposes.
- SMAC for testing the intelligent and dynamic management of demand, and for analysing – from both a technical and economic point of view – the reliability of the grid managing the high energy power necessary to trucks and vehicles for logistics.

The following table represents the CANVAS of the identified business model, a more detailed description of the “E-trucks” business model alongside with the related market analysis is reported in **Annex 4 “E-trucks business model analysis”.**

3.5.1 CANVAS – E-trucks

Table 6: E-trucks CANVAS

<table>
<tr>
<td rowspan="2">KEY PARTNERS
Charging Point Operators
Technology Solution Providers
Grid Infrastructure Managers
Energy supplier companies
Local Authorities/Mobility Agencies
National/European Authorities
Real estate companies/Landowners/TSPs
Research institutions</td>
<td>KEY ACTIVITIES
Analysis of local energy grid characteristics and power capacity
Engagement is strategic for logistics operators
Analysis of local ordinances
Public space context analysis
Evaluation of e-trucks sales
Analysis of most strategic logistics and industrial sites</td>
<td rowspan="2">VALUE PROPOSITION
Suitable solutions for logistics and distribution with e-trucks
Charging infrastructure pertinent to logistics and urban distribution
Ultra-fast charging for logistics vehicles in strategic areas
Range anxiety reduction
Energy storage solutions</td>
<td>CUSTOMER RELATIONSHIP
charging infrastructures available at:
company places,
public spaces,
at the destination and customer’s premises,
at company depot
strategic hubs</td>
<td rowspan="2">CUSTOMER SEGMENTS
Logistics operators (catering, courier/express, retail food, retail non-food, etc.)
Public multiutility companies (e.g. waste management companies, TSPs)
Industrial companies
Logistics real estate companies</td>
</tr>
<tr>
<td>KEY RESOURCES
Municipal electrical assets
Power grid
National and local charging infrastructure plans
Logistics operations data
Strategic logistics and industrial locations
Deals with most important energy suppliers</td>
<td>CHANNELS
Specific contact channels for industrial and logistics partners
Web site
Contact persons
Apps
Location-based visibility
Utility company channels
Charging point totems</td>
</tr>
<tr>
<td colspan="3">COST STRUCTURE
Electricity grid upgrade (especially for DC fast charging points)
Purchase of charging points specific for heavy vehicles and logistics operations
Cost of energy
Installation of charging points
Land procurement
Administrative expenditures
Maintenance</td>
<td colspan="3">REVENUE STREAMS
Logistics vehicles recharging
Ancillary logistics services
Grid balancing
Advertisement
Fees for charging points renting</td>
</tr>
</table>

3.6 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.

For many years the accent on e-Mobility in cities has been put mainly on mass public transportation, but now the focus has shifted also in the adoption and optimization of e-taxis. The taxi sector still plays an important role in the urban field, by providing promptness, door-to-door service, privacy, comfort, high city space coverage, and all daytime availability.

Therefore, replacing ICE taxis with BEV taxis could have a significant positive effect on urban air quality and noise pollution. This is even more crucial considering the increase of Zero Emissions Zones (ZEZ), which allows for significantly more e-taxis.

If considering introducing a greater number of e-taxis in the fleets, crucial importance should be given to the location of charging stations. Important consideration must be taken of how professional users such as e-taxi drivers and users of electric light commercial vehicles have different use and charging patterns than private users, making many of them more likely to depend on daily use of public charging infrastructure. E-taxi drivers may use the public charging infrastructure extensively and, in many cases, multiple times a day.

Moreover, several studies, which have investigated e-taxis potential penetration, have found that due to their intensive use and daily distance compared to private EVs, the viability of an increase of e-taxis in the fleets is critically relying also on the existence of an extensive urban fast-charging infrastructure.

As reported in a study conducted in Japan[21], this might imply an increase in queues in the charging stations during peak hours, causing time and revenues losses for e-taxi drivers. Based on the research findings, one of the possible ways to mitigate these congestion problems at charging stations is to enlarge the amount of EV charging infrastructure if the number of charging events at the charging station exceeds ten per day.

[21] Oda et al., 2017.

Then, given that charging events could be rather random and influenced by demand conditions and the e-taxi fleet composition, it might be considered how a certain degree of overcapacity would be a possibility to minimise the possibility of congestion problems.

In any case, some insights provided by recent studies on e-taxi growth reveal how limited access and congestion at the charging stations can be considered the main barriers for e-taxi growth. E-taxi vehicles significantly impact the public fast-charging stations at certain times of the day, primarily during midday hours when e-taxis are the majority of these stations' users.

Consequently, from a local electricity grid capacity distribution perspective, the realization of a wide fast-charging outline of e-taxis could be an advantage for the grid operators since electricity peaks at the grid level usually occur in the late afternoon and morning. This means that the additional consumption on the local grid due to fast-charging of e-taxis might be better placed at off-effect peak hours.

Finally, different strategies and policies can then be implemented to mitigate these charging capacity issues, and to strengthen the position of e-taxis on the market: temporal price differentiation, letting taxi drivers moving to less busy charging stations in case of queues, developing of a route planning system for e-taxis considering both charging and Zero Emission Zones (ZEZ) locations, prioritising e-taxis in the customer queue, smart queue systems that helps e-taxi drivers to keep their position while charging or prioritising e-taxis at the coordinator, etc.

In this operational and market context USER CHI project elaborated a business case addressing E-taxis and proposing recharging services addressed to their operational necessities.

These operational and business solutions analysed for electric taxis will be studied in Barcelona and Turku demo site and can help to maximise the productivity and adoption of their e-fleets.

Charging solutions for urban environment where it is possible to find every time suitable solutions for the taxi business operated with electric vehicles (fast charging systems, fleets tailored solutions, prioritizationin the queues, etc.). The designed value proposition is therefore to implement such solutions with the project tested products such as:

CLICK	
TURKU	*planning toolkit in the framework of the electromobility master plan that will foresee both quick chargers and standard chargers suitable for e-taxis stop purposes.*
INCAR	
BARCELONA	*For implementing a hub allowing CPOs management systems for roaming and extra-services through OCPI 2.2 communication.*
TURKU	*For providing users with a high-quality tool allowing for an interoperability among EMSPs.*
SMAC	
BARCELONA	*For creating a software tool calculating the optimal charging profile (i.e. the amount of energy to provide) of the charging stations.*

TURKU	*For testing the intelligent and dynamic management of demand, and for analysing – from both a technical and economic point of view – the reliability of the grid managing the high energy power necessary to trucks and vehicles for e-taxis.*

The following table represents the CANVAS of the identified business model, a more detailed description of the "E-taxis" business model alongside with the related market analysis is reported in **Annex 5 "E-taxis business model analysis".**

3.6.1 CANVAS – E-taxi stops

Table 7: E-taxi stops CANVAS

<table>
<tr>
<td rowspan="2">KEY PARTNERS 
• Local Authorities/Mobility Agencies
• Charging Point Operators
• Technology solution providers
• E-taxi drivers/organizations
• National Authorities and European Authorities
• Grid Infrastructure managers
• Energy Supplier companies
• Taxi vehicle manufacturers
• TSPs</td>
<td>KEY ACTIVITIES 
• Analysis of local energy grid characteristics and power capacity
• Analysis of most strategic taxi sites
• Engagement strategic for taxi corporations
• Analysis of most important taxi routes
• Analysis of local ordinances
• Deals with most important energy suppliers</td>
<td rowspan="2">VALUE PROPOSITION 
• Provision of taxi specific charging solutions
• Fast charging solutions
• Provision of private and fleet charging solutions under particular circumstances</td>
<td>CUSTOMER RELATIONSHIP 
• Temporal price differentiation
• Charging subscriptions
• Ultra-fast charging solution
• Taxi specific prices
• Taxi specific charging strategies (queues, lines, prioritization, etc.)</td>
<td rowspan="2">CUSTOMER SEGMENTS 
• Taxi drivers
• Taxi corporations
• Private EV drivers
• Companies with vehicle fleets</td>
</tr>
<tr>
<td>KEY RESOURCES 
• Power grid
• Taxi parking bays
• Taxi operating areas</td>
<td>CHANNELS 
• Apps specific for taxis
• Telephone contacts
• On-street visibility
• Location based visibility
• Public administration visibility</td>
</tr>
<tr>
<td colspan="3">COST STRUCTURE 
• Electricity grid upgrade (especially for fast charging points)
• Purchase of charging points
• Cost of energy
• Installation of charging points
• Land procurement (if necessary)
• Market analysis
• Maintenance</td>
<td colspan="3">REVENUE STREAMS 
• Taxi charging session (during the day)
• Private users charging session (during the night)
• Grid balancing
• Ancillary services</td>
</tr>
</table>

3.7 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, occasional events, etc.

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 plans[22]. 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.

Some examples can be sport and fair events, conferences, congresses, etc. These are situations that were not considering infrastructures for electric vehicles in the past. But now, with the market growing and the increasing importance of green policies, fortunately the care and awareness about organizing events “friendly” to EVs is growing and becoming relevant, also simply for marketing reasons.

During out of normal demand values, the electric grid has to face two main troubles for adopting new mobility technologies: the extraordinary request of energy, mainly during emergency and special situations, and the managing of weekly and seasonal peaks, foreseeable but often not enough to justify the general upgrading of the grid.

The risky failure of the grid is the new common concern for those new to electric cars, and a potential limit to the public’s adoption of EVs. It is the new face of range anxiety, oriented more around an inadequacy from infrastructure than from a car that won't hold true. Although there might be adequate infrastructure when everything is up and running, there needs to be a contingency plan when normal circumstances fall, and something not planned happen.

Furthermore, with the EV market growing and a world always more dealing with special circumstances, the lack of electric mobility in disaster events planning is becoming more urgent and complicated, considering also how the rush to charge vehicles at once could seriously impact the grid. Beyond the huge number of chargers that could be needed, countries also need to consider the distance at which they are located.

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22 https://www.greencarreports.com/news/1128036_mobile-charging-solutions-can-help-fight-the-new-face-of-ev-range-anxiety

Some companies have already started to develop systems suitable for these situations. Two examples are SparkCharge[23] and FreeWire[24], companies working in the realization of different backup plan ideas for battery-based charging solutions during special and emergencies.

The value and the size of the EV market for special events are related mainly to three voices characterizing charging station utilization[25]: the present ability be used in the time and location where they are installed, the ability to satisfy extraordinary situations when there is an over request of charging due to special occasions or emergency situations, and the capacity to provide and satisfy additional services not directly connected to recharging a vehicle.

Also in the case of special events, the analysis of how many and where it is useful to deploy charging stations needs to consider the habits and trends of EVs utilization. There is not a charging point kind that fits all the situations, and it is necessary a clear view about the potential peaks and drops of the different places utilization for understanding the time trends in the different day and year phases.

Analyses reveal how currently only a 10% EV penetration of the predicted values may cause unacceptable power peaks[26]. The power grid may not be able to handle the new peaks because of its power production capabilities and inadequate distribution infrastructure. For this reason, backup plans and recovery systems must be put in place, not only for emergency situations, but also to follow through the growing EV market until the distribution grid is properly updated.

For not upgrading the grid, one option could be to adopt smart charging strategies to deal with peaks and drops. One of them is to shift potential peaks to the valleys using techniques such as time-of-use rates, decentralizing EV charging (as Mobile Charging Stations), real-time scheduling, and automated charging management systems. An intelligent management of the EV charging process allows the exploitation of the potential EV flexibility.

In this operational and market context USER CHI project elaborated a business case addressing Special events and proposing recharging services for e-drivers travelling during extraordinary situations.

These operational and business solutions analysed for Special events will be studied in Budapest, Turku, and Rome demo sites and can help to maximise the adoption, reliability, and usability of the EVs in every situation.

Charging solutions for every event that can support e-drivers with fast charging, back-up and energy storage systems, provision of mobile charging stations and grid balancing schemes. The designed value proposition is therefore to implement such solutions with the project tested products such as:

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[23] https://www.sparkcharge.io/

[24] https://freewiretech.com/

[25] Flamini M. G., Prettico G., Julea A., Fulli G. - Statistical characterisation of the real transaction data gathered from electric vehicle charging stations. Joint Research Centre, Politecnico di Torino

[26] https://www.tdworld.com/electrification/article/20973333/preferential-charging-for-government-authorized-emergencyelectrical-vehicles

CLICK	
BUDAPEST	*For supporting local urban mobility planners in defining the most suitable places to install new chargers that can suit for special situations.*
TURKU	*For the framework of the city-wide master plan for EV expansion project foreseeing both quick chargers and standard chargers (with and without photovoltaic production) that can be located in places suitable for every kind of situations (also extraordinary ones).*
ROME	*For supporting the development of the City's Traffic Masterplan in a holistic mode (also considering problems due to presence of Cultural Heritages).*
INCAR	
BUDAPEST	*For a unique interoperability management system for roaming, charging, and parking to both users with an EMSP contract and users without an EMSP contract (considering that the EMSP is participating to the INCAR platform) in every particular situation, also special and emergency ones.*
TURKU	*For providing users with a high-quality tool allowing for interoperability among EMSPs also in situations out of normal daily routine.*
ROME	*for short range services as useful tool for different user categories to allow a unique interoperability management system for roaming, charging, and parking.*
SMAC	
BUDAPEST	*For dynamically optimise the power supplied to the charging points and so offering both the maximum power and a high-quality level.*
TURKU	*For testing the intelligent and dynamic management of demand, and for analysing – from both a technical and economic point of view – the efficiency of managing the energy supplied to CPOs as well as for improving the service to the end-user.*
ROME	*For providing to CPOs and EMSPs with a tool including smart grid integration services, RES electricity supply, reduction of grid impact and demand management features.*

The following table represents the CANVAS of the identified business model, a more detailed description of the "Special events" business model alongside with the related market analysis is reported in **Annex 6 "Special events business model analysis".**

3.7.1 CANVAS – Special events

Table 8: Special events CANVAS

<table>
<tr>
<td rowspan="2">KEY PARTNERS 

Technology Solution Providers
Grid Infrastructure Managers
Energy supplier companies
Local Authorities/Mobility Agencies
National/European Authorities
Grid Infrastructure Managers
Location owners
TSPs
Electromobility service operators
</td>
<td>KEY ACTIVITIES 

Analysis of local energy grid characteristics and power capacity
Analysis of local ordinances
Local space context analysis
Identification of local conditions as neighbourhoods
Analysis of local power utilization trends
</td>
<td rowspan="2">VALUE PROPOSITION 

Support to EVs in: Emergency cases, Occasional Events
Provision of fast charging stations
Provision of back up charging and energy storage systems
Provision of Mobile Charging Stations
Grid balancing solutions (as ancillary services, not as main business)
</td>
<td>CUSTOMER RELATIONSHIP 

Charging subscriptions (private and business)
Special discounts depending on the charging pattern
Energy storing subscription
Charging infrastructures renting
</td>
<td rowspan="2">CUSTOMER SEGMENTS 

Private drivers
Professional EV drivers
Grid infrastructure managers
Road infrastructure managers
Fair and event organizers
</td>
</tr>
<tr>
<td>KEY RESOURCES 

Deals with most important energy suppliers
Power grid
Deals with local emergency authorities
Deals with local event and fair organizers
</td>
<td>CHANNELS 

Specific contact channels for industrial partners
Specific contact channels for private customers
Web site
Apps
Location based visibility
Charging point totems
</td>
</tr>
<tr>
<td colspan="3">COST STRUCTURE 

Electricity grid upgrade (especially for DC fast charging points)
Purchase of charging points
Purchase of mobile charging points
Cost of energy
Installation of charging points
Land procurement
Administrative expenditures
Maintenance
Market analysis
Systems transferring
</td>
<td colspan="3">REVENUE STREAMS 

Ancillary services
Fees for charging points renting
EV drivers' data (preferences, tendencies, behaviour, itineraries, charging time)
Session-level charging data
Private vehicle recharging
Emergency or governmental vehicle recharging
Grid balancing
Advertisement
Fees for charging operations
</td>
</tr>
</table>

3.8 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.

The market "is just starting to get underway", says a report of Navigant Research published in 2020[27], and even if the mobile charging will be "a small portion of the overall EV charger market forecast", the total value is expected to grow from $16 billion in 2020 and more than $60 billion by 2030.

In particular, MCSs have been developed to meet:

- The need of solving the issue of overloaded Fixed Charging Stations (FCSs);
- The request coming from EVs.

Mobile charging stations can be set up at defined points, for example, spread out across a city, and their flexible locations can be easily found by developers and users via internet or apps.

The service can be integrated with trucks or inside vans. This means that the station can move freely in every location where charging is needed, thanks also to their ability to be installed with or without the connection to the grid. When independent from the grid, they are usually equipped with solar panels, self-contained generating systems, or with Battery Energy Storage Systems (BESS).

In this last situation, how the charging station is used, and consequently the duration of the battery package, depends on both the provider and the user's demand.

Depending upon on-site capabilities, chargers can be powered not only through existing power at the location, but also by solar panels, or self-contained generating systems.

Mobile EV charging solution offers a highly adaptable Electric Vehicle Supply Equipment (EVSE) and Charging as a Service (CaaS) option that is available for long-term renting or for immediate use.

Installing traditional fixed fast-charging stations is usually a cost- and labour-intensive process that requires a lot of electrical upgrades to support the connection between charging stations

[27] https://guidehouseinsights.com/reports/mobile-ev-chargers

and the main electrical grid. Mobile charging stations remove that complication, often using low-voltage power and allowing operators to use existing power outlets simply.

Furthermore, when equipped with independent internal batteries, power grid companies and distribution operators can benefit from MCSs thanks to their ability to store energy. This element could be helpful not only to reduce the negative influence of Direct Current Fast Charging (DCFC) in the grid but also to reduce the total number of FCSs needed to cover charging requests in a specific location and to temporarily store sustainably generated power.

MCSs can also be a solution to lower stress on grid infrastructure and a support to fill the charging gap and provide a fast remedy. As CaaS providers directly to e-drivers, MCSs can provide vehicles charging directly where is necessary, saving the travelling time for going to the nearest FCS.

As it is possible to imagine, the cost of the battery and the cost of the travelling carrier are the two major capital investments for the implementation of MCSs. These obstacles can be managed by carrying out a proper optimization analysis regarding the number of MCSs and the number of charging piles of each MCS to reduce the service delays.

As a solution, MCSs can play a prominent role in addressing the debate of whether it is better to create a wide network of charging facilities to stimulate electric vehicles adoption, or it is better to promote a sufficient rate of EV adoption before expanding the charging network.

Analysis and uncertainties are in any case still pointed out from some business experts about the real profitability of the Mobile Charging Stations operated as a "specialistic" player. This sector operated as an independent business still has to show the real ability to produce value and revenues for the operator. This is why some major players (as Enel X) provide mobile charging stations as ancillary on-demand services to their customers and do not consider this as their main product.

In this operational and market context USER CHI project elaborated a business case addressing Mobile Charging Stations and proposing recharging solutions for exploiting the potentialities and benefits derived by using MCSs.

These operational and business solutions analysed for Mobile Charging Stations will be studied in the Rome demo site and can help to maximise the adoption, reliability, and usability of the EVs with the support of MCSs.

Charging solutions for every kind of e-drivers, increasing their confidence with electric vehicles thanks to the services provided by the MCSs as the Charging-as-a-Service, support in emergency situations, off grid charging, back-up and storage systems, etc. The designed value proposition is therefore to implement such solutions with the project tested products such as:

- CLICK planning toolkit for the development of the City's Traffic Masterplan in a holistic mode and for finding the locations, with Enel X, of the new charging points to realize (and before to test with solutions as the mobile charging stations).
- INCAR for the implementation of a platform allowing a unique interoperability management system for roaming, charging, and parking with all the kind of charging stations available, also MCSs. In the Rome demo site this solution will be tested only for charging stations of ENEL X. No other MSP will be engaged.

- INSOC for the Integrated Solar DC – Charging stations. Some solutions of mobile charging stations integrate also solar panels.
- SMAC for the optimal charging profile (amount of energy to provide) in all the kind of charging stations.

The following table represents the CANVAS of the identified business model, a more detailed description of the "Mobile charging stations" business model alongside with the related market analysis is reported in **Annex 7 "Mobile charging stations business model analysis".**

3.8.1 CANVAS – Mobile Charging Stations

Table 9: Mobile Charging Stations CANVAS

<table>
<tr>
<td rowspan="2">KEY PARTNERS 

Electromobility Service Providers
Technology Solution Providers
Grid Infrastructure Managers
Energy supplier companies
TSPs
Local Authorities/Mobility Agencies
National/European Authorities
Financial and payment system companies
</td>
<td>KEY ACTIVITIES 

Analysis of local energy grid characteristics and power capacity
Analysis of market growth (users and operators)
Analysis of local ordinances
Deals with most important energy suppliers
Analysis of local power utilization trends
Analysis of local most important events and fairs
Analysis of users and energy providers demand
</td>
<td rowspan="2">VALUE PROPOSITION 

Charging as a service (CaaS)
Possibility to park and charge in every situation
Support to EVs in: Emergency cases, Occasional Events
Grid balancing solutions
Provision of charging solutions also in areas underserved
On-time service solutions
Temporary charging solutions
Off grid charging solutions
</td>
<td>CUSTOMER RELATIONSHIP 

Charging subscriptions (private and business)
Special discounts depending on the event
Grid load balancing discounts
Charging infrastructures renting
Emergency readiness on-call solutions
</td>
<td rowspan="2">CUSTOMER SEGMENTS 

Private drivers
Professional EV drivers
Grid infrastructure managers
CPOs
Road infrastructure managers
Fair and event organizers
Power energy providers
</td>
</tr>
<tr>
<td>KEY RESOURCES 

Power grid assets
Deals with most important energy suppliers
Deals with local emergency authorities
Deals with local event and fair organizers
Appropriate charging technology solutions (grid and off grid)
Energy storage systems
</td>
<td>CHANNELS 

Specific contact channels for industrial partners
Web sites
Local and/or national public visibility
Location based visibility (commercial, business, etc)
</td>
</tr>
<tr>
<td colspan="3">COST STRUCTURE 

Purchase of charging points
Purchase of energy storage systems
Cost of energy
Market analysis
Administrative expenditures
Maintenance (especially batteries)
Transport vehicles and systems transferring
</td>
<td colspan="3">REVENUE STREAMS 

Ancillary services
Fees for charging points renting
EV drivers' data (preferences, tendencies, behaviour, itineraries, charging time)
Session-level charging data
Private vehicle recharging
Emergency or governmental vehicles recharging
Grid balancing
Energy storage
Advertisement
</td>
</tr>
</table>

4. Conclusions

This deliverable has outlined the first results of a preliminary business model analysis about the seven use cases considered in the project objective O5. Different areas of impact have been considered, and in all the cases with a focus on the project's cities that have expressed interest in the specific business case. The analyses have been realized with the direct support of the pilot leaders and with the direct involvement of relevant business stakeholders through the organization of several mini-workshops. During these meetings there have been discussed for each BM: the market characteristics, market trends, market limits and constrains, target clients and their profile, market size and business opportunities.

The reason of this approach is because assessments and evaluations, when shared and disseminated effectively, can also lead to broader changes outside the system in question. This preliminary step will be continued during the next period and will be reported in the final version of Business models analysis, the D8.9 "Business model validation results II" in M36.

The second analysis period of the BMs will be conducted following the practical execution of the demo tests and considering the uptake of the different steps characterizing the adoption of new services/products: the "start-up" phase, the "early innovator" phase, and then the “crossing the chasm” phase. This last one is the most critical because it is necessary to take the step with the proper support and incentives. For this reason, the services and models will be analysed and designed, focusing on methods to properly sustain the adoption of the case and examining strategies such as pricing solutions, subscription schemes, nudging and gamification.

5. Acronyms

Acronym	Meaning
AC	Alternating Current
BESS	Battery Energy Storage Systems
BEV	Battery Electric Vehicle
CaaS	Charging as a Service
CC	Consolidation Centre
CCS	Combined Charging System
CLICK	Charging infrastructure Locatlon and HolistiC Planning Kit
CNG	Compressed Natural Gas
CPO	Charging Point Operator
DC	Direct Current
DCFC	Direct Current Fast Charging
EVE	Electric Vehicle Equipment
EVSE	Electric Vehicle Supply Equipment
FDI	Freight Directive Investment
GHG	Green House Gas
HPCCV	High-Power Charging for Commercial Vehicles
ICE	Internal Combustion Engine
ICEV	Internal Combustion Engine Vehicles
INCAR	Interoperability, Charging and Parking Platform
INDUCAR	Inductive Charging for e-Cars
INSOC	Integrated Solar-DC charging for LEVs
KPI	Key Performance Indicators
LEV	Light Emissions Vehicle
LEZ	Low Emission Zone
EME	Electro Mobility Europe
EMSP	Electric Mobility Service Provider
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
MCM	Mobile Charging Station
MW	Mega Watt
MSP	Mobility Service Provider
M2M	Machine-to-Machine
OEM	Original Equipment Manufacturer
OCPI	Open Charge Point Interface
PHEV	Plug-in Hybrid Electric Vehicle
ProEME	Promoting Electric Mobility Europe
SBM	Sustainable Business Model
SMAC	Smart Charging Tool
SUMP	Sustainable Urban Mobility Plan

TCE	Total Cost of Ownership
TEN-T	Trans European Network - Transport
TSP	Transport Service Provider
WP	Work Package
ZBE	Zone de Baixes Emissions
ZEZ	Zero Emission Zone

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7. ANNEXES

7.1 Annex 1: Logistics Hubs business model analysis

7.1.1 Business case overview

7.1.1.1 Market characteristics

In the last years, more than ever, the entire transport and logistics sector has been facing deep changes regarding its environmental impacts.

Technological innovations are showing how the mobility sector can contribute to reducing its pollution footprint and how both public and private firms are carrying out numerous actions to demonstrate their contribution to these necessary changes.

The changes not only regard vehicle fleets but also related issues such as administrative and legal obstacles, infrastructure limits, economic troubles, etc.

The electrification of logistics and mobility is one of the top treated topics in relation to the environmental impacts of transport. The subject does not involve only local industries but also international operators with their international logistics hubs.

Eco-friendly cars, vans, and trucks are undeniably a great way to reduce the business' carbon footprint.

With the growing importance of this trend, almost every major car manufacturer and public authority has committed an industry plan and policy program to reduce the environmental impact of urban transport and logistics to communities and to promote sustainability with concrete initiatives.

Car manufacturers are committing to electric and hybrid vehicles, while governments implement plans for internal combustion vehicles' sales bans. UK[28] and France[29] are set to ban petrol and diesel from 2040 onwards, while Paris will introduce a similar ban as early as 2030[30].

The focus on trends and opportunities for more sustainable logistics is looking to all the three main sectors characterising the business: supply, storage and last mile distribution.

Different investments actions and projects have been realised for each of these logistics sectors to get a more sustainable business.

[28] https://www.ft.com/content/5e9af60b-774b-4a72-8d06-d34b5192ffb4
[29] https://www.bbc.com/news/world-europe-40518293
[30] https://www.reuters.com/article/us-france-paris-autos-idUSKBN1CH0SI

At a global level, the digitalisation of the supply chain should imply for the sector a value of about 4 billion dollars by 2025[31]. The digitalisation should mainly support the growing international logistics demand due to e-commerce business. The business in recent years has felt large changes and that is moving funds and investments coming from three main sector players: e-commerce sellers, real-estate firms, and express couriers[32]. Investments directed not only to digitalisation of business but also to improve the efficiency of local facilities and operational solutions.

7.1.1.2 Market growth and trends

At a more local level, to reduce the pollution footprint of mobility in urban areas, European, national and local authorities have been promoting policies and projects for electrification of transport and delivery for many years[33]. Those strategies have the aim to promote both electric vehicles and related infrastructures, especially for those segments of mobility with the greatest potential for electrification.

This means not only for private mobility but plans with specific policies to support the development of urban freight distribution and, consequently, also the related necessary cargo infrastructures [34]. Not only funds for the acquisition of new fleets and realisation of facilities, but also rules and incentives for facilitating the transition to new operating systems like harmonisation of rules, discounts or exemptions from congestion charges/tolls, access to priority lanes, access to pedestrian areas and/or non-restriction or more time extension in pacified areas, free parking, priority at public recharging points, etc.

Some specific actions realized by local authorities for the development of zero-emission urban distribution are:

- Strengthening and creating new infrastructures linked to electric vehicle penetration in the city (charging points, semi-fast charging points – 22kW, quick charging points – 50 kW, etc.)
- Pilot test for charging points for urban goods distribution
- Regulating parking and budget to oversee the promotion of electric vehicles in the city
- Introducing consolidated services with the sharing of last mile using electric vehicles
- Promoting last-mile distribution by bike, electric motorbike, etc., through micro platforms.

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[31] Logistica in Catalonia. Sector Snapshot. Catalonia Trade&Investment

[32] https://www.mhlnews.com/global-supply-chain/article/22051522/ecommerce-drives-the-demand-for-logistics-real-estate

[33] International Transport Forum - How Urban Delivery Vehicles can Boost Electric Mobility.

[34] Arroyo, J.L., Ortuno M. T., Tirado G. - Effectiveness of carbon pricing policies for promoting urban freight electrification: Analysis of last mile delivery in Madrid

The implementation of an operational strategy for zero-emission logistics raises different questions regarding the use of battery electric vehicles. Most of them are related to the charging infrastructure required and apply to three sectors[35]:

- Charging stations:
    - Which location is ideal for business?
    - What kind of charging stations are needed, and what capacity should they have?
    - What effect the charging speed has on operational use (delivery on time) and the energy and personnel costs (waiting times while charging)?
- Journey profiles:
    - What are the operational requirements for each logistical segment (e.g. e-commerce, fresh produce, food, and construction) regarding the capacity of the vehicle, the journey length, the depot/charging point location, and the number of stops?
- Charging strategy vs batteries
    - Currently, batteries are both costly and have low capacity. What is the best charging strategy for each segment and type of vehicle to work operationally and to deliver predictably in practice?

The answers to these questions affect all parties involved in future planning of zero-emission logistics: businesses of all sizes, local governments (public charging infrastructure, urban planning, accessibility, economic necessity of supply, location of industrial sites, location of hubs, location of car parks with charging stations), and grid operators (infrastructure planning, ability to cover power demand).

Seven market segments make the vast majority of logistics operations in an urban context: waste, construction, catering, courier/express, retail food, retail non-food and services. From their point of view the core question in the adoption of a zero-emission distribution strategy is influenced by the everyday route profiles and operational plans.

Where can vehicles be charged based on operating routes? Three charging strategies are basically conceivable:

- Overnight charging and performing the entire journey during the day without recharging

[35] Charging infrastructure for electric vehicles in city logistics. CE Delft, Amsterdam University of Applied Sciences

- Overnight charging and performing the journey during the day, with the battery capacity being insufficient to complete the entire journey, so that a charging station along the route has to be used to recharge
- Charging overnight and recharge during stops at customer's premises and getting through the day in that way

Basically, there are four possible locations where vehicles can be charged: the charging infrastructure available at companies, in the public space, at the destination on the customer's premises, and at the depot.
For each vehicle kind, there is a preferable charging station type to be implemented:

- Delivery vans: these mainly use charging solutions of up to 50 kW. In the future, with larger battery capacities, they could possibly also use 150 and 350 kW.
- Trucks and buses up to a GVW of 10 tons: these mainly use solutions of up to 50 kW. Thanks to the bigger necessary battery packs they will probably switch to 150-350 kW solutions.
- Heavier goods transport (from a GVW of 10 tons) mainly uses faster charging solutions (starting at 150 kW). Charging solutions of up to 1 MW are under development, but for now their implementation is limited.

Analysis reveals how in Amsterdam almost 40,000 charges are expected per day, more than 90% of them involving delivery vans, over the next ten year[36]. The greatest demand for electricity for charging occurs at business locations and depots - usually on industrial sites - (according to the model, 78% of the charging demand comes from trucks and 44% comes from delivery vans), spread out during the night when vehicles are parked. Analysis of the spatial distribution shows that a relatively high charging demand is detected in the port area, and where industrial sites (on the edge of Amsterdam) are located. This mainly involves recharging trucks and delivery vans in depots. Furthermore, a high charging demand is observed in areas with a large number of construction companies (as in Hoofddorp and Edam-Volendam). As well as charging in depots, the possibility of charging delivery vans at home must be also considered.

In general, the cheapest way for charging is by using the company own charging points at the depot in consideration that the company is a bulk consumer of electricity and with a low rate. The highest-capacity charging stations (350 kW) are often necessary for a small proportion of companies. A lower-capacity charging station is usually sufficient for vehicles and less heavily laden journeys.

Still in Amsterdam, in the large operating zones where logistics firms operate only with electric vehicles, an energy demand of about 866 GWh per year is expected. 248 GWh of which in Greater Amsterdam and the rest outside. The energy demand in Greater Amsterdam would

[36] Charging infrastructure for electric vehicles in city logistics. CE Delft, Amsterdam University of Applied Sciences

mainly come from about 1,100 trucks, charged in depots every day, and about 15,000 delivery vans, which are charged in depots or at other locations (as at home) every day.

'Ultra-fast chargers' (350 kW) for logistics vehicles are mostly installed at the delivery location so as to be able to recharge quickly during the day. Due to the high-power draw, a liquid-cooled (CCS) plug is used for this.

7.1.1.3 Market problems and pains

For CE Delft, BEV trucks expected total costs should be at about the same level as for diesel vehicles in 2030 if the tax for both types of vehicles will remain at the same level and there will not be integrated new tax benefits for a BEV.
Generally talking, working with electric vehicles and a hub/depot for charging operations is still subject to some questions and uncertainties that need to be clarified:

- Reliability: in general, the equipment is handled quite roughly during different operations. In the logistic sector, charging plugs often result not being resistant enough.
- On-board AC-DC converter or DC charging station: a truck gets more expensive if it needs to have an AC/DC converter onboard. An external (44 kW) AC charger is cheaper than an external 50 kW DC charger.
- The introduction of "smart charging" systems for appreciating benefits as the optimum use of charging infrastructure to spread the costs. In any case, smart charging only has added value if the vehicle can be connected to the charger for a prolonged period of time, allowing to manage the power draw (for example, at night).
- Using a pantograph instead of a plug (on the vehicle or the charging infrastructure). This is a system theoretically easy to use but relatively expensive and that takes up a lot of space. For pantographs attached to the charging infrastructure, a wireless connection is required to operate it, which makes the system less robust. Generally, the pantographs reveal to be fragile systems that get damaged quickly.
- Battery swap: the price per kWh of capacity makes the investment of a second battery still too expensive. Swapping a battery also costs extra time and the battery may get damaged. Therefore, this should be in some way be automated, which requires yet another investment.
- Induction: Induction technology is still under development. Despite the loss of efficiency, the charging technique results to be somehow interesting thanks to its being easy to use. The drivers do not have to do anything. Inductive high-efficiency (>95%) systems are currently still very expensive. Furthermore, safety aspects relating to radiations for high power systems still have to be investigated.

- Increasing the number of electric vehicles in a depot can reveal issues with the local grid. Smart charging systems can be a solution to spread out the peaks or new transformers can be introduced, which require time and money. According to grid operators, a higher capacity connection can be provided but often has to be planned around one year in advance if no (medium voltage) connection is yet available in the area. If one is available, the lead time for a new connection from the grid operator is usually 18 weeks after submitting the application.

Currently, a specific policy with regard to charging infrastructure specifically for depots in urban goods transport is not developed in many sites. Everything is left to private parties. In Oslo, Stockholm, and Amsterdam the focus on electric logistics and related infrastructures is slowly increasing, but it is almost entirely absent for HGVs[37].

7.1.2 Barcelona demo site business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-Logistics Hubs solutions in Barcelona from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 10: Barcelona logistics hubs summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: Electric mobility is a wide market with every year more players involved. From public authorities to logistics operators, from vehicle manufacturers to software houses, this kind of business is catching more different market sectors interests every year due to its growing involvement and its still limited discovered potentialities. The Spanish government is working to the implementation of a zero-emission transport and urban mobility since 2017 with the MOVALT program[38]. The Spanish Program for Electric Mobility was operative until 2019 and around 20 million euro were allocated for the fleet renovation (both public and private). At the end of the program the new ecologic vehicles acquired were around 2,882, and the second-hand ecologic vehicles were 95. 43% of the vehicles were electric (1,286) and 10% (297) hybrid. The remaining were gas vehicles. In the group of electric vehicles sold, the commercial ones were 245. In the group of incentive requests received by the Ministry for Ecological Transition, 1,176 were from the Region of Madrid and 692 from Catalunya.

[37] Charging infrastructure for electric vehicles in city logistics. CE Delft, Amsterdam University of Applied Sciences

[38] Ministerio para la Transicion Ecologica, IDAE - Informe Final Programa MOVALT Vehiculos

In 2019 MOVES I was launched, the new plan for promoting efficient and sustainable mobility in Spain [39]. MOVES I has the been substituted by MOVES II in 2020 and by MOVES III in 2021.

The programs have provided a total budget of 45 million euros, and their purpose is to incentive the acquisition of new alternative vehicles, the implementation of new charging stations, the opening of new bike-sharing systems and the implementation of Mobility Plans at working places.

The funds have been divided with these percentages:

- Between 20% and 50% for acquisition of alternative vehicles
- Between 30% and 60% for implementation of recharging infrastructures (at least 50% must be fast or ultra-fast recharging points)
- Plans for bike-sharing systems can represent between 5% and 20% of the allocated budget and plans for supporting Mobility Plans in offices can be up to 10%.

The support for the acquisition of vehicles spans from 700 euro for electric motorcycles and to 15,000 euro for trucks and busses with alternative propulsion.

The economic support for the acquisition of light electric vehicles can be up to 5,500 euro.

At the same time, manufacturers, importing companies and dealers are required to discount at least 1,000 euros in the invoice when a new EV is sold, except for the purchase of quadricycles and motorcycles.

Aid for vehicles with traditional engines are reserved only for trucks and vans due to the reduced number of developed alternatives.

Regarding recharging stations (public and private) and bike-sharing systems, the aid can be between 30% and 40% of the total value invested; the final percentage depends on the beneficiary and with a maximum of 100,000 euro.

Finally, MOVES plans can provide support up to a value of 200,000 euro and 50% of the investment for the implementation of a company Mobility Plan.

At a more local level, in 2019, in Catalonia, the three-year plan PIRVEC (Action Plan for developing the recharging infrastructure for electric vehicles 2016-2019) was completed to promote and implement a more electric and sustainable mobility[40]. This plan was a part of the

[39] Ministerio para la Transicion Ecologica, IDAE - PLAN MOVES. INCENTIVOS A LA MOVILIDAD EFICIENTE Y
SOSTENIBLE

[40] https://www.iea.org/policies/6676-pirvec-2016-2019-strategic-plan-for-the-deployment-of-recharging-infrastructure-of-electric-vehicles-in-catalonia

wider "Action Plan 2017 – 2025: Clean Energy for all Catalans"[41]. Nowadays, the PIRVEC objectives have been included in the wider MOVES plans.

With a total budget of 5,8 million € the PIRVEC Plan tried to remove technological, administrative, legal, and economic obstacles to the electrical mobility development in Catalonia.

The target plan was realised with the aim to set up:

- 100 quick charging points accessible from the public road network (50 kW)
- 400 new stations for semi-fast charging in urban networks and leisure centres (22 kW)
- 25,000 new charging points (4,000 in 2016) with subsidies covering up to 50% of installation costs in cases where there are difficulties in setting them up, such as in private community car parks
- A unified identification and payment system, developed for users and accessible through smartphones for easier access to EV charging network
- Promote regulatory changes to achieve the technical and economic feasibility of electric mobility

Market size:
From a purely economic point of view for logistics activities, the Catalonia region represents the point of entrance not only to Spain but to different markets in Europe.

The entire Catalonia region represents 20.1% of the Spanish GDP. In the region, there are 37,605 industrial companies (2018), corresponding to 23.7% of the Spanish industry. The foreign companies are 8,642 (2018).

The total export value is 71,624 million euros, the companies regularly exporting are 17,239 and around 64% of Catalan sales are export. The companies with innovation interests are 9,282 (2016) and represent 20% of the total number in Spain and 23.3% of the total Spanish expenditure for research and innovation[42].

For these activities, the Catalan logistics industry registered in the period 2014 - 2018:

- 85 FDI (Foreign Direct Investment) projects
- 2.67 million € of capital investment
- 9,146 jobs created

And it has registered in the period 2013 – 2017:

41 http://icaen.gencat.cat/web/.content/10_ICAEN/17_publicacions_informes/11_altres_publicacions/arxius/20170720_PNTE_ang.pdf

42 Logistica in Catalonia. Sector Snapshot. Catalonia Trade&Investment

- 34.7% of the FDI projects received in Spain
- 35.7% of the capital investments received in Spain
- 34.6% of the jobs created in Spain

Focusing more specifically on the city of Barcelona and the surrounding area, it is one of the most important logistics hubs on the Iberic Peninsula.

40% of the warehouse market comprises structures between 2000 and 4999 sqm, 29% between 5000 and 9999 sqm, 19% between 10000 and 19000sqm, 10% with surface >20000 sqm and 2% with surface < 1999 sqm[43].

Half of the exports and imports of the Province of Barcelona have as destination or origin the EU-15 (56% and 51% respectively). The manufacture of motor vehicles is the main sector both as exporter and importer in the Province of Barcelona (10,447 million and 12,423 million €, respectively. The chemical industry sector occupies the second position in both exports (8,445 million euro) and imports (10,552 million euro). Finally, the manufacture of pharmaceutical products ranks third in exports (5,837 million euro) and imports (5,917 million euro)[44].
The main business sectors interacting with the logistics industry in the Area of Barcelona are:

- Food and drinks (27.9% of Spanish food&drinks exports, 32% of the production is exported)
- Automotive (22.7% of Spanish automotive exports, 65% of the production is exported)
- Pharma (43.7% of Spanish pharma exports, 77.3% of Catalan exports of life science)
- Chemical and plastics (47.2% of Spanish chemical exports, 42% of production is exported)
- Textile and design (32.1% of Spanish textile and design exports, 6.6% of Catalan exports)
- ICT (34.9% of Spanish exports, 35.9% over total ICT exporters companies are regular)

These sectors' operational level can be divided into three layers: local, intermediate, and international.

Local operators focus mainly on transport and logistics activities for the Catalan market. Their logistics facilities are positioned mainly in the external area of Barcelona. This business sector in the last years has performed large changes thanks to the increasing value of e-commerce market.

Intermediate operators are those with a focus not only on the local area (in this case Catalunya) but with focus and interest to also international markets.

[43] Logistics. The revolution of a rising market. JLL
[44] FLAIX metropolità 2019 i Evolució socioeconòmica a l'AMB 2015-2019

International operators are those players that in Barcelona focus mainly on international transport and shipping operations. Most of these companies have logistics facilities and plans located in the area surrounding the port and airport of Barcelona. Their predominant activities are cross-docking and freight transit.
Client profile: The target profiles are, logistics operators (catering, courier/express, retail food, retail non-food, etc.), public multiutility companies (e.g. waste management companies), industrial companies, and logistics real estate companies.
PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY
Problem to solve: - Missing specific policies for a zero-emissions logistics - Missing charging points specifically for logistics vehicles both on street and at logistics sites - Missing specific incentives for decarbonisation in logistics operations - Missing specific incentives for decarbonising logistics operations
Business opportunity: The area of Barcelona is the Southern Europe entry point for goods arriving from the Middle East and Southeast Asia, allowing swift delivery to the entire Mediterranean corridor. Cross-docking and transit activities predominate. Some examples: Decathlon, Ikea, Amazon, Henkel, Honda, Ups, FedEx, TNT, Nintendo, Nissan, Seat, etc[45]. In the entire Catalonia region, a special interest for logistics themes is reported by companies of sectors: food & drinks, automotive, e-commerce, pharma, electronic products, steel products, chemical and plastics, textile, and design. Different top international companies have located their European logistics hubs in Catalonia and the e-commerce sector represents a very important part of their operational activities. For 2 out of 3 logistics companies active in Barcelona, e-commerce represents a very important part of their customer portfolio, covering a percentage between 10% and 40% of the business. There is another 21.1% of the companies that only accounts for up to 5% of the business and 15.8% of those consulted already have between 30% and 60% of clients coming from e-commerce. Electric vehicles are becoming increasingly prominent in logistics settings, and this needs to be accompanied by considerable investment in-vehicle charging facilities both along roads and in featured logistics sites. In the area of Barcelona, all these trends have seen a translation in the operational field with on one side a continuous higher demand for city logistics spaces, but with a lack in the supply of industrial buildings and offices with a consequent pushing up of prices, and on the other side with municipal policies for fighting urban congestion and pollution with specific actions

[45] Logistica in Catalonia. Sector Snapshot. Catalonia Trade&Investment

such, for example, the so-called “superblocks” and the restrictions imposed on vehicle access to the city centre[46] (Zone de Baixes Emissions - ZBE)[47].

The introduction of regulatory incentives for electric vehicles in Barcelona is part of the wider Climate Plan 2018 - 2030 where specific actions are reported (short, medium, and long term) for the development of a zero-emissions urban distribution[48].

Some elements specific for electric mobility growth are part of the short-term actions:

- To strengthen and create new infrastructures linked with electric vehicle penetration in the city: increase the number of charging points in municipal car parks, pilot test for charging points for urban goods distribution, taxis, etc.
- To regulate parking and budget to oversee the promotion of electric vehicles in the city.
- To introduce consolidated services associated with the promotion of electric vehicles: electric taxis, sharing the last mile with an electric vehicle, etc.
- To improve goods distribution and promote last mile distribution by bike, electric, motorbike, etc., through micro platforms.

Regarding the last point, the Barcelona Metropolitan Area has put in place specific policies for zero-emission logistics: ZBE areas, local ZBE areas, promotion of cyclo-logistics, but the sector has refused the project, asking for a delay in the restrictions and for more subsidies to renew the fleet.

To ensure interoperability between different municipalities that act as CPOs, the Catalunya Administration created a Memorandum of Understanding (MoU) to make all the municipal Radio-Frequency Identification (RFID) cards usable around the region to avoid users to carrying multiple cards when travelling around Catalonia with an electric car[49].

At present, the existing public on-street charging points do not consider payment for utilising energy, as a promotional local strategy for electromobility.

To emphasise the sustainability of electromobility, all the public charging points located in the Metropolitan Area of Barcelona are fed with renewable energy and almost 30 of them are connected to solar panels.

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[46] Logistics. The revolution of a rising market. JLL

[47] https://www.zbe.barcelona/en/index.html

[48] https://www.c40knowledgehub.org/s/article/Barcelona-s-Climate-Action-Plan-2018-2030?language=en_US#:~:text=Barcelona's%20Climate%20Plan%202018%20%2D%202030,plan%20released%20in%20April%202018.&text=It%20is%20an%20ambitious%20plan,carbon%2Dneutral%20city%20by%202050.

[49] https://livebarcelona.cat/es/condueix-el-teu-vehicle-electric-per-tot-catalunya-fent-servir-una-sola-targeta-de-recarre/

The charging stations realised by the Municipality of Barcelona, and those realised by the Metropolitan Area, use the same equipment, conditions and instructions but are activated with different apps (AMB Electrolineres for the Metropolitan Area, SMOU for Barcelona). In both cases, the Municipality and the Metropolitan Administration operate as CPO (Charging Point Operator) and EMP (ElectroMobility Provider). Today the two apps are the common way to activate charging points in the metropolitan public space.

For the future implementation and wider technological development of smart, digitalised and electric logistics in Catalunia, the Generalitat has reported a series of trends and opportunities that companies are invited to realise[50]:

- Digitalisation of the supply chain
- Smart Facilities
- Blockchain in the railway network
- Machine learning
- Smart warehouses with robotics
- Flexible order delivery
- Sustainable distribution
- Autonomous transport
- Big Data analysis via IoT

The reason for this advice is the important consideration at regional level for smart facility solutions to perform a more efficient delivery management organisation.

In this field, the Generalitat has also included the development of solutions to support logistics facilities such as parking spaces inside cities to increase the availability of public areas for urban distribution operators or shared consolidation centres. Some examples of this action are in Madrid and Rotterdam. In both cases, the facilities are also equipped with charging infrastructures for electric vehicles.

In the Spanish capital, the consolidation centre (CC) is located at the former Legazpi fruit and vegetable market[51]. This is a very convenient location as it is close to the old city centre and to the Low Emission Zone (LEZ) boundary and has excellent access to the city. The building is owned by the Madrid municipality and is managed in cooperation by TNT and Calidad Pascual. After a public tender, the charging infrastructure for the CC was installed by IBIL in February 2014, starting the operations of the centre in the city.

To increase consolidation and to strengthen the local distribution, in Madrid, different local providers, together with the support of the Municipality, have worked also for the realisation of shared delivery consolidation centres inside the city.

[50] Logistica in Catalonia. Sector Snapshot. Catalonia Trade&Investment

[51] Logistics. The revolution of a rising market. JLL

Different express couriers in different parts of the country have settled smart local delivery centres (locker-based facilities): Amazon, Correos, Pudo, Citibox, Hapiick, Mayodomo, Lavalocker, etc.

Smart centres to twin with smart distribution activities like automation and robotisation using drones that can deliver faster, avoid traffic jams, and provide access to areas where the last mile distribution is poorly developed, such as rural areas.

In Barcelona, Amazon, with contribution from the Generalitat, has also started to apply machine learning to their operations in the new multilevel centre connected by ramps realised in Prat de Llobregat. The system supports the analysis of data to establish demand patterns for specific products. At the same time, the introduction of robotics solutions and 4.0 technologies has been deeply analysed in logistics sectors and other manufacturing and traditional industry sectors.

Finally, regarding data management, the Generalitat is promoting studies and activities for the implementation of blockchain solutions as the most advanced methodology for data management in freight transport. Several applications have already been identified such as the smart contract, the smart goods payment or the maintenance of assets and ownership history.

VALUE PROPOSITION AND SOLUTION

Value proposition:
Logistic Hubs for electric vehicles in Barcelona can help to maximise the productivity of the EV fleet (both regarding “peripheral logistics hubs” - heavy vehicles - and "transhipment urban logistics hubs" - small and medium vehicles).

Logistics Hubs within urban perimeters, such as sharing services hubs (for cars, vans, scooters, motorcycles, bikes, etc.), can offer easy charging, visibility in front of the customers, and less expensive logistic operations.

Solution:
Between the different USER-CHI tools that the city of Barcelona is developing, the ones useful in the framework of the Logistics Hubs are:

- INCAR for the implementation of a hub allowing Charging Point Operators (CPOs) management systems for roaming and extra-services through OCPI 2.2 communication
- SMAC for creating a software tool calculating the optimal charging profile (i.e. the amount of energy to provide) of the charging stations and for smart grid integration and demand management services for slow, medium, fast and ultrafast charging inside the logistics hubs.
- INDUCAR for the vehicles inductive charging during the time at the logistics hub.

USER NEEDS AND RELATED SOLUTION BENEFITS

User need #1: Assure van operations for urban distribution in restricted areas	Related solution benefit/s: create a logistic hub around the zero-emission boundary (or pedestrian areas) with several facilities:

	parking, charging points (up to 22 kWh), cargo bikes sharing services (to combine vans and cargo bikes for deliveries into the ZE area), small warehouses, lockers related to the e-commerce, ancillary services. To realise this kind of solution, Barcelona must tackle problems related to space availability and affordable price.
User need #2: Logistic hub inside big metropolitan areas	Related solution benefit/s: combine parking and charging points -with smart charging- for different fleets: EV taxis, EV commercial vans, car-sharing service. Several small hubs must be realised and not a unique big logistic hub (this is more appropriated outside the urban area).
User need #3: Take profit from existing small parking lots in the street for loading and unloading operations	Related solution benefit/s: add adequate charging solutions for EV vans (inductive charging?) in the existing parking lots for loading and unloading. Do the same in the taxi stops for EV taxis (see BM "E-taxi stops")
User need #4: Built an underground Logistic hub	Related solution benefit/s: As initially planned in the new Abaceria Market. In the end, the solution is no more considered and very expensive.
User need #5: Logistics hub in a strategic location	Related solution benefit/s: Strategic locations can allow collaboration between different sectors that can share space in different day times. For electric buses during the day (or also during the night) and waste service trucks mainly during the night. This solutions has been already considered in Barcelona with ultra-rapid chargers (pantographs) for busses but there is a lack of alternative heavy e-vehicles for testing the partnership.
COMPETITIVE ADVANTAGE	
For Metropolitan Authority: • Sustainable approach for political reason, also providing economic subsidies. • A social responsibility approach (to reduce the number of Internal Combustion Engine (ICE) vehicles in the city area and changing them with e-vehicles). For logistics operators: • the possibility to use the charging points for recharging vehicles and to have more profitability with their e-fleet.	

7.1.2.1 Key stakeholders

The following table lists the key stakeholders in the Logistics Hubs Barcelona use case. These organisations play a key role in applying the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities, not related to the solution's application, are excluded from the analysis.

Table 11 Key stakeholders in the Logistics Hubs ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	For rules and urban planning
Charging Point Operators	Realisation and management of charging points
National Authorities and European Authorities	For standards and policies
Grid Infrastructure Managers	Connection, management, and upgrading of charging points with the local power grid. Approval of new charging points
Energy supplier companies	Supply of power energy (sometimes can correspond to the CPO)
Logistic operators	As customers and partners in logistics e-hubs
Technology solution providers	Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)
Landowners and logistics real estate companies	For the provision of areas where realise charging points for logistics (logistics areas, petrol stations, etc)
Manufacturers of freight transport vehicles	As providers of vehicles operating in logistics hubs

7.2 Annex 2: Citizens e-mobility stations business model analysis

7.2.1 Business case overview

7.2.1.1 Market characteristics

Pollution reduction in our cities and decarbonisation of industries are no longer a choice, but they also represent a need and opportunity from an economic perspective.

In different European countries, mostly in southernmost areas of the European continent and in countryside zones, there is an excessive utilisation of pollutant private cars. This is also the case of regions with a low concentration of alternative mobility solutions and still the vision of private cars as status symbols. For example, in Italy, six private cars are registered every ten citizens, with a utilisation rate of around 5% and an average age of almost 11 years[52].

A turnaround must be put in place, with the reorganisation of both public and private mobility by focusing on decarbonisation. In this framework, an improvement of integration between mobility infrastructure and land development (residential districts, commercial, cultural, tourist poles, etc.) must be included together with a boosting for intramodality in terms of combination between public transport and alternative mobility, personal or shared, by using more sustainable technologies such as electric scooters, e-bikes, or e-cars. Also in the public transport domain a change has been occurring during the last years, with the inclusion in many cities of electric busses in the fleets. UITP, the International Association of Public Transport, estimates that by 2030, 52% of busses operating in the world will be electric[53].

The introduction of new urban transport solutions, the restoration of stations and interchange nodes towards more electric mobility are all policies that public administrators must incentivise in combination with new regulations for promoting sustainability also for citizen habits.

For example, Oslo is limiting the mobility of polluting cars by gradually introducing restrictions for entering the city centre, while incentivising electric mobility. Initially, electric cars could access the city centre, and for them also priority lanes were planned. But the proliferation of electric vehicles resulted in congestion of these priority lanes that now are allowed only for shared electric vehicles[54].

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[52] Legambiente Italia - Città MEZ 2020. https://www.legambiente.it/citta-mez-mobilita-emissioni-zero/

[53] Legambiente Italia - Città MEZ 2020. https://www.legambiente.it/citta-mez-mobilita-emissioni-zero/

[54] World Economic Forum with Bain&Company – Electric Vehicles for Smarter Cities: The Future of Energy and Mobility

Following the direction taken by European mayors that participated in the 3rd European Conference on Sustainable Urban Mobility Plans (Bremen 2016), better use of public space is the basis for a more efficient urban transport[55]. The public space does not have to be seen only as a private parking for polluting cars, but this space needs to be considered in various ways as door entrance for different public services, also mobility related. This is the concept behind also the mobility stations.

7.2.1.2 Solution types and alternatives

Hence, the mobility stations combine and provide different transport modalities in a unique hub. They allow finding the most suitable means of transport at any time and any place in order to reduce private vehicle ownership of residents and customers. The innovative aspect is to combine several mobility technologies (car-sharing both stationary and free-floating, scooters, normal bikes and cargo bikes) in connection and complementation with, if possible and available, the use of public transport and ancillary services (Wi-Fi, toilettes, cafeteria, bike repairing, etc.).

In the most connected and advanced future, these mobility hubs can provide services related to electromobility: different zero-emission and shared transport modes available and linked together in a network, as well as, connected to sustainable public transport services.

Mobility stations feature a new design and are a new way of providing access to transport and services in cities and neighbourhoods. Their realisation needs to consider local conditions and to consequently be adapted to the different neighbourhoods, different travel destinations, and different centres (commercial, business, educational, cultural, tourist etc).

Mobility hubs can have different sizes, features, types, quantities, and modes of transport available, and additional service levels. Everything depends on the existing context, transportation level and user needs. They can be as small as only two (e-)bikes at a street corner or they can contain a combination of e-(cargo)bikes, light electric vehicles (such as e-scooters and e-cargo bikes), even electric carsharing and/or public transport possibilities.

Depending on the convenience of the location, the number and kind of people crossing the station, additional services such as ticketing facilities, waiting zones, (postal) lockers, etc., can be considered.

The provision of these multimodal mobility hubs aims to bring to citizens a private-car-free-lifestyle or at least have significant lower mobility costs and reduced emissions[56].

The redesign of public spaces – such as pavements, streets, green spaces, and squares - should be a core consideration for a better quality of life for the inhabitants of a city. Public space plays a role for much more than only transport and mobility. Especially in densely populated urban areas, space is also needed for recreation and places for social exchange. The scope of mobility stations is to improve the quality of public areas creating spaces of mobility where currently there

[55] https://www.eltis.org/SUMP2016

[56] http://www.europeanenergyinnovation.eu/Latest-Research/Summer-2020/CIVITAS-ECCENTRIC-project-Intermodal-E-Mobility-Stations-in-Munich

are only parking lots for private vehicles. They also create an attractive and environmentally friendly mobility offer that is easily accessible and available to all citizens[57].

The mobility hubs also aim to address the issue of the physical barriers between transport modes. Public transport stations are often not close to sharing mobility stations, or to car-sharing parking areas[58]. Furthermore, they also try to solve the 'cluttering' of public space caused by the wide variety of shared services, bikes, cars and e-scooters, which are often indiscriminately parked on pavements and in pedestrianised areas[59].

Another opportunity for the mobility hub is linked with city logistics which needs relief in an environment of constantly growing traffic load, especially in city centres. At the same time, parallelly guarantee all parcel deliveries and collection on a safe way[60]. For this reason, locker systems are one of the additional services and facilities that can be provided at the mobility hubs.

To sum up, mobility services that can be accumulated to mobility hubs are different[61].

- **Shared (electric) low impact soft mobility (such as bikes, cargo bikes, scooters, etc.).** The service provided with these vehicles is for small distances, often referred to as the last mile. For this reason, the offer is focused on soft (shared) mobility options in order to create the lowest possible impact on the public domain. These vehicles are often provided in a large number of means and types due to a large number of potential travellers and areas covered.
- **Low impact mobility parking**. There can be extensive parking spaces for shared low impact mobility options as well as private ones. Easy to use, safe and accessible parking space motivates the usage of these infrastructures for transport.
- **Shared (electric) cars.** This type of service is often conceived for people that need longer transport connections. The arrival or departure using a private car, even when shared, should generally be discouraged.

The presence of electric transport systems means the necessity of parking spaces with charging facilities. Parking needs to be safe, secure and (possibly) covered, this can be accomplished with a conscious selection of the location (social control), the design and lighting.

Some of the charging services that can be provided at electromobility stations:

- Battery swapping: changing the battery for a charged one. This does not require extensive charging facilities at the eHUBs.
- Inductive charging: through induction of an electromagnetic field between the road surface and the car.

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[57] http://www.city2share.de/city2share.html

[58] https://www.bikeitalia.it/2019/02/21/mobility-hub-e-la-mobilita-sostenibile-in-citta-diventa-piu-facile /

[59] https://www.eltis.org/discover/news/leuven-install-50-mobility-hubs-foster-multimodality

[60] http://www.city2share.de/city2share.html

[61] eHUB – technical and functional requirements

- Conductive charging: connection of the car to an electric charging station with a cable.
- Fast charging.
- Slow charging. This solution is most suited to parking where people typically stay for at least 30 minutes to 2 hours or longer. This should be sufficient for private cars when visiting a specific location.

Shared electric cars would preferably have fast charging to increase the usage per day.

As reported, there are two service modalities at the stations for electric vehicles: charging and battery swapping. Electric means of transport charged at the station require more space as well as a connection to the electrical network while working with systems like battery swapping requires less space and provides more flexibility. Battery swapping for a large number of widely dispersed sites is not cost-efficient. In this case, charging at the location is preferable. Charging electric scooters require a household outlet (115 Volt AC, 15A) and produce about 1.5 kW[62]. With charge time from 7 to 30 hours, overnight charging or battery swap is preferable [63].

Examples of places where an electromobility hub can be integrated are:

- On-street parking spaces. This solution incentivises sharing mobility while discouraging private vehicles parking. A parking space for one car can provide parking for over six low impact mobility options. Disadvantages are that public opinion is more often negative, at least at first.
- In space between existing landscaped areas of existing infrastructure. This solution has the advantage to be more visible. The negative aspect is the risk to be settled in a public domain already occupied, which can become overwhelming. Other possibilities are infrastructure blocking existing walking lines or reducing the accessibility of the location.
- Dead space. A positive element is the fact of being settled in an unused space. A negative aspect can be being less visible or even less safe for the potential users.

Layers and context that must be taken into consideration for the realisation of multimodality hubs[64]:

- The existing transportation networks
- The existing travel routes
- Network of cycling routes and routes for low impact mobility
- Transport barriers

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[62] https://www.researchgate.net/publication/323672096_Location_Optimization_for_Multiple_Types_of_Charging_Stations_for_Electric_Scooters

[63] Joint methodology for eHUBs

[64] Joint methodology for eHUBs

- Large, medium and small nodes of transport
- Car-free zones and limited traffic zones
- Pools of attractions (residential, commercial, business or combinations)
- Car and bike parks
- Electricity network

7.2.1.3 Market growth and trends

In Europe, there are already different examples and projects (with different sizes of service and impact) regarding mobility hubs.

One city is Munich (Germany), which has set up four mobility stations as part of the EU-funded CIVITAS ECCENTRIC project. The purpose is with multimodal mobility to offer a real alternative to car ownership and to help emissions reduction, especially in an area with only few alternatives to individual car use[65]. In the project area the aim is the provision of multimodal mobility service that allows residents to live without private cars or at least to lower their mobility costs and emissions. Mobility stations want to offer new design and a new alternative of access to services in the city of Munich. They are combined with new regulations that enable reserving parking space only for carsharing vehicles. The stations are provided by the City of Munich on public space offering a platform for all interested private mobility suppliers.

Another European project is the Interreg North-West Europe eHUBS (Smart Shared Green Mobility Hubs). The pilot site cities are: Amsterdam, Leuven, Arnhem, Nijmegen, Manchester, Kempten, and Dreux. The project purpose is the realization of on-street locations that bring together e-bikes, e-cargo bikes, e-scooters and/or e-cars, offering users a wide range of options to experiment and use in various situations. eHUBS can vary in size (minimalistic, light, medium, large), type of location, and type of offer. They can be small and located in residential areas, with just one or two parking spots, or bigger and positioned close to stations and major public transport interchanges.

Finally, as already anticipated, one more component that can characterise multimodal hubs is the presence of also urban logistics services. An example is the City2Share project where, since July 2017, UPS is involved[66]. UPS in Munich has relied on the sustainability of parcel delivery in the urban context. Every morning three containers are set up by UPS at the mobility hubs of Kidlerplatz, Glockenbach and Zenettistraße. From these depots, UPS only uses load wheels (conventional and electronically supported) for the delivery of parcels to the accommodations. In the evening, the containers are taken back to the nearby UPS Center, where they are loaded again for the following day. With the help of these load wheels, UPS delivery traffic in the involved suburbs no longer emits any pollutants. This saves 65 tons of CO2 per year.

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[65] http://www.europeanenergyinnovation.eu/Latest-Research/Summer-2020/CIVITAS-ECCENTRIC-project-Intermodal-E-Mobility-Stations-in-Munich

[66] http://www.city2share.de/

In the market of electromobility, and with its inclusion in charging stations, service providers focus can take two directions:

- Developing the charging point network as CPOs, focusing on where locate points, how to use them, how to make them more profitable, etc.
- Deploying electric mobility fleets.

For both directions, revenue stacking is crucial. Operators need to consider the generation of multiple revenue streams to mitigate investment and utilisation risk.

Moreover, for CPOs, the proliferation of EV charging and the competition increasing will erode energy margins, emphasising the need to deliver additional services. The growth needs to be delivered with profitability.

An alternative can be focusing on electric fleets deployment, especially with high-use vehicles. Nowadays, most public and alternative mobility services in urban areas have to operate with electric vehicles: car/scooter/bike-sharing, public transport, taxis, etc.

All these operative sectors imply a high use of vehicles that can generate revenues for the mobility operator, maintenance operator and charging point operator.

Although personal-use vehicles will likely remain a significant portion of the vehicle stock for many years, they are on the road less than 5% of the time, representing a low volume of overall kilometres driven[67]. The approach of sharing mobility and mobility as a service also helps to avoid the main barriers to adoption of electric mobility by individual customers (concerns about vehicle range and charging) and the long vehicle-replacement cycles.

Furthermore, public and private fleets, mobility-as-a-service and later automatic vehicles as public service, will exhibit a decreasing cost of travelling thanks to electric propulsion, driving down the cost to around 0.22 euro per km by 2030[68]. This new mobility cost benchmark will challenge traditional self-ownership models and will affect customers' choices.

The development of recharging infrastructure is in any case the basic element for improving electric mobility, both public and private.

For CPOs, having a large group of workplaces charging users provide a captive network to sell secondary services such as advertising, maintenance, etc. Moreover, once these spaces are fitted with a sophisticated offering, workplace charging could act as a balancing mechanism for the grid. Having cars parked for some eight hours a day could help to manage peak and off-peak periods, especially in heavy industrial and power-intensive locations. All these energy-related services can create new sources of value for the customers as well as for energy and mobility service providers.

CPOs typically do not own the land where charging assets are installed. The important element is to figure out benefits for site owners. Operators have to understand what to offer to site

[67] Legambiente Italia - Città MEZ 2020. https://www.legambiente.it/citta-mez-mobilita-emissioni-zero/

[68] World Economic Forum with Bain&Company – Electric Vehicles for Smarter Cities: The Future of Energy and Mobility

owners, such as a commission or rental income, that will allow their business model to work and be profitable. In some cases, the site owner may not expect an income, treating charging as a free service (as in the case of Wi-Fi) to attract footfall.

In the world the drop out of fossil fuels is planned to 2050. In order to respect the Paris Agreement (1.5 degrees), cities and urban areas have to be the first to switch off internal combustion engines, and for this reason in the European CO2 standards regulation revision (2021) the proposed phase out date of new ICE cars is in 2035 (subject to approval by the Council and the EP).[69].

Different firms look to be already in action for developing electric infrastructures in public spaces. While public infrastructures are indispensable along highways for private cars, in cities they look to be an independent variable of number of operating and sold electric vehicles. This element shows how recharging is mainly private[70].

Today, public- and private-sector stakeholders often develop policies, deploy charging infrastructure, and follow business models based on current mobility patterns and vehicle-ownership norms, with limited consideration of energy implications. A common or clear vision for how a right design and deployment of required infrastructure would be affected by changes in mobility patterns, vehicle technology or energy systems is still missing.

An efficient and integrated deployment could generate more than 2.8 trillion euros of value globally for society and industry by 2025. An increase in efficiency of the overall system could be realized, optimizing capital allocation and creating new services for customers[71].

Deployment of critical charging infrastructure today while anticipating the tomorrow transformation of mobility is fundamental.

7.2.2 Berlin business model

The following table provides an overview of the business case, i.e., the rationale for developing citizens e-Mobility stations in Berlin from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 12 Berlin Citizens e-Mobility Stations summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector:

[69] Legambiente Italia – Città MEZ 2019: https://www.legambiente.it/wp-content/uploads/Cita_MEZ_report.pdf

[70] PWC – Powering ahead! Making sense of business models in electric vehicle charging

[71] World Economic Forum – The future of electricity: New technologies transforming the grid edge.

The German Federal Government, assisted by the National Platform on Electric Mobility, is leading different actions to develop the electromobility market in the country and establish Germany as the leading market in Europe[72].

Since 2016, different specific packages have been submitted to promote the market, and up to now, values greater than a billion euros of investments have been presented. The basis for this is the Government Programme for Electric Mobility[73].

One of the main topics is related to market incentives, and this is addressed to three measures with a financial impact: temporary purchase incentives, the expansion of the charging infrastructure, and the purchase of electric vehicles by public authorities.

The purchase incentives (environmental bonus), are paid towards new vehicles:

- €3,000 for non-hybrid electric cars
- €2,250 for plug-in hybrids

The grant is valid for purchases of cars with a list price of up to €40,000. The total funding is limited to €1.2 billion. The Federal Government and the automotive industry are each responsible for covering half of the costs. The funding from the Federal Government is disbursed only if also the manufacturer provides a grant. The environmental subsidy was planned to end by 2021, but now the German Ministry for Economy expressed interest in extending the bonus until 2025[74].

Together with the promotion of the e-vehicles to citizens, the Federal Government is providing incentives also for expanding the charging infrastructure: €300 million divided between rapid charging infrastructure (€200 million) and normal charging (€100 million).

The fostering of electromobility needs to be also addressed by a coherent behaviour of the public administration. This is why the Federal Government aims to renovate at least 20% of the public authority's vehicle fleets with electric vehicles.

The invitation by the Federal Government looks to have been embraced by local authorities. Indeed local public transport companies in Berlin, Hamburg, Munich, Cologne and Frankfurt (the five largest German cities) have planned to purchase at least 3,000 electric buses by 2030[75].

As requested by the EU Directive (2014/94/EU), suitable use of electromobility needs uniform charging and payment standards. For this reason, the German government has enacted the Charging Station Ordinance, which entered into force on 17 March 2016. The ordinance, as

[72] https://www.bmwi.de/Redaktion/EN/Artikel/Industry/regulatory-environment-and-incentives-for-using-electric-vehicles.html

[73] https://www.bmwi.de/Redaktion/DE/Downloads/P-R/regierungsprogramm-elektromobilitaet-mai-2011.pdf?__blob=publicationFile&v=6

[74] https://www.reuters.com/article/idUKKBN27W2FT?edition-redirect=uk

[75] https://www.sustainable-bus.com/news/bvg-orders-15-solaris-urbino-18-electric-and-brings-to-45-the-electric-bus-fleet/

the European Directive, regulates the establishment of the infrastructure for alternative fuels. In particular, it reports rules necessary to harmonise socket standards for publicly accessible charging stations and contains minimum requirements for the establishment and operation of publicly accessible charging stations for electric vehicles, thus giving investors greater certainty as they build their charging infrastructure. Operators of publicly accessible charging stations must inform the Federal Network Agency when installed and come on stream. They also must provide regular evidence that rapid charging stations are compliant with the technical requirements.

The harmonization procedure must include authentication and payment system at charging stations. Minimum payment standards are to ensure non-discriminatory access to charging facilities. In May 2017, the Ordinance amending Charging Station Ordinance II was approved with new rules regarding ad-hoc charging, abolishing the need to participate in an electricity supplier's in-house invoicing system[76]. With the new system, users of electric vehicles can charge their vehicles and pay for the electricity at all publicly accessible charging stations using a common web-based payment system, or (if available) in cash or by electronic cash or credit card.

Regarding smart grid systems, in 2011 was approved the Energy Industry Act that brought in the sector some essential changes, creating a legal basis in terms of energy law, data protection, and data security[77]. In the context, specific preconditions have been put in place for grid charges to be reduced where electric vehicles are used to support the grid, thus cutting the cost of charging.

For strengthening legal certainty and security of investment there is the National Electricity Market Act. This document improves the policy environment to establish a needs-oriented charging infrastructure and ensures legal certainty for investment. Now investors from all sectors, and with many different motivations, can contribute towards the installation of charging facilities in the context of fair competition. Grid operation rules no more strictly constraint and address the development of charging stations, and the formation of a monopoly over the operation of the charging stations is now prevented. The obligations of the charging infrastructure operators under energy legislation are restricted to the necessary minimum.

With an act adopted in 2016, advantages granted by an employer in the form of the charging up of electric or hybrid electric vehicles are now exempted from income tax. Tax breaks are granted for employers also when they provide charging devices to the employee for free of charge or at a reduced price and for grants to use these charging devices.

Finally, in the first quarter of 2015, the Federal Cabinet adopted the Electric Mobility Act[78]. The document, in force until 2030, assigns a label and related privileges to electric cars on Germany's roads. The Act gives municipalities the possibility to grant preferential treatment to

[76] https://www.bmwi.de/Redaktion/DE/Downloads/V/aenderungsverordnung-zur%20ladesaeulenverordnung.pdf?__blob=publicationFile&v=4

[77] https://www.bmwi.de/Redaktion/EN/Artikel/Energy/smart-grids.html

[78] http://www.gesetze-im-internet.de/emog/index.html

electric vehicles (purely battery-driven vehicles, plug-in hybrids and fuel cell vehicles) mainly in terms of parking and the use of bus lanes. These privileges are applicable only to electric vehicles and to plug-in hybrid vehicles with a minimum range of at least 40 km in purely electrical use or maximum carbon dioxide emissions of 50 g/km when in operation.

Market size:

According to BDEW (German Association of Energy and Water Industries), currently in Germany there are around 35. 000 publicly available EV charging stations. But there are not yet enough e-cars on the road to utilise the infrastructure in an economically viable way.

The following picture (Figure 3) shows the accumulated new registrations of electric vehicles in Germany from 2010 to the end of October 2019. As it is possible to see, the cumulated new registrations reached 285.000 electric vehicles at the end of 2019, 55% of which are Battery Electric Vehicles (BEVs)[79].

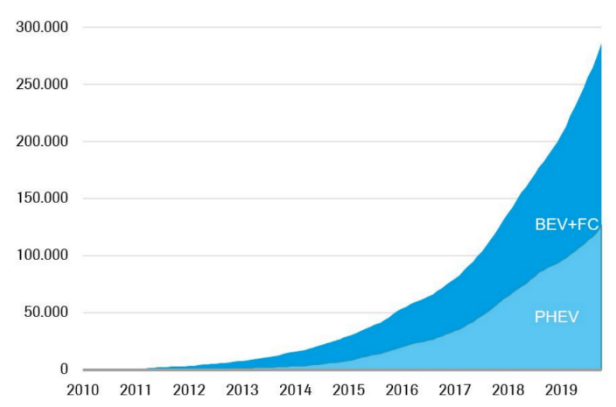

Figure 3: Cumulated new registrations from January 2010 to End of October 2019 (KBA, VDA calculation)

Based on data of BDEW, at the end of 2020 the purely electric cars in use were around 240,000, while the plug-in hybrid cars registered 200,000[80].

[79] https://www.vda.de/en/topics/innovation-and-technology/electromobility/Electric-Mobility-in-Germany.html

[80] https://www.cleanenergywire.org/news/germanys-charging-infrastructure-outgrows-demand-e-car-drivers-energy-industry#:~:text=According%20to%20the%20energy%20industry,electric%20cars%2C%20the%20group%20argued.

The following picture (Figure 4) reports the value of electric buses in Germany in 2019 by type of technology[81].

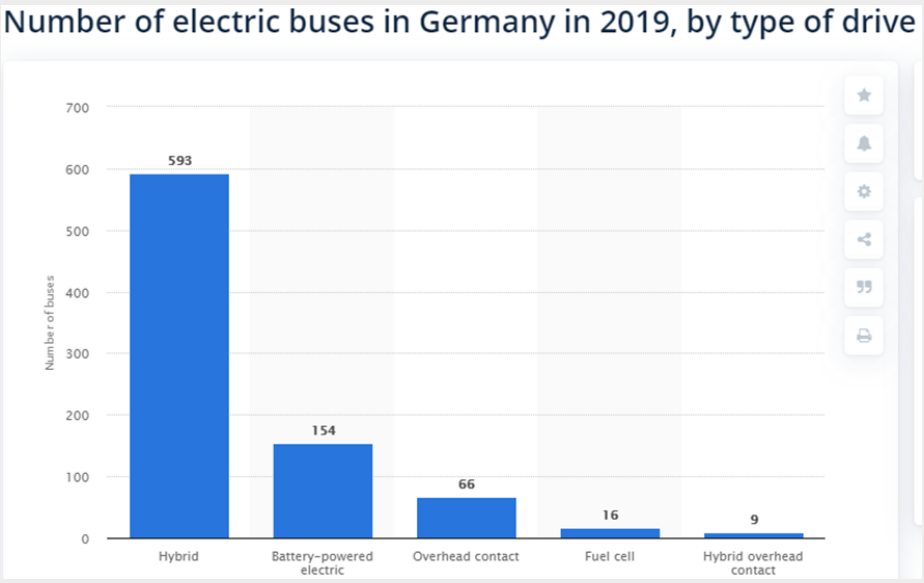

Figure 4: Number of electric busses in Germany by type of drive - 2019 - statista.com

In 2020 the total amount of German funding for e-buses reached the value of 650 million euros. A value with an increase of 300 million compared to the previous subsidies budget. The German aid scheme is valid until the end of 2021 and covers the additional costs of purchasing electrically powered or plug-in hybrid buses instead of conventional diesel buses. The subsidies also cover the setting up of necessary charging infrastructure[82].

Despite the considerations of BDEW and the growing numbers of electromobility in Germany, new potential customers continue to cite a lack of charging infrastructure as one of the main reasons they hesitate to buy electric vehicles.

Analysis conducted by BDEW reports that in Germany the best charging opportunities exist in Munich, with 1103 public points, and Hamburg, with 1070 public points. The largest city, Berlin, follows in third place with 974 points.

To boost the electromobility development, in 2020 the German Federal Government introduced a plan that requires all fuel stations to also offer EV charging in the future. This will mean that fuel stations will also function as EV charging stations to increase the electric mobility sector. Electromobility, according to the BDEW, for achieving a mass market will need at least 70.000 charging stations and 7.000 fast-charging stations[83].

[81] https://www.statista.com/statistics/1167274/electric-buses-number-type-of-drive-germany/

[82] https://www.sustainable-bus.com/news/german-fundings-for-e-buses-grow-up-to-650-million-euros/

[83] The Ultimate Guide to EV Incentives in Germany. Wallbox

Together with the previously exposed example of e-Mobility stations in Munich (within the CIVITAS ECCENTRIC project), other cities in Germany where mobility hubs have been developed are[84]:

- Bremen. The site of the first mobility hubs in Europe. More than a dozen "mobil.punkt" ("mobility point") have been developed since the early 2000s. They feature Cambio carshare vehicles and bikeshare parking at transit stops.
- Offenburg. In 2012, Offenburg kicked off a multimodal mobility initiative called "Einfach-Mobil," ("easy mobile") which included targeted mobility outreach and research as well as the installation of four Einfach-Mobil mobility stations. These mobility stations feature carshare and bike-share close to Offenburg's main transit stations. The payment and activation of these services are integrated through a single smartcard called the Einfach-Mobil card.
- Würzburg. Funded collaboratively by the city and the Federal Ministry of the Environment, Würzburg installed nine mobility hubs across the city, which feature bikeshare, car-share, and informational kiosks close to major transit stations.
- Hamburg. Hamburg's "Switchh" mobility station (11 in total across the city) feature round-trip carshare vehicles, free-floating car-share vehicles, bike-share, bike parking, and electric carsharing charging stations. The transit agency (HVV) smartphone application integrates transit information with locations of bike-share and carsharing.
- Leipzig. Leipzig's "Mobil" station features electric and standard carsharing, bike-sharing and transit. These services are integrated on a smartphone app called "Leipzig mobil" which offers payment integration and discounted monthly rates for carsharing and bike-sharing.
- Berlin. With 14 Jelbi stations and 9 Jelbi points located near the train, tram, or bus stops, the Berliner Verkehrsbetriebe (BVG) connects its services with other mobility providers available in the city. Each Jelbi station allows its users to rent and return a preferred type of vehicle, be it a car, a bike, or a scooter. Additionally, being equipped with charging infrastructure, Jelbi stations offer charging services for electric cars. For non-drivers, the stations might serve as stops for taxis or on-demand shuttles. The Jelbi points are smaller hubs offering renting services of exclusively two-wheel vehicles. For users' convenience, all Jelbi sharing services can be viewed, booked, and paid for using a free Jelbi app. Of all housing companies in Berlin, Gewobag was the first one to provide space for this kind of mobility hubs[85].

[84] https://international.fhwa.dot.gov/sum/ch3.cfm
[85] https://www.jelbi.de/en/home/

An interesting element about the Munich mobility hubs is the possibility for members of the stations to also receive discounted transit passes and information about the variety of available transportation options. Everything in a vision to the future development of a local MaaS (Mobility-as-a-Service) ecosystem. At the moment, the biggest opportunity in Germany for developing integrated and smart e-mobility stations is the Pioneer Park Hanau residential project in the Rhine-Main region. Around 1,600 new residential units will be built on an area of 50 hectares, and for sustainable mobility, up to 15 e-Mobility stations will be realized. With over 100 e-vehicles (e-cars, e-bikes, and e-load bikes), the objective is to offer an attractive, flexible and reliable mobility solution that makes second or third vehicles superfluous. The sharing option would be an alternative to use a vehicle especially for seldom and occasional drivers. The wide range of vehicles on offer would invite citizens to use another vehicle as needed: while the e-bike is sufficient for a short errand, the e-car is more suitable for the next appointment[86].
Client profile: The targeted clients are private and business EV drivers (both at the working location and at home), private companies with electric fleets, shopping venues interested in charging solutions as a means for attracting new customers.
PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY
Problem to solve: • More publicly accessible charging infrastructure • Existence of many different operators: a unified loading system, incompatibilities in access and payment methods • Improvement of maintenance level • More fast chargers • Need to know if the charging points are busy and provide the possibility to make a reservation? • Managing the time required for charging EVs • Price regulation at private EV charging points • Less complex processes to register as CPO • Leaner site approval processes • Transparent tender process and willingness to increase infrastructure
Business opportunity: In Germany different local authorities are involved, with specific policies, in the growing and developing of electromobility.

[86] https://moqo.de/en/blog/gp-joule

The city of Berlin and its Senate have chosen their own way for installation and operation of electric infrastructure (especially public charging points) with the so-called “Berliner Modell” (Berlin Model). The overall approach of the “Berlin model” towards electromobility aims to give easy and non-discriminatory access to charging infrastructure on public streets to every EV driver.

The infrastructure was set up in specified search areas for which particular needs were determined according to a location concept. In the current phase of charging infrastructure expansion, up to 700 additional charging points will be built on the basis of a proven demand. Under certain conditions, private individuals and commercial enterprises, as users of electric vehicles, have the opportunity to apply for charging infrastructure near their place of residence or regular workplace at the be-emobil website[87]. Currently there are about 60 DC chargers and about 650 AC chargers operational within the city borders of Berlin[88].

The main aim of the Municipality, and its Agency for Electromobility (eMO), is to reduce motorised private transport in the city with the support of mobility transition and with the implementation of best practice solutions on a sustainable basis. For example, with the construction of mobility stations (as well as car-sharing car parks) that play a particularly important role in this field. Mobility hubs increase the attractiveness of mobility services as they bundle various means of transport both spatially and through digital platforms[89].

Currently, in Berlin, public transport services provided with electric vehicles are metro, tram, buses, ferries and suburban trains (S-Bahn).

Metro and tram network lengths are 151.7 and 193 km, respectively. While the S-Bahn railway network length is 340 km.

The public ferry lines in Berlin are six, and some of them are operated with electric boats. The first solar-powered e-ferry was introduced in 2014 and realized by Weiße Flotte. Now catamarans operating on the river Spree and lakes around the German capital are four. The ferries are equipped with a particular magnetic mooring system and allow to produce directly through solar radiation up to 40% of the energy needed annually. During summer, the ferries‘ batteries still have 75 % capacity remaining after 15 hours of shuttle service[90].

The first provision of electric busses in Berlin was in 2015 with four Solaris Urbino. After this order, by the end of 2021, around 225 e-buses are expected to operate in Berlin’s streets.

In 2020 the first articulated e-bus was introduced. This was the first out of 17 "Solaris Urbino 18 Electric" ordered as part of the “E-MetroBus” project. These articulated vehicles are equipped with Solaris High Power batteries with a total capacity of 174 kWh and are able to be charged within minutes by pantograph at the terminal stops. The project is carried out by

[87] www.be-emobil.de

[88] “German Charging Infrastructure Regulations – Supporting Dutch companies understanding the German framework” – APPM Gmbh and SuMoCo, March 2019.

[89] http://hyer.eu/wp-content/uploads/2018/10/Berlin_ThomasMeissner.pdf

[90] https://www.frs.world/company/csr/environment/reduction-of-co2-emissions

BVG together with TU Berlin and the Reiner Lemoine Institute. The rapid charging columns required by the system are supplied by Siemens [91]. The "E-MetroBus" project is funded by the Federal Ministry of Transport and Digital Infrastructure with a total amount of 5.6 million euros and is part of the framework related to the Electromobility Funding Directive. The implementation of the funding directive is coordinated by NOW (National Organisation for Hydrogen and Fuel Cell Technology)[92].

Finally, in the BVG plans for the electrification of the bus fleet by 2030, there is also the partial installation of trolleybus overhead lines for Spandau district. In the feasibility study carried out by BVG, and presented at German fair ElekBu 2020, It is reported that the aim is to provide between 50 and 65% of journeys by wire in the district. Between the different scenarios analysed by the local operator, the one considered more sustainable is electrifying 245 km of lines, including 148 under wire. No less than 15 lines would be converted to trolleybus operation according to the program. The total investment should be around 300 million euros and will consider the procurement of 190 vehicles (115 articulated plus 75 double-articulated)[93].

Regarding sharing services, in Berlin, the operators with 100% electric vehicles are different and operate in different mobility sectors.

Car sharing operators with electric vehicles are two: Flinkster (with Mini electric, Renault Zoe, Opel Ampera) and WeShare (Volkswagen e-Golf, Volkswagen ID.3)

E-moped and e-bike sharing providers are two, respectively: TIER and Emmy, Wheels and Lime.

TIER and Lime are also e-scooter providers together with also Circ, Voi and Bird.

VALUE PROPOSITION AND SOLUTION
Value proposition: *Provision of an all-in-one location that combines different services for electromobility. Furthermore, systems useful to locate, reserve and route to free and available e-car charging points in public and semi-public parking areas.*
Solution: *The most suitable solutions for e-Mobility stations in Berlin are:*

[91] https://www.sustainable-bus.com/electric-bus/bvg-berlin-starts-taking-deliveries-of-107-new-e-buses-from-solaris/#:~:text=The%20first%20articulated%20e%2Dbus%20in%20Berlin&text=The%20delivery%20of%2017%20Solaris,on%20Line%20200%20from%20summer.&text=The%20remaining%20additional%20costs%20are%20borne%20by%20the%20State%20of%20Berlin.

[92] https://www.sustainable-bus.com/news/bvg-orders-15-solaris-urbino-18-electric-and-brings-to-45-the-electric-bus-fleet/

[93] https://www.sustainable-bus.com/news/trolleybuses-in-berlin-bvg-is-considering-massive-deployment-in-spandau-district/#:~:text=Trolleybuses%20among%20the%20options%20for%20Berlin&text=By%202021%2C%20some%20225%20e,with%20deliveries%20from%20spring%202020

• *INCAR for the implementation of a platform allowing a unique interoperability management system for roaming, charging, and routing to booked parking slots.* • *CLICK for the top-down location planning of charging infrastructure.* • *SMAC for dynamically optimizing the power supplied to the charging points*

USER NEEDS AND RELATED SOLUTION BENEFITS	
User need #1: Lack of public charging stations is discouraging the citizens from renewing their vehicles by shifting from ICE vehicles to Evs	Related solution benefit/s: Most of the necessary activities connected to laying the foundations for the market ramp-up of electric cars in Berlin have already been carried out with the "Berlin Model". Now a large part of the charging infrastructure will have to be built on publicly accessible areas as well as in private areas in the future. This is because the public space in a growing city like Berlin is subject to diverse and sometimes competing usage requirements.
User need #2: Searching for unoccupied charging stations	Related solution benefit/s: Interactive-map overview of unoccupied charging stations
User need #3: No possibility to reserve the desired charging point and assure its availability	Related solution benefit/s: Reservation within a short time (30 mins) of a charging point
User need #4: Finding the location (address) of the selected charging station	Related solution benefit/s: Routing to the selected charging station
User need #5: Accessibility limited to public charging stations	Related solution benefit/s: "digital key" allowing to open the parking barrier and enter the semi-public parking spaces equipped with charging infrastructure
User need #6: Questionable safety of publicly available charging stations	Related solution benefit/s: gaining accessibility to enclosed semi-public charging stations

COMPETITIVE ADVANTAGE
- The routing and access to charging stations is ensured with available parking space connected to charging station - Creation for location partner (such as a housing company like Gewobag), of opportunities and incentives to build charging infrastructure on private ground and open it to a larger user group (not only tenants). This increases the economic viability of private investments in charging infrastructure.

7.2.2.1 Key stakeholders

The following table lists the key stakeholders in the citizens e-Mobility stations Berlin use case. These are the organisations playing a key role in applying the new solution to achieve the benefits

described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities not related to the solution's application, are excluded from the analysis.

Table 13: Key stakeholders in the Citizens e-Mobility Stations ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Public authorities/Mobility agencies	*For rules and urban planning*
Transport Service Providers (TSPs)	*For installation of charging points in transport hubs*
Charging Points Operators	*Realization and management of charging points*
Technology solution providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
National and European Authorities	*For standards and policies*
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging points.*
Financial and payment system companies	*For the provision of payment solutions*
Location owners	*For provision of public and "semi-public" areas where to realize charging points*
Electromobility Service Providers	*As provider of services and solutions in the electromobility*
Original equipment manufacturers (OEMs	*As providers of e-vehicles*

7.2.3 Budapest business model

The following table provides an overview of the business case, i.e., information and strategies for developing citizens e-Mobility stations in Budapest from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 14 Budapest Citizens e-Mobility Stations summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: In Hungary, the first significant market-setting regulations for e-mobility were settled in 2015. Then in 2019, the new national electromobility strategy (Jedlik Ányos Plan 2.0) was introduced with the target to have 450,000 electric vehicles on domestic roads by 2030 and 45,000 vehicle chargers across the nation. Beyond legislation, in 2017 was created e-Mobi Elektromobilitás Nonprofit Kft., an agency responsible for improving interconnectivity in the country. The general agency purpose is to provide a significant contribution to the development of the Hungarian domestic market. It has

promoted the updating of the scheme for purchasing electric vehicles and the construction of charging infrastructures by both market players and state-owned entities.

The plan introduced in 2019 (Jedlik Ányos Plan 2.0) has clarified some important questions pending in past years. For example, the conditions and definitions for charging, whether as a service or at home.

It renewed regulations around green license plates and the preparation, adoption, and implementation of an electromobility legislative package that defines the operational framework for the national strategy.

The Jedlik Ányos Plan 2.0 is based on nine main points that define, regulate, and implement[94]:

1. a detailed market model
2. development of charging infrastructure
3. promotion of electric vehicles
4. government and municipal charging station installation and fleet expansion
5. decarbonization of public transport
6. municipal power generation and smart network solutions
7. development of national standards for local smart networks
8. potential exploitation for cost savings in charging energy
9. socialization of electromobility

Thanks to the plan, municipalities and state institutions have now a clear vision on how and how much to apply for subsidized grants necessary to procure EVs and charging equipment. It has brought a significant breakthrough because it has given several partners the right vision to deploy normal and high-power chargers nationwide.

With the new provisions, the construction of charging infrastructure is progressing at a good pace, connectivity has improved much, and market players have recognized the business potential from the field of energy and have taken an active role in the expansion of e-Mobility[95].

Together with the national electromobility strategy, in September 2020 was launched also the National Green Bus Programme. The aim is to replace half of the conventional bus fleet in the largest cities with electric buses by the end of the decade. The government decision reports that cities with more than 25,000 inhabitants will be able to only put emission-free (= electric) buses into operation for public transport from 2022 onwards.

For helping cities in the procurement of the zero-emission buses, municipalities will be able to count on co-financing from national and EU funds. Ministry of Innovation and Technology

[94] https://hungarianinsider.com/jedlik-anyos-plan-2-0-launched-to-promote-electric-vehicles-1688/

[95] http://jedlikanyosklaszter.hu/en/feladataink/

reported that a total of 104 million euros would be available over the next ten years to co-finance procurement of the buses, with the co-financing proportion expected to be 20%[96].

Progress and improvements are pushing electromobility in Hungary but, despite them, different problems are still in place at the national level regarding electromobility and its network. For example, a comprehensive registry of public charging points is still missing, although a number of interactive maps help drivers orientate.

Since 2019, the number of cars with green number plates has also been rising. It is hovering around 10,000. According to official statistics, by the end of March 2019, 9,925 cars have been registered. A large proportion of these cars (5,710) are second-hand plug-in hybrids coming from Western Europe.

That growth was surely appreciated, but at the same time, it created some new questions and debates on e-Mobility. About two-thirds of electric vehicles in Hungary are running in Budapest and its hinterland. With the present regulations, this element means thousands of vehicles with green number plates that are driven, charged, and parked in the capital area for free.

In consideration of the national policies and incentives, this situation will become an unsustainable trend in the long run. Consequently, some lawmakers have started to discuss the idea to rethink incentives linked to green number plates. This element is causing some heated debates at the national level and with e-Mobility industry associations.

Market size:
With the new provisions, the construction of charging infrastructure is progressing at a good pace, connectivity has improved much, and market players have recognized the business potential from the field of energy and have taken an active role in the expansion of e-mobility.

Eon, one of the pioneers, installed between 20 and 30 charging stations in 2019. Its purpose is to expand more in next years. The company recently signed an agreement with hypermarket chain ALDI according to which it will install chargers in the parking lots of ALDI's 123 outlets (360 charging points in total).

In the same year, MOL installed 18 rapid chargers under the NEXT-E program, an EU project that aims to improve connectivity from the borders of the Czech Republic to the Black Sea and the Adriatic. The network at the end will offer drivers charging points at 252 places; 100 of them will be installed by MOL. A total of 141 charging points will be available at MOL filling stations, 59 in Hungary.

ELMÚ-ÉMÁSZ has 65 filling stations, while NKM Mobilitás Kft., a subsidiary of state-owned utilities company Nemzeti Közművek Zrt. (NKM), in 2019 installed nearly 66 EVBox charge points at 17 high traffic locations in the country.

[96] https://www.eltis.org/in-brief/news/hungary-launches-green-bus-programme

In 2019 the food retail chain SPAR has announced the interest in installing EV charging infrastructure across their 500 locations through Hungary[97].
Client profile: EVs users for short and long haul and LEVs users.
PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY
Problem to solve: • Existence of many different operators: a unified loading system, incompatibilities in access and payment methods • Improvement of maintenance level • More fast chargers • Need to know if the charging points are busy and provide the possibility to make a reservation • Managing of the time required for charging EVs • Price regulation at private EV charging points • Adequacy of service areas (charging points) with additional services
Business opportunity: The Budapest Mobility Plan 2014 - 2030 (BMT, also known as Balázs Mór Plan) was studied to support environmentally friendly, zero-emission transport in the Hungarian capital. Measures aim directly to address the topics and challenges of procurement of zero-emission vehicles, support of environmentally friendly public transport technologies, and environmentally friendly technologies in freight transport. The diffusion of environmentally friendly fuels and zero-emissions transportation is supported by introducing tax and fee discounts. These solutions are part of the national financial measures aiming to impact transport modes, with the mitigation of the access restrictions imposed for environmental protection reasons, and with the development of wide coverage of electric charging stations. The promoting plan wants to cover all the different kinds of vehicles and their use. For example, in order to encourage the mitigation of air pollution, hybrid, purely electric and compressed natural gas (CNG) powered taxis are granted a 20% reduction in fees payable for the use of taxi stations. Furthermore, the plan reports how electric vehicles may not spread either in public services without adequate infrastructure, thus one of the main objectives is the installation of integrated electric charging points at more and more taxi stations. Together with restrictions related to environmental categories, in the Hungarian capital, the support to private citizens of environmentally friendly vehicles with alternative modes of

[97] https://www.electrive.com/2019/07/25/hungary-spar-invests-in-charging-infrastructure/

propulsion is also intended to be gradually strengthened (electric, hydrogen and hybrid technologies, human-powered transport, freight bicycles).

In the plan, there is also a focus on urban freight distribution. There is specified that in order to mitigate the burden on the environment, environmentally friendly transport modes (railway, waterborne transport, electric-powered, and freight bicycles) will be prioritized, on the basis of which new terminals and stores will be served.

With the application of the term "environmental load" in a wider way, the plan specifies that the use of public roads and public areas for short periods of time with technologies resulting in smaller environmental loads (electric, renewable, or hybrid technologies) will be promoted with the help of financial regulations.

Currently, in Budapest, there is a program for implementing "Mobility Points" as part of the Cities-4-People project[98].

The first mobility station was realized in June 2019 in St. Gellért Square. The hub is the result of a Co-development process carried out by local authorities, citizens, mobility providers and academics during several rounds of co-creation and prototyping.

Essentially, the Mobility Point Network would bring together services of all the mobility providers operating in Budapest, such as e-cars, e-bikes and e-scooters. At the end of the project, the central hubs will be four[99]:

- Szent Gellért square (Szent Gellért square, facing the M4 exit)
- Egry József street (in front of the Budapest Unviversity of Technology and Economics)
- Magyar tudósok körútja
- Infopark tram station

Currently, in Budapest, the public transport services provided with electric vehicles are metro, trolley bus, tram and suburban trains.

The metro lines are four, for a total network length of 39.4 km. The suburban train network system is 97 km, the tram lines network system is 149 km, while the trolley bus network is 69 km.

Car sharing operators that provide service also with electric vehicles are 3: ShareNow (Smart EQ, BMW i3), MOL Limo (Smart EQ, Volkswagen eUP, Hyundai KONA electric, BMW i3), and GreenGo (Volkswagen eUP).

Lime and Breezy withdrew their e-scooter service in Budapest during 2020. The sharing mobility company Blinkee was going to (re)launch its e-mopeds service in March 2021. Currently, no e-bike sharing company is operating in Budapest.

[98] https://civitas.eu/news/budapests-first-mobility-point-pieces-together-transport-mode-puzzle
[99] https://cities4people.eu/2020/11/03/a-mobility-point-network-in-budapest/

VALUE PROPOSITION AND SOLUTION	
Value proposition: "Sustainable services improving quality of life in urban areas". For getting this purpose, a series of initiatives will be launched: • Cooperation with for-profit and non-profit players • Studied and acquired relevant input to urban planning (mobility, energy) • Carried out active and micro-mobility strategies (in development phase) composed of three levels of mobility points: o micro-mobility points o mobility points (with car, moped sharing) o mobility stations (with extra services, at major hubs) → those could be pilot for e-Mobility stations.	
Solution: *The most suitable solutions for citizens e-Mobility stations in Budapest are:* • *CLICK (demo web service) for supporting local urban mobility planners in defining the most suitable places to install new chargers* • *INCAR to offer innovative services to both users with an EMSP contract and users without an EMSP contract, considering that the EMSP is participating in the INCAR platform.* • *INSOC for Integrated Solar DC – Charging stations. INSCOC is considered interesting for e-bikes and also for e-scooters services.* Budapest foresees to deploy two facilities characterized by a theft-proof parking for e-bike equipped with solar panels for renewable energy production. • *SMAC is a software tool that will calculate the optimal charging profile (amount of energy to provide) in the charging stations.*	
USER NEEDS AND RELATED SOLUTION BENEFITS	
User need #1: Increase the number of e-vehicles	Related solution benefit/s: Realization o more developed charging infrastructure
User need #2: Valorise and quantify the relations between the e-Mobility value chain members	Related solution benefit/s: Realize projects as USER CHI that not only carry out valuable products for e-Mobility but also put in contact all the relevant stakeholders involved
User need #3: Economic and regulatory barriers (roaming, pricing etc.)	Related solution benefit/s: INCAR product
User need #4: Urban planning challenges (→ optimization of public space usage)	Related solution benefit/s: CLICK product
COMPETITIVE ADVANTAGE	

- Strengthening the Budapest brand and the role of BKK (as a mobility manager) in this area
- Sustainable operation model development (innovate together with stakeholders)
- Advantages for "signatory service providers" → they will be visualized by Municipal channels and promoted within administrative communication systems
- Usage data → calling for competition in order to get the maximum benefits from the managing of citizens data

7.2.3.1 Key stakeholders

The following table lists the key stakeholders in the citizens e-Mobility stations Budapest use case. These are the organisations playing a key role in the application of the new solution to achieve the benefits described above. For each stakeholder the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities, not related to the solution's application, are excluded from the analysis.

Table 15 Key stakeholders in the Citizens e-Mobility Stations ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*
Electromobility Service Providers	*As provider of services and solutions in the electromobility*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Technology Solution Providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
Transport Service Providers (TSPs)	*For installation of charging points in strategic transport locations*
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging point connections*
National/European Authorities	*For standards and policies*
Financial and payment system companies	*For the provision of payment solutions*
Charging Point Operators	*Realization and management of charging points*
Location owners	*For the provision of public and "semi-public" areas where to realize charging points*
Original equipment manufacturers (OEMs)	*As providers of e-vehicles*

7.2.4 Rome business model

The following table provides an overview of the business case, i.e., information and strategies for developing citizens e-Mobility stations in Rome from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 16 Rome Citizens e-Mobility Stations summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: Since 2014, various national regulatory interventions, consistent with European guidelines, have been prepared to promote different approaches for mobility (especially for alternative propulsion systems)[100]. In 2014, the Italian Government approved the National Infrastructure Plan for the Recharging of Vehicles powered by Electricity [101]. The plan was updated in 2020 with an increase of funds available (+1000 million euro for 2020, +200 million euro for 2021) and with a new form of incentives for people and companies. New subsidies are divided into two groups, with and without vehicle scrapping, and are available to customers that buy a new vehicle from August 2020[102]. In 2019, the National Strategic Plan for the Sustainable Mobility was approved[103]. The Plan, between the different objectives, aims to renovate public (regional and municipal) transport bus fleets and to promote and improve air quality through innovative technologies (in a consistent way with international and European agreements to polluting emission reduction). In 2018, the Italian government assigned up to 100 million euros for innovative and experimental projects for sustainable mobility in public transport fleets. The main constraint for projects was to be coherent with local SUMPs (Sustainable Urban Mobility Plans). Projects could be presented by Municipalities or Metropolitan administrations and could be related to the introduction of road and maritime mobility with alternative propulsion systems and relevant supporting infrastructure. One-third of the budget was directly assigned to Municipalities and Metropolitan Areas with high PM10 and Nitrogen dioxide pollution levels and were invited to adopt structural actions for environmental pollution level reduction. In 2019 two important Ministerial Decrees were settled for promoting electromobility[104]. The first one regarding the identification of steps to follow for realizing the national platform for electric vehicle charging points. The second is about investments related to National

[100] https://temi.camera.it/leg18/temi/l-innovazione-nel-trasporto-stradale-e-la-mobilit-sostenibile.html

[101] https://www.gazzettaufficiale.it/do/atto/serie_generale/caricaPdf?cdimg=14A09267002000101100010&dgu=2014-12-02&art.dataPubblicazioneGazzetta=2014-12-02&art.codiceRedazionale=14A09267&art.num=1&art.tiposerie=SG

[102] https://www.mise.gov.it/index.php/it/per-i-media/notizie/it/198-notizie-stampa/2041340-ecobonus-al-via-i-nuovi-contributi-per-i-veicoli-a-basse-emissioni

[103] https://www.mit.gov.it/sites/default/files/media/normativa/2019-06/DPCM_PSNMS.pdf

[104] https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legge:2019;32

Infrastructure Plan for Recharging Vehicles powered by Electricity that can be used only for realizing projects immediately feasible, evaluated, and selected by the Italian Ministry of Infrastructure and Transport.

In 2015, a specific fund was settled (the so-called "Fondo Mezzi") to promote innovation of local and regional public transport fleets [105]. The Fund is finalized for direct purchase vehicles for local and regional public transports, also through specific companies. The energy/electric renovation and renting of vehicles is also possible. The main objective was to update local fleets to European standards.

The National Strategic Plan for Sustainable Mobility and renovation of local and regional bus fleets was included in the Budget Stability Law of 2017 (L. 232/2016) [106]. The law reports for sustainable mobility the increase of the total budget for "Fondo Mezzi" of around 200 million euro for 2019 and 250 million euros for each year between 2020 and 2023. The total final budget is 3.7 billion euros, and it is valid also for supporting necessary technological infrastructures, such as recharging points for electric vehicles. This element also settles to the National Infrastructure Plan for the Recharging of Vehicles powered by Electricity.

The Budget Stability Law of 2018 considers, in relation to the Strategic Plan for Sustainable Mobility, a program of actions aiming to increase the competitivity of the national industry in the public transport vehicles and smart transport systems. Actions consist of investments supporting the production with standards more sustainable and looking to research and development of alternative propulsion systems. The total available budget is 2 million euros for 2017 and 50 million euros for 2018 and 2019 each.

Finally, from the 1st of January 2019, vehicles of categories M2 and M3 (for the carriage of passengers comprising more than eight seats in addition to the driver's seat), with petrol or diesel engines, and Euro 0 emission standard can no longer operate on the Italian national territory[107].

At the end of 2020, Enel X and ASSTRA (Italian association of public transport operators) have signed a partnership, of two years, for promoting a more sustainable public transport, for reducing polluting emissions (also noises) from urban and extra-urban services, and so for improving the quality of services provided to citizens[108].

Enel X and ASSTRA will also work together to realise new infrastructures and charging points specific for busses. Furthermore, the two companies will develop a new solution for “Smart Cities” to reduce fleet consumption, maintenance and refuelling costs, and redraw mobility services with greater added value. Finally, the two companies will also work together to create more efficient solutions to be applied to offices and depot sites of transport companies.

[105] https://www.gazzettaufficiale.it/eli/id/2015/12/30/15G00222/sg

[106] https://www.sipotra.it/wp-content/uploads/2019/03/Piano-Strategico-Nazionale-della-Mobilit%C3%A0-Sostenibile-per-il-rinnovo-del-parco-mezzi-su-gomma-per-i-servizi-di-trasporto-pubblico-locale-e-il-miglioramento-della-q.pdf

[107] https://www.gazzettaufficiale.it/eli/id/2014/12/29/14G00203/sg

[108] https://www.hdmotori.it/auto/articoli/n528164/autobus-elettrici-italia-enel-x-asstra-trasporti/

An example of cooperation between the urban transport company and sustainable electric mobility is the City of Parma where, as part of LOW CARB project, the existing electric public transport infrastructure (like the trolley grid) will be used for charging other electric vehicles like buses, cars and bikes[109].

Since 2016 in Milan, a positive partnership between public and private sectors in the field of electromobility has been active for the realization of 28 electric charging stations within the project called "Digital Islands"[110].

Each Digital Island is equipped with: Wi-Fi, Multimedia and multifunction touch-screen totem (services: infomobility, taxi and emergency calls, bookings, e-commerce, e-government, tourism), smart cameras for territory monitoring and control, smart lighting, and recharging systems for private users (computer, phones, etc.).

Furthermore, each island is equipped with 12 charging points (Level 1 and Level 2) aligned on a bar where the vehicles are accommodated and, to encourage car-sharing mobility, reserved shared electric quadricycle parking and charging stations[111].

Finally, still in Milan, the local urban sustainable mobility plan reports an investment strategy for the renovation of the bus fleet that also considers the upgrading of depots and transforming them into new hubs for electromobility[112].

Market size:

In December 2020, in Italy, there were around 19,324 charging points in 9,709 public charging stations. During 2020, charging points installation has grown with a trend of 39%. At the end of 2019, the charging stations were 7,203 (+2,506 in 2020) and charging points were 13,721 (+5,602 in 2020). The average subdivision of public stations is 80% in public areas and 20% in private areas with public access (e.g. supermarkets and malls). The AC charging points are 96% while the DC charging points are 4%. The DC high power points are slightly growing, from 3 to 4%.

The charging stations are mainly present in the centre-north of Italy and in the metropolitan areas. 57% of the infrastructures is distributed in the North of Italy, around 23% in the Centre while only 20% in the South and islands.

Lombardy is the region with the most charging points. It represents 17% of all the installations. In February 2020, there were 2,467 points registered. At the end of 2020, they were 3,326. After Lombardy there is Piemonte (10.6%), then Emilia-Romagna, Lazio, Veneto and Toscana with the 9% each.

[109] https://ec.europa.eu/regional_policy/en/projects/Italy/improving-the-sustainability-of-urban-mobility-in-central-europe

[110] https://www.icscarsharing.it/wp-content/uploads/2019/02/2016-Car-Sharing-in-Milan.pdf

[111] https://international.fhwa.dot.gov/sum/ch3.cfm

[112] Electric Mobility in a Smart City: European Overview. 2021.

At the end of 2020, in the last update of PNIRE (National Infrastructure Plan for the Recharging of Vehicles powered by Electricity), the mandatory indication for highway concessionaires to install a charging point every 50 km was introduced.

In 2020 the charging stations registered in Rome were 503, for a total of 941 charging points. Regarding electric vehicles, in 2020, the market share of this sector (BEV+PHEV) was around 0.25% of the total (BEV+PHEV= 99,257, total vehicles in Italy = 39.6 million), while registrations were around 4.33%. Despite the very small numbers, the trend is rapidly growing (+120% CAGR 2018-2020), thanks mainly to national and regional incentives[113].

In 2019, electric and hydrogen busses registered in Italy were 63: 16 in Messina (Sicily), 15 in Milan and Bergamo (Lombardy), 13 in Turin (Piedmont) and 10 in Genoa (Liguria). The total value represents only 5.4% of the busses registered in Italy in 2019. This trend represents a lack and a missed opportunity for the Italian system, also considering the draft version of the Italian Recovery Plan that plans the acquisition of around 5,000 new buses, with 2,700 of them still powered with fossil fuels. Italian values are generally lower than the ones in other European countries. In 2019 the electric and hybrid busses bought in Germany were 2,900, in France 2,044 and in the UK 1,749.

ANFIA (the Italian Association of the Automotive Industry) underlined how the low results reached in 2019 risk being even more frustrated in next future. While cities like Milan, Turin and Bergamo have structural plans for getting zero emissions urban mobility by 2030, Messina does not have a complete strategy, with the risk of erasing the acquisition carried out in 2019 and not feeling real impacts in local urban mobility. For the next future, the situation should be better thanks to the Clean Vehicle directive of the European Commission. As of 2021, in Italy at least 22.5% of the new busses have to respect the zero-emissions standard[114].

In the ranking of the 80 Italian more accessible and environmentally friendly cities, realized by the no-profit Legambiente, Milan results to be the first. The main reason is not only related to the number of electric busses, but more to the efficiency of the local railways' system (tram, metro, and suburban trains). Rome is in the 39th position[115].

Client profile:

- EVs users for the short and long haul and LEVs users.
- Companies with electric fleets
- Professional EV drivers

PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY

Problems to solve:

- Existence of many different operators: a unified loading system, incompatibilities in access and payment methods

[113] https://www.motus-e.org/wp-content/uploads/2021/01/Report-IdR_Dicembre_2020-2.pdf
[114] https://ec.europa.eu/transport/themes/urban/clean-vehicles-directive_en
[115] https://www.legambiente.it/rapporti/citta-mez-mobilita-emissioni-zero/

- Improvement of maintenance level
- More fast chargers
- Need to know if the charging points are busy and provide the possibility to make a reservation
- Managing of the time required for charging EVs
- Price regulation at private EV charging points
- Adequacy of service areas (charging points) with additional services

Business opportunity:
Currently, in Rome, there are around 6,000 electric vehicles running every day. Unfortunately, 15% of owners do not have their own charging point and around 300 e-cars every day have to look for a place to charge.

In 2018 the Rome Plan for public charging was drawn for the three years 2018 – 2020, with the final aim to provide at least one charging pole every 1000 inhabitants[116].

The plan was studied with the forecast that by 2020 the total municipal demand was of 700 charging stations, integrated with fast stations along the GRA (Grande Raccordo Anulare - Great Ring Road) and along the internal railway ring.

Unfortunately, due to some difficulties with the Ministry of Cultural Heritage, at the end the charging points installed by 2020 have only been 340, divided between 22 kW AC and 50 kW DC, with some of them still pending to be activated (before the plan 140 were already installed before the plan).

In December 2020, in response to the Electric Mobility Plan, the Municipality of Rome approved the new program of ACEA for installing 100 more additional charging points. In total, by the end of 2024, ACEA has planned to install more than 2,000 points in Rome, for a total investment of around 29 million €[117].

Furthermore, the plan settled in 2018 aimed at reaching as soon as possible a network where users can access charging infrastructures with smart systems and in a seamless way all around the country. Smart access systems will have to be compatible with the ones used for public transport in order to have a single key for all mobility modes (in view of a MaaS ecosystem).

Moreover, in 2017, with the participation to the European Initiative "Urban Innovative Actions", in Rome a specific project for the realization of Mobility Hubs was settled[118]. The purpose is the realization of an integrated system of public and private services able to fill the gap between the main connection points (as metro and railway stations) and the most attractive

[116] https://roma.repubblica.it/cronaca/2020/10/12/news/trasporti_a_roma_6mila_auto_elettriche_ma_solo_339_colonnine_ricarica_obiettivo_arrivare_a_622_previste_anche_aree_sosta_-270328171/
[117] https://www.gruppo.acea.it/media/comunicati-stampa-e-news/comunicati-stampa/2020/12/e-mobility-acea-parte-da-roma-con-piano-installazione-prime-100-colonnine-ricarica
[118] https://www.tekneco.it/energia/roma-arriva-forse-il-mobility-hub

urban points missing appropriate transport systems. The final structure of the hubs will provide a wide set of mobility solutions such as bike-sharing, car-sharing, shuttle busses, information centres for passengers and a dynamic strategy for parking spaces management.

Currently, no mobility centres have been realized, and the focus, as part of the mobility hubs project, is more addressed to the realization of 408 "bike boxes" in the seven main metro stations[119].

ENEL X has planned to realize two sustainable mobility hubs is Rome.

The first one will be located in Corso Francia (Rome north area), with ultrafast and fast charging points, parcel lockers, postal services, cafeteria, smart working facilities and ENEL X shop. The installation of solar panels is still under study.

The second will be realized in Via Cristoforo Colombo (Rome south area) with car, scooter and bike-sharing facilities, bike parking with maintenance services, smart working facilities, cafeteria, mini-hub for cargo-bikes and other services for users.

In Rome, the public transport services provided with electric vehicles are: metro, tram, bus and trolley bus.

The local metro network length is around 59.4 km with three lines. The trolley bus service length is 38.7 km with two lines, while the tram lines network length is around 36 km[120].

In 2019, after ten years, three bus lines service operated with electric minibuses have been reactivated in Rome. The original plan was to revamp 60 minibus "Gulliver" that were registered in Rome in 2010.

By the end of summer 2021, 100 hybrid bus Mercedes Citaro were to enter service.

Concerning e-cars sharing services, the company "CarSharing Roma" is the only operator with electric vehicles in its fleet (Nissan e-NV200). The service is directly managed by the Municipality of Rome and operates in a "station-based" modality. Until March 2020, there was also in operation the Sharengo service with a fleet of only ZD electric vehicles.

Concerning e-scooter sharing services, seven providers are operating in Rome (Helbiz, Lime, Wind, Bird, Dott, Link, Voi) while e-bike sharing providers are just 2 (Helbiz and Lime/Jump). Finally, to date e-moped sharing providers are 2: Ecooltra and Zig Zag, while until 2020, there was also Cityscoot..

VALUE PROPOSITION AND SOLUTION

Value proposition:

- Realization of at least three sustainable mobility hubs (with ultrafast and fast charging points, LEVs sharing facilities, and ancillary services)
    - One of them will also test V2G charging solutions.

[119] https://www.romatoday.it/politica/fermate-metro-bike-box.html

[120] https://www.agenzia.roma.it/documenti/schede/ra2020_cap_4_tpl_finale.pdf

• Installation of a LEVs facility integrated with solar panels (*initially planned*)
Solution: *The most suitable solutions between the ones under development in Rome are:* - *CLICK (demo web service) that should be used by professionals and with the collaboration of ENEL X.* - *INCAR for the implementation of a platform allowing a unique interoperability management system for roaming, charging, and parking.* - *INSOC for building theft-proof parking for e-bike/e-kick scooter equipped with solar panels for renewable energy production (DC – Charging stations).* - *SMAC for providing CPOs and EMSPs with a tool including smart grid integration services, RES electricity supply, reduction of grid impact and demand management features.*

USER NEEDS AND RELATED SOLUTION BENEFIT	
User need #1: Increase empowerment feeling of EV drivers	Related solution benefit/s: Implementing the Municipal electric charging plan in order to support and simplify the use of electric vehicles
User need #2: Realization of fertile ground to incentivize and spread the local electromobility	Related solution benefit/s: Using interoperability tools (as INCAR) able to provide additional services for the roaming, charging, and parking.
User need #3: Provision of different alternatives of charging solutions (from the infrastructure to the digital – apps – point of view)	Related solution benefit/s: Solution coming from the use of interoperability tools as INCAR that will allow in a unique interface to manage, find, and use services coming from different CPOs and EMSPs.

7.2.4.1 Key stakeholders

The following table lists the key stakeholders in the citizens e-Mobility stations Rome use case. These are the organisations playing a key role in the application of the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities not related to the solution's application, are excluded from the analysis.

Table 17 Key stakeholders in the Citizens e-Mobility Stations ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*
Electromobility Service Providers	*As a provider of services and solutions in the electromobility*

Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Technology Solution Providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
TSPs	*For installation of charging points in strategic transport locations*
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging point connections*
National/European Authorities	*For standards and policies*
Financial and payment system companies	*For provision of payment solutions*
Charging Point Operators	*Realization and management of charging points*
OEMs	*As providers of e-vehicles*

7.3 Annex 3: City Centre (park & charge) business model analysis

7.3.1 Business case overview

7.3.1.1 Market characteristics

At present, the European Union (EU) imports 89% of its crude oil[121], the vast majority of which is used for transport fuel. Moreover, the rising carbon dioxide issue is stringent, with light-duty vehicles, cars, and vans producing approximately 15% of the EU's emissions of CO_2[122].

The environmental concerns are then pushing forward a shift towards the electrification of transport. National and local governments, OEMs, car manufacturers, utility companies are powering up electric sector from different angles. Utilities are developing electric vehicle (EV) charging stations across cities often combined with local administrations rolling out electric transportation systems. Governments are ensuring grants for implementing and incentivizing electric mobility in all its forms. More and more car manufacturers are investing in such a technology.

Global electric vehicle uptake has grown an average of over 60% per year from 2013 to 2018, to about 5 million light-duty electric vehicles on roads worldwide. Public charging infrastructure has also grown an average of over 60% annually over the same period, reaching 600,000 charge points at the end of 2018[123]. Nonetheless, there are still struggles to expand the public charging infrastructure due to technological and regulatory issues to allow people access to a charging point when and where needed.

Different aims and priorities between charging infrastructure needs and related policy goals are often barriers to market growth. During the early stages of the transition, when there is lower demand to support a private business case, governments often focus on building out basic spatial coverage of charging infrastructure. Many of these stations will likely face low utilization with limited numbers of electric vehicles on the road but are important for encouraging a greater range of confidence and promoting awareness of electric vehicles. As the market grows, the demand for charging in urban areas and along major travel corridors will far outstrip the capabilities of the initial stations. At that point, planning for new public chargers will be based on ensuring sufficient charging capacity at the most popular locations. This typically leads to larger stations with more chargers per location. As charger utilization grows with electric vehicle adoption, so does the number of electric vehicles per charger. Consequently, the utilization increase encourages more private investment in charging infrastructure.

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[121] "Oil Dependency in the EU" – Final Report, 2018, Cambridge Economics.

[122] "Optimal allocation of electric vehicle charging infrastructure in cities and regions", Joint Research Centre (JRC) 2016 – European Commission.

[123] "Electric Vehicle Charging Guide for Cities". ICCT Consulting Report

7.3.1.2 Market growth and trends

In the beginning, public charging solutions will account for a smaller share of total charging use. But its importance as the most publicly visible component of the charging ecosystem and as a crucial part of the transition to a mainstream electric vehicle market will be fundamental for promoting new business opportunities and sector growth.

For transition to electric vehicles, city governments have then a key leadership role. Their decisions in demographic, geographic, and infrastructural urban policies will, directly and indirectly, lead to the development of different charging infrastructure network solutions and, consequently, the growth of the local electric vehicle market.

Utility companies, being often the direct expression of policy decisions but with a vision in market direction, are foremost to understand EVs market potentialities. They can be useful to express to people that when they get into electromobility, the "product" they buy is not a luxury, but rather an essential tool to complete daily activities: getting to work, going grocery shopping, visiting friends and travelling to go see family. All of these are potential touchpoints for utilities and governments to connect with EV drivers and engage with them in new ways that are going to be leveraged[124].

Analysis of market growth, engagement with users and citizens, the collaboration of stakeholders are prerequisites fundamental for understanding kind, location, power capacity (in kW) and plug-in type to install. These elements are all components that categorize electric vehicle charging equipment: regular, such as from a household outlet; alternating current (AC) fast, also called accelerated, which is typical for public chargers; and direct current (DC) fast, or rapid charging. Each electric vehicle model has different limits on the charging speeds. It can accept from AC and DC, with longer-range vehicles typically able to accept more power. For example, no new electric vehicle models can accept AC charging over 22 kW, suggesting that high-power AC chargers may not be built in the future. Therefore, charging times can vary substantially based on the vehicle[125].

Within the market sector, cities can assume different roles in facilitating the implementation of electric charging urban solutions, adopting different policies to increase deployment. This can take the form of direct installation of charging, often in partnership with power companies or network operators, providing land for private installations, adjusting codes and zoning, offering subsidies, and streamlining permitting processes. City governments are increasingly leveraging their electrical assets, including lampposts or utility poles, to enable low-cost curbside charging, like in London, Berlin, Los Angeles, and Tokyo. The most common solutions adopted for public charging points are[126] (Table 18):

Lamp Post Charging	Roadside Charge Stations

[124] Beinot Marcoux – ChargeHub Central - 2020
[125] Electric Vehicle Charging Guide for Cities. ICCT Consulting Report
[126] City Centre Charge Points – Don't be put off by no off-street parking. DriveGreen

	
Curb side pavement charging sockets	**Charging stations/bays.**
	

Table 18: The most common solutions adopted for public charging points

Another important element to consider is the impact of vehicle charging on the electric grid and how this component puts downward pressure on electricity rates. This can be good for utilities and their ratepayers. However, public charging operators cannot make money unless the utility (or other stakeholders) support them, and regulators often approve of this. Utilities and cities should get something in return[127].

To minimise the costs of constructing a charging network, cities can[128]:

- Use stations with dual rather than singular connectors, and (cheaper) wall-mounted rather than freestanding charging stations;

[127] Beinot Marcoux – ChargeHub Central - 2020
[128] How to build an electric vehicle city: deploying charging infrastructure. C40 Cities Climate Leadership Group

- Construct multiple stations in the same area, depending on demand, to reduce installation and electrical infrastructure costs;
- Prioritise charge points in, or nearby, areas with sufficient electrical capacity;
- Install slower chargers, or low-power fast chargers of 50kW, wherever possible, particularly for on-street residential and workplace charging, as these are cheaper and are less likely to require upgrades to the electricity grid.

Increased availability of public charging enhances drivers' confidence to move to electric vehicles, and additional electric vehicle drivers put more demand on governments, automakers, and property owners to install charging stations.

It is key to understand what kind of drivers live in cities and what their spaces are. Two main categories can be identified: urban, which would mean placement charging stations in a city network (urban road network), and rural, placement in a regional or national network (rural roads and highways)[129].

The growth of electric charging utilization means for utility regulators and operators an exert downward pressure on rates for all ratepayers. For instance, among the around 3.500 utility companies operating in North America, some offer specific EV programs while others are considering EV-specific rates to reduce demand charges at public stations. Such practices make sense but are not yet common practice. Furthermore, to foster a wider development of a public charging infrastructure, different regulators are also considering the decrease or the abolition of demand charges as a legacy of the limitations of the electromechanical meters that were used to measure electricity in businesses.

7.3.1.3 The importance of drivers' data

Lastly, session-level charging data are precious and valuable elements to utilities and cities for both planning development of infrastructure and managing services to users. Therefore, as a best practice, some municipalities and utilities are requesting access to session-level charging data from charging operators in exchange for access to city-owned properties or support from the utility. Operators can also be asked by cities and utilities to fulfil particular performance indicators in order to keep on benefiting from access or support[130].

A critical part of building an efficient, convenient charging ecosystem is creating a comprehensive strategy in line with data recorded, forecast analysis, users' tendencies, local targets and broader transport policy. These plans ideally involve multiple relevant government agencies, consider the roles of the public and private sectors, and take into account both public and private charging options. Cities are increasingly choosing to set concrete targets for chargers based on analysis of driver behaviour. These kinds of plans and analyses require to be constantly updated as

[129] Optimal allocation of electric vehicle charging infrastructure in cities and regions. Joint Research Centre (JRC). European Commission
[130] Beinot Marcoux – ChargeHub Central - 2020

technology and consumer attitudes can quickly change; such plans may be limited in their time horizon and can need to be periodically inspected.

A right monitoring and forecast analysis can also support strategies to identify areas where the grid can potentially be more stressed by vehicle charging. In these cases, the adoption of smart parking and charging solutions can increase space efficiency and revenues for the CPO and MSP by mitigating overuse (vehicle parked but not charging) or high simultaneous demand (e.g. after hours).

In terms of technical implementation, these solutions can also consider the ability of the charging point to communicate with the local booking and parking system, preventing situations of error or abuse (e.g. I reserve the parking space, but only for parking).

The booking procedure must be lean for users, and the system adopted for utilization of charging points (e.g. smartphone apps) has to be "friendly".

As previously mentioned, a critical element to consider for the charging urban infrastructure realization is the impact of vehicles on the electricity grid. The implementation of "smart solutions" can support in this field with electricity market-based load management. It means with solutions where charging of vehicles is incentivized (maybe with cheaper tariffs) on sunshine days or when the wind blows (mainly for charging stations equipped with solar panels or fed by windy energy).

Among electric vehicle early adopters, most of the charging is done at home. In many places where people drive to work, workplace charging is the second-largest share of charging energy used. For drivers with reliable home or workplace charging, both AC and DC public charging may typically be used only for longer trips or in unusual circumstances. For those without home charging, such as those who live in apartment buildings in urban centres, and those with high daily mileage, however, public charging is a critical precondition to use an electric vehicle. Therefore, in denser cities with less home and workplace charging, more public charging is needed. For example, Amsterdam, where few people have off-street charging points and so need more public charging stations, has as much charging per capita as Oslo, although the latter has far fewer electric vehicles. Dense cities with more residents in high-rises, such as Beijing, will often need more public fast chargers. To support the growth of the electric vehicle market, much more charging of all types will be needed.

7.3.1.4 Planning charging infrastructure (benefits and pains)

While most cities are working to create paths for more private investments in charging infrastructure, in parallel, they may also work to create targets for each type of charging infrastructure in order to meet specific electric vehicle goals. To this end, the ICCT (International Council on Clean Transportation) has studied a method for estimating the future charging demand. As illustrated below (Figure 5), the procedure developed considers different calculations at each step (i.e. blue boxes) together with questions to be answered at each phase of the process (i.e. grey ovals) and key data inputs (i.e. gold trapezoids). Moreover, a similar methodology has

been used to create country-specific charging benchmarks for future charging growth using detailed data on driver behaviour, vehicle mix, and housing stock[131].

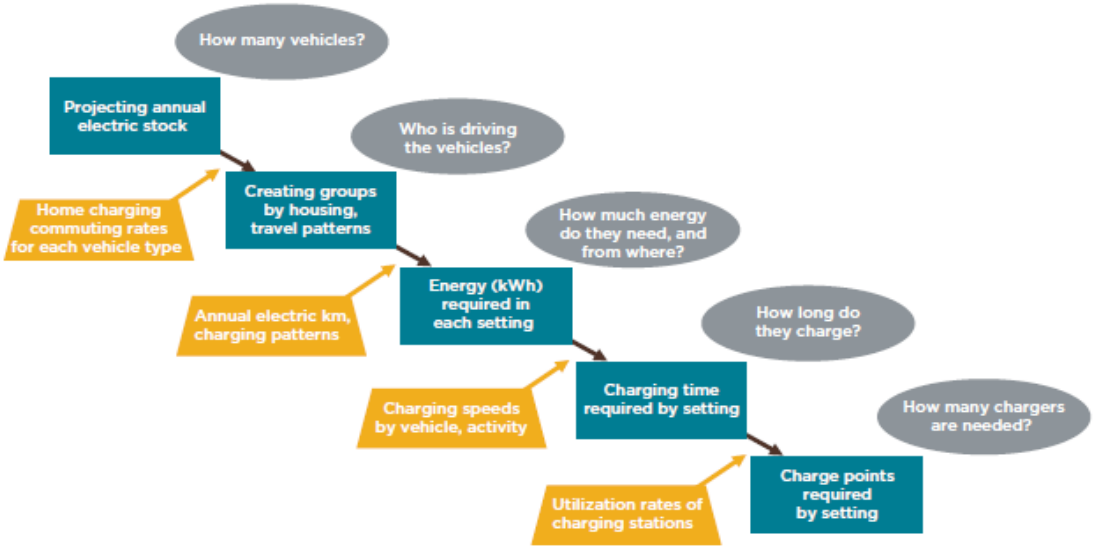

Figure 5: Illustration of the process to estimate future charging demand (ICCT Report. Electric vehicle Charging Guide for cities)

Information related to EV drivers or telematics data care, useful for getting the best advice about the fraction of charging performed at home, workplaces or in public destinations, will change over time based on attributes of the mainstream market and technological improvements. For example, the share of EV drivers living in multi-unit buildings will likely increase year-over-year, and, consequently, the electric range is also likely to increase. Charging models could take such shifts into account in order to not base future policy solely on early adopters' behaviour. Ideally, regular updates with new data could be performed to gradually expand projections. Governments can also influence behaviour through broader transportation policy (e.g., congestion pricing, public transport, and private hire vehicle licensing), so it is important to align the analysis's assumptions on driving behaviour with other goals, such as parking reduction, modal shift, or development patterns.

Surveys and analyses on these topics have helped different governments and administrations to assess the program and status of charging infrastructure buildout. In Table 19, some examples of metrics frequently used for charging infrastructure plans are shown.

Table 19: Metrics frequently used for charging infrastructure plans

Metric	Policy example
Chargers	**Germany:** 1 million public charge points by 2030 **Region of Ile-de-France:** 12.000 chargers by 2023
Chargers per square kilometre	**State of Baden-Wurttemberg (Germany):** Minimum public charger coverage of one 20 kW charger every 10x10 km grid and one 55kW charger every 20x20 km grid

[131] Electric Vehicle Charging Guide for Cities. ICCT Consulting Report.

Charger per kilometre of road	**United Kingdom:** 95% of motorways and A-roads should be within 20 miles of a charger
Electric vehicles per charger	**France:** One charging station for every ten electric vehicles

Despite metrics to track and compare charging infrastructure developments over time provide key information to identify infrastructure and policy gaps and can be measured using easy-to-access data, they have several limitations. For example, some of them do not tell the difference between slower AC chargers and DC fast chargers, even if a DC fast charger can charge many more vehicles per day than an AC point. Moreover, such measurements do not identify the different types of electric vehicles. In particular, they do not consider the distinction between PHEVs (plug-in hybrid electric vehicles) typically using only AC chargers, and BEVs (battery electric vehicles) that can also employ DC fast charging. Therefore, the structure of an EV fleet market influences the optimal amount of AC versus DC charging. Furthermore, such an approach does not look at important local factors like differing housing types and car ownership rates. This implies a difficulty in making comparisons even of markets of similar electric vehicle uptake. On the other hand, the measurement of chargers per road distance does not consider traffic volumes on those roads, making it more useful to determine coverage in the early stages of the market for supplying primary geographic coverage[132].

Hence, the implementation of public charging infrastructure needs to focus on citizens journey habits and urban residential distribution. For example, cities in Netherland show a high percentage of people charging their vehicles during the night time, with a low exchange rate of vehicles in charging stations during the day. This means that most curbside public charging points are slow while rapid ones are only 5%. In China is the opposite and the rapid charging stations are around 40%[133].

As reported in an ICCT report, among the major factors affecting the type and volumes of charging a city will need, and consequently, both the share of electric vehicles per charge point and the proportion between fast and slow charging, there are[134]:

Table 20: Major factors affecting type and volumes of charging in a city

Housing Stock	Commuting Patterns	Vehicle Mix
Typical driving patterns	Amount of DC fast charging	

As reported previously for Amsterdam and its central-city residents, the concentration of apartment buildings typically implies less access to home charging, which means the necessity of more and different charging types.

Where the share of residents that commute to work by private car is prevalent, workplace charging can play a major role. For example, in San Jose, California, the vast majority of residents drive to work, and, consequently, this area registers the highest density of workplace charging in

[132] Charging infrastructure in cities: Metrics for evaluating future needs. ICCT Working Paper
[133] Electric Vehicle Charging Guide for Cities. ICCT Consulting Report
[134] Electric Vehicle Charging Guide for Cities. ICCT Consulting Report

the United States due to installations at large technology company campuses. Differently, where active or public transportation is the norm, workplace charging is less prevalent.

The vehicle mix impacts the differentiation in the implementation of the charging points. For example, the Beijing market is almost exclusively BEVs, and this has implied a much higher fraction of DC fast charging than AC slower charging points. Battery electric vehicles (BEVs) require fast charging, while plug-in hybrid vehicles (PHEVs) generally do not. Stockholm market has a higher share of PHEVs in its electric vehicle fleet, and it has a lower concentration of public charge points (due to the higher rate of in-house charging points). Consequently, only a small percentage of these points are DC fast charging. In general, PHEVs benefit more from the workplace and regular public charging.

The most typical driving patterns influence the charging points distribution because when cars are driven for more kilometres, more energy is needed for refilling the vehicles. For example, in Germany, where drivers typically drive more kilometres at higher speeds than in other European countries, more inter-city charging is usually needed.

One DC fast charger can provide as much energy as many regular speed chargers, influencing the ratio of charging points and types necessary in a certain place. Typically places with a high ratio of fast charging looks to have a higher EV/charge point ratio. For example, Birmingham, in UK, has a higher electric vehicle-per-public-charge-point ratio than other cities in the UK (48), but also has a much higher share of fast charging (29%).

Another key dimension to consider is the economic aspect. Technological innovation and the greater scales of production have rapidly declined the cost of electric vehicle charging infrastructure during the last decade. For example, Amsterdam has seen the costs of their curbside charging stations falling from 12.000 euros to 2.000 euros since 2009. Nevertheless, government investment is needed, at least initially, for launching and incentivizing market growth, and infrastructure development[135].

Usually, the major costs incurred by governments are dealing with the fostering of an electricity grid upgrade for rapid chargers together with the purchase and installation of charge points, in parallel with land procurement, administration, and maintenance. On the other hand, cities can help stimulate innovation and reduce prices by setting ambitious targets for deployment on a large scale.

The ICCT has analysed major government charging infrastructure programmes showing the cost per fast charge point and per regular Level 2 charge point (Figure 6)[136].

[135] How to build an electric vehicle city: deploying charging infrastructure. C40 Cities Climate Leadership Group

[136] Emerging best practices for electric vehicle charging infrastructure. ICCT White Paper

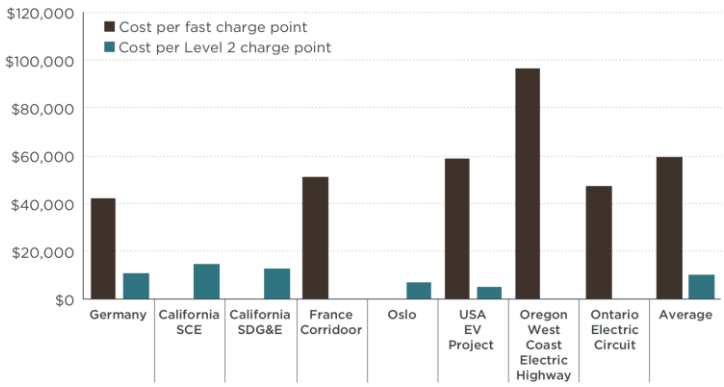

Figure 6: cost per fast charge point and per regular level 2 charge point (ICCT white paper. emerging best practices for electric vehicle charging infrastructure)

ICCT also analysed the most advanced electric vehicles markets – China, the United States and Europe – for public charging. In particular, from 2016 to 2018, Paris, London and Amsterdam got globally about 40.000 registered electric vehicles with 4.700, 5.800, and 9.100 charging points, respectively, while Oslo achieved 109.000 electric vehicles with 4.300 charge points.

Regarding customers profile and their attributes, in the UK, 90% of all charging is done at home, making running an electric car simple for people with off-street parking space. But in city centres, and for built-up terraced areas, not having access to a charge point on the street that they live on can be the reason that is holding many people back from jumping into the world of electric plug-in cars[137].

Considering that in different regions of Europe, there are a lot of cities with an urban shape that does not allow the presence of off-street parking, there must be alternatives put into place that cope with the growing demand for electric vehicles and the absence of proper charging spaces.

To increase the EV drivers' satisfaction level concerning the current public charging infrastructures, different actions can be undertaken, among which:

- Allowing EV drivers to find out where they can charge easily.
- Simplifying the EV charging buying process to improve time and cost savings.
- Supporting EV drivers in being involved with local EV communities for generating feedback loops on their EV charging experience.
- Disseminating the utility or city programs concerning EV charge points.

Generally, to accelerate the DC fast charging deployment, two are the point to follow first, based on best cases seen up to now. First, to develop infrastructure for intercity travels, along main national and international routes where drivers, travelling between cities, do not have hours to spend charging the vehicle. Secondly, it is necessary to focus on drivers who do not have access to home or work charging.

[137] City Centre Charge Points – Don't be put off by no off-street parking. DriveGreen

Cities consider the latter the most relevant: without access to a robust DC fast charging infrastructure, EV penetration could be limited to suburbs dominated by single-family homes. A solution would be to issue policies that promote curbside destination chargers, workplace charging and charging in multi-dwelling units, reducing pressure on the urban DC fast charge infrastructure [138].

7.3.2 Berlin business model

The following table provides an overview of the business case, i.e., information and strategies for developing City Centre (park & charge) solutions in Berlin from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 21 Berlin City Centre (park & charge) summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: The German legal framework for charging infrastructure consists of[139]: • Low-Voltage Grid Connection Ordinance (Niederspannungsanschlussverordnung - NSV): the NSV regulates, among other things, the influence of Distribution System Operators (DSOs) on the approval of new charging stations. Installations without a permission are not allowed. • Federal Building Code (Baugesetzbuch - BauGB): the BauGB defines the principles and procedures to be followed by municipalities when drawing up land-use plans. This may include charging infrastructure, and there are specific situations where a new charging station is permit-free and where it is not. • Charging Station Ordinance (Ladensäulenverordnung - LSV): The LSV regulates the main aspects of operating charging infrastructure, authentication, use, payments and interoperability for AC and DC charging. To comply with these requirements, direct payments and German and English user menus have to be taken into account. • Calibration Law and Regulations (Eichrecht): the Calibration Law sets the requirements to be complied with for the measuring instrument in order to be state-of-the-art to ensure correct measurement results within the German Law. Therefore, the metering and processing of measured values must fit all requirements, which is currently hard to fulfil. ISO 15118 is seen as a long-term solution.

[138] Beinot Marcoux – ChargeHub Central - 2020
[139] German Charging Infrastructure Regulations. APPM Gmbh, SuMoCo

- Regions and cities might have particular regulations or policies for charging infrastructure that have to be taken into account.

Table 22 provides an overview of the actual regulations and the field in which they are applied. All of them apply to (semi-)public charging infrastructure and some of them to private charging infrastructure. Charging infrastructure can only be seen as private when a site is only accessible with the owner's permission and is used without any commercial services.

Legislation	(Semi-) public	Private
Niederspannungsanschlussverordnung (NSV) – Low-Voltage Grid Connection Ordinance (LWGCO) The LWGCO regulates, among other things, the influence of DSOs on the approval of new charging stations for electric vehicles. Installations without permission are not allowed.	✔	✔
Baugezetsbuch (BauGB) – Federal Building Code (FBC) The FBC defines the principles and procedures to be followed by municipalities when drawing up land-use plans. This may include charging infrastructure, and there are specific situations where a new charging station is permit-free and where it is not.	✔	~
Ladesäulenverordnung (LSV) – Charging Station Ordinance The LSV regulates the main aspects of operating charging infrastructure, authentication, use, payments and interoperability for AC and DC charging.	✔	×
Eichrecht – Callibration Law The Calibration Law sets the requirements to be complied with for measuring instruments in order to be state-of-the-art to ensure correct measurement results within the German Law.	✔	×
Regional regulations All kinds of regional polices and regulations that apply to charging infrastructure.	✔	×
Legend	✔ Applies	~ May apply / × Does not apply

Table 22 Overview of the German regulations for charging infrastructure (APPM Gmbh, SuMoCo. German Charging Infrastructure Regulations)

The Ladesäulenverordnung (LSV) or Charging Station Ordinance regulates the main aspects of operating charging infrastructure, authentication, use, payments and interoperability for AC and DC charging. The basis for the Charging Station Ordinance on a national level is the Energy Industry Law (Energiewirtschaftsgesetz, EWG) - §49 IV, 1 ENWG to be precise.

Prerequisite on EU Level is the Directive 2014/94/EU of the European Parliament and the Council on the development of alternative fuel infrastructure issued on 22. October 2014.

The Bundesnetzagentur (BNetzA) or Federal Network Agency is the German regulatory office for electricity, gas, telecommunications, post and railway markets. It is a federal government agency of the German Federal Ministry of Economics and Technology and headquartered in Bonn, Germany. It is the regulatory authority in the sense of the charging station ordinance. This agency is also the formal authority responsible for any topics regarding the Ladesäulenverordnung.

Technical requirements regarding safety and interoperability in the Charging Station Ordinance are:

a. Each AC (≥ 3.7 kW) charging station should be equipped with Type 2 connectors in accordance with the DIN EN 62196-2, issued in December 2014

b. Each DC charging station with the possibility for AC charging should take condition a. into account

c. Each DC (> 22 kW) charging station should be equipped with a Combo 2 connector in accordance with the DIN EN 62196-3 issued in July 2012

Charging stations with a charging capacity < 3.7 kW are excluded from the LSV regulations.

In the ordinance, there are reported also billing requirements. Each electric driver should be able to charge and pay spontaneously at any time, without any contract with a service provider signed beforehand. The regulation is intended to enable the unhindered use of electric vehicles across operators, municipalities and countries. Authorities can choose between the following variants:

a. Authentication is not required when using the charging station without any payment.

b. Cash payment or cashless payment (standard card-based payment system such as a credit card) in the immediate vicinity of the charging point.

c. Web-based system (meaning a QR-code, app or website) including at least one variant of access to the web-based payment system (i.e. PayPal, Credit Card or others), which must be available free of charge. The menu navigation for charging should be available in at least German and English.

As already anticipated, a large part of the legal framework is applicable in all federal states. Thus, it can be regarded as the basis for the regional implementation of (semi-) public charging infrastructure. Different local authorities are involved in the assessment of a charging infrastructure project within the framework of a preliminary building application or a resulting (building) permission process. This is executed in accordance with specific local building regulations and/or with the local permitting authority.

Market size:

There are around 35.000 publicly available EV charging stations in Germany. The national plan is to increase this number to over 50.000 in the next few years and to one million by 2030[140].

In 2020, the German government announced plans that will require all gas stations to also offer EV charging in the future. This will mean that fuel stations will now function also as EV charging stations in order to increase electric mobility sector. Electromobility, according to the BDEW (German Association of Energy and Water Industries), for achieving a mass market, will need at least 70.000 charging stations and 7.000 fast-charging stations[141].

BDEW also reports that in Germany the best charging opportunities exist in Berlin (1789 charging points) and Munich (1310). The third city is Hamburg, with 1226 charging points, while Stuttgart is the fourth, with 616[142].

According to BDEW register, more than 75% of the public charging points are built and operated by energy companies, and quick charging stations account for around 15% of the total ports.

Currently, there are around 240,000 fully electric cars and 200,000 plug-in hybrid cars registered in Germany. But for BDEW profitable operation of the charging infrastructure would require at least 550,000 fully electric cars[143].

Client profile: The targeted clients are private and business EV drivers (both at working location and at home), private companies with electric fleets, shopping venues interested in charging solutions as a means for attracting new customers.
Charging at home is more focused for clients who cannot have private charging locations.

PROBLEM TO SOLVE (CUSTOMER PAINS) AND BUSINESS OPPORTUNITY

Problems to solve:

- Lack of public charging stations. This element discourages citizens from renewing their vehicles by shifting from ICE vehicles to EVs
- Lack of systems to protect public EV parking spaces from abuse of utilization
- Systems able to inform drivers if charging points are busy and to provide the possibility to make a reservation
- Improvement of maintenance level for public charging points

[140] Statkraft - 2020

[141] The Ultimate Guide to EV Incentives in Germany. Wallbox

[142] https://www.cleanenergywire.org/news/berlin-continues-lead-german-cities-most-e-car-charging-stations

[143] https://www.cleanenergywire.org/news/germanys-charging-infrastructure-outgrows-demand-e-car-drivers-energy-industry#:~:text=According%20to%20the%20energy%20industry,electric%20cars%2C%20the%20group%20argued.

- Bureaucracy and overlap between different administrative regulation and guideline levels
- The mismatching between low demand areas and charging stations
- More fast chargers especially in locations with high turnaround
- Policy willingness to increase services for EVs

Business opportunity:

Germany is getting serious about boosting EV adoption in the country. As defined in the 2030 Climate Action Programme issued in October 2019, the Government aims to have up to 10 million EVs and 1 million charging stations on German roads by 2030. To achieve this ambitious objective, several EV incentives have been extended or added for infrastructure development, tax cuts, and further subsidies to invigorate Germany's EV market[144].

While EV incentives are regulated and harmonized at the national level, benefits for private EV charger purchases and installation vary between cities, municipalities, and federal states. The only nationwide incentive is offered by the German state-owned development bank KfW-Bank (10-30% incentive for the purchase and installation of a wallbox charger).

Regarding public charging points, the Federal Ministry of Transport and Digital Infrastructure has introduced an incentive program to encourage the roll-out of public charging stations.

Subsidies[145]:

- Up to €3.000 for purchasing charging stations of up to 22 kW.
- Up to €12.000 for purchasing DC chargers up to 100 kW.
- Up to €30.000 for purchasing DC chargers above 100 kW.
- Up to €5.000 for low voltage and up to €50.000 for medium voltage grid connections.

Tax benefits:

- Private and company car owners of plug-in electric vehicles that charge their cars in their employer premises are exempt from declaring this as a cash benefit in their income tax return.
- Company car owners that charge their EVs at home can even benefit from a tax reduction.
- Employers offering free charging of electric vehicles or bicycles will not be taxed for this service until 2030.

[144] The Ultimate Guide to EV Incentives in Germany. Wallbox

[145] https://wallbox.com/en_us/guide-to-ev-incentives-europe#Germany

As anticipated before, in Germany, different local authorities are involved, with specific policies, in growing and developing charging infrastructure.

The city of Berlin and its Senate have chosen their own way to install and operate public charging infrastructure with the so-called “Berliner Modell” (Berlin Model). The infrastructure was set up in specified search areas for which a need was determined according to a location concept. Up to now more than 700 charging points have been built based on a proven demand. Under certain conditions, private individuals, and commercial enterprises as users of electric vehicles have the opportunity to apply for charging infrastructure near their place of residence or regular workplace at www.be-emobil.de[146].

The overall approach of the “Berlin model” towards electromobility aims to give easy and non-discriminatory access to charging infrastructure on public streets to every ESPs that want to operate in Berlin and to every EV driver that needs to recharge. The city started this objective in 2010 with the creation of eMO (the Berlin Agency for Electromobility) and in 2012 with the project's launch “be emobil”. It was a European tender for the installation of 250 charging stations in the public street network. Since the beginning of the project, thanks to SenUVK for installations on public spaces and to the eMo agency for private and semi-private areas, a multitude of charging possibilities have been created.

The main aim is to reduce motorised private transport in the city with the support to mobility transition in the capital region and with the implementation of best practice solutions on a sustainable basis. For example, with the construction of mobility stations (as well as car-sharing car parks) that play a particularly important role in this field. Mobility hubs increase the attractiveness of mobility services as they bundle various means of transport both spatially and through digital platforms.

Within the approach of the “e-mobil” project, by the end of September 2021, 1,789 publicly accessible charging points have been put into operation in public and private spaces. This includes 1,168 charging points that were installed on public roads. Of these, Allego GmbH operates a total of 994 charging points at 523 locations, which were built on behalf of the Senate Department for the Environment, Transport and Climate Protection in the period from 2015 to the end of 2020.

In addition, still thanks to the "Berlin model", together with the charging stations built on behalf of the state, four so-called "third-party operators" have signed the operator contract with the state of Berlin, which gives the possibility to operate and install charging infrastructure in public spaces.

Currently, five companies are allowed to operate charging facilities in the city's public space according to the Berlin Model:

- Allego GmbH (on behalf of the State of Berlin).

[146] “German Charging Infrastructure Regulations – Supporting Dutch companies understanding the German framework” – APPM Gmbh and SuMoCo, March 2019.

- E.ON Drive Infrastructure GmbH
- Vattenfall Smarter Living GmbH
- TEK Netz Europe GmbH
- Comfortcharge GmbH

Recently, the local model for electromobility growing focuses on "complementary" charging solutions not installed on public spaces, but more with charging infrastructures in public-access areas, e.g., in private parking lots at supermarkets, gas stations, etc. The aim is to increase the numbers in these areas and private spaces for the charging infrastructure development in the next future.

The reason for this is that the public space of a growing city like Berlin is subject to diverse and sometimes competing usage demands of the public spaces. In the inner-city area, in particular, not even half of the households own a car, which is why an appropriate share of the traffic space here, and one that is appropriate in terms of bringing about the mobility turnaround, must be allocated to the environmental alliance. Nowadays, companies interested in developing charging infrastructure in the urban area of Berlin need to be really motivated and have to find their own consistent space for the installation. The financing of smart parking and charging infrastructures is settled to come by higher parking fees in the city.

The eMO agency also operates in innovative business models and operating concepts in urban logistics and the electrification and digitization of commercial transport through the use of new vehicle concepts.

In the field of "Intelligent Infrastructure", eMO deals with the energy-, infrastructure- and data-based framework for new mobility solutions in passenger and freight transport. One of the energy policy goals of the State of Berlin is to promote the connection of energy and mobility transition (sector coupling). An integrated view on the electricity, heat and transport sectors is being promoted more intensively with regard to increasing volatile renewable energies. Stationary and mobile storage plays an increasingly important role in the future energy system.

Storing and releasing electricity from the public power grid into electric vehicles and vice versa have become a relevant element for a better control of the grid load. The aim is to use electric vehicles as mobile storage devices.

Regarding charging points technology and feature, now Berlin wants to raise e-mobility to the next level by bringing more standardised and easy-to-use solutions to its streets. From charging with alternating current (AC) at 3.7 kW, 7 kW, 11 kW, to direct current (DC) at up to 43 kW, or co-current flow up to 50 kW, there is the aim to serve all current standards and all connector types.

A partnership with Ubitricity, a specialized provider in lamp post charging, was initially planned in 2020 to install around 1.600 new public and private charge points in Berlin's network. But finally, the partnership was not concretized. Another company that has decided to invest in Berlin's electric vehicle charging market is Qwello. Its business model is structured to be completely "user-friendly", developing in an independent way both hardware and software. Qwello finances the entire charging point infrastructure. Cities have only to address locations

for the charging points. They want to be at the same time CPO, hardware developer and firm in charge for OEM. With one distribution cabinet, they can install up to four charging poles. Qwello wants to provide a seamless process. Every charging pole is equipped with 11 kWh cable and a Type 2 socket. If users want to charge at 22kWh, they have the possibility to plug their own cables. It is possible to pay both via Qwello app or directly at the charging point with a card tap. The charging tariff can be both by time and kWh: 0.02 euro/min or 0.26 euro/kWh. Currently, their back-end communication system is provided by be.ENERGISED, but with a horizon to become a totally independent company, Qwello is working on an alternative system.
VALUE PROPOSITION AND SOLUTION
Value proposition: Provision of an all-in-one platform that combines different services to locate, reserve and route to free and available e-car charging points in public and semi-public parking areas. Considering the two project locations: - "Outside location": provision of charging solutions more fitting for overnight charging to local tenants - "Inside location": charging solutions more suitable for urban context and so to all "all kind of users". Even though the two locations will be realized in private/semi-public spaces, both of them will be open all day and will be available to all kind of e-drivers.
Solution: Both INCAR and CLICK, the USER-CHI tools that VMZ is developing in the city of Berlin, can lead to advantages in the framework of the city centre (park & charge). INCAR (in the demo led by Qwello and in the demo led by Gewobag) for the implementation of a platform allowing a unique interoperability management system for roaming, charging, and parking. CLICK (demo web service) for the top-down location planning of charging infrastructure.
USER NEEDS AND RELATED SOLUTION BENEFITS

User need #1: Lack of public charging stations is discouraging the citizens from renewing their vehicles by shifting from ICE vehicles to EVs	Related solution benefit/s: Most of the necessary activities connected to lay the foundations for the market ramp-up of electric cars in Berlin have already been carried out with the "Berlin Model". Now a large part of the charging infrastructure will have to be built on publicly accessible areas and private areas in the future. This is because the public space in a growing city like Berlin is subject to diverse and sometimes competing usage requirements. The increase in public charging points will support citizens renew their vehicles by shifting from ICE to EVs.
User need #2: Economic incentives/advantages for new charging points	Related solution benefit/s: Semi-public areas: Economic feasibility of Charging Infrastructure is facilitated, and the number of charging stations is increasing.

User need #3: Searching for unoccupied charging stations	Related solution benefit/s: Interactive-map overview of unoccupied charging stations
User need #4: No possibility to reserve the desired charging point and assure its availability	Related solution benefit/s: Reservation within short time (30 mins) of a charging point
User need #6: Finding the location (address) of the selected charging station	Related solution benefit/s: Routing to the selected charging station
User need #7: Accessibility limited to public charging stations	Related solution benefit/s: "digital key" allowing to open the parking barrier and enter the semi-public parking spaces equipped with charging infrastructure
User need #8: Questionable safety of publicly available charging stations	Related solution benefit/s: gaining accessibility to enclosed semi-public charging stations
COMPETITIVE ADVANTAGE	
The service platform INCAR: - Can show accessibility of public as well as semi-public (private) charging station - The routing and access to charging stations is ensured with available parking space connected to charging station - Creates opportunities and incentives for location owners (such as a housing company like Gewobag) to build or provide space for charging infrastructure on private ground and open it to a larger user group (not only tenants). This increases the economic viability of private investments in charging infrastructure.	

7.3.2.1 Key stakeholders

The following table lists the key stakeholders in the City Centre (park & charge) Berlin use case. These are the organisations playing a key role in the application of the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities unrelated to the solution's application are excluded from the analysis.

Table 23 Key stakeholders in the City Centre (park & charge) ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Cities/ Public authorities	For rules and urban planning
TSPs	For installation of charging points in transport hubs
Charging Points Operators	Realization and management of charging points
Technology solution providers	Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)

Energy supplier companies	Supply of power energy (sometimes can correspond to the CPO)
National and European Authorities	For standards and policies
Grid Infrastructure Managers	Connection, management, and upgrading of charging points with the local power grid. Approval of new charging points.
Financial and payment system companies	For the provision of payment solutions
Landowners	For the provision of public and “semi-public” areas where to realize charging points

7.4 Annex 4: E-trucks business model analysis

7.4.1 Business case overview

7.4.1.1 Market characteristics

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.

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 the USA, California is pushing to have 40,000 zero-emission trucks on its roads by 2030[147].

In the EU, the Commission is leading companies' awareness for bringing together measures compelling truck-makers to produce and sell zero-emission vehicles. Large companies, including Nestlé, retailers Carrefour and Spar Austria, and transport companies Alstom, Geodis, and DB Schenker, are inviting policymakers and negotiators to promote strong legislation on truck CO2 emission standards.

In 2018, a similar request was presented by Carrefour, IKEA, Unilever, Heineken, Nestlé, Geodis, national transport associations and other big players[148].

This is the direction where the market, together with demand, is going. Indeed, some electric trucks are already here. Big, medium and small companies specialise in providing new and alternative solutions aiming at electric and zero emissions road transport and logistics.

Some electric general lorries prototypes have been designed or produced by small manufacturers since the 2000s. Often they were the simple conversion of diesel units. While trials with different important companies, for example Renault, in real-world conditions for several months or more, have already been conducted from 2010.

Renault launched its small electric Maxity in 2010, and Mitsubishi Fuso its slightly larger eCanter in 2017. Since 2018, other major manufacturers, including MAN, Mercedes-Benz and DAF, have begun to deliver prototypes or pre-production heavy-duty units to companies for real-world testing.

In 2019, Renault, Volvo, and MAN began the first series production of heavy-duty lorries. In the USA, the market is heavily developing both by small and big players. Some of them have developed only chassis for electric vehicles able to be fitted with proper glider kits. For example,

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[147] https://www.trucks.com/2019/03/08/2019-work-truck-show-adoption-electrification-wont-be-fast/

[148] Recharge EU trucks: time to act! – Transport&Environment

Spartan Motors[149] and Xos Trucks[150] have developed electric chassis for small trucks as Ford Transit Connect and intermediate chassis for medium-duty trucks.

Freightliner, the North American branch of Daimler Trucks, has just started to test its eM2 Class 6 van and its heavy-duty semi-trailer e-Cascadia with important logistics partners such as Penske[151] and NFI[152]. The plan is to demonstrate the reliability of these vehicles to get, time by time, bigger companies placing larger orders to drive down relevant costs still slowing the business, for example, the battery.

7.4.1.2 Market sectors and policy trends

Thanks to research conducted by Transport&Environment (T&E)[153], if the EU wants to be in line with its Green Deal objective of climate neutrality by mid-century, diesel and natural gas truck sales must be phased out between 2035 and 2040 at the latest.

To achieve this level of decarbonisation, several legislative and policy changes are necessary to accelerate both the production supply of electric trucks and to deploy charging infrastructure at the depot (overnight charging), at the intermediate/distribution centres (destination charging) and at publicly accessible locations (public charging). To achieve these objectives, policymakers need to bring about a comprehensive strategy to rapidly electrify all steps.

In 2019, the Dutch National Climate Agreement decided to take this direction precisely with a series of measures in the Netherlands to reduce CO_2 emissions[154]. The first target was to reduce figures by at least 49% by 2030, compared to 1990 levels. The agreement set out the key actions to follow on sustainable mobility and logistics, including requiring the 30-40 largest cities in the Netherlands to introduce zero-emission zones for freight. The Dutch government has also taken care with municipal authorities to provide clarifications on how the introduction of zero-emission zones would take place in order to allow Dutch businesses to make preparations in good time. Importantly, the Dutch government has also elaborated a national incentive program offering grants for the purchase of electric trucks and vans.

There are two main branches of action in consideration of the different existing kinds of truck and lorry: urban contexts vehicles and long-haul vehicles. Looking at how technology and innovation are moving forward, electric lorries are penetrating first within the urban environment.

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149 https://www.spartanrvchassis.com/?utm_source=spartanmotors.com&utm_medium=lp&utm_campaign=2020.DomainTransition

150 https://xostrucks.com/

151 https://www.truckinginfo.com/321715/daimler-delivers-electric-em2-truck-to-penske-truck-leasing

152 https://insideevs.com/news/366608/nfi-penske-first-two-freightliner-ecascadia/

153 Unlocking electric trucking in the EY: recharging in cities – Transport&Environment

154 https://www.c40knowledgehub.org/s/article/Zero-Emission-Zones-for-Freight-Lessons-from-the-Netherlands?language=en_US

Distribution vans and refuse collection trucks are two examples of vehicles operating in the urban context that can excellently be fitted with electric solutions. Most of their time is spent stopping, starting, or idling, and this is a perfect driving pattern where an electric engine can be more efficient than an internal combustion engine.

In 2017 the Municipality of Sacramento, California, has decided to add all-electric refuse collection trucks in its fleet. It was the first time in California[155]. Trucks were developed and built by Motiv Power Systems. After Sacramento also Chicago has decided to adopt the Motiv developed solution with the acquisition of 20 electric trucks. Vehicles have been designed to meet the demands of their former diesel collection fleets, with a 95-km range and a payload of 9 tons.

Half of EU's total truck activity (in tonnes-km, a good proxy for CO_2 emissions) is driven over distances of less than 300 km[156]. These trips with present technology could be covered without problems by electric trucks through new models currently on to the market with about 300 km range (enough to cover nine trips out of ten). Furthermore, it is expected that the range of the electric trucks available will swiftly increase to 500 km, covering about two-thirds of kilometres and 19 trips out of 20.

Analyses report that road freight vehicles that come back to the depot overnight and travel a maximum of 300 km to 400 km per day should be the first to electrify at a fast pace as their economic and environmental benefits are easily demonstrable with new technologies[157]. On the demand side, the adoption of electric freight vehicles depends mainly on the total cost of ownership, better driver comfort, much lower noise levels (eight times lower according to Renault Trucks), reduced congestion, and air quality benefits in cities.

Transport&Environment foresees that with the present number of freight vehicles in Europe and the present standard of utilization, it could be enough to supply depot plants with recharging systems of 30 kW of power delivered overnight for each truck. However, in reality, the needs will vary greatly from one truck to another: a large share of small and medium electric trucks could charge with tri-phase AC chargers of 11 or 22 kW overnight. On the other hand, larger heavy trucks with larger batteries need up to 80 kW overnight charging.

Regarding destinations where trucks can stop and operate, vehicles frequently spend two hours or more per day there (distributions centres, logistics hubs, malls, shops, etc.) for loading and unloading cargo operations. T&E estimates that one destination charger would be required for every 15-20 electric trucks (one for 25 electric trucks in 2025 and one for 19 electric trucks in 2030). This was based on assuming 300 kW charging in 2025 and 350 kW in 2030, 90% real-world charging efficiency, and a utilisation rate of 4 hours per day. As a result, in a scenario with all operating trucks substituted with electric units, a total of 5,000 destination chargers would be needed in 2025 and 27,500 in 2030.

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155 https://www.todaysmotorvehicles.com/article/motiv-electric-refuse-truck-sacramento-062717/

156 Recharge EU trucks: time to act! – Transport&Environment

157 Unlocking electric trucking in the EY: recharging in cities – Transport&Environment

Finally, in the early market phase, where most trucks will need to come back to the depot, public charging could be used as a necessary safety net, allowing a top-up of the battery when operations require a bit more range. Assuming about 5% of the total energy is delivered at public chargers in 2025 and 10% in 2030, and that public charging points have a power of 600 kW in 2030 (500 kW in 2025), an 80% real-world charging efficiency, and that the charger is used two hours per day on average. There would be a need for one public charger for every 50 electric trucks on the road in 2025 and one every 30 electric trucks in 2030. In 2017, medium and heavy-duty commercial vehicles emitted a total of GHG emissions of around 200 Mt CO_2[158]. Commercial vehicles emit roughly 100 gCO_2 eq/tkm (TtW - Tank-to-Wheel emissions) on average in the EU. Thanks to diesel truck efficiency improvements mainly driven by the truck CO_2 regulation, the CO_2 emissions per tkm of the truck fleet should improve by 5% in 2030 and 1.5% in 2025. Considering these percentages, it is possible to compute the total direct CO_2 savings from shifting a given part of the road freight activity from diesel to electric. In a scenario where the present trucks fleet is totally converted into electric vehicles, in 2030, the annual TTW (tank to wheel) savings should be equivalent to a greater value than the total heavy commercial vehicle emissions from Germany in 2017 (44 Mt CO_2 eq.).

7.4.1.3 Market growth and size

The delivery of electric trucks is still limited to small numbers compared to values related to internal combustion vehicles. In the USA, the value in 2018 was fewer than 200 trucks delivered. Most of them were light-duty vehicles for urban operations[159].

In reality, as previously anticipated, there are already truck makers delivering heavy duty vehicles but, in most cases, only to specific customers and only for testing phases (e.g. Freightliner with e-Cascadia for Penske and NFI).

Experts expect that values will grow in next years, but still limited to small and medium duty trucks and with exceptions for big players as Amazon, DPD, UPS, etc. with greater capacity to tackle trials and to accept challenges for new business sectors and opportunities.

In reality, as previously anticipated, there are already truck makers delivering heavy-duty vehicles but, in most cases, only to specific customers and only for testing phases (e.g. Freightliner with e-Cascadia for Penske and NFI).

Experts expect that values will grow in the next years, but still limited to small and medium duty trucks and with exceptions for big players such as Amazon, DPD, UPS, etc., with greater capacity to tackle trials and accept challenges for new business sectors and opportunities.

In any case, the trucks' sector is an industry that has to get used to the technology before it really takes off, so this is not going to be a giant breakout in next future.

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[158] Unlocking electric trucking in the EY: recharging in cities – Transport&Environment

[159] https://www.trucks.com/2019/03/08/2019-work-truck-show-adoption-electrification-wont-be-fast/

One of the most reported problems that truck manufacturers have to tackle in the realization of e-vehicles includes overcoming range anxiety and the fear of being stranded if the charge runs out. Even if a charger is available, all the operation cases can take hours. A business relying on electricity powering its trucks risks missing deliveries and losing money.

Spartan Motors reported that they observed more range anxiety with chassis studied for greater trucks (400- to 600-horsepower) than for those settled for urban/regional vehicles.

For now, the use of gas or diesel with some electric boost in a hybrid combination is gaining more traction. The Boston-based start-up XL Fleet Electrification is studying a system where, differently to the Chevrolet system that uses an electric charge for the first 80 km of driving before switching to a gas-powered electric generator, the engine spread the charge across the full range of a trip. Their intent is to analyse customer data and to use them in a solution that could leverage the existing infrastructure limits and technology gaps[160].

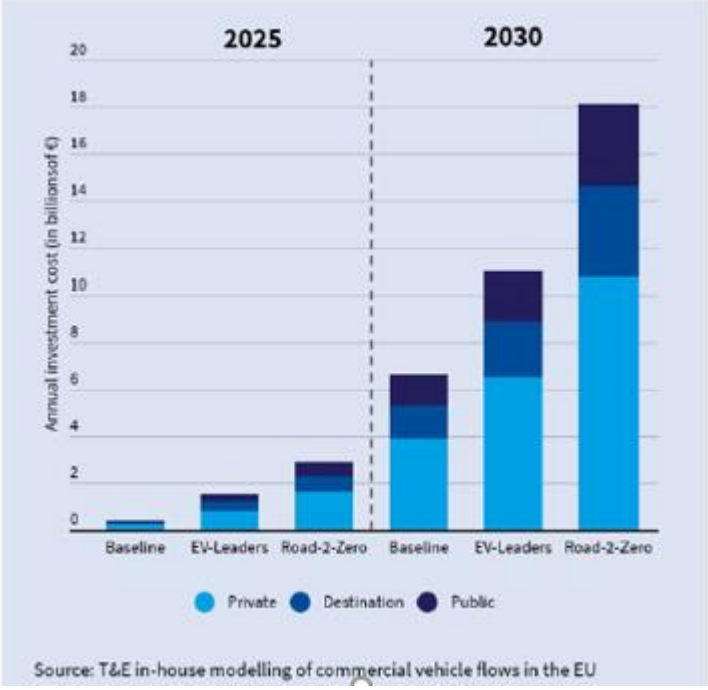
At present different truck makers (big and small players) are working to offer electric vehicles with up to 300 km range in the heavyweight category (above 26t), after that most of them have committed to battery electric vehicles for urban and regional operations. The real-world range of the current generation electric trucks is expected to increase up to 400 km and to 500 km in the next few years. The gross weight is expected to reach the 44 tonnes segment, which is by far the largest emitter GHG for commercial use vehicles[161].

[160] https://www.trucks.com/2019/03/08/2019-work-truck-show-adoption-electrification-wont-be-fast/

[161] Unlocking electric trucking in the EY: recharging in cities – Transport&Environment

Next to the realization of vehicles able to range longer distances, another aspect for tackling range anxiety and charging runs out is the growth of reliable charging infrastructure. Substantial investment will be needed in public charging infrastructure to serve the growing electric market. Analysis conducted by T&E reveals that annual investments in Europe for the deployment of all charge points (depot, destination and public, including equipment, installation and grid upgrades) would increase up to about 1.4 - 2.7 billion euros in 2025 and up to 11 - 18 billion in 2030 (Figure 7).

Figure 7: Energy demand from electric trucks in the EU (Source: Transport&Environment)



7.4.1.4 Market problems and new opportunities

Most of the troubles related to developing e-vehicles are related to battery costs. This problem has been deeply tackled in the last years, with technological progress and consequent dropping of prices (from 1,183 $/kWh in 2010 to 156$/kWh in 2019, an 87% drop in 9 years). Progresses that increased the energy and power density of batteries and allowed electric trucks to be more competitive than diesel in recent years[162].

According to McKinsey, in Europe, long haul heavy-duty electric trucks will be cost-competitive by 2031 at the latest, while for regional haul, heavy duty electric trucks reach price parity by 2029 and medium-duty trucks by 2023 (Figure 8)[163]. Some light-duty and medium-duty trucks are already cost-competitive today. Scania estimates that battery-electric trucks would hit price parity with diesel trucks for the long haul in 2027.

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[162] Recharge EU trucks: time to act! – Transport&Environment

[163] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/whats-sparking-electric-vehicle-adoption-in-the-truck-industry

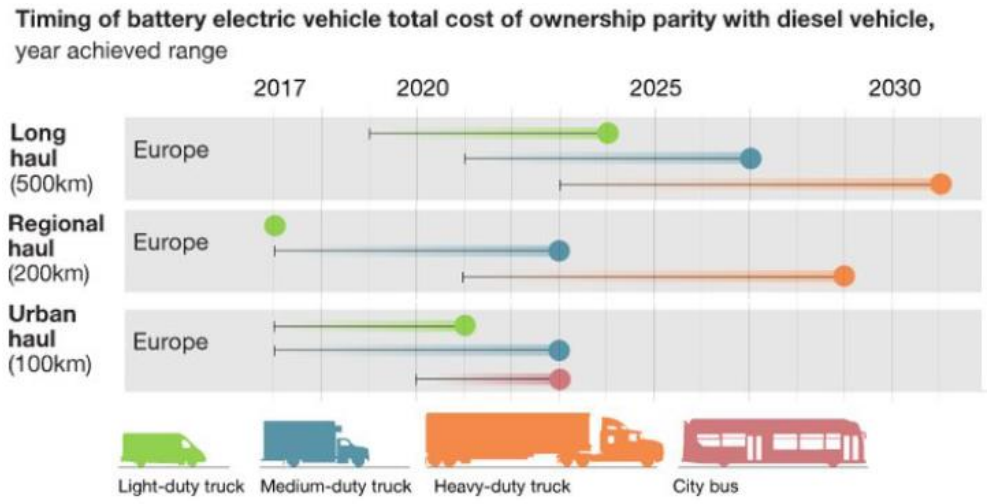

Figure 8: Cost parity timeline of electric vehicles with diesel in Europe (source: McKinsey Center for Future Mobility)

For Motiv, the number to make electricity cost-effective for a medium-duty truck battery system is $200 a kilowatt-hour[164].

If values will remain or drop more in next future, in different applications, electric can finally be competitive compared to diesel engines, thanks also to combination with other particular features as less wear and tear and regenerative braking that captures the energy and returns it to the battery.

Despite reported progress, uncertainty remains over the resulting volume of electric truck sales during the next years. To ensure a speedy uptake of electric truck sales, it is fundamental that the implementation of charging infrastructure ramps up in parallel with the sales of electric trucks.

Requirements for e-truck charging should be tailored to their specific needs, which are three: depot charging, destination charging (shared infrastructure at the distribution centre or logistic hub while loading/unloading) and public charging. For trucks coming back to the depot, about 80% of the energy recharged will be delivered while staying at the depot. In comparison, destination charging covers 15% of the total energy, and public charging about 5%[165].

A solution for fast and competitive recharging of electric trucks are the so-called "mega chargers" (also called HPCCV or High-Power Charging for Commercial Vehicles). These are specific sites that could be placed along the main highways and at truck rest areas and natural stops on the roads. Truck drivers are mandated to take a 45-minute break every 4.5 hours[166], and this time period could be used to recharge the truck batteries. The power requirements for electric truck

[164] https://www.trucks.com/2019/03/08/2019-work-truck-show-adoption-electrification-wont-be-fast/

[165] Recharge EU trucks: time to act! – Transport&Environment

[166] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006R0561

chargers, particularly high-power opportunity charging (HPCCVs), can be significant and might need grid upgrades in many cases.

With a megawatt capacity, electricity grid infrastructure can be costly due to the fact that the charging site needs to be connected to a medium voltage electricity grid. This can require important civil engineering work to deploy the cables. Nonetheless, installing connections of up to several dozens of MWs is common for grid operators, especially when connecting industrial sites.

Grid and electric truck operators need to cooperate on planning new and smart infrastructure to reduce network and installation costs by optimising location strategy for HPCCVs in particular. The planning of HPCCVs needs to take into account the pre-existing grid infrastructure, including the location of high or medium voltage lines, which would help reduce the distance over which the new grid has to be deployed[167].

Considerations must also be given to combining grid upgrade works with "future-ready" infrastructure implementation plans (for example, preparing the grid capacity for electric vehicles). This planning cooperation in order to ensure that local authorities and the electricity sector could be able to plan ahead.

Support and subsidies by public authorities can drive the adoption and realization of e-trucks. This is what different administrations have already decided to do in recent years. Different companies, especially small ones and start-ups, are taking advantage of public offers and subsidies for realizations of their electric projects. For example, XOS Trucks, is making battery systems for medium- and heavy-duty trucks. The company reported that its business should be profitable from the start of production thanks to public incentives received.

In the USA, California is the most involved in electric mobility through its Air Resources Board (ARB). The state plan aims to get 2.5%of trucks operating on electricity by 2024, with an increase to 15% by 2030. For this purpose, California is offering incentives to encourage truck makers to invest and truck operators to use an electric vehicle, as the 315,000 dollars per company on purchases and leases of zero-emission trucks and buses[168].

Freightliner, the industry leader in heavy-duty truck sales, is using 16 million dollars from the South Coast Air Quality Management District in Southern California as part of its electrification of the M2 vehicles and the heavy-duty truck eCascadia[169].

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[167] https://insideevs.com/news/372749/charin-hpccv-over-2-mw-power/

[168] https://www.trucks.com/2019/03/08/2019-work-truck-show-adoption-electrification-wont-be-fast/

[169] https://www.trucks.com/2019/03/08/2019-work-truck-show-adoption-electrification-wont-be-fast/

Still in the USA, in 2019, the Department of Energy announced 51.5 million dollars in grants for heavy-duty and off-road truck technology research, including up to 18 million dollars for projects aimed at battery-electric vehicles and up to 6 million dollars for hydrogen-fuelling technologies[170].

In Europe, electric trucks are being embraced by all major truck makers as an answer for the newly adopted heavy-duty vehicle CO2 emission standards (15% average emission reduction by 2025 and 30% by 2030 compared to 2019 levels)[171].
In Europe, electric trucks are being embraced by all major truck makers as an answer for the newly adopted heavy-duty vehicle CO2 emission standards (15% average emission reduction by 2025 and 30% by 2030 compared to 2019 levels)[172].

The objective is to improve technological maturity, better cost-effectiveness, and better air quality in urban areas. New rules allow an additional maximum permissible weight for vehicles (two tons more for zero-emission trucks) and a new incentive mechanism for zero- and low-emission vehicles. In the European Commission, the political pressure is high. Targets are a 90% reduction of transport emissions by 2050 and a clear pathway from 2025 onwards towards zero-emission mobility. In the 2030 Climate Action Programme, the German government sets the goal that by 2030, one-third of truck traffic shall be powered by electricity (directly and indirectly).

According to the US Department of Energy, regarding cost-effectiveness for electric trucks, 3.8 litres of fuel is equivalent to 33.7kwh[173]. Adopting a truck that uses 2 kilowatt-hours per mile is equivalent to using 10 kWh per every 5 miles (8 km). The diesel truck that this e-truck can replace used to consume the equivalent of 33.7kwh per 5 miles (8 km). Thus, the diesel truck uses 3.37 times the amount of energy that the electric truck is using.
As a result, thanks to the new economic and social opportunities deriving by the development and adoption of electric trucks, different major truck makers are starting production of new electric solutions in the next years (Figure 9).

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170 https://www.energy.gov/articles/department-energy-announces-50-million-commercial-truck-road-vehicle-and-gaseous-fuels

171 Recharge EU trucks: time to act! – Transport&Environment

172 Recharge EU trucks: time to act! – Transport&Environment

173 https://nepis.epa.gov/Exe/ZyNET.exe/P100BAV0.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2011+Thru+2015&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C11thru15%5CTxt%5C00000001%5CP100BAV0.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

Daimler Trucks in October 2019 communicated its intent to sell only zero-emission vehicles by 2039 and to abandon the development of natural gas-powered trucks[174].

Both Volvo Trucks and Renault Trucks started production of e-trucks in 2019[175], while DAF opened its production in this sector in 2020, with technology coming from the bus manufacturer partner VDL[176].

Scania initially has entered the e-truck market with hybrid trucks equipped with a pantograph charging system. While at the end of 2020 it has started the production of BEVs with a focus more on urban commercial truck series (L and P-series cabs)[177]. Iveco, for now, has an electric freight vehicle production focused only on the Daily van, but it has planned to deliver battery electric trucks with a range of about 500 km in 2021 with the partner Nikola[178], with the Port of Hamburg as pilot customer with 25 trucks in 2022[179]. Overall, the new electric trucks from EU OEMs will mainly focus on urban and regional delivery with ranges up to 300 km.

	Model	Stage	Production	GVW	Battery	Range	Source
Daimler Trucks	eCanter	In production		7.5 tonne	83 kWh	120 km	(Mitsubishi Fuso, 2017)
	eActros	Customer tests	2021	26 tonne	240 kWh	200 km	(Daimler AG, 2018)
MAN	eTGM, 6x2	Customer tests	2021	26 tonne	225 kWh	200 km	(electrive.net, 2018)
	eTGM, 4x2	Customer tests	2021	32 tonne	149 kWh	130 km	(eurotransport.de, 2018)
	CitE	Prototype	2021	15 tonne	110 kWh	100 km	(MAN AG, 2019)
Volvo Trucks	FL Electric	Customer tests	2019	16 tonne	300 kWh	300 km	(AB Volvo, 2018a)
	FE Electric	Customer tests	2019	27 tonne	300 kWh	200 km	(AB Volvo, 2018b)
Renault Trucks	D Z.E.	Customer tests	2019	16 tonne	300 kWh	300 km	(Renault Trucks, 2018)
	D Wide Z.E.	Customer tests	2019	26 tonne	200 kWh	200 km	(Renault Trucks, 2018)
DAF	LF Electric	Customer tests	Not announced	19 tonne	222 kWh	220 km	(DAF, 2018a)
	CF Electric	Customer tests	Not announced	37 tonne	170 kWh	100 km	(DAF, 2018b)

Table 1: Electric trucks from main truck makers in the EU (Source: ICCT[14])

Figure 9: electric trucks from main truck makers in the EU (source: icct)

174 https://www.daimler.com/investors/reports-news/financial-news/20191025-co2-neutral-fleet-of-new-vehicles.html

175 https://www.prnewswire.com/news-releases/volvo-trucks-launches-sales-of-electric-trucks-for-urban-transport-300952613.html

176 https://www.daf.com/en/news-and-media/news-articles/global/2018/q4/18-12-2018-jumbo-takes-delivery-of-first-daf-cf-electric

177 https://www.electrive.com/2020/11/27/scania-announces-market-launch-of-bev-phev-trucks/

178 https://www.ft.com/content/96d93366-112b-11ea-a225-db2f231cfeae

179 https://www.electrive.com/2021/09/15/iveco-nikola-to-build-truck-plant-in-germany/

As previously anticipated, the share of e-trucks in next years are expected to grow only for small and medium vehicles optimised for urban use.

7.4.1.5 Best practices and alternative solutions

From December 2020, DPD Switzerland, a parcel delivery company, uses a new electric truck developed by Designwerk with a range of up to 760 kilometres. The vehicle, commercialized with the brand Futuricum, is equipped with a battery of 680 kWh. According to forecasts by Designwerk, the model will save around 90 kilograms of CO2 per 100 kilometres compared with similar diesel-powered trucks, which would correspond to about 72 tonnes of carbon emissions saved per year[180].

DPD will launch a pilot test with electric trucks also in the UK. The Swedish start-up Volta Trucks will provide its first electric vehicle, Volta Zero, in the first quarter of 2021. The Zero is a 16-tonne delivery vehicle larger than a normal van and with an autonomy range between 150 and 200 km. The company scheduled to start the official commercial production of the Zero in 2022, and it is aiming to have as many as 500 vehicles on the road by the end of that year[181].

In March 2021, Amazon started testing phases for its first fully electric delivery van in San Francisco (USA). The vehicle, realized in partnership with the American start-up Rivian, is part of the "The Climate Pledge" program to achieve net-zero carbon across all company operations by 2040. In 2021 the cities involved in testing the vehicle's performance will be 15. By 2022 Amazon and Rivian have planned to introduce in delivering operations 10,000 vehicles. By 2030 the vehicles will be 100,000. Each van has a range of 150 miles per charge[182].

7.4.2 Turku business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-trucks solutions in Turku from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 24 Turku E-trucks summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: Finland has started its commitment to developing electromobility since 2009 when the first studies for the importance of electric cars and electric mobility in the local society have been

[180] https://www.electrive.com/2020/06/14/dpd-switzerland-gets-electric-truck-with-680-kwh-battery/

[181] https://www.pesmedia.com/volta-trucks-dpd-pilot-london-04082020/#:~:text=Swedish%20electric%20vehicle%20manufacturer%2C%20Volta,micro%2Ddepot%20strategy%20in%20Westminster.

[182] https://www.cnbc.com/2021/03/18/amazon-begins-testing-rivian-electric-delivery-vans-in-san-francisco.html

carried out. The main result of these studies was the identification of business possibilities for the Finnish industry in mobile machinery electrification, vehicle software, charging technology, automotive industry components, and electric mobility infrastructure.

Thanks to these results, in 2011, a specific program was launched: the five-year program called EVE - Electric Vehicle Systems. The project coordinator was Tekes, the Finnish Funding Agency for Innovation, and the total budget was 100 million euros. The programme's main target was to create an electric mobility ecosystem that could generate new knowledge and competence in EV-related technologies and services.

The program's main focuses were on electric passenger traffic and services, electric commercial vehicles, testing services for EVs, testing environments for EVs, and ecological urban living. The automotive industry was not seen as a particular focus since Finland has only one company assembling passenger vehicles (Valmet Automotive, highly involved in conversion of the sector to electromobility[183]).

With the support of the program, different start-ups have been founded, and existing companies have increased their business volume in international markets remarkably. Two good examples are Virta[184] and Linkker[185].

Unlike other Nordic countries, the Finnish approach to electric mobility has always been more conservative with limited support from the Ministry of Employment and the Economy. Moreover, the support has been often linked to the participation in the EVE programme. The greater focus by the national government has been on biofuels solutions.

However, despite the minuscule Finnish fleet of about 1,500 EVs at the end of the EVE program, the growth during the five years has been notable: in 2011 there were about only 40 Evs in the country. At the same time, also the IT-based service providers have been successful internationally.

The Tekes EVE – Electric Vehicle Systems programme was composed of five consortia, three of which – Eco Urban Living, EVELINA and Electric Traffic – focused mainly on passenger cars and services, whereas WintEVE was active in testing services for the automotive industry and Electric Commercial Vehicles in the electrification of public transportation and heavy-duty vehicles.

The ECV (Electric Commercial Vehicles) consortium was a project entity focused mainly on the electrification and development of business in the field of commercial vehicles, including buses and trucks, utility vehicles, cargo transport and work machines. The ECV consortium created extensive testing and development environments for heavy-duty electric vehicles and their components. The core themes were testing and research, as well as modelling and simulation. The ECV consortium took an active part in research projects concentrating on electrochemical

[183] https://www.valmet-automotive.com/
[184] https://www.virta.global/ev-drivers
[185] http://www.linkkerbus.com/

energy storages, electric bus technology, hybrid-electric working machine, system engineering, power grid, and charging.

Thanks to results obtained with the program and the government's new incentives, the electromobility numbers have continued to grow in Finland after 2016.

In 2016, as part of the national energy investment program, the Ministry of the Employment and Economy allocated €4.8 million to develop public charging infrastructure in the nation. This program provided subsidies to commercial organizations willing to build charging infrastructure and lease electric vehicles as company cars.

Moreover, in 2017, the Finnish Housing Finance and Development Centre budgeted €1.5 million in subsidies for housing co-operatives, condominiums, and other similar organizations that build charging points for their residents.

In total, 5,708 new electric vehicles were sold in 2018, including 776 battery electric vehicles (16 % of the sales). Year over year, the growth was 129%, following the positive trend from 2016 and 2017.

In 2018, the total fleet of EVs in Finland was 15,499, including both plugin hybrids and battery electric vehicles. In the same year, the number of imported second hand Evs was one-third of all new registrations.

In 2019, the national subsidy rate for the realization of new fast-charging points was 35%, and for normal chargers, 30%[186]. The prerequisite for getting national subsidies was that the chargers could support smart charging and could provide an open data interface for monitoring the charger's availability and condition.

Government subsidies have also considered incentives for housing companies for building EV charging infrastructure. In 2018 the budget was around 1.5 million euros for the first year. The subsidy covered 35% of the costs incurred from building electrical system surveys, wiring installations, and charging equipment. The minimum requirement was to build readiness for five charging points. Still in 2018, the Prime Minister's office procured research, coordinated by VTT Technology Research Centre of Finland, to identify cost-effective means for advancing the electric vehicle market. According to the modelling performed by VTT, the national incentives should be able to lead the government's energy and climate strategy to the goal of 250,000 EVs by 2030. By taking into use multiple new incentives, it would be possible to double the number of EVs by 2030. The Tampere University of Technology, in collaboration with ETH Zürich, modelled the potential for BEVs in Finland and Switzerland according to the current passenger vehicle usage needs and trends. The study found out that 85% of the current car trips could already be performed using BEV's, utilizing the current vehicle models and charging infrastructure.

[186] http://www.ieahev.org/assets/1/7/Report2019_Finland.pdf

Finally, in 2020 electric vehicle sales reached 14% of the entire market share. As a sort of incentive, fuel taxes have been more than doubled for the diesel price and more than tripled the price for gasoline, making EVs a much more affordable option.

There have also been confirmed some subsidies addressed to EVs, in particular:

- Purchase grants. Private people can receive up to €2,000 for new BEVs. The car price cannot exceed €50,000.
- Scrapping schemes run by the Finnish Government that offer individuals bonuses of up to €2,000 for scrapping old diesel/gasoline vehicles and buying new BEVs/PHEVs.

Furthermore, the so-called "ownership tax benefits" have been confirmed, allowing EVs owners to pay the minimum rate (5%) of the CO2 based registration tax.

Still in 2020, the Finnish government has announced that it will support the installation of over 5,000 EV charging points at apartment blocks and detached home complexes. This action aimed to contribute to achieving the goal of carbon neutrality by 2035[187].

In total, the government has allocated 5.5 million euros for installing electric vehicle charging points. In 2018 and 2019, the introduction of 3,000 charging points had already been financed by the government agency in charge of the development of the EV charging infrastructure network. In 2020, the funding for EV infrastructure had increased by 4 million euros from the € 1.5 million allocated in 2019[188].

Housing companies and parking firms can now apply for this funding to add charging points to their facilities. As in the previous years, the subsidy covers around 35% of the cost for installing EV chargers. However, the subsidy could be higher if at least half of the units are at least 11-kilowatt chargers. In such cases, the Housing Finance and Development Centre of Finland can cover up to 50% of the installation costs.

Market size:

In the national market, the leader company regarding battery electric vehicle distribution is Tesla. Nissan is the second. In 2018 the two brands held two-thirds of the new electric vehicle market[189]. In the same year, Volvo was the market leader for plug-in hybrid vehicles.Figure 12Table 25 and Table 26 show the distribution and sales of the electric vehicles, Plug-In Hybrid Electric Vehicles (PHEVs) and Hybrid Electric Vehicles (HEVs) in 2018.

[187] https://www.eltis.org/in-brief/news/finland-increases-funding-ev-charging-points

[188] https://yle.fi/uutiset/osasto/news/finland_aims_to_add_5000_domestic_ev_charging_points_/11148160

[189] http://www.ieahev.org/assets/1/7/Report2019_Finland.pdf

Table 25: distribution of EVs, PHEVs, and HEVs in 2018 (Source: Traficom Autoalan Tiedotuskeskus)

Fleet Totals on 31 December 2018					
Vehicle Type	**EVs**	**HEVs**	**PHEVs**	**FCVs**	**Total**
Bicycles	n.a.	n.a.	n.a.	n.a.	n.a.
Mopeds	1,211	0	0	0	125,381
Motorbikes	43	0	0	0	154,323
Quadricycles	144	0	0	0	15,347
Passenger vehicles	2,404	40,374	13,095	1	2,696,334
Commercial vehicles	256	n.a.	26	0	325,656
Buses	21	n.a.	0	0	12,481
Trucks	2	n.a.	0	0	96,169
Totals without bicycles	**4,081**	**40,374**	**13,124**	**1**	**3,425,691**

Table 26: Sales of EVs, PHEVs, and HEVs IN 2018 (Source: Traficom Autoalan Tiedotuskeskus)

Total sales during 2018					
Vehicle Type	**EVs**	**HEVs**	**PHEVs**	**FCVs**	**Total**
Bicycles	n.a.	n.a.	n.a.	n.a.	n.a.
Mopeds	474	0	0	0	4,927
Motorbikes	10	0	0	0	3,307
Quadricycles	16	0	0	0	242
Passenger vehicles	776	11,855	4,932	0	120,499
Commercial vehicles	46	n.a.	9	0	15,515
Buses	1	n.a.	n.a.	0	475
Trucks	1	n.a.	n.a.	0	3,897
Totals without bicycles	**1,324**	**11,855**	**4,941**	**0**	**148,862**

Most EVs are concentrated in the capital, the Helsinki region, and around larger cities. 44% of plug-in hybrids and 42% of battery electric vehicles operate in the capital region.

As of June 2020, there were 1,109 electric charging stations in Finland. One-third of them were located in the Uusimaa region, where is located the Capital Helsinki. The region of Turku, Varsinais-Suomi, is the second of the ranking with 94 charging stations. The third is the region of Pirkanmaa (Tampere), with 92 charging stations (Figure 10)[190].

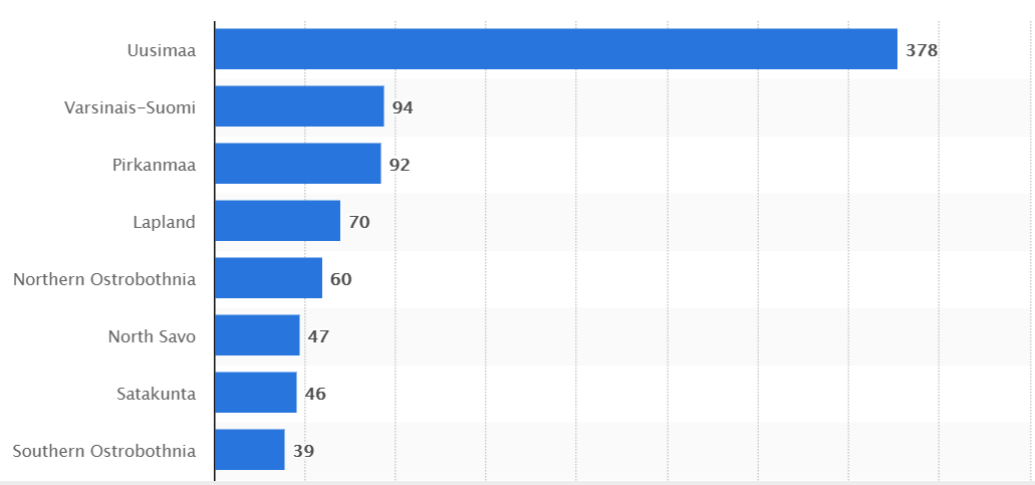

Figure 10: Number of electric car charging stations in Finland as of June 2020, by region (Source: statista.com)

Client profile: The target profiles are logistics operators, freight forwarders, logistics real estate companies, retail companies, multi-utility companies.
Two layers of e-trucks operators to consider:

- Long-haul logistics operators
- Vans and medium trucks for short distances/urban distributors

Initially planned quick charging points in the Turku demo site and interests for the opportunity charging in combination e-bus and e-trucks. Already installed charging devices for e-bus but missing operators of e-trucks for sharing the solution.

PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY

Problem to solve:

- Lack of charging stations for e-trucks
- Operating range (and consequent range anxiety)
- Upgrading of depots and distributions centres
- Upgrading of the energy grid
- E-Mobility performance during extreme weather conditions
- Limited vehicles offer

190 https://www.statista.com/statistics/1178531/electric-car-charging-stations-finland-by-region/#:~:text=As%20of%20June%202020%2C%20there,with%2092%20e%2Dcharging%20stations.

Business opportunity:
The main instrument currently employed by the City of Turku for achieving its carbon neutrality by 2029 is the CIVITAS ECCENTRIC PROJECT [191]. Thanks to this project the Municipality aims to develop electric transport, shared use of cars and bicycles, and the Mobility as a Service (MaaS) model. Electricity will become the primary source of energy in public transportation.

In the long run, the goal is to have a wide variety of electric transport services linked to one open public transport platform operating as a MaaS ecosystem.

Thanks to the ECCENTRIC project, now in Turku six e-busses (produced by the Finnish start-up Linkker) are operating along line nr. 1. These vehicles have been acquired in 2015, together with quick charge stations for each end of the line and an overnight charging station for the depot.

The operating of these vehicles is carried out in cooperation with an EV research project conducted by the Turku University of Applied Sciences The research aims to identify and propose future solutions for technical and operative bottlenecks of expanding electric bus operations.

The research covers a wide variety of topics:

- Specifications and procurement of electric buses and the charging infrastructure;
- Innovative business and contract models for (service) procurement;
- Adapting bus line planning and optimising models for EV operation;
- Finding solutions for accurate measurement of energy consumption;
- Using data from onboard and charging systems to plan future choices of buses;
- Effect of driver training to cost of operation;
- Reliability and total cost of ownership (TCO) of EVs versus diesel vehicles.

Another activity implemented in Turku thanks to the ECCENTRIC PROJECT was the electrification of the municipal fleet for promoting e-mobility. This action was carried out between 2017 and 2018 and consisted of the procurement of different e-vehicles used by city employees. The vehicles acquired by the municipality were eight LEVs, including e-bikes and e-scooters. Parallelly to the vehicles' introduction, an awareness campaign was settled for raising e-mobility awareness in different city municipal departments. LEVs acquired were adopted to replace the use of a passenger car, especially for trips shorter than 10 kilometres.

In Finland, the main principle for public charging points, and electromobility in general, is to encourage private companies to offer EV services and the needed charging services. Finnish cities or other public authorities have not started to directly invest in public charging points on a large scale yet.

[191] https://civitas.eu/sites/default/files/civitas_eccentric_booklet_turku_web.pdf

This is why most e-stations in Turku are provided by private actors such as gas stations, hypermarkets, shopping centres, and restaurants. Often the charging pole is installed in their parking areas, and the charging is free of charge.

The charging stations in street parking zones are seven, and the parking is free of charge during the charging of the EVs for a maximum of 4 hours. These charging stations are operated by the national company Liikennevirta Oy under the brand name Virta.

The first high-power charging station (HPC) in Finland was opened in 2018 along the Helsinki-Turku motorway. The infrastructure was realized at the Lohja ABC service station in collaboration with Suur-Seudun Osuuskauppa . The charging station opened along the highway is part of the high-power charging network that Fortum has planned to build between Helsinki, Turku, Stockholm and Oslo.

The Tekes EVE – Electric Vehicle Systems programme reported that the Finnish economy has a long history in mining equipment, straddle carriers, and forklift manufacturing. And most of these firms are directly involved in growing and developing the national industry and mobility decarbonization. Some examples are Kalmar, Sandvik and Rocla.

Aiming to this purpose, in 2018, Sandvik opened its battery electric vehicle research centre in Turku. The innovation and development centre aims to create innovative battery products and electric solutions for the global mining and construction vehicle markets and to develop technology talent in Finland[192].

In the field of electrifying urban distribution and logistics, in 2018, DB Schenker opened its new terminal in Turku with 14 Type 2 Smart Chargers for electric vehicles. The charging points have been installed by Virta and are part of the DB Schenker program to make its transport activities in European cities emission-free by 2030[193].

VALUE PROPOSITION AND SOLUTION

Value proposition:

Despite there is no longer interest in this use case, the City of Turku, together with relevant stakeholders (as the TSPs and energy suppliers), has expressed interest in this business solution to realise the electromobility masterplan in the Finnish city.

This aspect, together with the other programs already in phase of implementation (within and without the USER CHI project), is an important element for the users and citizens of e-vehicles because express how the city is involved for advancing the local electromobility and how much people can rely on local institutions.

Solution:

The most suitable solutions for e-truck services in Turku are:

[192] https://im-mining.com/2018/06/14/sandvik-opens-battery-electric-vehicle-research-centre-turku/

[193] https://www.parking-net.com/parking-news/virta/helps-futureproof-worlds-leading-global-logistics-provider

- *CLICK planning toolkit in the framework of the electromobility master plan that will foresee both quick chargers and standard chargers suitable for logistics purposes.* - *SMAC for testing the intelligent and dynamic management of demand and analysing – from both a technical and economic point of view – the grid's reliability managing the high energy power necessary to trucks and vehicles for logistics.*	
USER NEEDS AND RELATED SOLUTION BENEFITS	
User need #1: Charging systems appropriate to logistics business	Related solution benefit/s: CLICK tool will allow the planning and location of charging solutions suitable for both the levels of logistics operators: long haul operators (heavy trucks) and short/medium haul operators (vans and trucks for urban distribution)
User need #3: Fast charging points in the urban context	Related solution benefit/s: SMAC solution for dynamic management of the high-power needs related to logistics purposes, especially in urban contexts, and for keeping grid balancing and reliability.
User need #5: Range anxiety	Related solution benefit/s: Realization of the city-wide master plan for EV expansion that will foresee (together with the support of CLICK and SMAC tools) the most appropriate localization of charging points useful for e-truck operations and, consequently, reduce the range anxiety and troubles for the operators.

7.4.2.1 Key stakeholders

The following table lists the key stakeholders in the E-trucks Turku use case. These organisations play a key role in applying the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities unrelated to the solution's application are excluded from the analysis.

Table 27 Key stakeholders in the E-trucks ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*
Charging Points operators	*Realization and management of charging points*

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging points*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Technology solution providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
Logistics Real estate companies, Landowners, TSPs	*Providers of hubs and areas (**distribution centers, supermarkets, "intermediate" logistics centers, petrol station areas, construction site locations**, etc.)*
Manufacturers of freight transport vehicles	*As providers of electric vehicles*
National/European Authorities	*For standards and policies*
Research institutions	*For research in the electromobility sector (especially with critical wheatear/environment)*

7.5 Annex 5: E-taxi stops business model analysis

7.5.1 Business case overview

7.5.1.1 Market characteristics

Zero-emission vehicles such as Battery Electric Vehicles (BEV) have a high potential to decrease climate and health effects related to exhaust gas emissions from the transport sector. The peculiar characteristics of the electric powertrain, if compared to the Internal Combustion Engine Vehicles (ICEVs), are particularly attractive in urban environments: zero tailpipe emissions, higher energy efficiency and silent operations. 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. Moreover, the European Commission in early December 2020 presented its "Sustainable and Smart Mobility Strategy", which defines milestones for a smart and sustainable future. In particular, all transport modes need to become more sustainable, with green alternatives widely available and the right incentives put in place to drive the transition. To this end, one of the targets will be to get by 2030 at least 30 million zero-emission cars in operation on European roads.

This mindset shift, combined with the constantly decreasing cost of batteries and an increased supply of BEVs in previously underserved vehicle classes, pave 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.

Mobility needs are continuously increasing, but the resources are not; that's why their utilisation should be optimized. This also concerns taxi management systems, which are an important part of the sustainable urban transport ecosystem. For many years the accent has been put on mass public transportation. Still, inflexibility, long total travel time, overcrowding and insufficient service coverage resulted in being potential obstacles in the long term. In this framework, the taxi sector still plays an important role by providing promptness, door-to-door service, privacy, comfort, high city space coverage, and all daytime availability. Hence, as the popularity of using taxis increases, their availability plays a key role. Therefore, taxi corporations are incessantly working on improving the scheme of vehicle distribution so that taxis can travel the shortest possible route by transporting as many passengers as possible. Increasing the size of the rolling stock of taxis seems to be the simplest way to improve the level of service. Besides their intensive use, taxi vehicles are believed to be most often used in densely populated urban areas. Therefore, replacing ICE taxis with BEV taxis (i.e. e-taxis) could have a significant positive effect on urban air quality and noise pollution. This is even more crucial considering the increase of Zero Emissions Zones (ZEZ), which allows for significantly more e-taxis.

If considering introducing a greater number of e-taxis in the fleets, crucial importance should be given to the location of charging stations. Existing literature indicates that private EV users generally do not rely on public charging infrastructure and home charging is still significantly more important. Nonetheless, a public charging infrastructure network can alleviate limited range as a barrier for EV adoption. Besides that, charging infrastructure in urban areas is frequently

used by BEV users with a relatively low driving range and intensive users, thus, motivating a need for public charging to be built and operated in urban areas.

On the other hand, professional users such as e-taxi drivers and users of electric light commercial vehicles have different use and charging patterns than private users, making many of them more likely to depend on daily use of public charging infrastructure.

7.5.1.2 Market problems and new opportunities

In a study conducted in the Greater Stockholm area, it was found that e-taxis drove on average 335 km daily, and that e-taxi drivers used the public charging infrastructure extensively, in many cases multiple times a day[194]. Moreover, several studies, which have investigated e-taxis potential penetration, have found that due to their intensive use and daily distance compared to private EVs the viability of an increase of e-taxis in the fleets is critically relying on the existence of an extensive urban fast-charging infrastructure.

As reported in a study conducted in Japan[195], this implies an increase in queues in the charging stations during peak hours, causing time and revenues losses for e-taxi drivers. Based on the research findings, one of the possible ways to mitigate these congestion problems at charging stations is to enlarge the amount of EV charging infrastructure if the number of charging events at the charging station exceeds ten per day. Then, given that charging events could be rather random and influenced by demand conditions and the e-taxi fleet composition, it was supposed that a certain degree of overcapacity would be required to minimise the possibility of congestion problems. Therefore, it has been concluded that urban fast-charging infrastructure could respond to two main needs concerning on one side private users having forgotten to charge overnight and on the other side professional users, such as e-taxi drivers, that need to charge during the day.

From the insights provided by recent studies on e-taxi growth, limited access and congestion at the charging stations can be considered the main barriers for e-taxi growth. E-taxi vehicles significantly impact the public fast-charging stations at certain times of the day, primarily during midday hours when e-taxis are the majority of charging stations' users. Consequently, an increasing fleet of e-taxis can be seen as a key enabler for improving an urban fast-charging network given their more intensive use compared to EVs private users.

7.5.1.3 Market sectors and policy trends

Different strategies and policies can then be implemented to mitigate these charging capacity issues: temporal price differentiation (even if there seems to be a general resistance against that rule[196]), the use of ultra-fast charging stations allowing a reduction in charging time and an increase in the capacity of these charging stations; coping strategies such as letting taxi drivers

[194] Hagman and Langbroek, 2018.

[195] Oda et al., 2017.

[196] "Coping with a growing number of e-taxis in Greater Stockholm: A stated adaptation approach", J.H.M. Langbroek, J. Hagman, 2018.

moving to less busy charging stations in case of queues; and/or developing a route planning system for e-taxis considering both charging and Zero Emission Zones (ZEZ) locations.

By considering e-taxi drivers charging needs during working days, there could probably be the necessity for fast charging operators to provide peak capacity rather than average daily capacity (i.e. the fast-charging network is not likely to be fully used during the whole day since charging peaks are the results of the driving patterns and demand optimisation of taxi drivers). Hence, from a local electricity grid capacity distribution perspective, the existing fast-charging outline of e-taxis could be an advantage since electricity peaks at the grid level usually occur in the late afternoon and morning. This means that the additional consumption on the local grid due to fast-charging might be better placed at off-effect peak hours, such as midday.

Finally, some policies or regulations in favour of e-taxis could strengthen their position on the market. For instance, their utilisation rate could be improved by prioritising e-taxis in the customer queue by any means, such as a smart queue system that helps e-taxi drivers to keep their position while charging or prioritising e-taxis at the coordinator (if the case).

7.5.2 Barcelona business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-taxi stops in Barcelona from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 28 Barcelona E-taxi stops summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector[197]: In Spain, access to the taxi market is subject to quantitative restrictions combined with qualitative barriers (such as the need to pass an exam before applying for a license). Licenses may be issued to individuals or companies, but the same person cannot hold more than a certain number of licenses (3 in Madrid and 50 in Barcelona, provided they do not represent more than 10% of the total available licenses). For taxis, the law provides minimum working hours and mandatory resting days, depending on the number issued on the license. Therefore, if a company exploits a license with various drivers, the drivers cannot cumulatively work more than the prescribed hours for each license. Certain municipalities, such as Madrid and Barcelona, also impose certain car models to be used as taxi vehicles. The geographic market for taxis is local, and taxis cannot pick up passengers outside their designated area (municipality). Moreover, certain municipalities also impose a residence requirement upon the applicant for a taxi license.

[197] "Study on passenger transport by taxi, hire car with driver and ridesharing in the EU", ANNEX III – Country Reports Study contract no. MOVE/D3/SER/2015-564/SI2.715085.

The Spanish taxi and hired car with driver market has experienced great uncertainty and various changes. The arrival of new intermediaries has created new opportunities for hire transport, especially in the hired car with driver segment, but this led to the protests of the taxi operators. Between 2012 and 2015, it is estimated that more than 10,000 applications for hired car with driver licenses have been submitted in Madrid. Many of the applicants who were refused the license appealed before the courts and new licenses will be released based on the courts' decisions. In the last years, the government changed the legislation twice to limit the number of hired cars with driver licenses. In April 2016, the Spanish Competition Authority (Comisión Nacional de los Mercados y la Competencia - CNMC) brought an appeal before the Audiencia Nactional against the Real Decreto 1057/2015, which amended the law on transport introducing even more stringent requirements for accessing the hire car with driver profession. According to the CNMC, the new provisions unjustifiably restrict the competition between providers in the hire transport market to consumers' detriment.

Almost all regions have promulgated autonomous rules to regulate taxis within their territory at the regional level. Spain is made up of 17 regions and two autonomous cities.

The taxi market is fragmented across the various licensing areas. Taxis and hired cars with drivers are two separate markets. Both markets are geographically restricted and characterized by quantitative barriers. As clarified by the Spanish Competition Authority (CNCM), the national legislation allows the taxis to be active in the rank, hailing and pre-booked services (via phone or web applications), but the hired car with driver service is active only on the last segment.

The technological developments narrowed down the distinction between the two segments. According to the CNCM, the users, at least in the largest cities, do not wait or call the taxi but search for it with applications.

The majority of the operators are self-employed. In the Spanish largest cities, there are various radio taxi services that also provide their own applications (Pidetaxi Radiotelefono in Madrid and Radio taxi 033 in Barcelona, which has the largest number of affiliated taxis). In recent years, the taxi operators have started to aggregate around "professional associations" such as Elite taxis,1509, lobbying the Government and bringing court cases against Uber and Cabify.

The radio taxi services also provide apps to book a taxi, however one of the most used taxi IT intermediaries is Mytaxi (now Free Now) which is owned by Daimler AG.

It is worth mentioning that, as reported in the Ayuntamiento de Barcelona website , the Covid-19 health crisis and the lockdown have led to a drop in journeys made using the various types of transport in the city. In a move to adapt the taxi sector to mobility during the different stages of the lockdown exit and regain economic sustainability and feasibility, Barcelona City Council, the Barcelona Metropolitan Area and the Metropolitan Taxi Institute, in coordination with taxi drivers' associations, are promoting a shock plan with ten short- and medium-term measures.

The plan contains measures to adapt the sector to the new forms of mobility during the lockdown exit stages and to ensure hygiene and safety measures for taxi journeys.

One of the main points in the plan is the creation of a public mobile app for the entire fleet of taxis in the metropolitan area, enabling professionals to receive journey requests and to be

able to contact users online or by phone. At present, only half of the taxi drivers can be contacted via apps or radio. They will also have access to telematic support, along with an e-window to conduct procedures relating to the profession.

Another measure is the application of hygiene and disinfection protocols for vehicles and protection systems, with face masks obligatory to protect taxi drivers and users during journeys.

In order for taxi services to match users' needs, a study will be carried out on new forms of mobility that appear from now on in metropolitan cities. This will enable the network of taxi ranks in the main locations to be adapted to meet demand.

The shock plan also includes other measures to help modernise the fleet and a one-year moratorium for vehicles that need to be renewed as they are ten years old.

Market size[198]:

The taxi sector in Barcelona comprises 10,523 taxi licenses, from which 5% belong to private companies and 95% to individuals. The number of taxi licenses has been frozen since 2005 (one license per 275 inhabitants).

However, the number of driver licenses has increased significantly over the last years (13,136 in 2010, with the rate of drivers to vehicles of 1.26, while this rate was 1.14 in 2007). The demand for taxi services has been estimated by the Metropolitan Taxi Institute (IMT) as more than 200,000 trips per day, which corresponds to 1.52 % of the total number of trips in the wider area (roughly 13,000,000trips daily). A 2013 study[199] estimates the demand for taxi trips at 60,000,000 trips per year based on the GPS trackers collecting origin and destination of trips during the last ten years. On the supply side, the input data has been calculated by Salanova based on the data provided by the IMT surveys where all the drivers participated.

[198] "Large-scale microscopic simulation of taxi services. Berlin and Barcelona case studies" M. Maciejewski, J.M. Salanova, J. Bischoff, M. Estrada, 2016.

[199] "Modeling of taxi cab fleets in urban environment", J.M. Salanova, Universitat Polite`cnica de Catalunya, 2013.

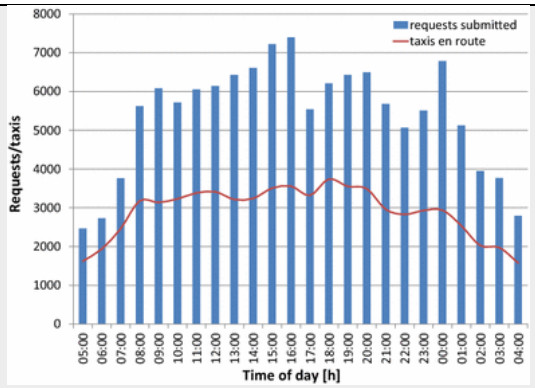

Figure 11: Hourly request submissions and active taxicabs in Barcelona (Source: "Modeling of taxi cab fleets in the urban environment", J.M. Salanova, Universitat Politecnica de Catalunya, 2013)

Client profile: The targeted clients are mainly taxi drivers working in the Barcelona area. For specific business strategies and under particular circumstances clients can be also private EV drivers and other companies (with EV fleets).

PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY

Problems to solve:

- The lack of charging stations is discouraging taxi drivers from renewing their vehicles by shifting from ICE vehicles to EVs.
- Lack of charging stations specific for e-taxis.
- Misusing of the few existing charging stations available for e-taxis.

Business opportunity: Barcelona is where 15 % and 38 % of Spain and Catalonia's electric vehicles (EVs) are respectively registered. That means that Barcelona leads the way in adopting measures for promoting electric vehicles and is a benchmark model for other cities in the world. The Barcelona City Council has developed an Electric Vehicle Master Plan, which is a strategic plan promoting the introduction of electric vehicles in the city, encouraging sustainable mobility and improving air quality by reducing fossil-fuel emissions and encouraging locally sourced consumption, to the benefit of positive urban community life.

As reported in the Ajuntament de Barcelona website, the city has a growing privately-owned fleet of electric vehicles, motorcycles and cars, which will benefit from the facilities both in place and under further development. As for now, that includes 450 free public recharging points located at many stations and car parks in every city district, of which 125 are realised explicitly for electric motorcycles, and 17 are fast-charging stations.

There are also some economic incentives to foster the adoption of zero-emission vehicles in Barcelona. In particular, electric vehicles are subject to a 75% rebate on the mechanically powered vehicle tax (IVTM), as well as free parking in blue- and green-zone parking areas, except where places are reserved or for local residents only, provided that parking times and maximum periods are respected. Moreover, the owners of e-vehicles can benefit from: free tolls on motorways of the Generalitat in the mid-week air protection area for electric vehicles

with the ecoviaT identification; up to a 30% discount on sections of motorway and tunnels with the identification of low-emission cars with the identification of ecoviaT; discounted tariffs for electricity to recharge the vehicles; energy recharge bonus both for underground parking spaces and at public surface recharging points; and the possibility to use bus-HOV lane in the C-58 highway if having the ecoviaT identification.
VALUE PROPOSITION AND SOLUTION
Value proposition: Operating in a city that leads the way in adopting measures for promoting electric vehicles for encouraging sustainable mobility and improving air quality. The Ajuntament and the Metropolitan Administration are widely working for electromobility also within the commercial and industrial sector improving their commitment and their feeling for a real business opportunity in Barcelona.
Solution: Among the different USER-CHI tools that the Barcelona Metropolitan Area is developing, the main ones to be taken advantage of in the framework of the e-taxis use case are INCAR and SMAC. The first one foresees the implementation of a hub allowing CPOs management systems for roaming and extra-services through OCPI 2.2 communication; the second one aims at creating a software tool calculating the optimal charging profile (i.e. the amount of energy to provide) of the charging stations.

USER NEEDS AND RELATED SOLUTION BENEFITS	
User need #1: additional fast-charging infrastructure	Related solution benefit/s: SMAC for a smart grid integration and demand management services for slow, medium, fast and charging inside the city.
User need #2: no queues at charging stations	Related solution benefit/s: INCAR for the implementation of a platform allowing a unique interoperability management system for roaming, charging, and parking
User need #3: economic incentives/advantages	Related solution benefit/s: Economic incentives in the Electric Vehicle Master Plan to foster the adoption of zero-emission vehicles in Barcelona

COMPETITIVE ADVANTAGE
For the Metropolitan Authority: • Sustainable approach for political reason, also providing economic subsidies. • A social responsibility approach to reduce the number of ICE vehicles in the city area also within the fleets providing public services.

7.5.2.1 Key stakeholders

The following table lists the key stakeholders in the E-taxi stops Barcelona use case. These are the organisations playing a key role in applying the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities unrelated to the solution's application are excluded from the analysis.

Table 29 Key stakeholders in the E-taxi stops ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*
Charging Point Operators	*Realization and management of charging points*
Technology Solution Providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
E-taxi drivers/organizations	*For common planning about strategies and locations to adopt for recharging*
National Authorities and European Authorities	*For standards and policies*
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging points*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Taxi vehicle manufacturers	*As providers of vehicles for taxi business*
Transport Service Providers (TSPs)	*For realization of charging points in strategic transport hubs*

7.5.3 Turku business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-taxi stops in Turku from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 30 Turku E-taxi stops summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector[200]:

[200] "Study on passenger transport by taxi, hire car with driver and ridesharing in the EU", ANNEX III – Country Reports Study contract no. MOVE/D3/SER/2015-564/SI2.715085.

The Finnish Taxi Transport Act (Taksiliikennelaki 217/2007) entered into force in 2007. However, in 2015 the Ministry of Transport and Communications started discussions on a thorough reform of the whole transport legislation, including the Taxi Transport Act. The Transport Code would cover all transport modes. In its first phase, the focus has been on road transport, including taxi transport, where the need for changes is most significant. In the legislative proposal, road transport regulation will become closer to market regulations in force for other transport modes.

The maximum number of taxi licences (quotas) per municipality is decided on an annual basis by the regional authorities, and the licences are then granted in a specific order to those applicants that meet the general criteria laid down in the Act. The competent authority for issuing taxi licenses is the Centre for Economic Development, Transport and the Environment (EDTE-centre). The EDTE-centres set the quota for available taxi licenses in each municipality each year. Requirements on taxi car's accessibility for disabled persons may be imposed in the licence. To meet the criteria, all applicants have to successfully complete the training for taxi transport operators and must have no criminal background. Since in many locations, and in larger towns and cities, in particular, the number of applicants is usually a lot higher than the number of licences granted, the Taxi Transport Act contains specific provisions on the order of priority to be used to determine which applicants are granted a licence. Taxi licenses in Finland are not assignable or otherwise transferrable (Sec. 11 Taxi Traffic Act), except in case of an uncompensated transfer of taxi business (and the licence) to a near relative.

Finland has approximately 5,492,000 inhabitants. The greatest market potential is in Helsinki and other big cities. On the other hand, Helsinki is strongly committed to developing bicycle routes and public transport, which may affect the demand for passenger transportation by car as well.

Taxi traffic has a 1.4 % share of the total amount of passengers as well as passenger kilometres of all the passenger transportation in Finland (including private cars and public transportation). About 55 % of the cars operate in cities and the rest in rural areas. In total, the taxi sector employs about 14,000 people.

Finland's Taxi Association has responded to the newly emerging service models with their own nationwide smartphone application called Valopilkku. Furthermore, there is an application called Lähitaksi, which operates in Helsinki metropolitan area.

There is no differentiation between pre-booked taxi services and taxis hailed from the streets; all licensed taxis can operate both. There are few hired cars with drivers, and the service does not compete effectively with taxis.

Although there are a number of ridesharing intermediaries, the rides shared are mostly for longer distances, e.g. between cities, and thus they compete mainly with buses and trains.

Market size[201]:

[201] https://www.taksiliitto.fi/en/home-2/

The taxi sector is arguably the most talked-about transport sector in Finland. The Act has maintained that status on Transport Services that entered into force on 1 July 2018, transferring the taxi sector from quantity regulation to a liberal market model. Actors in the sector are mainly operating in the Finnish market, ensuring that the Finnish society can function even in areas where other services are no longer available. Taxis are an integral part of the chain of mobility. As a flexible form of service, they support other forms of public transport and allow moving when using private cars are not an option.

Total revenues of the taxi business are about EUR 1.1 billion, of which customers paid for by the public sector make up about 40%, private consumers about 30% and business customers about 30%. In Finland, 50 million passenger journeys are driven each year, constituting 830 million journey kilometres. Approximately 40 % of all the journeys are private, 40 % are procured or subsidized by public authorities and 20 % are procured by companies.

The biggest private sector customers of the taxi business are municipalities where the school transports, the transports of old persons granted under Act 1301/2014 governing social welfare and the transports of severely handicapped persons granted under Act 380/1987 governing the services of disabled persons are subjected to competitive tendering, and taxi entrepreneurs and passenger traffic entrepreneurs produce the services. Another major customer is Kela which refunds the costs of taxi transport to and from medical care when other forms of transport cannot be used.

There are approximately 10,000 holders of traffic licences in the field. (The exact number advised by Traficom on 30 June 2019 was 10,716.) Some 12,500 vehicles are registered for use as taxis. Entrepreneurship in the taxi business requires a licence, and the licence entitles its holder to operate as a taxi entrepreneur everywhere in Mainland Finland. The entrepreneur can freely decide on the number of vehicles deployed.

In addition to the holders of taxi licences, 77 entrepreneurs in the passenger or goods transport businesses have also registered as taxi service businesses. (Traficom 31 July 2019) Most of the taxi traffic licences have been granted to private persons, i.e., the operations take place under a trading name. The sector employs tens of thousands of people as drivers, taxi order service operatives, and other business positions.

According to the replies of the Taxi Association, the demand for taxi services has decreased because of the general financial situation. In order to better exploit the market, taxis are investing in smart technologies to put into practice ‘Mobility as a Service (MaaS)' and rideshare solutions and improving the utilisation rate of taxis, as well as encouraging new customer groups to choose public transport over private cars. According to the Finnish Taxi Owners’ Federation, the demand conditions vary significantly. Generally, January and July are quieter, and November and December are the busiest months, but demand varies depending on the times of the day and of the week as well. Most nights are quiet, but Fri-Sat and Sat-Sun nights are busier. Mornings are often busy. Weather conditions have quite a big impact on demand, too.

Client profile: The targeted clients are mainly taxi drivers working in the Turku area. For specific business strategies and under particular circumstances clients can be also private EV drivers and other companies (with EV fleets).

PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY
Problem to solve: The lack of charging stations discourages taxi drivers from renewing their vehicles by shifting from ICE vehicles to EVs.
Business opportunity: For many years, Finland had very few incentives and no subsidies for EVs. Combined with the government adoption of biofuels and a reluctance of EVs, the country had very low EV sales until a few years ago. With the introduction of more incentives, sales have risen over the last couple of years, reaching a 14% market share in 2020. As a sort of incentive, fuel taxes have more than doubled the price of diesel and more than tripled the price of gasoline, making EVs a much more affordable option. There are also some subsidies addressed to EVs, in particular: Purchase grants foreseeing that private people can receive up to €2,000 for new BEVs, as long as the car price does not exceed €50,000. Scrapping schemes run by the Finnish Government every couple of years (in 2015, 2017 and 2018, and probably again in the near future) that offer individuals bonuses of up to €2,000 for scrapping old diesel/gasoline vehicles and buying new BEVs/PHEVs. There are also the so-called ownership tax benefits allowing EVs owners to pay the minimum rate (5%) of the CO2 based registration tax. In addition, there are also incentives devoted to improving charging infrastructure. In particular, in 2016, the Ministry of Employment and Economy extended its EV charging subsidy program as part of an energy investment program and allocated €4,8 million for developing public charging infrastructure in the country. This program provides subsidies to commercial organizations willing to build charging infrastructure and lease electric vehicles as company cars. Participating organizations can receive up to 35% of charging investments and up to 30% of the capital share of leasing expenses. Moreover, in 2017, the Finnish Housing Finance and Development Centre budgeted €1,5 million in subsidies for housing co-operatives, condominiums, and other similar organizations that build charging points for their residents. Such organizations can apply for a subsidy to cover 35%, or €90,000, of the total expenses of purchasing and installing charging points on the condition that they build charging points for at least five vehicles[202].
VALUE PROPOSITION AND SOLUTION
Value proposition: For the customer, there is the case of environmental benefits deriving from the use of e-taxis and also the possibility for a quiet and calm ride thanks to an electric vehicle. For companies, together with the points underlined before, there is also a cost benefit and image benefit. For the rides inside the city, the use range of e-taxis is more than enough.
Solution:

[202] https://wallbox.com/en_us/guide-to-ev-incentives-europe#Finland

Among the different USER-CHI tools that the city of Turku is developing, the main ones to be taken advantage of in the framework of the e-taxis use case are: - *CLICK planning toolkit in the framework of the electromobility master plan that will foresee both quick chargers and standard chargers suitable also for e-taxi stops purposes.* - *SMAC for testing the intelligent and dynamic management of demand, and for analysing – from both a technical and economic point of view – the reliability of the grid managing the high energy power necessary to vehicles for e-taxis.* - *INCAR for providing users with a high-quality tool allowing for an interoperability among EMSPs*

USER NEEDS AND RELATED SOLUTION BENEFITS	
User need #1: additional charging points specifically for e-taxis	Related solution benefit/s: The Turku Master plan development for electromobility will operate exactly with this purpose in the field of taxi business and operations.
User need #2: access to the different chargers (several apps, interfaces) is a second obstacle	Related solution benefit/s: INCAR to allow a unique interoperability management system for roaming, charging, and parking.
User need #3: Who will pay for charging stations	Related solution benefit/s: Problem that will be tackled with the development of the Turku Master plan for electromobility

COMPETITIVE ADVANTAGE
- *E-taxis have much lower running costs than petrol or diesel taxis.* - *Customers are willing to choose e-taxi rather than fossil fuel one.* - *In city use range of e-taxis are more than enough.*

7.5.3.1 Key stakeholders

The following table lists the key stakeholders in the E-taxi stops Turku use case. These are the organisations playing a key role in applying the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities unrelated to the solution's application are excluded from the analysis.

Table 31 Key stakeholders in the E-taxi stops ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Charging Point Operators	*Realization and management of charging points*
Technology Solution Providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
E-taxi drivers/organizations	*For a common planning about strategies and locations to adopt for recharging*
National Authorities and European Authorities	*For standards and policies*
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging points*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Taxi vehicle manufacturers	*As providers of vehicles for taxi business*
Transport Service Providers (TSPs)	*For the realization of charging points in strategic transport hubs*
Research institutions	*For research in the electromobility sector (especially with critical wheatear/environment and vehicles with high rate of utilizations)*

7.6 Annex 6: Special events business model analysis

7.6.1 Business case overview

7.6.1.1 Market characteristics

Electric vehicle (EV) numbers are growing at an exponential pace. However, these numbers could risk getting in difficulty the present power grid due to its capacity limits, old distribution infrastructure, and limits in power production ability. The grid could be unable to provide simultaneous charging to all actual and future EVs[203].

Market and business necessities are pushing the sector to find out different solutions for providing necessary energies to all potential situations, either normal or special ones. Special ones mean different situations, out of routine regimes like emergency cases, occasional events, special occasions, etc. Often these examples are not directly considered by actors out of business, but in a growing market and a world always more dealing with special circumstances, situations previously considered more "border line" are nowadays new business opportunities and field for new services to provide.

Services provided in the "special events" business can be divided into two branches:

- Emergency Cases
- Occasional events

The first voice has to deal with catastrophic events (like storms, fires, grid failure, etc.). The growing EVs market, both in private and public fleets, is moving the business to consider assistance, services, and support to EVs in situations out of normal, and where this type of vehicles can have limitations compared to internal combustion ones.

While, with occasional events, it is meant those situations where solutions for electric vehicles are a temporary opportunity, but not a regular situation. So, it can be useful and profitable to install and realise flexible and adaptable systems that can fit differently for different occasions.

7.6.1.2 Market growth and trends

EVs have been already highlighted as future participants in the electricity market and, together whit their numbers, also the related market of additional services is growing. Services that are not targeted only to vehicles, but also to ancillary components of the electric market and from

203 https://www.tdworld.com/electrification/article/20973333/preferential-charging-for-government-authorized-emergencyelectrical-vehicles

where companies can get additional advantages as, for example, the electric grid and power infrastructures (frequency and voltage regulation, load balancing, etc)[204].

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 plans[205].

The evacuation and extraordinary scenario amplify range anxiety and charging speed concerns. 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. This new vision of the EV market and its infrastructure could have a wide effect on technology adoption and the public's impression of EVs.

Even if in the next future there might be adequate infrastructure when everything is up and running, it is always more considered the idea that the instauration of a backup plan is needed to help the connection of the dots on the map when the network breaks and reveals its inability to serve all potential circumstances.

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

Some examples can be sport and fair events, conferences, congresses, etc. These are situations that were not considering infrastructures for electric vehicles in the past. But now, with the market growing and the increasing importance of green policies, the care about organizing events "friendly" to EVs is relevant, also simply for marketing reasons.

Messe Munchen, the exhibition centre of Munich, as part of its corporate social responsibility and following its commitment to environmental protection and sustainability, has installed in the fair site several "supercharger" stations. The guests and customers can refuel EVs free of charge and with totally sustainable energy thanks to the internal photovoltaic system[206].

Other examples can be sporting centres, entertainment arenas, and university campuses. During special events or matches, these places can adapt their parking areas for electric vehicle fleets. In the USA, the universities of Tennessee[207] and New Mexico[208] have specific parking rules and fees for promoting electric vehicles during sport events. In Tennessee, the University wants to support advanced transportation technologies, and for this reason, 19 charger stations have been installed around campus. EVs can park and recharge during special events without paying rates for four hours. The time limit was introduced to promote turnover between the bays in order to maximize their availability and the use by EV vehicle owners.

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[204] Flamini M. G., Prettico G., Julea A., Fulli G. - Statistical characterisation of the real transaction data gathered from electric vehicle charging stations. Joint Research Centre, Politecnico di Torino

[205] https://www.greencarreports.com/news/1128036_mobile-charging-solutions-can-help-fight-the-new-face-of-ev-range-anxiety

[206] https://messe-muenchen.de/en/company/responsibilities-csr/e-mobility/

[207] https://parking.utk.edu/electric-vehicles/

[208] https://pats.unm.edu/parking/electric-vehicle-charging.html

7.6.1.3 Market problems and pains

During out of normal demand values, the electric grid has to face two main troubles for adopting new mobility technologies: the extraordinary request of energy, mainly during emergency and special situations, and the managing of weekly and seasonal peaks, foreseeable but often not enough to justify the general upgrading of the grid.

During emergency occasions, where massive groups of drivers tend to concentrate along main routes for leaving urban areas, the situation to support EVs looks to be more complicated. The problem and related risks are already known and seem to be even more complex than for internal combustion vehicles, which can suffer from an insufficient amount of fuels and have high utilization rates. The number of charging stations often is already limited during normal situations. With a wildfire or a hurricane on the way, there is also the expected escalation of system overutilization with the potential risk of grid failure[209].

The risky failure of the grid is the new common concern for those new to electric cars, and a potential limit to the public's impression of EVs. It is the new face of range anxiety—oriented more around an inadequacy from infrastructure than from a car that won't hold true. Although there might be adequate infrastructure when everything is up and running, there needs to be a contingency plan when normal circumstances fall, and something not planned happen.

In a report of 2017, researchers at the Universities of Oxford, Michigan and Vermont have looked at how EVs would fare in a storm in some regions of the USA, often dealing with extraordinary meteorological events. While electric cars can present some grid service opportunities when the power is out, the results shown how governments up to now have ignored electric cars out of disaster planning and how an electrified future will add serious logistical challenges to the already complicated dance of mass evacuation[210].

The lack of electric mobility in disaster events planning is becoming more complicated, considering how the rush to charge vehicles at once could impact the grid. Beyond the huge number of chargers that could be needed, countries also need to consider the distance at which they are located. Even if EV drivers have their cars fully charged prior to an evacuation, it is unlikely they can make the full journey without recharging. The evacuation scenario amplifies range anxiety and charging speed concerns.

Usually, the most viable charging option in disaster zones is DC fast chargers, the most expensive type, which can recharge a car with a 130 km range in half an hour.

Some companies have already started to develop systems suitable for these situations. Two examples are SparkCharge[211] and FreeWire[212], companies working in the realization of different backup plan ideas for battery-based charging solutions during special and emergencies.

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[209] https://www.greentechmedia.com/articles/read/a-new-challenge-for-disaster-zones-driving-an-electric-evacuation

[210] https://www.sciencedirect.com/science/article/abs/pii/S0301421517305906

[211] https://www.sparkcharge.io/

[212] https://freewiretech.com/

7.6.1.4 Best practices and alternative solutions

The value and the size of the EV market for special events are related mainly to three voices characterizing charging station utilization[213]:

- Actual flexibility
- Potential flexibility
- Ancillary flexibility

With "actual flexibility" is meant the present ability of charging stations to be used in the time and location where they are installed, the ability to promote turnaround of users and to charge vehicles thanks to power installed and connected features.

With "potential flexibility" is meant the ability of the station to satisfy extraordinary situations when there is an over request of charging due to special occasions or emergency situations. The ability is not related only to the single station but also to the situation around the single charger, as the number and distance of other points, the capacity of the grid, additional supports provided, features installed, etc.

Finally, related also to potential flexibility, there is "ancillary flexibility". It means the capacity of the station to provide and satisfy additional services not directly connected to recharging a vehicle. In case of emergency situations, some examples can be requesting assistance and providing medical support.

The analysis of how many and where it is useful to deploy charging stations needs to consider the habits and trends of EVs utilization. There is not a charging point kind that fits all the situations.

Analysis needs to study the potential peaks and drops of the different station utilization for understanding the time trends in the single day and the entire year.

The lack of demand among energy peaks is a critical situation that needs to be handled in a smart manner to avoid the realization of not economic infrastructure upgrading. During workdays peak hours occur during the central part of the day and after 6 pm so when vehicles tend to stay parked at the workplace and at home.

The majority of charging stations installed in the Netherland is of the slow kind. This is because up to 72% of them is located in residential areas where most of the vehicles are recharged during the night-time[214].

During these time phases, the grid tends to feel stressed due to energy requests coming simultaneously from vehicles parked and from energy requested from work and home activities.

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[213] Flamini M. G., Prettico G., Julea A., Fulli G. - Statistical characterisation of the real transaction data gathered from electric vehicle charging stations. Joint Research Centre, Politecnico di Torino
[214] Flamini M. G., Prettico G., Julea A., Fulli G. - Statistical characterisation of the real transaction data gathered from electric vehicle charging stations. Joint Research Centre, Politecnico di Torino

During weekends request accounts for 24.7% of the yearly electricity demand. The peak trends are more difficult to be evaluated due to uncertainty in people activities. Generally, due to longer travel activities in the weekend, the cars consume more electricity than on the working days.

Usually, the two most stable seasons are winter and spring. There are no remarkable peaks and valleys during these two periods, except for a few cases like during national holidays. On the other hand, summer months have a remarkable decline in urban utilization profile, especially in August's central weeks. In these months, the demand value drops up to 20%. In this period, most of the peaks are concentrated along the main arterial roads for getting to holiday destinations. The most suitable charging solution in these places is the fast charge station that can guarantee high turnaround values in short periods.

Bloomberg predicted that the sales of electric vehicles (EVs) will increase from 1.1 million worldwide in 2017 to 8.5 million in 2025, and then to surge to 26 million in 2030[215]. Currently, only a 10% EV penetration of the predicted values may cause unacceptable power peaks[216]. The power grid may not be able to handle the new peaks because of its power production capabilities and inadequate distribution infrastructure. For this reason, backup plans and recovery systems must be put in place, not only for emergency situations, but also to follow through the growing EV market until the distribution grid is properly updated. As EV adoption increases and weather-related disasters surge, utilities will need to invest in additional infrastructure to ensure reliability during an emergency that peaks demand.

One option is to adopt smart charging strategies to deal with peaks and drops. One of them is to shift potential peaks to the valleys using techniques such as time-of-use rates, decentralizing EV charging, and real-time scheduling.

With decentralized EV charging often is meant the acquisition and distribution in strategic locations of mobile charging stations (MCSs) that can be used and moved when there is necessity or an emergency.

MCSs can support stationary charging solutions for EVs in a flexible and practical way during emergency situations. The system is often designed to give stranded electric vehicles a top-up that allows them to reach the nearest charging point, but it is also planned to provide emergency support in situations with high energy demand and potential grid crisis for standard recharging stations.

Mobile EV charging is often used for emergency services or as a temporary solution, and for promotional purposes. It is employed by event organizers for festivals, sporting events, EV launch events, etc.

In the UK, RAC (Royal Automobile Club) has already started using Mobile Charging Station to support EV in case of emergencies. Since 2019, six Ford Transit Custom patrol vans have been

[215] https://about.bnef.com/electric-vehicle-outlook/

[216] https://www.tdworld.com/electrification/article/20973333/preferential-charging-for-government-authorized-emergencyelectrical-vehicles

equipped with portable electric car chargers to help vehicles that run out of battery at the roadside in London, Birmingham and Manchester[217].

The real-time scheduling techniques are often the most effective. They are used, for example, for arranging into a hierarchy the vehicle kinds that can charge first, as emergency vehicles and government vehicles. It is important to schedule a "priority charging" for all those vehicles that cannot wait on the schedule for their turn because they have to tackle extraordinary situations.

The charging prioritization can be operated in an analogic or digital way depending to the technology readiness of the institution that wants to implement it. In one, the EV management implements priority charging to ensure vehicles availability to drivers based on different fleets importance in normal and critical situations. This is more of a management policy-based solution rather than a technology-based one. In the other, more sophisticated, the management of the charging space implements priority-based charging of EVs in the stations. Furthermore, the EVs with excess capacity are discharged to assist in charging the other EVs in the charging spaces, bypassing the utility company. Then the discharged vehicles are charged back based on the vehicle kind pick-up time priority. This solution can be structured in a fully automated, nationwide, communication network-based architecture to provide priority charging for the different emergency and governmental vehicle kinds[218].

The most common option to provide EV charging flexibility in a smart way is to use automated charging management systems. An intelligent management of the EV charging process allows the exploitation of the potential EV flexibility.

The utilization of charging management solutions can avoid situations such as load imbalances, excessive currents or voltage deviations, and steep power requests. Properly designed and well-coordinated EV integration approaches can benefit the whole system.

For example, the EV aggregations (in both Grid-to-Vehicle - G2V - and Vehicle-to-Grid – V2G - paradigms) are considered as a possible source of operational flexibility. Another option is Vehicle-to-Building, in which the EV batteries can also be used as electrical energy storage units for the local building without sending power to the external grid.

Finally, the integration of smart grid management can also provide valuable facts and info as the average duration of recharges and on the ranges of time in which the vehicles are fully recharged but still connected to the stations, thus potentially available to offer V2G services to the grid.

7.6.2 Budapest business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-Mobility solutions for Special Events in Budapest from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

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[217] https://uk.motor1.com/news/347131/rac-emergency-electric-car-chargers/

[218] https://www.tdworld.com/electrification/article/20973333/preferential-charging-for-government-authorized-emergencyelectrical-vehicles

Table 32 Budapest Special events summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: In Hungary, the target for the national electromobility is to have 450,000 electric vehicles on domestic roads by 2030 and 45,000 vehicle chargers across the nation. The first market-setting regulations for e-Mobility were settled in 2015. But the greatest boost for the sector was released in 2019 with the new national electromobility strategy (Jedlik Ányos Plan 2.0). Next to the national regulations, in 2017 was created e-Mobi Elektromobilitás Nonprofit Kft., the national agency in charge of improving interconnectivity in the country. The agency is providing significant contributions for developing the domestic market, for example, by updating the scheme for the purchase of electric vehicles and for the construction of charging infrastructures by both market players and state-owned entities. The Jedlik Ányos Plan 2.0 has also contributed to the clarification of important questions pending in previous years. One example is the condition and definition of charging, whether as a service, or at home. Furthermore, it was useful in redefining green license plates and preparing, adopting, and implementing an electromobility legislative package that clearly defines the operational framework for the national strategy. The Jedlik Ányos Plan 2.0 is based on nine main points that define, regulate, and implement[219]: 1. a detailed market model 2. development of charging infrastructure 3. promotion of electric vehicles 4. government and municipal charging station installation and fleet expansion 5. decarbonization of public transport 6. municipal power generation and smart network solutions 7. development of national standards for local smart networks 8. potential exploitation for cost savings in charging energy 9. socialization of electromobility The plan has supported municipalities and national institutions in clarifying the opportunities, and the modalities for getting the subsidized grants necessary to procure EVs and charging equipment. It has brought a significant breakthrough, because it has given to several partners the right vision to deploy normal and high-power chargers nationwide.

[219] https://hungarianinsider.com/jedlik-anyos-plan-2-0-launched-to-promote-electric-vehicles-1688/

Thanks to the new provisions, the construction of charging infrastructure is progressing at a good pace and connectivity has improved much. Furthermore, finally, main market players have recognized the business potential from the field of energy and have taken an active role in the expansion of e-Mobility[220].

Despite the progress and positive trends, different problems are still in place in Hungary regarding electromobility and its network. A comprehensive registry of public charging points is still missing, although several interactive maps help drivers orientate.

Since 2019 also, the number of cars with green number plates has raised. It is hovering around 10,000. By the end of March 2019, 9,925 cars had been registered, according to official statistics. A large proportion of these cars (5,710) are second-hand plug-in hybrids coming from Western Europe.

This growth has been surely appreciated, but at the same time, it has underlined some new questions and debates on e-mobility. About two-thirds of electric vehicles in Hungary are running in Budapest and its hinterland. With the present regulations, this element means thousands of vehicles with green number plates that are driven, charged and parked in the capital area for free.

Consequently, this situation can become an unsustainable trend in the long run. Some lawmakers have pointed the problem and opened a discussion on the idea to rethink incentives linked to green number plates. This element is causing some heated debates at the national level and with e-Mobility industry associations.

From 2020, the Hungarian Ministry of Innovation and Technology, together with the European Institute of Technology (EIT) InnoEnergy, has opened a sector-wide consultation regarding the possibility to develop a national strategy for the Hungarian battery industry[221]. The purpose is to ensure a successful green transition of the Hungarian energy and mobility industries, together with a thriving economic development and related market growth. According to plans, the Hungarian National Battery Strategy should be realized by the end of 2021. The core concept of the plan is electromobility as the future of national transports. The availability of the highest quality energy storage is a prerequisite for developing the next energy industry. This ensures the successful transition of the national mobility sector. Under the Effort Sharing Regulation (ESR), Hungary's 2030 target for greenhouse gas emissions is 7% points lower than the 2005 levels.

A Hungarian example about combining occasional events and electromobility is the company Chargingrentals, whose main business focuses on the provision of mobile charging solutions[222]. Its purpose is to promote the always greater relevance of electric mobility also in contexts such as events, trade shows and congresses, and to satisfy the growing demand of consumers who pay attention to the sustainability level of companies. Charginrentals also aims

[220] http://jedlikanyosklaszter.hu/en/feladataink/

[221] https://www.innoenergy.com/news-events/hungary-to-a-play-key-role-in-europes-250b-battery-market/

[222] http://www.chargingrentals.com/

to promote its mobile charging solutions as a preliminary investment for CPOs to temporarily test new locations for future fixed charging stations. The company also promotes the importance of labelling charging points with bands and advertisements as secondary revenue for CPOs.
Market size: As already anticipated, new provisions of the last years have boosted the country's construction and realization of modern charging infrastructure. The connectivity has improved much, and market players have recognized the business potential from the field of energy. They have also taken an active role in the expansion of e-Mobility. Market players not only directly operating in energy production and distribution but also companies outside the market but that, in any case, can take advantage of electromobility and its growth. For example, the food retail chain SPAR in 2019 has announced the interest in installing EV charging infrastructure across their 500 locations around Hungary[223]. In the same year, the hypermarket chain ALDI signed an agreement with the electric utility company Eon to install chargers in the parking lots of ALDI's 123 outlets (360 charging points in total). Still in 2019, Eon has also installed between 20 and 30 charging stations and has anticipated its purpose to expand more in the Hungarian market. The Hungarian multinational oil and gas company MOL installed 18 rapid chargers in 2019. These stations are part of the European Project NEXT-E program which aims to improve connectivity from the borders of the Czech Republic to the Black Sea and the Adriatic. The network at the end will offer drivers charging points at 252 places. 100 of them will be installed by MOL. A total of 141 charging points will be available at MOL filling stations, 59 in Hungary. ELMÚ-ÉMÁSZ has 65 filling stations, while NKM Mobilitás Kft., a subsidiary of state-owned utilities company Nemzeti Közművek Zrt. (NKM), in 2019 installed nearly 66 EVBox charge points at 17 high traffic locations in the country.
Client profile: All the kinds of EV drivers which need to feel empowered to charge in every kind of situation.
PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY
Problem to solve: • Comprehensive registry of public charging points • Backup plan for recharging vehicles in emergency situations • Rules for incentivising e-vehicles in cities • Mobile charging stations (public and private) for special situations

[223] https://www.electrive.com/2019/07/25/hungary-spar-invests-in-charging-infrastructure/

- Plan for grid failures
- Preferential/scheduling program for charging in case of special events
- Regulation regarding EVs charging in case of exhibitions, congresses, and special events

Business opportunity:

In order to support environmentally friendly and zero-emission transport in the Hungarian capital, in 2013, the Budapest Mobility Plan 2014 - 2030 (BMT, also known as Balázs Mór Plan) was settled. The plan reports the measures aiming to address the topics and challenges for the procurement of zero-emission vehicles and to support environmentally friendly technologies in public transport and freight transport.

The plan supports the diffusion of environmentally friendly fuels and zero-emissions transportation by introducing tax and fee discounts. These solutions are part of the national financial measures aiming to impact transport modes, with the mitigation of the access restrictions imposed for environmental protection reasons, and with the development of wide coverage of electric charging stations.

All the different kinds of vehicles and their uses are promoted by the municipal plan. For example, in order to encourage the mitigation of air pollution, hybrid, purely electric and compressed natural gas (CNG) powered taxis are granted a 20% reduction in fees payable for the use of taxi stations.

Anyhow, the plan underlines how electric vehicles may not spread without adequate infrastructure, thus one of the main objectives is the installation of integrated electric charging points all around the city.

In the plan, a focus regarding urban freight distribution is also reported. In order to mitigate the burden on the environment, sustainable transport modes (railway, waterborne transport, electric-powered, and freight bicycles) will be prioritized, on the basis of which new terminals and stores will be served.

Budapest is also the head office of the Hungarian Electromobility Association[224]. The organization aims to promote electromobility diffusion and market all around the country. Furthermore, it wants to replicate the foreign best practices and the widest opportunities inside the national borders. The association regularly organizes professional events on specific topics to increase public awareness of mobility and support networking among industry players, experts, and policymakers.

The main event organized by the association is the E-Mobility Forum (EMF)[225]. It is the most important regional professional event covering global, regional, and domestic trends of the

[224] http://www.elektromobilitas.hu/index.php/hu/
[225] https://www.avere.org/event/emobility-forum-2019/

electromobility and smart city sectors. It includes legislation topics, innovation and ongoing or upcoming trends, and cooperation at the regional and European level.

Finally, the Hungarian Electromobility Association is a partner of the EU project ProEME (Promoting Electric Mobility Europe)[226]. The main objective of the project is to support the development of electric mobility in urban Europe by building capacities, networks, and tools to reach decision-makers and contribute to positive investment decisions for EVs, for example, LEVs, e-busses, e-trucks and plugin cars.

VALUE PROPOSITION AND SOLUTION

Value proposition:

- Users can easily find and understand which are free and available EVs and charging points to use in every kind of situations.
- CPOs can increase profitability and the value of their charging points.
- CPOs also have the possibility to better manage, understand, and foresee peaks of demand. This allows them to increase the resilience and reliability of the grid and, consequently, of the charging points.

Solution:
The most suitable solutions between the ones under development in Budapest are:

- *CLICK for supporting local urban mobility planners in defining the most suitable places to install new chargers that can suit for special situations.*
- *INCAR to allow a unique interoperability management system for roaming, charging, and parking to both users with an EMSP contract and users without an EMSP contract (considering that the EMSP is participating to the INCAR platform) in every particular situation, also special and emergency ones.*
- *SMAC for dynamically optimise the power supplied to the charging points and so offering both the maximum power and a high-quality level.*

USER NEEDS AND RELATED SOLUTION BENEFITS

User need #1: keep a reliable and sustainable e-Mobility network (e-vehicles, power grid, charging points, etc.)	Related solution benefit/s: Systems able to keep a whole view of the electric power consumption in the city in a total and general way (also due to present and future e-vehicles consumption)

COMPETITIVE ADVANTAGE

Stable and available systems to realize a well-planned back-up system that easily allows to get everywhere in every special situation. This will help companies and users to feel more empowered in the use of electromobility.

[226] https://www.pro-eme.eu/

7.6.2.1 Key stakeholders

The following table lists the key stakeholders in the Special events Budapest use case. These organisations play a key role in applying the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities not related to the solution's application are excluded from the analysis.

Table 33 Key stakeholders in the Special events ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local authorities/ Mobility agencies	*For rules and urban planning*
Charging Point operators	*Realization and management of charging points*
Technology solution providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Grid infrastructure managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging points*
National/European Authorities	*For standards and policies*
Transport Service Providers (TSPs)	*For installation of charging points in strategic transport locations*
Location owners	*For location provision*
Electromobility service operators	*For the provision of vehicles (e-bus, e-cars, e-scooters, etc.) in extraordinary situations*

7.6.3 Turku business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-Mobility solutions for Special events in Turku from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 34 Turku Special events summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: Finland has started its commitment to developing electromobility since 2009 when the first studies for the importance of electric cars and electric mobility in the local society have been carried out. The main result of these studies was the identification of business possibilities for Finnish industry in the field of mobile machinery electrification, vehicle software, charging technology, automotive industry components and electric mobility infrastructures. Thanks to these results, in 2011, a specific program was launched: the five years program called EVE – Electric Vehicle Systems. The coordinator of the project was Tekes, the Finnish Funding Agency for Innovation, and the total budget was 100 million euros. The main target

of the programme was to create an electric mobility ecosystem that could generate new knowledge and competence in EV related technologies and services.

The program's main focuses were on electric passenger traffic and services, electric commercial vehicles, testing services for Evs, testing environments for Evs, and ecological urban living. The automotive industry was not seen as a special focus since Finland has only one company assembling passenger vehicles (Valmet Automotive, highly involved in the conversion of the sector to electromobility[227]).

With the support of the program, different start-ups have been created and existing companies have increased their business volume in international markets remarkably. Two good examples are Virta[228] and Linkker[229].

Unlike other Nordic countries, the Finnish approach to electric mobility has always been more conservative with limited support from the Ministry of Employment and the Economy. Moreover, the support has been often linked to participation in the EVE programme. The greater focus by the national government has been on biofuels solutions and, aside from the CO2 emission dependent taxation, there have been no special incentives for Evs.

However, despite the small Finnish fleet of about 1,500 Evs at the end of the EVE program, the growth during the five years has been notable: in 2011 there were about 40 Evs in the country. At the same time, the IT-based service providers have also been successful internationally.

The Tekes EVE – Electric Vehicle Systems programme was composed of five consortia, three of which – Eco Urban Living, EVELINA and Electric Traffic – focused mainly on passenger cars and services, whereas WintEVE was active in testing services for the automotive industry and Electric Commercial Vehicles in the electrification of public transportation and heavy-duty vehicles.

One of the main challenges of the Electric traffic group was to make things easy for EV drivers. For this reason, a free application and a website for locating the chargers have been created to guide the national pioneers of EV driving.

Furthermore, inside the Electric traffic consortium different Finnish charging system companies and infrastructure companies have been introduced to key international EV markets. Two examples are Virta Ltd and Fortum.

The EVELINA consortium was set up to demonstrate the viability of electric vehicles and to develop new services for electric vehicles. The main objective of the EVELINA consortium was to establish a national test environment for electric vehicles in consideration also of the difficult weather and environment of Finland in which Evs have to operate. The grid impact on charging and the grid malfunction impact on charging were tested within a unique electric test and with a learning environment developed in cooperation with research and enterprise partners and

[227] https://www.valmet-automotive.com/
[228] https://www.virta.global/ev-drivers
[229] http://www.linkkerbus.com/

with the Tampere Adult Education Centre. The consortium also researched in energy distribution systems. As a result, new information on smart charging, the charging business models, and smart grid concepts were generated.

Finally, the WintEVE consortium and its successor, the EVGA project, coordinated by Centria University of Applied Sciences, were composed principally by participants from the northernmost parts of Finland. This is the reason why this consortium had a strong emphasis on the development of vehicle testing in arctic conditions. Within the WintEVE consortium, University of Oulu has been developing the vehicles' information safety and a modular battery solution.

The development achievements within the WintEVE and EVGA entities have found a decisive role in the launching of electrification in Northern Finland. New charging stations have been installed in the Oulu region as well as in several positions above the arctic circle. Participation in the EVE programme has helped the operator network coordinated by Centria to open the doors for collaboration with European research institutes and enterprises.

Thanks to the results obtained with the Tekes EVE – Electric Vehicle Systems programme, also after 2016, the electromobility numbers have continued to grow in Finland.

The year 2018 showed continuing growth in EV sales, with plug-in hybrids leading the market with a clear margin. In total, 5,708 new electric vehicles were sold in 2018, including 776 battery electric vehicles (16 % of the sales). Year over year, the growth was 129%, which is following the positive trend from 2016 and 2017.

In 2018 the total fleet of Evs in Finland was 15,499, including both plugin hybrids and battery electric vehicles. In the same year, the number of imported Evs was one-third of all new registrations. The market share of new passenger Evs sold during 2018 was 4.7 % of all new registrations.

Most of the Evs are concentrated in the Helsinki region and around larger cities. 44% of plug-in hybrids and 42% of battery electric vehicles operate in the capital region.

In 2019, the national subsidy rate for the realization of new fast-charging points was 35%, and for normal chargers, 30%[230]. The prerequisite for getting national subsidies was that the chargers could support smart charging and could provide an open data interface for monitoring the charger's availability and condition.

Government subsidies have also considered incentives for housing companies for building EV charging infrastructure. In 2018 the budget was around 1.5 million euros for the first year. The subsidy covered 35% of the costs incurred from building electrical system surveys, wiring installations, and charging equipment. The minimum requirement was to build readiness for five charging points.

Still in 2018, the Prime Minister's office procured research, coordinated by VTT Technology Research Centre of Finland, to identify cost-effective means for advancing the electric vehicle

[230] http://www.ieahev.org/assets/1/7/Report2019_Finland.pdf

market. According to the modelling performed by VTT, the national incentives should be able to lead the government's energy and climate strategy to the goal of 250,000 Evs by 2030. By taking into use multiple new incentives, it would be possible to double the number of Evs by 2030.

Tampere University of Technology, in collaboration with ETH Zürich, modelled the potential for BEVs in Finland and in Switzerland according to the current passenger vehicle usage needs and trends. The study found out that 85% of the current car trips could already be performed using BEV's, utilizing the current vehicle models and charging infrastructure.

Finally, in 2020 the Finnish government has announced that it will support the installation of over 5,000 EV charging points at apartment blocks and detached home complexes. The purpose of this action was to achieve the goal of carbon neutrality by 2035[231].

In total, the government has allocated 5.5 million euros for installing electric vehicle charging points. In 2018 and 2019, the introduction of 3,000 charging points had already been financed by the government agency in charge of developing the EV charging infrastructure network. In 2020, the funding for EV infrastructure increased by 4 million euros from the € 1.5 million allocated in 2019[232].

Housing companies and parking firms are now able to apply for this funding to add charging points in their facilities. As in the previous years, the subsidy covers around 35% of the cost for installing EV chargers. However, the subsidy could be higher if at least half of the units to install are at least 11-kilowatt chargers. In such cases, the Housing Finance and Development Centre of Finland can cover up to 50% of the installation costs.

Market size:
In the national market, the leader company for the battery electric vehicles distribution is Tesla. Nissan is the second. In 2018 the two brands were holding two-thirds of the new electric vehicle market[233]. In the same year Volvo was the market leader for plug-in hybrid vehicles.

Figure 12 shows the distribution of the electric vehicles sold according to brand. Figure 13 represents the sales distribution for plug-in vehicles.

[231] https://www.eltis.org/in-brief/news/finland-increases-funding-ev-charging-points

[232] https://yle.fi/uutiset/osasto/news/finland_aims_to_add_5000_domestic_ev_charging_points_/11148160

[233] http://www.ieahev.org/assets/1/7/Report2019_Finland.pdf

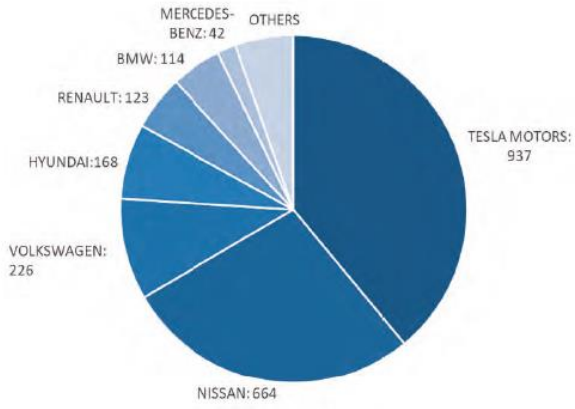

Figure 1: Number of newly registered passenger BEVs for specific OEMs (Source: Technology Industries of Finland)

Figure 12: Number of newly registered passenger BEVs for specific OEMs (source: technology industries of Finland)

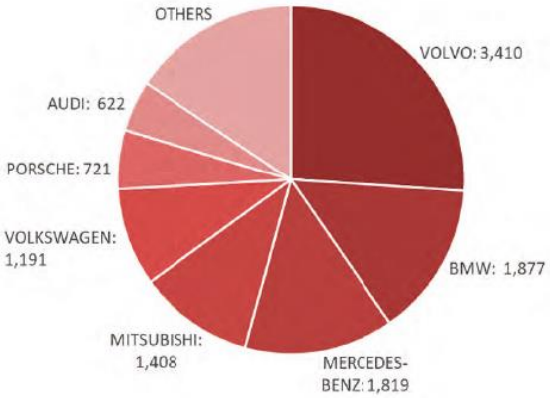

Figure 2: Number of newly registered passenger PHEVs for specific OEMs (Source: Technology Industries of Finland)

Figure 13: Number of newly registered passenger PHEVs for specific OEMs (source: Technology industries of Finland)

As of June 2020, in Finland, there were 1,109 electric charging stations. One-third of them were located in the Uusimaa region, where is located the Capital Helsinki. The region of Turku, Varsinais-Suomi, is the second of the ranking with 94 charging stations. The third is the region of Pirkanmaa (Tampere) with 92 charging stations (Figure 14)[234].

[234] https://www.statista.com/statistics/1178531/electric-car-charging-stations-finland-by-region/#:~:text=As%20of%20June%202020%2C%20there,with%2092%20e%2Dcharging%20stations.

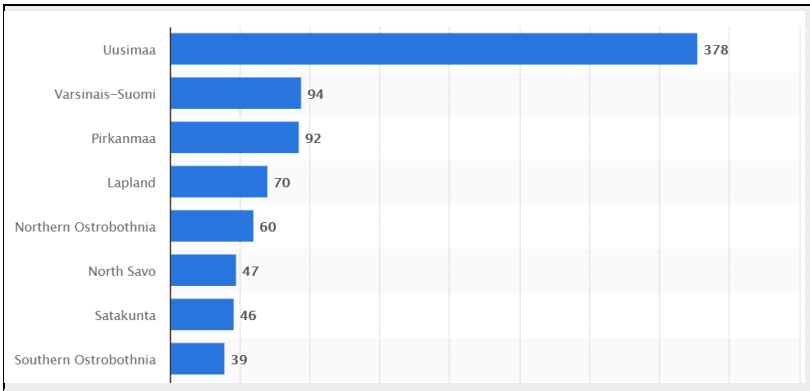

Figure 14: Number of electric car charging stations in Finland as of June 2020, by region (Source: statista.com)

Client profile: Visitors of the different events planned and carried out in the harbour area (*initially planned demo location but now a demo site the city is no more interested into*).

PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY

Problem to solve:

- Comprehensive registry of public charging points
- Lack of charging stations for e-drivers
- Backup program for e-Mobility services during special events
- E-Mobility services during extreme temperatures
- Improvement of e-Mobility services in less populated areas
- Plans for grid failure

Business opportunity:

The main instrument currently employed by the City of Turku for achieving its carbon neutrality by 2029 is the CIVITAS ECCENTRIC PROJECT[235]. Thanks to this project, the Municipality aims to develop electric transport, shared use of cars and bicycles, and the Mobility as a Service (MaaS) model. Electricity will become the primary source of energy in public transportation.

In the long run, the goal is to have a wide variety of electric transport services linked to one open public transport platform operating as a MaaS ecosystem.

Thanks to the ECCENTRIC project, now in Turku, six e-busses (produced by the Finnish start-up Linkker) are operating along line nr. 1. These vehicles have been acquired in 2015, together with quick charge stations for each end of the line and an overnight charging station for the depot.

The operating of these vehicles is carried out in cooperation with an EV research project conducted by the Turku University of Applied Sciences. The research aims to identify and

[235] https://civitas.eu/sites/default/files/civitas_eccentric_booklet_turku_web.pdf

propose future solutions for technical and operative bottlenecks of expanding electric bus operations.

The research covers a wide variety of topics:

- Specifications and procurement of electric buses and the charging infrastructure;
- Innovative business and contract models for (service) procurement;
- Adapting bus line planning and optimising models for EV operation;
- Finding solutions for accurate measurement of energy consumption;
- Using data from onboard and charging systems to plan future choices of buses;
- Effect of driver training to cost of operation;
- Reliability and total cost of ownership (TCO) of EVs versus diesel vehicles.

Another activity implemented in Turku thanks to the ECCENTRIC PROJECT was the electrification of the municipal fleet for promoting e-mobility. This action was carried out between 2017 and 2018 and consisted of the procurement of different e-vehicles used by city employees. The vehicles acquired by the municipality were eight LEVs, including e-bikes and e-scooters. Parallelly to the vehicles' introduction, an awareness campaign was settled for raising e-mobility awareness in different city municipal departments. LEVs acquired were adopted to replace the use of a passenger car, especially for trips shorter than 10 kilometres.

According to the results of the Mobility Survey which employees of the City of Turku took part in 2013, 15% of all commuting is under five kilometres, and 42% of work-related trips (during working hours) are under five kilometres and are done by a passenger car (as a driver or passenger). The 31% of these work trips (during working hours) is done by employees using their own cars. Final assumption resulted by the survey was that many, if not all, of these trips could be done with some other mobility device/form than a car.

In Finland, the main principle for public charging points, and electromobility in general, is to encourage private companies to offer EV services and the needed charging services. Finnish cities or other public authorities have not started to directly invest in public charging points on a large scale yet.

This is why most e-stations in Turku are provided by private actors such as gas stations, hypermarkets, shopping centres, and restaurants. Often the charging pole is installed in their parking areas, and the charging is free of charge.

The charging stations in street parking zones are seven, and the parking is free of charge during the charging of the EVs for a maximum of 4 hours. These charging stations are operated by the national company Liikennevirta Oy under the brand name Virta.

Finland uses public ferries for transport at particular sites. E-ferries have been used for transport of passengers and vehicles. There has been discussion of taking to use E-ferries in

Helsinki, but so far only the Elektra hybrid ferry in greater Turku region (Parainen-Nauvo) is in use since 2017.[236]

The first high-power charging station (HPC) in Finland was opened in 2018 along the Helsinki-Turku motorway. The infrastructure was realized at the Lohja ABC service station in collaboration with Suur-Seudun Osuuskauppa[237]. The charging station opened along the highway is part of the high-power charging network that Fortum has planned to build between Helsinki, Turku, Stockholm and Oslo.

The Tekes EVE – Electric Vehicle Systems programme reported that the Finnish economy has a long history in mining equipment, straddle carriers, and forklift manufacturing. And most of these firms are directly involved in growing and developing the national industry and mobility decarbonization. Some examples are Kalmar, Sandvik and Rocla.

Aiming to this purpose, in 2018, Sandvik opened its battery electric vehicle research centre in Turku. The innovation and development centre aims to create innovative battery products and electric solutions for the global mining and construction vehicle markets and to develop technology talent in Finland[238].

VALUE PROPOSITION AND SOLUTION

Value proposition:

- Provision of easy-to-use tools and solutions for electromobility local improvement.
- Development of systems useful to improve and stabilize the reliability of the grid infrastructure.

Solution:

The most suitable solutions for Special events in Turku are:

- *CLICK planning toolkit in the framework of the city-wide master plan for EV expansion project foreseeing both quick chargers and standard chargers (with and without photovoltaic production) that can be located in places suitable for every kind of situations (also extraordinary ones)*
- *SMAC for testing the intelligent and dynamic management of demand, and for analysing – from both a technical and economic point of view – the efficiency of managing the energy supplied to CPOs as well as for improving the service to the end-user.*
- *INCAR for providing users with a high-quality tool allowing for interoperability among EMSPs also in situations out of normal daily routine.*

[236] https://spbes.com/portfolio/electric-ferry-elektra/

[237] https://www.fortum.com/media/2018/11/finlands-first-high-power-charging-station-opens-along-helsinki-turku-motorway

[238] https://im-mining.com/2018/06/14/sandvik-opens-battery-electric-vehicle-research-centre-turku/

USER NEEDS AND RELATED SOLUTION BENEFITS	
User need #1: Realization of the urban masterplan for electromobility and identifying specific pain points of the grid	Related solution benefit/s: CLICK toolkit for confirming the chargers' location
User need #2: Balancing the demand and the supply of power for electromobility	Related solution benefit/s: SMAC toolkit for smart and dynamic energy management
User need #3: (More for public administrations) Understanding how much to invest in electromobility solutions keeping the technology neutrality and being conscious about new solutions that might come up in the future	Related solution benefit/s: Combination of the three solutions under development (SMAC, CLICK, and INCAR) able to provide mobility alternatives, manage users' demand, providers' services, and technology innovations in a fair and neutral way.
COMPETITIVE ADVANTAGE	
With the direct involvement of local companies and institutions, citizens and users can see how the city is advancing the local electromobility and how much they can rely on it. - The future plans (both for climate and mobility) under implementation - The progress that the community is getting - Reliability in public institutions - Possibility for different stakeholders to be part of these progresses (the system will be available and open to all the players) - Progressing and ensuring of the system working and its resilience	

7.6.3.1 Key stakeholders

The following table lists the key stakeholders in the Special events Turku use case. These organisations play a key role in applying the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities not related to the solution's application are excluded from the analysis.

Table 35 Key stakeholders in the Special events ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*
Charging Point Operators	*Realization and management of charging points*
Technology solution providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
National authorities	
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with local power grid. Approval of new charging points*

Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Transport Service Providers (TSPs)	*For installation of charging points in strategic transport points*
National/European Authorities	*For standards and policies*
Shared service providers	*For provision of vehicles in extraordinary situations*
Location owners	*For location provision*

7.6.4 Rome business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-Mobility solutions for Special Events in Rome from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 36 Rome Special events summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: The PNIRE (Piano Nazionale delle Infrastrutture di Ricarica Elettrica - National Infrastructure Plan for the Recharging of Vehicles powered by Electricity)[239], prepared by the Italian Ministry of Infrastructure and Transport, defines the guidelines for ensuring a unique development of the national charging system. The plan considers the institution of a national service of electric vehicle charging, the introduction of precise procedures for managing charging service, the provision of benefits for upgrading systems, the realization of integrated plans for technological updating of existing buildings, and the promotion of technological research for realizing charging infrastructure grids. The PNIRE underlines how important is the presence of an electric mobility plan inside the wider mobility and logistics plans. These plans must contain: - A plan for settling charging infrastructure - Plans for parking spaces and related services (car-sharing, city logistics, etc) - Technical features of charging infrastructure - Localization principles for public and private infrastructures The PNIRE defines that, regarding the charging infrastructure:

239 https://www.gazzettaufficiale.it/do/atto/serie_generale/caricaPdf?cdimg=14A0926700200010110001&dgu=2014-12-02&art.dataPubblicazioneGazzetta=2014-12-02&art.codiceRedazionale=14A09267&art.num=1&art.tiposerie=SG

a) For charging in public areas, with normal power (slow charging) and medium power (fast charging), the charging modes are:
    - "Mode 3" - slow or fast charging using a specific EV socket-outlet with control and protection function installed - and
    - "Type 2" - single and three-phase vehicle coupler - reflecting the VDE-AR-E 2623-2-2 plug specifications -

b) For charging in public areas with high power (ultrafast charging):
    - With a medium time horizon (2-3 years) - the Combo Connector (or Combo 2) that combines in one unit the fast charging in CC and the charging standard of level 2

In the second half of 2020, the Italian Government updated the PNIRE with new indications and time horizons. The new target is to install in Italy around 60,000 charging stations. For getting these values, by the first half of 2021, all the Italian municipalities have to regulate the installation, realization, and management of the infrastructures, and where possible, consider the implementation of one charging sport every 1,000 inhabitants[240].
With the purpose to accelerate the infrastructure implementation, the new regulation includes easier authorizations and support for companies, as the possibility to reduce or erase the fees for the occupation of public spaces. The only condition is the provision and certification of electricity coming from renewable sources. In any case, the fee will be counted only on the area covered by the charging station, not including the parking surface.

The plan also considers the reduction of charging fees for customers. The new tariffs have to be settled both for public and private charging spots and have to be computed in order to ensure a price for electric power is not greater than the price considered for domestic inhabitant customers. This prescription aims to promote e-Mobility for citizens that cannot recharge off-street.

In the last version of the plan, it is also considered a measure for people who abuse of charging spaces. In the case the vehicle is occupying the area also after the necessary charging time, there is now the possibility to apply a fee aiming to disincentivize the utilization of the station over a maximum period of one hour after the necessary refilling time. The time limit is not considered between 11 pm - 7 am, with the exception of charging points with power over 22 kW[241].

Finally, in the last update of PNIRE there is also the indication for highway concessionaires to install a charging point every 50 km[242].

[240] https://www.gazzettaufficiale.it/eli/id/2020/09/14/20A04921/sg
[241] https://insideevs.it/news/443390/auto-elettriche-decreto-semplificazioni-colonnine-tariffe-ricarica/
[242] https://www.repubblica.it/motori/sezioni/attualita/2020/12/21/news/colonnine_di_ricarica_ogni_50_km_in

Analysing the last released version of PNIRE, Motus-E, the Italian Association representing main national stakeholders of electric mobility, has underlined different gaps and mistakes still present in the plan updating.

First, Motus-E underlined how the document still works, relying on infrastructure "asset ownership", a modality that in last years has been often a failure. The system is based on the concept that money is handled by regions that transfer them to municipalities as promoters and owners of charging stations. Municipalities up to now have been not able to manage them. 30 million euros have been allocated to local administrations and have not been used yet. Furthermore, money used was organized in a manner not able to remove the two main nodes characterizing the Italian network: a few number of fast and ultrafast charging stations and lack of infrastructure in smaller municipalities. Motus-E requires that final beneficiaries of public funds are no more Municipalities but private charging point operators[243].

Regarding special events as an opportunity to promote electromobility, since 2019, Italy has held two stages of the FIM ENEL MotoE World Championship: San Marino and Emilia Romagna. The Italian multi-utility public company ENEL is, thanks to a partnership with DORNA that holds rights on the championship, at the same time Title Sponsor and Sustainable Power Partner of MotoE. The purpose of the partnership and the event is to communicate to a wide audience of how electromobility works and how much this technology can be already available for all[244].

Furthermore, an Italian company produces the innovative motorcycles used in MotoE Championship. Energica Motor Company produces Ego, the world's first street-legal electric Italian sport motorcycle. A performance-oriented model Ego Corsa is used in the single-make class championship[245].

Market size:
In 2020 0.25% of the market share was represented by e-vehicles (BEV+PHEV= 99,257, total vehicles in Italy = 39.6 million). Regarding registration, the percentage was around 4.33%. Despite the very small numbers, the trend is rapidly growing (+120% CAGR 2018-2020), thanks mainly to national and regional incentives. The charging points in Italy are around 19,324 in 9,709 public charging stations. The value grew in 2020 with a trend of 39%. At the end of 2019, charging stations were 7,203 (+2,506 in 2020) and charging points were 13,721 (+5.602 in 2020). 80% of the public stations are installed in public areas, while 20% in private areas with public access (e.g. supermarkets and malls). The AC charging points are 96%, while the DC charging points are 4%. Slightly growing are the DC high power points, from 3 to 4%.

_autostrada-279263587/#:~:text=Un%20emendamento%20a%20favore%20della,al%20momento%2C%20non%20prevede%20sconti.

[243] Indicazioni al piano nazionale delle infrastrutture di ricarica dei veicoli elettrici – Motus-e

[244] https://www.enel.com/it/azienda/storie/articles/2018/02/mobilita-elettrica-fim-enel-motoe-dorna

[245] https://www.energicamotor.com/motoe/

The 57% of the infrastructures are installed in the North of Italy, around the 23% in the Centre while only the 20% in the South and Islands.

Lombardy is the region with the most of charging points, it represents 17% of all the installations. In February 2020, there were registered 2,467 points, at the end of 2020 they were 3,326. After Lombardy there are Piemonte (10.6%), then Emilia-Romagna, Lazio, Veneto and Toscana with the 9% each.

In 2020 the charging stations registered in Rome were 503, for a total of 941 charging points[246].

Client profile: The target profiles are all the kinds of EV drivers (private drivers, professional EV drivers, emergency vehicles, etc.).

PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY

Problems to solve:

- Lack of charging stations for e-drivers
- Lack of backup plan for recharging vehicles in emergency situations.
- Missing of mobile charging stations (public and private) for special situations
- Wide range of regulation levels
- Missing of a preferential charging program for emergency and government vehicles
- Missing of regulation regarding EVs charging in case of fairs, congresses, and special events
- Programs for incentivising private business in electric mobility

Business opportunity:

Currently, in Rome 15% of e-drivers does not have their own charging point. In the Italian Capital, thanks to analyses by Rome Mobility Agency, the electric vehicles running are around 6,000. At least 300 cars every day have problems finding a place to charge.

In 2018 the Rome Plan for the public charge was drawn for the three years period 2018 – 2020, with the final aim to provide at least one charging pole every 1000 inhabitants[247].

The plan was drawn following the forecast that by the end of 2020 the total municipal demand would have been of 700 charging stations, integrated with the fast stations along the GRA (Grande Raccordo Anulare - Great Ring Road) and along the internal railway ring.

Due to concerns from the Ministry of Cultural Heritage for the impacts in the historical city centre of Rome, at the end of the 2020, the charging points installed were only 340, divided

[246] https://www.legambiente.it/wp-content/uploads/2020/06/rapporto-cittaMEZ_2020.pdf

[247] https://roma.repubblica.it/cronaca/2020/10/12/news/trasporti_a_roma_6mila_auto_elettriche_ma_solo_339_colonnine_ricarica_obiettivo_arrivare_a_622_previste_anche_aree_sosta_-270328171/

between 22 kW AC and 50 kW DC, with some of them still pending to be activated. Before the plan, the columns were 140.

In December 2020, in response to the Electric Mobility Plan, the Municipality of Rome approved the new program of ACEA for installing 100 more additional charging points. In total, by the end of 2024, ACEA has planned to install more than 2,000 points in Rome, for a total investment of around 29 million euros[248].

Currently, electric vehicles in Rome do not pay parking fees and can have access to restricted traffic zones.

The plan settled in 2018 has anticipated some objectives reported in the last National Program, with indications to reach, as soon as possible, a network where users can access charging infrastructures with smart systems and in a seamless way all around the country. This functionality wants to anticipate a wider MaaS ecosystem and can be provided by the same smart access systems used for public transport. The purpose is to have a single key for all mobility modes.

The plan identified 320 areas where each supplier can propose a project for a new electric charging point (22 kW and 50kW). The plan was also studied to support private investments in the sector with specific rules, including technical and administrative regulations that define:

- How to submit applications.
- Technical specifications for charging points.
- Road signs for parking lots.
- Technical requirements.
- Obligations and penalties.

Furthermore, the plan includes a specific action to support private investments in:

- Urban freight distribution (every proposed plan must include at least a loading/unloading parking space)
- Taxies (Planned at least 18 new taxi charging stations)
- Petrol stations
- Parking lots and garages
- Private buildings

[248] https://www.gruppo.acea.it/media/comunicati-stampa-e-news/comunicati-stampa/2020/12/e-mobility-acea-parte-da-roma-con-piano-installazione-prime-100-colonnine-ricarica

The plan contains a specific section related to a future development scheme for wireless electric car charging and stations for battery swapping.

Charging stations, where feasible from a technological and economic point of view, have to include smart measuring systems for analysing grid stability. They have to be able to detect and analyse data to understand, for example, when it is the best time to recharge vehicles. This in order to maintain the grid integrity.

Following national regulation, from 2017 construction and renovation plans of non-residential buildings with a surface greater than 500 m2 have to supply the provision of charging points for each internal parking space. Construction and renovation plans of residential buildings with more than ten housing units have to consider the provision of charging points for at least 20% of internal parking spaces.

Since 2018, Rome has held the Italian stage of the ABB-FIA Formula E World Championship. The purpose of the event is to promote the positive features of electric vehicles, giving them the opportunity to run on streets where every day mainly petrol and diesel vehicles move.

For the occasion, ENEL X has developed the JuicePump80 FE that enables the racing vehicles to complete the race – 45 minutes plus one lap – on a single charge, so they do not need to stop for a car swap, thing that they were obliged to do before.

Since 2020, E-GAP has been operating in Rome, an Italian company that provides on-demand fast charging service and mobility with dedicated vehicles. The vans used are 100% electric. The energy provided comes from renewable sources, and the service is supplied with a recharge power equal to a fast type column (50 kW). E-GAP also provides other services:

- Car reactivation that has been stuck for too long which presents difficulties in electric ignition.
- Vehicle sanitation of interior with ozone treatment.

VALUE PROPOSITION AND SOLUTION

Value proposition:
As ancillary service provided by e-Mobility operators:

- Where power grid or charging points are not available, the possibility is to provide charging solutions for all types of users, especially for emergency vehicles and units.

Solution:
The most suitable solutions between the ones under development in Rome are:

- *CLICK planning toolkit for supporting the development of the City's Traffic Masterplan in a holistic mode (also considering problems due to presence of Cultural Heritages)*
- *INCAR platform for short range services as useful tool for different user categories to allow a unique interoperability management system for roaming, charging, and parking.*

- *SMAC for providing to CPOs and EMSPs with a tool including smart grid integration services, RES electricity supply, reduction of grid impact and demand management features.*	
USER NEEDS AND RELATED SOLUTION BENEFITS	
User need #1: Increase empowerment feeling of EV drivers	Related solution benefit/s: Implementing the Municipal electric charging plan in order to support and simplify the use of electric vehicles
User need #2: Slowing down of electromobility infrastructure development due to Cultural Heritages.	Related solution benefit/s: Using holistic planning toolkits (as CLICK) that will support in the local managing problems that can slow down the development of electromobility (as the strong bindings provided in Rome by the Ministry of Cultural Heritage)
User need #3: Realization of a fertile ground to incentivize and spread the local electromobility	Related solution benefit/s: Using interoperability tools (as INCAR) able to provide additional services for the roaming, charging, and parking.
User need #4: Treat in a fair way all the service providers with the same rules and with a neutral attitude	Related solution benefit/s: Using tools able to provide integrations services and demand management features (as SMAC), and able to provide a unique interoperability management interface for roaming, charging, and parking in a fair way (as INCAR)
User need #5: Provision of different alternatives of charging solutions (from the infrastructure to the digital – apps – point of view)	Related solution benefit/s: Solution coming from the use of interoperability tools as INCAR that will allow in a unique interface to manage, find, and use services coming from different CPOs and EMSPs.
COMPETITIVE ADVANTAGE	
- Illimited access to limited traffic zones for free o To improve the advantages for drivers who do not pollute and whose behaviour is respectful with environmental problems - Improve the electromobility shared services for reducing the vehicles road space occupancy - Provision of different types of charging modality - E-drivers can rely on and see an environment open to innovation in electromobility	

7.6.4.1 Key stakeholders

The following table lists the key stakeholders in the special events Rome use case. These organisations play a key role in applying the new solution to achieve the benefits described above. For each stakeholder, the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities unrelated to the solution's application are excluded from the analysis.

Table 37 Key stakeholders in the Special events ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*
Charging Point operators	*Realization and management of charging points*
Technology Solution Providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with local power grid. Approval of new charging points*
National/European Authorities	*For standards and policies*
Transport Service Providers (TSPs)	*For installation of charging points in strategic transport locations*
Location owners	*For location provision*
Mobility agencies	*To inform, steer, and manage the local mobility based on expected and unexpected events.* *For planning the location and realization of charging points infrastructure*

7.7 Annex 7: Mobile charging stations business model analysis

7.7.1 Business case overview

7.7.1.1 Market characteristics

Electric vehicles (EVs) adoption and charging infrastructure implementation are not growing in a parallel way. With an insufficient infrastructure adoption, there is the risk of hindering the development of the EV market. The electric vehicles penetration is expanding at a rapid pace. In 2018 more than two million EVs were sold, and forecasts reveal that 10 million EVs will be sold by 2025. With this trend, it is expected that in 2040 57% of all passenger vehicle sales and over 30% of the global passenger vehicle fleet will be electric[249].

In parallel to the greater EV market shares, the related necessary recharging infrastructure is growing to keep up. But 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; this because of their technology that has yet to mature, their significant construction costs, together with a lack of standardization. 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. The first Truck Mobile Charging System (TMCSs) was introduced in 2010. Nation-E AG, a Swiss company for energy storage, realized the TMCSs with the purpose to help EVs to continue their path towards a nearby charging station. This established a new type of charging equipment able to provide EV charging services at different places or times required.

In Figure 15 different classifications of charging methods are reported:

[249] A literary Review on Mobile Charging Station Technology for Electric Vehicles. Afshar S., Macedo P., Farog M., Disfani V., ConnectSmart Research Laboratory, University of Tennessee at Chattanooga, April 2020.

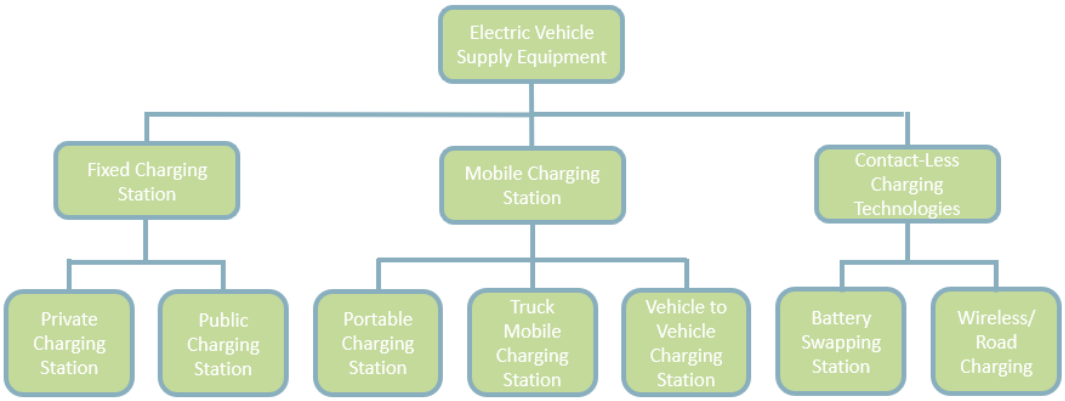

Figure 15: Different classifications of charging methods (Source:" A Literature Review on Mobile Charging Station Technology for Electric Vehicles", ConnectSmart Research Laboratory, University of Tennessee at Chattanooga)

In particular, MCSs have been developed to meet:

- The need of solving the issue of overloaded Fixed Charging Stations (FCSs);
- The request coming from EVs.

Mobile charging stations can be set up at defined points, for example, spread out across a city. The flexible locations can be easily found by developers and users via internet or apps.

The service can be integrated with trucks or inside vans. This means that the station can move freely in every location where charging is needed (e.g. Nation-E, E-GAP). Otherwise, the charging system is simply an external battery solution that needs to be moved where necessary through an external lifting and moving system.

If necessary, depending on the kind of service or reason they are requested, MCSs can easily be built up anywhere and connected to the grid. There is also the flexibility to set them up off-grid. In that case, the charging station must be removed for charging if the built-in battery pack (BESS - Battery Energy Storage Systems) is low (Figure 16). How the charging station is used, and consequently the duration of the battery package, depends on both the provider and the user's demand.

Figure 16: Truck mobile charging station: (a) TMCS with BESS, (b) TMCS without BESS (Source: "A Literature Review on Mobile Charging Station Technology for Electric Vehicles", ConnectSmart Research Laboratory, University of Tennessee at Chattanooga)

Installing traditional fixed fast-charging stations is usually a cost- and labour-intensive process that requires a lot of electrical upgrades to support the connection between charging stations and the main electrical grid. Mobile charging stations remove that complication, often using low-voltage power and allowing operators to use existing power outlets simply. These solutions enable drivers to take advantage of all the benefits of fast charging without operators needing to go through the hassle of establishing a high-voltage connection to the grid.

MCSs can provide immediate benefits also to businesses that are considering a permanent EV charger installation or waiting for infrastructure to be built.

Depending upon on-site capabilities, chargers can be powered not only through existing power at the location, but also by solar panels, or self-contained generating systems. In the event fossil-fuelled generators are required, some companies (es. EV Safe Charge[250]) offsets the carbon footprint by planting trees, a commitment vital to the vision of a greener future.

Mobile EV charging solution offers a highly adaptable Electric Vehicle Supply Equipment (EVSE) and charging as a service (CaaS) option that is available for long-term renting or for immediate use.

Mobile EV charging is often used not only for emergency services or as a temporary solution but also for promotional purposes. It is employed by event organizers for festivals, sporting events, EV launch events, etc.

[250] https://evsafecharge.com/mobile-ev-charging-stations/

In the following picture (Figure 17), MCS benefits for users, Fixed Charging Stations (FCS) and the power grid are reported.

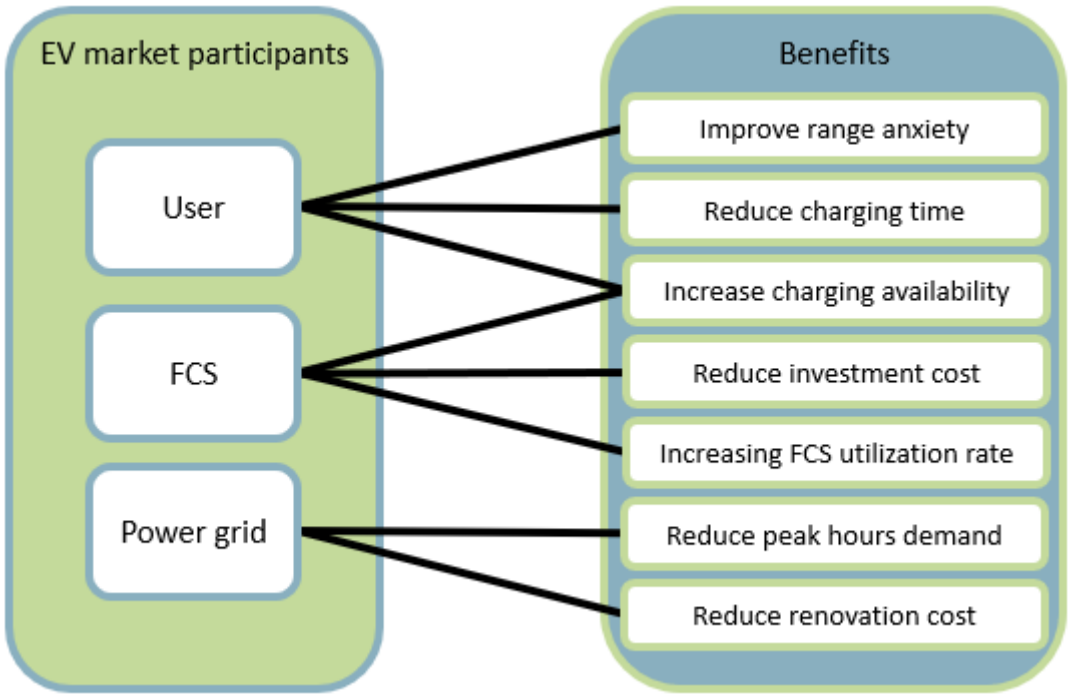

Figure 17: MCs benefits from different perspectives (Source: "A Literature Review on Mobile Charging Station Technology for Electric Vehicles", ConnectSmart Research Laboratory, University of Tennessee at Chattanooga)

7.7.1.2 Market sectors and trends

As already anticipated, analysts forecast that by 2040 57% of all passenger vehicle sales and over 30% of the global passenger vehicle fleet will be electric. Parallelly, the world's energy demand for EVs will grow from 20 billion kWh in 2020 to 280 billion kWh in 2030.

For reaching pace with these trends and carrying the turbulent growth of the EV market and related power needs, in January 2020, Navigant Research published a report on mobile EV chargers[251]. As an example of the potentialities and capacities of these mobile solutions, the analysis pointed out how a fleet of charging vans in China has already completed over 100,000 charging sessions in 2019.

[251] https://guidehouseinsights.com/reports/mobile-ev-chargers

The market “is just starting to get underway", and even if the mobile charging will be “a small portion of the overall EV charger market forecast”, the total value is expected to grow from $16 billion in 2020 and more than $60 billion by 2030 (Figure 18).

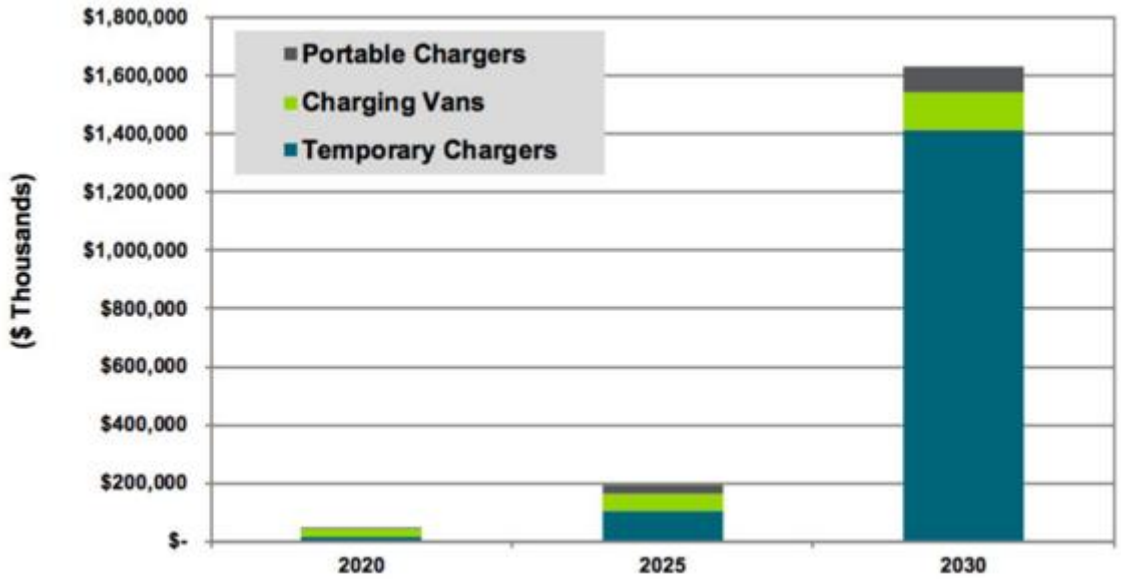

Figure 18: Mobile EV charger revenue by technology segment, World Market 2020 – 2030 (Source: “Research Report - Executive Summary: Mobile EV Chargers”, Guidehouse Insights, 2020)

According to Scott Shephard, Navigant senior research analyst, mobile chargers only make up 0.5% of charging at the present and will be around 2% by 2030.

Still in China, the electric vehicle start-up NIO is emerging as a serious competitor in the local EV market and is now courting Tesla owners with mobile charging stations (fitted in vans) which were designed for its vehicles – but also available to Tesla owners. The service costs 180 yuan or about 22 euro, and it can be performed without the owner if they can remotely unlock the charge port[252].

The construction of an adequate number of charging stations is the main concern that keeps up with the growth of EVs and the related charging demand. In the near future, an effective and necessary solution will be the diversification of charging methods with appropriate solutions to compensate for each methods shortcoming. Power grid companies and distribution operators can benefit from MCSs thanks to the ability to store energy. This element could be helpful not only to reduce the negative influence of Direct Current Fast Charging (DCFC) in the grid but also to reduce the total number of FCSs needed to cover charging requests in a specific location and to temporarily store sustainably generated power.

MCSs can be a support also during periods when there are peaks in energy requests. Often sessions peaks occur when drivers’ plugin at two main times: when they arrive at work and when

[252] https://electrek.co/2018/07/26/nio-courting-tesla-owners-mobile-charging-stations-electric-vans/

they come back after lunch. FCSs can offer little charging flexibility. On the contrary, MCSs can accumulate energy during off-peak hours and release charging services for electric vehicles based on real-time charging demand.

The DCFC is the only charging technology that has a charging process that can compete with the time required for Internal Combustion Engine Vehicles (ICEVs) in refilling their tank at gas stations. Generally, the EV charging process is much slower, but DCFC can charge an EV up to a 75% state of charge (SOC) in around a half-hour. However, only 16% of public charging stations currently installed are DCFCs[253].

The energy demand requested during fast charging can lead to power grid system insecurity if several EVs are charged simultaneously. Currently, with present network capacities and infrastructure features, the power grid is prone to failure, and the situation can lead to a significant voltage drop due to the vehicles fast charging. It is not possible to provide a high number of fast-charging stations with the current power grid; thus, proper scheduling of the EV charging process is essential to power grid safety. In the next future, together with the increase of EV penetration, and the consequent demand of DCFC connected to power grids, a proper upgrading of the existing power grid infrastructure will be necessary; this implies significant investments.

As a solution to lower stress on grid infrastructure, MCSs can be a support to fill the charging gap and provide a fast remedy. Furthermore, MCSs can provide vehicles charging directly where is necessary, saving the travelling time for going to the nearest FCS.

In Shenzhen, China, the number of charging piles has increased to 7,962, but only 3,697 charging piles are used regularly, which is 46.3% of the total number. This value expresses the usual low utilization rate of FCSs, even in cities with a high density of EVs. This hinders and slows down the rate of return for investment in FCSs. Although theoretically MCSs lead to a decay in the penetration of FCSs, their realization can increase the utilization of FCSs and their rate of return eventually. This can motivate more companies to invest in FCSs.

7.7.1.3 Market problems and new opportunities

The cost of the battery and the cost of the travelling carrier are the two major capital investments for the implementation of MCSs. However, the main challenge in MCS planning is the high cost of Battery Energy Storage Systems (BESS). These obstacles can be managed by carrying out a proper optimization analysis regarding the number of MCSs and the number of charging piles of each MCS to reduce the service delays. Analyses report that by increasing the number of charging piles from 1 to 4, the waiting time for service decreases from 89 minutes to 5 minutes.

As a solution, MCSs can play a prominent role in addressing the debate of whether it is better to create a wide network of charging facilities to stimulate electric vehicles adoption, or it is better to promote a sufficient rate of EV adoption before expanding the charging network. With MCSs, investors can analyse where the best locations for FCSs before realizing significant investments are to set up new fixed charging points. Indeed, with MCSs, it is possible to set up many charging

[253] A literary Review on Mobile Charging Station Technology for Electric Vehicles. Afshar S., Macedo P., Farog M., Disfani V.

points temporarily, to study when, where, and how long they are really necessary. This system helps investors to have a better view of the number of charging points necessary and to properly realize how to expand their fixed charging network.

Another positive element of MCSs is that they are a key component for reducing EV owners' range anxiety by providing them additional charges when necessary. Indeed, with the increase in EV penetration, MCSs can serve EVs out of charge on the road better and at a lower cost compared to tow service to the nearest charging station. Furthermore, this also means fewer investments in FCS infrastructures.

Analysis and uncertainties are in any case still pointed out from some business experts about the real profitability of the Mobile Charging Stations operated as a "specialistic" player.

This sector operated as an independent business still has to show the real ability to produce value and revenues for the operator. This is why some "major" players (as Enel X) provide mobile charging stations as ancillary on-demand services to their customers and do not consider this as their main product.

The mobile charging stations have shown their utility to provide support in occasional and extraordinary situations, and a form of gain to their providers derived from the renting of the tools in special events (such as congresses, fairs, sport venues, etc.), but still there is the open question about their business profitability in the long term.

Furthermore, other points are still discussed, such as their ability to really support the grid with balancing service. The ratio between the time they can operate on the street (e.g. during emergency situations) and the time in which they have to be linked to vehicles and to the grid for balancing purposes is a peculiar element for providing a real useful service. On the contrary, there is also the risk of not even being recognized by the grid infrastructure managers or even becoming a problem for them.

Together with the time, also the amount of power they are able to provide is a peculiar element to provide a useful and profitable service (at least 5 MW).

Indeed, the amount of power and the way in which these systems provide energy to the grid and to the vehicles for emergency reasons are elements for legal implications that are still discussed in different countries.

All these boundaries are elements that help to understand the doubts currently present about this business, and why for some analysts this sector is seen more as an ancillary service provided mainly by major electromobility players rather than as the main source of revenues for "specialistic" players.

7.7.1.4 Best practices and alternative solutions

Despite the different uncertainties and doubts about the future of the business, it is possible to find different companies still studying and working on MCSs as an alternative charging solution.

Together with NIO, also Volkswagen and Tesla are car manufacturers that consider MCS as a feasible charging service with potential future development.

Moreover, in parallel, the market of independent companies that provide mobile charging solutions as their main form of business or as an alternative one is also growing.

For example, Colorado-based Lightning Systems has introduced a mobile DC fast charger for electric vehicles. The Lightning Mobile solution puts 192 kilowatt-hours of energy in a package that goes into a vehicle or trailer. The idea is to rescue fleet-based EVs with a fast roadside charge. Lightning Mobile is charged from a standard Level 2 AC charger at up to 18kW and can deliver DC Fast Charging at up to 80kW and, optionally, Level 2 AC charging at up to 19.2kW[254] (Figure 19[255]).

Lightning Systems designed the solution to be installed in its Lightning Electric Transit 350HD cargo van, but the system can be installed in any vehicle or trailer that meets size and weight limits.

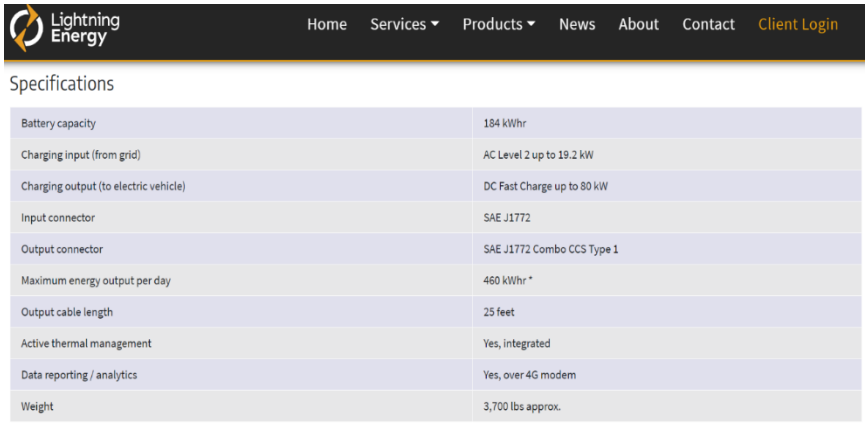

Figure 19: Lightning Energy MCS Specifications (Source: https://lightningenergy.biz/lightning-mobile/)

The first Mobile Charging Station produced by the Volkswagen Group Components subsidiary was installed in June 2019. At the end of January 2020, there were 12 delivered stations (nine installed permanently, while another three are deployed depending on the particular need/events)[256]. The chargers can deliver up to 100 kW of power (CCS DC Combo) and are widely independent from the grid connection, having up to 360 kWh battery inside. The Station has a footprint of roughly 1.4m x 1m and a height of 2.4m.

The solution was developed in a Joint Venture with DU-POWER and was realized considering how many charging stations have a big potential in rapidly growing markets for electric mobility, such as China.

The Charging Station was realized with the possibility to serve up to four vehicles simultaneously (also e-bikes can be charged): two with DC and two with AC connections. The total battery storage capacity is up to 360 kWh, a value sufficient to recharge 15 e-vehicles.

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[254] https://pontoon-e.com/mobile-ev-chargers-and-vans-get-ready-for-prime-time/

[255] https://lightningenergy.biz/lightning-mobile/

[256] https://insideevs.com/news/394881/volkswagen-mobile-charging-stations-wolfsburg/

The system was studied with the purpose to enable charging points to be free from any necessary structural changes or major financial outlay. When necessary, the battery pack in the charging station can be connected to the power supply directly, with alternating current up to 30 kW by means of a permanent standard grid connection.

With a connection to direct power, the charging time for the battery pack is around one hour. This time-independent recharging, together with the consequently buffering of power, is considered a positive element due to the possibility of considerably reducing the strain on the power supply at peak periods. The large "up to 360 kWh" energy storage system is based on the same battery pack found in the MEB (Modularer E-antriebs-Baukasten; modular electric-drive toolkit) platform on which all of Volkswagen's new electric vehicles are based[257].

As previously reported, recently also Tesla has released its last, and totally electric, version of its mobile Supercharger station. The version released in 2019 is powered by Tesla's Megapack (the energy storage product after the Powerpack and the Powerwall), and it is meant as an even bigger option targeting electric utility projects. According to Tesla, a single Megapack has up to 3 MWh of storage capacity and a 1.5 MW inverter. Previously, in the case of a forecasted increase in demand at specific charging stations or a station is temporarily down, Tesla has deployed mobile Supercharger stations built on skids and often powered by diesel generators. Now Tesla has combined the two products into a specific one, combining its smaller "Urban Supercharger" stalls around a flat trailer on which a large Megapack is installed. The stalls used can deliver 125 kW, which is a considerable power for a mobile station but is not comparable to the capacity of the new Supercharger V3[258].
In 2018 also Volvo decided to get into the business of electric vehicle infrastructure with an investment in FreeWire. FreeWire is a manufacturer of mobile rapid charging systems for electric vehicles that previously had already received a $5 million investment from the British oil company BP. The investment is related to the aggressive electrification plan of Volvo and to the objective to increase its importance in the EVs sector. In 2018, the Swedish automaker announced that it aims for 50% of sales to be 'fully electric' by 2025.

As previously reported, there are companies that have taken the mobile charging service as their main business. One of these is E-GAP, an Italian company that since 2019 in Milan, and from 2020 also in Rome, provides on-demand fast charging service with dedicated vehicles. The vans used are 100% electric. The energy provided comes from renewable sources, and the service is supplied with a recharge power equal to a fast type column (50 kW).

E-GAP also provides other services:

- Car reactivation that has been stuck for too long presents difficulties in electric ignition.
- Vehicle sanitation of interior with ozone treatment.

[257] https://electrek.co/2018/12/27/vw-mobile-charging-station/

[258] https://electrek.co/2019/11/29/tesla-mobile-supercharger-megapack/

Figure 20 reports the costs of E-GAP services:

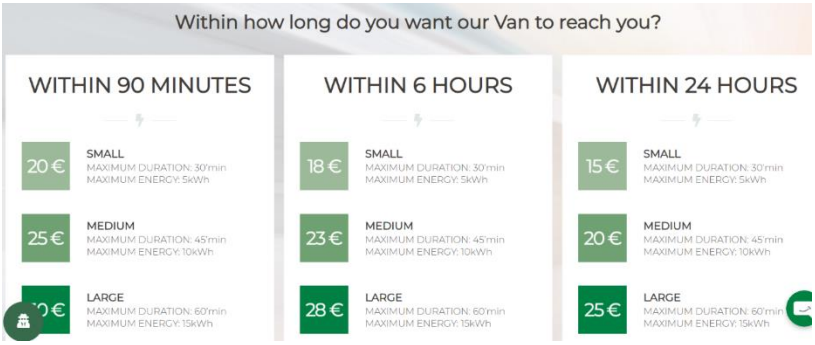

Figure 20: Cost of E-GAP services (Source: https://www.e-gap.com/en/rates/)

7.7.2 Rome business model

The following table provides an overview of the business case, i.e., information and strategies for developing e-Mobility solutions for Mobile Charging Stations in Rome from a business point of view. Hence it can be considered the starting point for business ecosystem and market analysis.

Table 38 Rome Mobile Charging Stations summary

TARGET MARKET SECTOR AND CLIENT PROFILE
Market sector: The PNIRE (Piano Nazionale delle Infrastrutture di Ricarica Elettrica - National Infrastructure Plan for the Recharging of Vehicles powered by electricity), prepared by the Italian Ministry of Infrastructure and Transport, defines the guidelines for ensuring a unique development of the national charging system. The plan considers the institution of a national service of electric vehicles charging, the introduction of precise procedures for managing charging service, the introduction of benefits for upgrading of systems, the realization of integrated plans for technological updating of existing buildings, the promotion of technological research for realizing charging infrastructure grids. The PNIRE underlines how important is the presence of an electric mobility plan inside mobility and logistics plans. These plans must contain: - A plan for settling charging infrastructure - Plans for parking spaces and related services (car-sharing, city logistics, etc) - Technical features of charging infrastructure - Localization principles for public and private infrastructures The PNIRE defines that, regarding the charging infrastructure: c) For charging in public areas, with normal power (slow charging) and medium power (fast charging), the charging modes are:

- "Mode 3" - slow or fast charging using a specific EV socket-outlet with control and protection function installed - and
- "Type 2" - single and three-phase vehicle coupler - reflecting the VDE-AR-E 2623-2-2 plug specifications -

d) For charging in public areas with high power (ultrafast charging):

- With a medium time horizon (2-3 years) - the Combo Connector (or Combo 2) that combines in one unit the fast charging in CC and the charging standard of level 2

In the second half of 2020, the Italian Government updated the PNIRE with new indications and time horizons. The new target is to install in Italy around 60,000 charging stations. For getting these values, by the first half of 2021, all the Italian municipalities have to have regulated the installation, realization, and management of the infrastructures, and where possible, consider the implementation of one charging sport every 1,000 inhabitants.

With the purpose to accelerate the infrastructure implementation, the new regulation includes easier authorizations and support for companies, as the possibility to reduce or erase the fees for the occupation of public spaces. The only condition is the provision and certification of electricity coming from renewable sources. In any case, the fee will be counted only on the area covered by the charging station, not including the parking surface.

The plan also considers the reduction of charging fees for customers. The new tariffs have to be settled both for public and private charging spots and have to be computed in order to ensure a price for electric power is not greater than the price considered for domestic inhabitant customers. This prescription aims to promote e-Mobility for citizens that cannot recharge off street.

In the last version of the plan, it is also considered a measure for people who abuse of charging spaces. In the case the vehicle is occupying the area also after the necessary charging time, there is now the possibility to apply a fee aiming to disincentivize the utilization of the station over a maximum period of one hour after the necessary refilling time. The time limit is not considered between 11 pm - 7 am, with the exception of charging points with power over 22 kW[259].

Finally, in the last update of PNIRE there is also the indication for highway concessionaires to install a charging point every 50 km [260].

[259] https://insideevs.it/news/443390/auto-elettriche-decreto-semplificazioni-colonnine-tariffe-ricarica/

[260] https://www.repubblica.it/motori/sezioni/attualita/2020/12/21/news/colonnine_di_ricarica_ogni_50_km_in_autostrada-279263587/#:~:text=Un%20emendamento%20a%20favore%20della,al%20momento%2C%20non%20prevede%20sconti.

Analysing the last released version of PNIRE Motus-E, the Italian Association representing main national stakeholders of electric mobility, has underlined different gaps and mistakes still present in the plan updating.

First, Motus-E underlined how the document still works relying on infrastructure "asset ownership", a modality that in last years has been often a failure. The system is based on the concept that money is handled by regions that transfer them to municipalities as promoters and owners of charging stations. Municipalities up to now have been not able to manage them. 30 million euros had been allocated to local administrations, and they have not been used yet. Furthermore, money used was organized in a manner not able to remove the two main nodes characterizing the Italian network: few numbers of fast and ultrafast charging stations and lack of infrastructure in smaller municipalities. Motus-E requires that final beneficiaries of public funds are no more Municipalities but private charging point operators. For doing this, it is necessary an exception to European rules regarding National Aids, as Germany and Romania have already done. Motus-E has also underlined aspects regarding the quality and location of chargers. It is fundamental that funds are allocated to ultra-fast systems (over 100 kW power) both in highways/extra-urban contexts than in selected urban nodes. In PNIRE there should be fixed technological criteria regarding new stations to be implemented. They all have to be interoperable for customers of different operators, and they have to always allow electronic payment[261].

Market size[262]:

In 2020 the market share of electric vehicles (BEV+PHEV) was around 0.25% (BEV+PHEV= 99,257, total vehicles in Italy = 39.6 million) of the total, and the registrations around 4.33%. Despite the very small numbers, the trend is rapidly growing (+120% CAGR 2018-2020) thanks mainly to national and regional incentives.

In December 2020 in Italy there were around 19,324 charging points in 9,709 public charging stations. During 2020, charging points installations have grown with a trend of 39%. At the end of 2019 charging stations were 7,203 (+2506 in 2020) and charging points were 13,721 (+5.602 in 2020). The average subdivision of public stations is 80% in public areas and 20% in private areas with public access (e.g. supermarkets and malls). The AC charging points are 96%, while the DC charging points are 4%. Slightly growing are the DC high power points, from 3 to 4%.

The charging stations are mainly present in the centre-north of Italy and in the metropolitan areas. The 57% of the infrastructures is distributed in the North of Italy, around the 23% in the Centre while only the 20% in the South and Islands.

Lombardy is the region with the most charging points. It represents 17% of all the installations. In February 2020, there were registered 2,467 points. At the end of 2020, they were 3,326. After Lombardy there are Piemonte (10.6%), then Emilia-Romagna, Lazio, Veneto and Toscana with the 9% each.

[261] Indicazioni al piano nazionale delle infrastrutture di ricarica dei veicoli elettrici – Motus-e

[262] https://www.motus-e.org/wp-content/uploads/2021/01/Report-IdR_Dicembre_2020-2.pdf

In 2020 the charging stations registered in Rome were 503, for a total of 941 charging points[263].
Client profile: The targeted clients are private drivers, professional EV drivers, grid infrastructure managers, CPOs, road infrastructure managers, fair and event organizers.
PROBLEM TO SOLVE AND BUSINESS OPPORTUNITY
Problems to solve: • Lack of charging stations • Lack of systems to protect EV parking spaces. • Specific regulation for mobile charging systems. • Low demand areas and charging stations. • Charging points for urban distribution and logistics vehicles. • Plans for special events where to use mobile charging stations. • Lack of standardization. • Mobile charging stations as grid balancers.
Business opportunity: The Rome Plan for public recharge was drawn in 2018 for the three years period 2018-2020[264]. The plan defines the specific actions to support the automotive charging systems and states where charging stations should be located in order to have an adequate coverage of the 6 PGTU (General Plan on Urban Traffic) zones in which the city is divided. The plan was studied with the forecast that by 2020 the total municipal demand would have been of 700 charging stations, integrated with fast stations along the GRA (Grande Raccordo Anulare - Great Ring Road) and along the internal railway ring. At the end of 2020, the final number of stations installed by the Municipality of Rome, in partnership with ACEA and ENEL, was around 340, divided between 22 kW AC and 50 kW DC. The final value lower than the expected one is mainly due to the doubts detected by the Mobility Department of Rome and coming from the Ministry of Cultural Heritage. The Ministry was worried about the potential impacts that charging stations could have in the historic centre of Rome. For this reason, 40% of the charging points proposed by ACEA and ENEL have been rejected. In any case, in December 2020, in response to the Electric Mobility Plan, the Municipality of Rome approved the new program of ACEA for the installation of 100 additional charging

[263] https://www.legambiente.it/wp-content/uploads/2020/06/rapporto-cittaMEZ_2020.pdf
[264] https://www.comune.roma.it/web/it/scheda-servizi.page?contentId=INF51556

points. In total, by the end of 2024, ACEA has planned to install more than 2,000 in Rome, for a total investment of around 29 million euros[265].

ACEA ensured that the new charging points would provide only energy coming from renewable sources for both slow and fast-charging stations.

The plan approved in 2018 identified 320 areas where each supplier could propose a project for a new electric charging point (22 kW and 50kW). The plan was also studied to support private investments in the sector with specific rules, including technical and administrative regulations that define:

- How to submit applications.
- Technical specifications for charging points.
- Road signs for parking lots.
- Technical requirements.
- Obligations and penalties.

Furthermore, the plan includes a specific action to support private investments in:

- Urban freight distribution (every proposed plan must include at least a loading/unloading parking space)
- Taxies (Planned at least 18 new taxi charging stations)
- Petrol stations
- Parking lots and garages
- Private buildings

The plan contains a specific section related to a future development scheme for wireless electric car charging and stations for battery swapping.

Charging stations, where feasible from technological and economical point of view, have to include smart measuring systems for analysing grid stability. They have to be able to detect and analyse data to understand, for example, when it is the best time to recharge vehicles. This to maintain the grid integrity.

The plan aims at reaching as soon as possible a network where user can access to charging infrastructures with smart systems and in a seamless way all around the country. Smart access

[265] https://www.gruppo.acea.it/media/comunicati-stampa-e-news/comunicati-stampa/2020/12/e-mobility-acea-parte-da-roma-con-piano-installazione-prime-100-colonnine-ricarica

systems will have to be compatible with the ones used for public transport in order to have a single key for all mobility modes.

Currently, electric vehicles in Rome do not pay parking fees and can have access to restricted traffic zones.

Following national regulation, from 2017, construction and renovation plans of non-residential buildings with a surface greater than 500 m2 have to provide the provision of a charging point for each internal parking space. Construction and renovation plans of residential buildings with more than ten housing units have to provide the provision of a charging point for at least 20% of internal parking spaces.

Since 2018, Rome has held the Italian stage of the ABB-FIA Formula E World Championship. The purpose of the event is to promote the positive features of electric vehicles, giving them the opportunity to run on streets where every day mainly petrol and diesel vehicles move.

For the occasion, ENEL X has developed the JuicePump80 FE that enables the racing vehicles to complete the race – 45 minutes plus one lap – on a single charge, so they do not need to stop for a car swap, which they had to do before.

Furthermore, during the days of the event, Enel X arranges an edutainment space where large numbers of people can enjoy a direct experience about how easy it is to use the Enel X gamma of Juice charging points (JuicePole, JuiceLamp, JuiceBox and JuicePump). They can see how charging stations operate and can drive virtual e-vehicles along an experience with plenty of charging stops, wearing a virtual reality headset.

VALUE PROPOSITION AND SOLUTION

Solution:

- *CLICK planning toolkit for the development of the City's Traffic Masterplan in a holistic mode and for finding the locations, with Enel X, of the new charging points to realize (and before to test with solutions as the mobile charging stations).*
- *INCAR for the implementation of a platform allowing a unique interoperability management system for roaming, charging, and parking with all the kind of charging stations available, also MCSs. In the Rome demo site this solution will be tested only for charging stations of ENEL X. No other MSP will be engaged.*
- *INSOC for Integrated Solar DC – Charging stations. Some solutions of mobile charging stations integrate also solar panels.*
- *SMAC, a software tool that will calculate the optimal charging profile (amount of energy to provide) in all the kind of charging stations.*

7.7.2.1 Key stakeholders

The following table lists the key stakeholders in the special events Rome use case. These are the organizations playing a key role in the application of the new solution to achieve the benefits

described above. For each stakeholder the table highlights its role in the solution's value chain, i.e., which of the stakeholder's activities are essential for the solution to deliver value according to its expected benefits. Other activities, not related to the solution's application, are excluded from the analysis.

Table 39 Key stakeholders in the Mobile Charging Stations ecosystem

STAKEHOLDER TYPE	ROLE IN THE VALUE CHAIN
Local Authorities/Mobility Agencies	*For rules and urban planning*
Electromobility Service Providers	*As provider of services and solutions in the electromobility*
Energy supplier companies	*Supply of power energy (sometimes can correspond to the CPO)*
Technology Solution Providers	*Provision of technology solutions for charging (poles, plugs, hardware, software, etc.)*
TSPs	*For installation of charging points in strategic transport locations*
Grid Infrastructure Managers	*Connection, management, and upgrading of charging points with the local power grid. Approval of new charging point connections*
National/European Authorities	*For standards and policies*
Financial and payment system companies	*For provision of payment solutions*