https://ruralmedmobility.interreg-euro-med.eu/

D2.3.1 – Joint Methodology for Pilot Implementation

PP13-CIMNE
November 2025

TABLE OF CONTENTS

❖ List of abbreviations

AC – Alternating Current

AGENEX - Consortium Extremadura Energy Agency

AREANATejo - Regional Energy and Environment Agency from North Alentejo

BEV - Battery Electric Vehicle

BSC KRANJ - Business support centre L.t.d., Kranj

CERTH - Centre for Research and Technology Hellas

CIMAA - Intermunicipal Community of Alto Alentejo

CIMNE - International Centre for Numerical Methods in Engineering

CMK - City Municipality of Kranj

COM - Consortium Oltrepò Mantovano

CP - Charging Point

D – Deliverable

DC – Direct Current

ECS – Electric Charging Station

EMSP - Electric Mobility Supplier

EU – European Union

EV - Electric Vehicle

EVSE - Electric Vehicles Supply Equipment

GHG – Greenhouse Gas

ICE - Internal Combustion Engine

ITS - Intelligent transportation system

JUNTAEX - Directorate-General for Transport of the Government of Extremadura

KCKZ – Koprivnica-Krizevci County

KPIs - Key Performance Indicators

MaaS - Mobility as a Service

MED - Mediterranean

MQEM - Monitoring and Quality Evaluation Methodology

N/A - Not Applicable

RAUSK - Development Agency of Una-Sana Canton

RDFWM - Regional Development Fund of Western Macedonia

REAN - Regional Energy Agency North

RES – Renewable Energy Sources

SZ REDA - Stara Zagora Regional Economic Development Agency

❖ 1. INTRODUCTION

Project Identification

Project full title	Adopting electric mobility in underserved rural and remote MED areas
Mission	Promoting green living areas
Programme priority	Greener MED
Specific objective	RSO2.4: Promoting climate change adaptation and disaster risk prevention, resilience, taking into account eco-system based approaches
Deliverable number and title	D2.3.1 – Joint Methodology for Pilot Implementation
Work package number and name	Work package 2: Preparation and fine-tuning for launching pilot activities
Activity number and name	-
Partner in charge	CIMNE
Partners involved	All
Status	Final
Distribution	Public
Date(s) of production	20/02/2025 (version 1 Guide) 15/10/2025 (version 2 Draft) 07/11/2025 (version 3 Final)

Previous steps/deliverables	**Reported deliverable**	**Further steps/deliverables**
D3.1.1	D2.3.1	D2.4.1

Project Overview

Rural areas make up 83% of the total EU territory, yet only 30% of the EU's population lives there. In the EU's Long-Term Vision for Rural Areas and its Rural Action Plan, one of the key initiatives focuses on addressing the challenge of sustainable multimodal mobility in these regions.

While electric mobility has gained significant momentum in urban areas, the development of EV charging infrastructure has largely concentrated in cities and along main transport corridors, where commercial operators find more viable business cases. This has left rural areas underserved, often resulting in "range anxiety"—the fear that electric vehicles will not be able to cover necessary distances due to the lack of charging points. Consequently, many rural residents may opt for conventional transport options instead of electric vehicles.

Local authorities in rural areas tend to install subsidized EV charging points mainly for awareness-raising purposes, but these efforts are often fragmented and lack a cohesive strategy for systematically developing and managing the network at both local and regional levels. In general, these authorities face significant challenges in three critical areas: funding, technical expertise, and coordination with network operators. Some of these challenges could be alleviated by improving awareness, capacity-building, and policy frameworks.

To tackle this issue, there is a clear need to support rural and remote local authorities, particularly in Mediterranean Europe, in developing robust policy frameworks and enhancing their capacities to facilitate the adoption of EV technology within their communities.

RuralMED Mobility aims to:

- Reduce the environmental impact of transport in rural areas, enabling participating municipalities to lower their CO_2 emissions
- Support the integrated planning and financing of EV charging infrastructure and the introduction of public shared EV rental schemes
- Promote low-carbon mobility solutions in alignment with energy goals and carbon neutrality targets
- Improve connectivity between urban centers and remote rural areas

Purpose of the Document

The Joint Methodology for Pilot Implementation (D2.3.1) serves as a structured framework to guide the deployment, coordination, and evaluation of pilot activities under Work Package 2 (WP2) of the RuralMED Mobility Project. This document ensures that pilot implementations follow a consistent approach across participating regions while allowing flexibility for adaptation to local contexts.

Specifically, this document outlines the methodological foundations for:

- EV Charging Infrastructure Allocation (Activity 2.1) – Defining the demand, strategic allocation, and integration of electric vehicle (EV) charging infrastructure in rural areas.
- RuralMED Mobility Platform and On-Demand Transport Testing (Activity 2.2) – Establishing a testing framework for the Mobility-as-a-Service (MaaS) platform, including shared mobility schemes and real-time monitoring capabilities.
- Pre-assessment and Joint Methodology (Activity 2.3) – Developing a transnational methodology for pilot implementation, ensuring alignment between regions, defining selection criteria, and integrating monitoring and evaluation mechanisms.

This document serves as a guiding reference for project partners to ensure that pilot projects are effectively deployed, monitored, and optimized for replication in similar rural territories. Additionally, it aligns with technical requirements for pilot monitoring, ensuring interoperability with the RuralMED ICT platform.

Scope

This document defines the methodological approach and technical requirements for the implementation of pilot projects under WP2 of the RuralMED Mobility Project. The scope of this deliverable is limited to the following activities:

This document does not cover aspects related to procurement (WP3), large-scale deployment, or policy development, but it provides foundational methodologies that will support those efforts in later stages of the project.

By defining a coherent and adaptable implementation framework, this deliverable aims to ensure that pilot activities are efficient, scalable, and interoperable across different regional contexts while remaining aligned with the project's overarching mobility objectives.

❖ 2. EV CHARGING INFRASTRUCTURE ALLOCATION

➢ 2.1 Spain

2.1.1. Demand Analysis for Charging Stations

The stock of Battery Electric Vehicles (BEVs) in Extremadura represents a practically residual share compared to national figures, despite having grown in recent years. According to General Directorate of Traffic (DGT) data for 2023, Extremadura accounts for 0.92% of the total electric vehicles in Spain, which totals 284,830.

Regarding the total vehicle stock in Extremadura, BEVs represent only 0.28% of the motorize vehicle fleet. However, in the last 10 years, the number of electric vehicles has grown exponentially, currently totaling 2,845 BEVs, representing an increase of more than 1,500% in a decade.

About the charging infrastructure network, the Spanish Association of Automobile and Truck Manufacturers (ANFAC), in collaboration with the Spanish government, has conducted a study on publicly accessible charging infrastructure in Spain as of August 2023, which provides a future projection of new scenarios related to the vehicle fleet, mobility, and automotive industry. This project is developed along the lines of action for sustainable mobility and its objective is to serve as a tool to assist in the necessary planning and monitoring of the deployment of this charging infrastructure to meet the European Union's Fit for 55 emissions reduction targets.

Table 1: Projection of the power of public access charging stations in Extremadura

Año	P<22 [kW]	22<P<50 [kW]	50<P<150 [kW]	150<P<250 [kW]	P>250 [kW]	Total
2023	371	67	237	33	34	742
2025	726	146	536	75	80	1.563
2030	2.054	573	2.337	330	263	5.557
2035	3.231	1.377	6.086	861	714	12.269

As shown in the table, the goal is to gradually increase the number of publicly accessible charging stations. By the end of 2023, the total number of publicly accessible charging stations proposed is 742, adding up the data for the different power capacities. By 2025, the goal is to reach a total of 1,563 charging points, and finally, by 2030, the goal is to establish a total of 5,557 points, across all power capacities. By 2035, although it is not within the timeframe of the plan, the goal is to reach 12,269 charging stations.

These objectives must be compared with the current status of publicly accessible charging infrastructure, with the aim of detecting potential deviations and shortcomings in the system.

To this end, the data provided by the "Electromobility Barometer 2nd semester 2025" prepared by ANFAC are presented below.

Table 2: Infrastructure of public access charging points in Extremadura

	P<22 [kW]	22<P<50 [kW]	50<P<150 [kW]	50<P<250 [kW]	P>250 [kW]	Total
Urban	507	45	108	17	8	507
Interurban	158	25	80	42	78	158
TOTALS	665	70	188	59	86	1,068

It is also worth noting that 35% of the public access charging points are interurban and 65% are urban, with a great predominance in the latter of charging points with powers lower than 22kW that have very long charging times, which constitutes a very important limitation to their use for the consumer.

In conclusion, for electric mobility to be competitive and for electric vehicles to become a real alternative to internal combustion vehicles, it is necessary to deploy a publicly accessible charging infrastructure on Extremadura's main communication routes, with particular emphasis on high-capacity roads (highways and motorways), but also in other centers of interest, as well as in rural areas, further from main communication infrastructures and therefore with greater autonomy requirements in terms of electromobility, so that the entire territory can be connected.

2.1.2. Strategic Allocation of Charging Infrastructure

Within the framework of the Rural MED Mobility project, and in accordance with the Application Form, a pilot project is planned, consisting of the installation of three electric vehicle charging stations in three different locations in the Spanish region of Extremadura.

The scope is to improve EV infrastructure and facilitate the adoption of sustainable mobility in rural areas, helping rural and remote local authorities by creating the conditions for the development of their policy framework and capacities that will help their communities to use EV. Investment will consider the installation of 3 EV charging stations, renting/leasing two electric vehicle for general public use through car sharing, and monitoring and ICT tools. This will increase the number of trips to and from the pilot municipalities using electric vehicles and multimodal solutions, reduce CO_2 emissions, and improve residents connection to public services.

As this is a pilot project, an area of operation must be selected that is appropriate to the overall objectives of the RuralMED Mobility project. This will allow for replicability of the tested solution not only in other rural areas within Extremadura but also expand the replicability options of the tested solution to other rural areas in the European Mediterranean region. Therefore, cross-border regions are ideal areas to serve as pilot areas for developing the planned actions, as they may present similar mobility problems and limitations.

Taking all these premises into account, the Sierra de Gata region has been selected as the area for implementing the pilot project in Extremadura, as it meets the basic characteristics indicated above and summarized below:

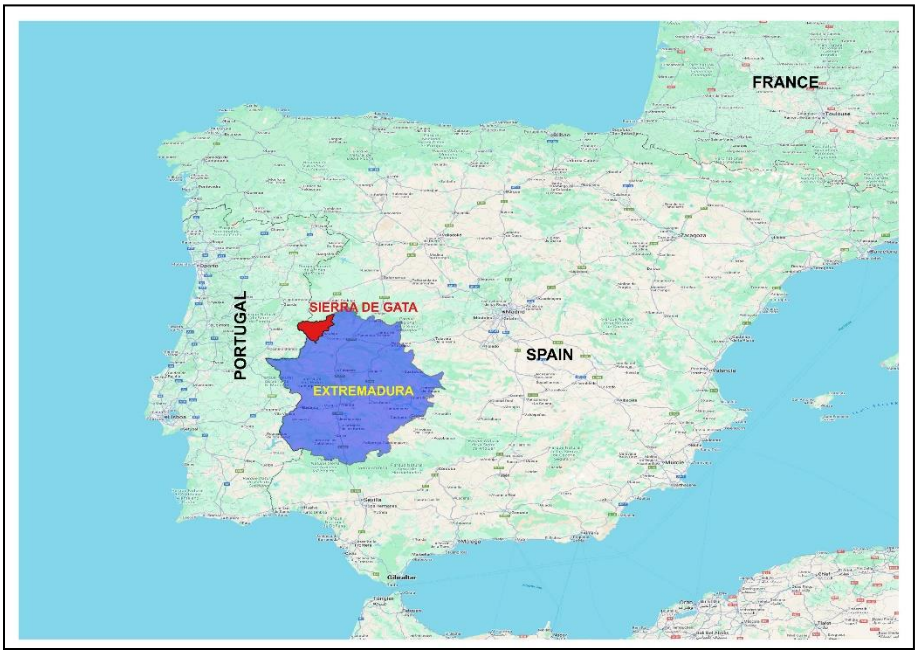
- This is an eminently rural area, where the low population density and dispersed urban centres make it difficult to provide a competitive and efficient regular public passenger transport service.

- It has a marked cross-border relationship with Portugal, where usual travels for social, commercial or other reasons allow for the testing of joint mobility solutions.

- The territorial scope allows for testing shared mobility solutions adapted to these low-demand environments, which are more flexible and economically profitable, and which can meet the real needs of citizens daily mobility.

- The selected area allows for testing the use of on-demand electric mobility solutions from the most isolated towns to their main travel centres, such as towns with a referral hospital, administrative services, other regular public transport services, etc.

- The results of the pilot project in this area can be replicated in other rural areas with similar characteristics, both regionally and throughout the European Mediterranean region.



Map 1: Geographical location of the Sierra de Gata region

Sierra de Gata is a rural area with small dispersed towns, so deciding on the location of stations requires considering the population served, distance from major travel centers, connectivity with existing road infrastructure, and others.

As a strategic decision, it was decided that **one of the three EV charging points will be located in the city of <u>Coria</u>**. Although Coria is not strictly part of the Sierra de Gata region, it is the closest (20-40 km) town with more than 10,000 inhabitants, and it offers most of the basic services for the population of the Sierra de Gata region, such as administrative, commercial, banking, and leisure centers. It also has the referral hospital for the towns of the Sierra de Gata region, making Coria the biggest travel attraction center in the area.

To decide the location of the other two EV charging points, a multi-criteria analysis has been used, considering the following selection criteria defined to meet the general objectives of the RuralMED Mobility project and maximize the benefit of the pilot:

1. **<u>Geographic coverage:</u>** Locations that allow us to serve the largest number of municipalities and the largest possible area in the region.

2. **<u>Complementarity with the existing network:</u>** Avoid duplicating existing or planned public charging EV points, maximizing the utility of the new infrastructure.

3. **<u>Coverage for the resident population:</u>** Providing service to the largest number of residents, adequately distributed throughout the region.

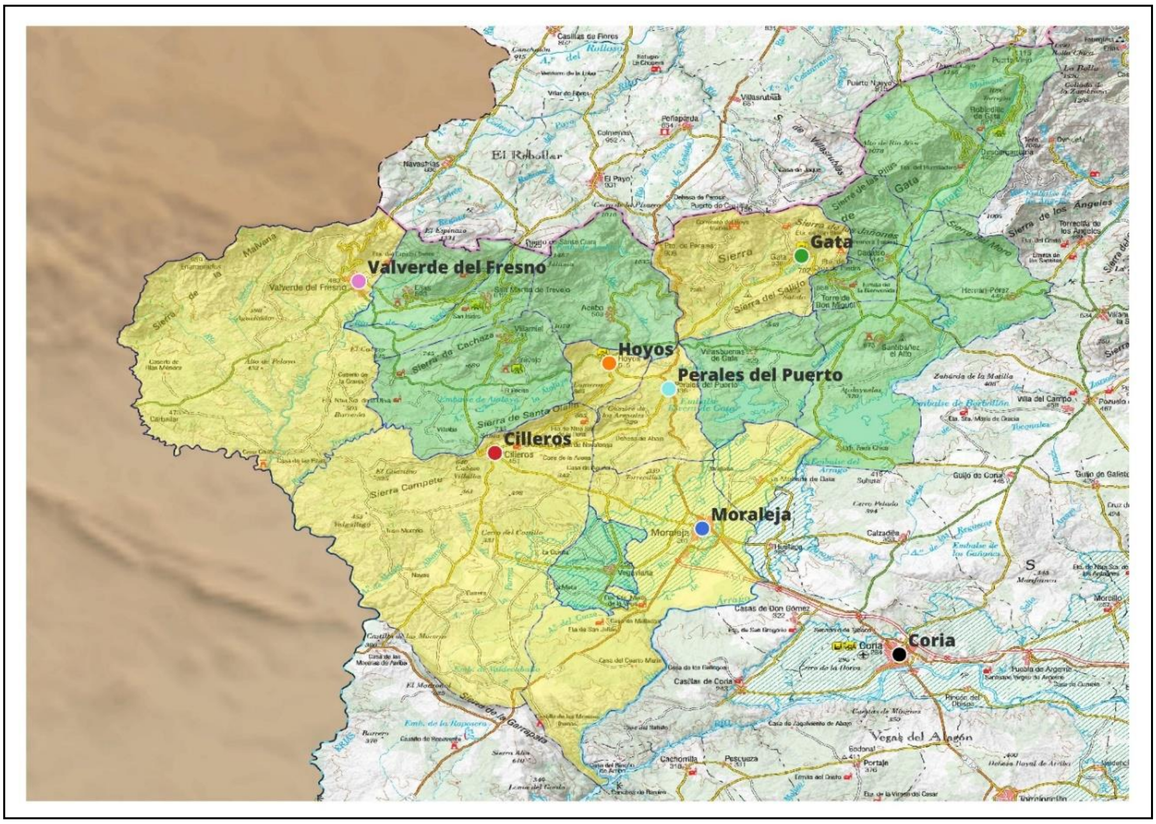
4. **Access to health and administrative services:** Prioritize municipalities that have health centers, hospitals, or administrative offices, or that are access points to such services for surrounding towns.

5. **Strategic location:** Localities with a central position in the region or communication hubs (good access via main roads), facilitating efficient travel.

6. **Electrical and digital infrastructure:** Availability of a connection to the electricity supply grid with sufficient capacity and communications coverage (digital connectivity) to manage the EV charging point.

7. **Impact on emissions and climate change:** Locations where the introduction of shared electric mobility can replace more kilometers of trips in combustion vehicles, reducing CO_2 emissions and contributing to the fight against climate change.

After an initial analysis of all the municipalities in the region (approximately 20 small towns), six candidate locations were identified that best meet the established criteria. These, along with Coria (already defined as a fixed point to place one of the EV charging stations), constitute the set of alternatives to be evaluated. The shortlisted locations are: Moraleja, Valverde del Fresno, Perales del Puerto, Gata, Cilleros, and Hoyos.



Map 2: Candidate municipalities (in yellow) to place EV charging stations

The main characteristics of these municipalities are set out below:

MORALEJA

Moraleja is the second largest town in the area (6,585 inhabitants) after Coria (12,125 inhabitants). It is considered the regional capital of Sierra de Gata, serving as the main administrative and service center for this rural region. It is well connected by the regional road EX-109, which connects it with Coria to the south (15 km away) and with other municipalities in the Sierra de Gata to the north.

Moraleja has a regional health center, which attracts residents from nearby towns for medical consultations. It also has administrative regional offices that serve the population of the Sierra de Gata.

Regarding electric mobility, Moraleja already has an active public EV charging station. This implies that, although Moraleja meets many criteria (large population served, strategic location, sanitary/administrative services), it would not be optimal to assign one of the pilot's new EV charging stations to this town, as this would duplicate existing infrastructure. In line with the complementarity criterion, it is proposed to rule out Moraleja as a new facility, taking advantage of the charging point already in operation in the town.

Table 3: Multicriteria evaluation of Moraleja

Geographic coverage	Complementarity with the existing network	Coverage for the resident population	Health and administrative services	Strategic location	Electrical and digital infrastructure	Impact on emissions and climate change
High (central-southern area, but close to Coria)	Public EV charger already exists	Very high (6,585 inhabitants)	With health center	Regional road junction, good communication	Solid urban electricity supply (large town)	High (large population

GATA

Gata (1,372 inhabitants) is one of the important towns in the eastern part of the region, close to the border with the neighbouring Las Hurdes region. In terms of population, Gata is among the notable mid-sized towns in the region, and its location helps cover the eastern part of the Sierra de Gata region (villages such as Santibáñez el Alto, Villasbuenas de Gata, Torre de Don Miguel, and Acebo are within its reach).

However, Gata already has a recently installed public charging station. This means that, as in the case of Moraleja, it is not efficient to allocate a new charging station for the project to Gata, given that the immediate need for charging infrastructure in that area is at least partially covered. Furthermore, Gata does not have a health centre (it has a lower-level local clinic) or major communication hubs (the CC-6.1 road that leads to Gata is secondary).

Table 4: Multicriteria evaluation of Gata

Geographic coverage	Complementarity with the existing network	Coverage for the resident population	Health and administrative services	Strategic location	Electrical and digital infrastructure	Impact on emissions and climate change
Medium (far east, some nearby towns)	Public EV charger already exists	Medium-Low (1,372 inhabitants)	Without health center	Isolated (local road)	Limited network (rural mountain area)	Medium (travel ≈ 40 km to Coria)

VALVERDE DEL FRESNO

Valverde del Fresno, with 2,106 inhabitants, is the most populated town in the western Sierra de Gata region. It is located close to the border with Portugal, and its influence extends to other towns in the Eljas River valley (such as Eljas and San Martín de Trevejo). Geographically, Valverde covers the western part of the region, a subregion far from the main towns (Coria/Moraleja).

In terms of transport links, Valverde is well connected via the EX-205 road, a regional road that connects it to the rest of the Sierra de Gata region (towards Hoyos) and to Portugal to the west. This location, although geographically peripheral, is strategic for providing charging services to the surrounding western municipalities. Furthermore, Valverde has its own Health Center, making it an access point to primary healthcare services for its area.

According to the information gathered, there is evidence of a fully operational public EV charging station in Valverde. Although its geographical location makes it a strong candidate for the installation of a new EV charging station, the priority will be given to locations where there are no existing EV charging stations.

In the final evaluation of the pilot, Valverde was not selected as one of the locations for the installation of a new EV charging station. Although it meets relevant criteria (territorial coverage, basic services, environmental impact), priority was given to installing it in a municipality which offers a more central situation in the Sierra de Gata region, with better transversal road access and no existing EV infrastructure, effectively filling a gap in the network without duplicating resources.

Valverde del Fresno remains an excellent option for future expansion of electromobility infrastructure. Its demographic, geographic, and functional profile make it a strategic candidate to strengthen the region's electric mobility network at a later stage.

Table 5: Multicriteria evaluation of Valverde del Fresno

Geographic coverage	Complementarity with the existing network	Coverage for the resident population	Health and administrative services	Strategic location	Electrical and digital infrastructure	Impact on emissions and climate change
High (far west, no nearby alternative)	Public EV charger already exists	High (2,106 inhabitants)	With health center	Regional road covers the western region	Acceptable urban electricity supply (medium-sized town)	Very high (travel >40 km to Coria)

PERALES DEL PUERTO

Perales del Puerto (911 inhabitants) is a centrally located municipality in the region, approximately halfway between the northern and southern borders of the Sierra de Gata region. It is located approximately 26 km from Coria and very close to the intersection of the main roads that connect the region: the EX-109 road (north-south Moraleja-Portugal axis) passes through the town, connecting it to the south with Moraleja and to the north with the Eljas River valley, while other nearby secondary roads connect to the east (Gata/Acebo area). This position gives it a "strategic location" in the geographic center of the Sierra de Gata region, which would allow freight coverage to multiple surrounding towns without major detours.

Perales does not have its own health center or other relevant regional services (Perales residents usually go to Hoyos or Moraleja for healthcare, and to Moraleja for administrative matters). However, its equidistant location means that a shared electric vehicle parked in Perales can travel in reasonable times to any of the service centers (Coria, Moraleja) or even to outlying towns, optimizing the shared transport service.

Perales del Puerto currently does not have a public charging station, so installing a charger there would not duplicate infrastructure. It would serve a modest local population but would indirectly benefit nearby towns: for example, it could provide charging service to users in Hoyos, Acebo, Villasbuenas de Gata, Torre de Don Miguel, etc., all of which are towns within a 10-15 km radius of Perales. Overall, the aggregate population of this central sub-region exceeds 3,000. Furthermore, Perales is on the route west (Valverde/Portugal) from Moraleja, so a charging point there would complement the one in Valverde, creating an internal charging corridor in the Sierra de Gata.

Considering all the allocation criteria, Perales del Puerto appears as the recommended location for the second charging point. It particularly meets the criteria of geographic and communications centrality, being a central and well-connected enclave, and closes the coverage gap in an area that currently lacks charging infrastructure and services. Although its population is smaller, it offers extensive territorial coverage and accessibility in multiple directions.

Table 6: Multicriteria evaluation of Perales del Puerto

Geographic coverage	Complementarity with the existing network	Coverage for the resident population	Health and administrative services	Strategic location	Electrical and digital infrastructure	Impact on emissions and climate change
High (center of the region, several towns around)	Public EV charger does not exists	Medium-Low (911 inhabitants)	Without health center	Regional road crossing, central position	Basic electricity supply (small town)	Medium (moderate population, 25 km to Coria)

HOYOS

Hoyos (851 inhabitants) is another town located in the heart of the Sierra de Gata region. It is located slightly northwest of Perales del Puerto, about 31 km from Coria, and is the head of its own regional health center, which serves surrounding towns (Acebo, Villasbuenas de Gata, etc.). In terms of transport, Hoyos is well connected by the EX-205 road, giving it good east-west accessibility. Its location is relatively central to the north within the region and, like Perales del Puerto, could be considered strategic for serving several nearby municipalities.

Hoyos would be a strong candidate due to its central location and the fact that it has a major healthcare service, but it already has an EV public charging point. However, in the planning of the pilot, it was considered more advantageous to locate the central charger in Perales del Puerto, mainly due to its slightly more accessible location from the south (Coria) and the west, and to avoid concentrating two new EV chargers on the same EX-205 road (Valverde del Fresno and Hoyos are on the same route). In other words, Perales del Puerto and Hoyos fulfill similar roles, but Perales del Puerto is prioritized based on criteria of better connectivity in all directions (north-south via EX-109 road, and proximity to both the east and west).

In conclusion, Hoyos remains an alternative or complementary location: it would be suitable if one of the selected locations is not viable, or in future project expansions. However, for the pilot definition, Hoyos is not chosen among the two final locations, given that its central coverage advantages are already achieved with Perales del Puerto, and it also avoids duplication of EV chargers in the same municipality.

Table 7: Multicriteria evaluation of Hoyos

Geographic coverage	Complementarity with the existing network	Coverage for the resident population	Health and administrative services	Strategic location	Electrical and digital infrastructure	Impact on emissions and climate change
High (north central)	Public EV charger already exists	Low (851 inhabitants)	With health center	Regional road, strategic position	Basic electricity supply (small town)	Medium (slow population, 30 km to Coria)

CILLEROS

Cilleros (1,813 inhabitants) is one of the most important towns in the southwest of the Sierra de Gata, located between Valverde del Fresno and Moraleja. It is connected by the EX-205 road and other regional roads, giving it an intermediate location between the western core and the south-central part of the region.

Its geographical position is key to covering a densely populated area, which also includes the towns of Villamiel, Trevejo, and part of the surrounding area of San Martín de Trevejo and Eljas. Despite not having a regional health center (it does have a local clinic), many of its residents travel to Coria or Moraleja for healthcare and administrative services, which could be provided in shared electric vehicles if an accessible EV charging point were available.

Cilleros does not currently have an operational public EV charging point, making it a priority location based on complementarity criteria. Its population is significant, its road access is adequate, and its electrical infrastructure is acceptable (as it is a medium-sized municipality with consolidated urban supplies).

Furthermore, its location allows for a cross-cutting axis that complements the coverage provided by the charging stations in Coria and Perales del Puerto, optimizing connectivity between the western and central sides of the Sierra de Gata region. In terms of environmental impact, a significant reduction in emissions is expected by facilitating the replacement of private vehicle travel with shared electric mobility.

In short, Cilleros stands out as a strategic alternative that provides territorial balance, avoids duplication, and efficiently aligns with the project objectives.

Table 8: Multicriteria evaluation of Cilleros

Geographic coverage	Complementarity with the existing network	Coverage for the resident population	Health and administrative services	Strategic location	Electrical and digital infrastructure	Impact on emissions and

						climate change
High (intermediate zone between center-south and western zone)	Public EV charger does not exists	High (1,813 inhabitants)	With health center	Regional road junction, good communication	Solid urban electricity supply (large town)	Very high (travel >40 km to Coria)

SUMMARY MULTICRITERIA EVALUATION

Below is a summary table that comparatively evaluates the five candidate municipalities analyzed (excluding Coria, which has already been decided) against the seven selection criteria defined. A qualitative score is assigned to each criterion per municipality:

- 2 = meets well
- 1 = meets moderately
- 0 = does not meet.

This matrix allows us to visualize which alternatives stand out in each criterion and support the final selection:

Table 9: Multicriteria evaluation of candidate locations for charging points

Municipality	Geographic coverage	Complementarity with the existing network	Coverage for the resident population	Health and administrative services	Strategic location	Electrical and digital infrastructure	Impact on emissions and climate change	Global evaluation	Result
Moraleja	1	0	2	2	2	2	2	11	Discarded (EV charger already exists)
Valverde del Fresno	2	0	2	1	2	2	2	11	Discarded (EV charger already exists)
Perales del Puerto	1	2	1	0	2	1	1	8	**Selected (Central strategic location)**
Gata	1	0	1	0	0	1	1	4	Discarded (EV charger already exists)
Hoyos	2	0	1	1	2	1	1	8	Discarded (EV charger already exists)
Cilleros	2	2	2	1	2	2	2	13	**Selected (Western strategic location)**

Some populations are ruled out mainly due to the existence of previous EV charging infrastructure (complementarity criterion).

In the case of Perales del Puerto, it is considered the best central option strategic location compared to Hoyos, thanks to its more direct access from the Moraleja–Coria axis and its complementarity routes with Valverde del Fresno (various routes), in addition to the lack of a EV charger.

As a summary of the selection of the municipalities where the chargers will be installed, we can indicate:

- **Coria:** An EV charger will be installed at the regional hospital. This charging point will serve the largest population and will be in a key healthcare center, guaranteeing access to EV charging while users make medical visits. Coria is also the main administrative center nearest the Sierra de Gata region. It also has good road connections, as an intersection of several major regional roads (EX-A1, EX-108, EX-109), which facilitates travel in multiple directions. The installation at the hospital ensures adequate electrical connection and connectivity, and its positive impact on greenhouse gas emissions will be significant, by electrifying frequent trips to the main healthcare and administrative center.

Figure 1: Coria EV charger location

Latitude: 39° 59' 28.76697"
Longitude: -6° 32' 29.89395"

- **Cilleros:** An EV charger will be installed at the urban center of this municipality. It will serve the western and south-central Sierra de Gata region, serving not only its more than 1,813 inhabitants but also the population of neighboring municipalities (Valverde del Fresno, Villamiel, Trevejo, San Martín de Trevejo, and Eljas), which together add up to another 4,000 inhabitants. As there are no operational EV charging points in this remote enclave, the incorporation of this infrastructure will fill an important gap. The central location of Cilleros will allow shared electric vehicles to efficiently cover the long distances separating this area from services in Coria/Moraleja. In terms of environmental impact, this point will significantly reduce CO_2 emissions by avoiding travel in combustion vehicles in the western and south-central regions. In short, Cilleros is a strategic and necessary location to ensure equitable territorial coverage for the project.

Figure 2: Cilleros EV charger location

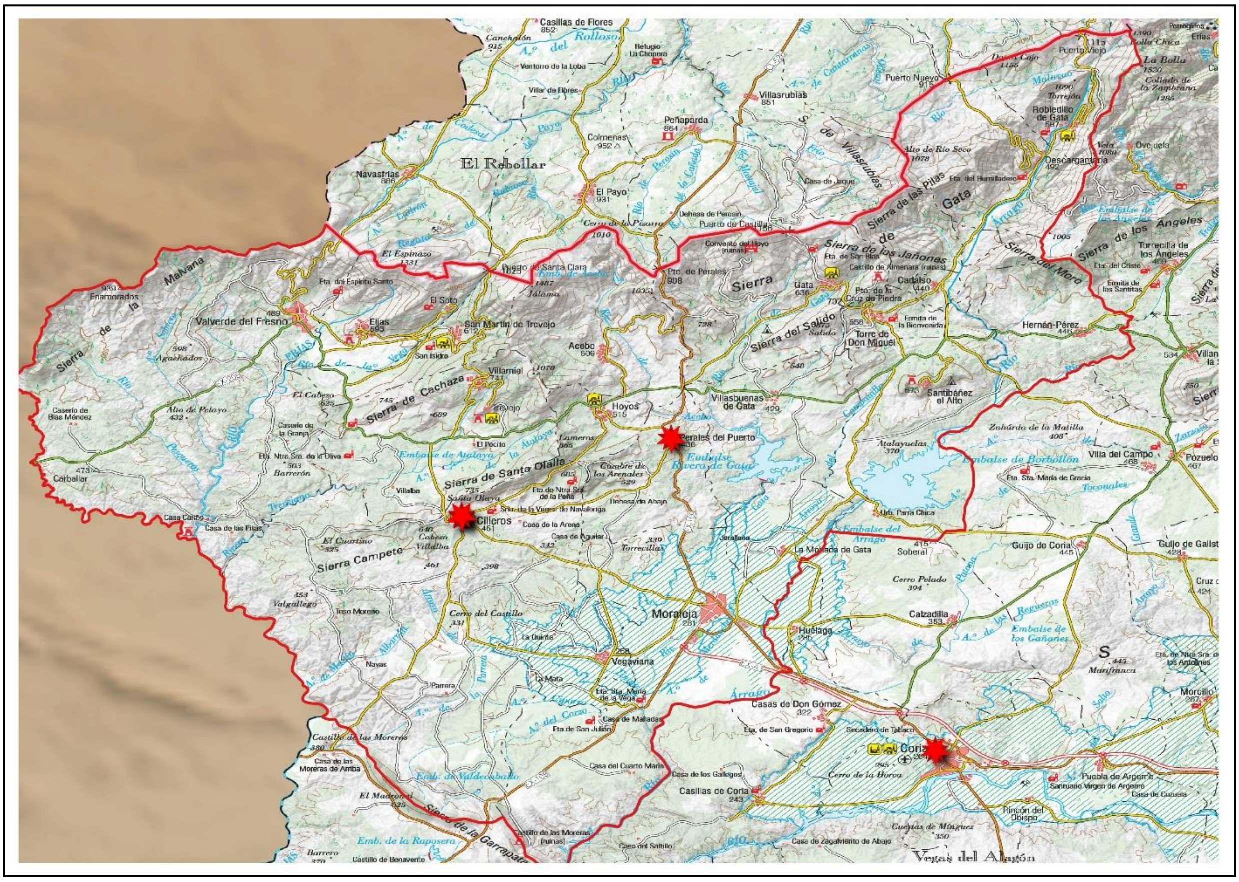
Latitude: 40° 6' 53.62346"
Longitude: -6° 47' 33.47889"

- **Perales del Puerto:** An EV charger will be installed at the main regional road that crosses this municipality. This central location aims to provide coverage throughout the region, connecting the infrastructure with the largest possible number of surrounding towns. Perales del Puerto is in the geographic center of Sierra de Gata region and on the main road (EX-109), allowing it to serve as a connecting node between the southern corridor and the routes to the north and east. Installing an EV charger in Perales del Puerto will directly benefit its residents and those in nearby towns, who would have an accessible EV charging point for its use. Although Perales del Puerto is small, the choice is justified by the broad territorial coverage it provides: virtually any resident in the northern/eastern half of the region would be less than 15 km from an EV charging point thanks to this installation.

Figure 3: Perales del Puerto EV charger location

Latitude: 40° 9' 24.45883"
Longitude: -6° 40' 53.83300"

Map 3: Location of Spanish pilot EV charging stations



REMARKS ON THE STRATEGIC LOCATION OF THE CAHRGING INFRASTRUCTURE

The three selected locations – Coria (Hospital), Cilleros, and Perales del Puerto – offer an optimal distribution for the EV pilot charging stations. This selection achieves:

- Extensive territorial coverage of the Sierra de Gata region, serving the north, south, east, and west.
- Synergy with the existing EV charging infrastructure, as duplication is avoided in that towns where EV charging stations are already active, concentrating investment in underserved areas.
- Service to the majority of the resident population (more than 80% of the Sierra de Gata region's inhabitants would fall within the catchment area of one of the three EV charging points).
- EV charging access in towns linked to key public services.
- Strategic locations that minimize detours and optimize routes for shared electric vehicles.
- Guaranteed technical feasibility, as they are located in areas with existing basic electric infrastructure.

- A notable impact on the reduction of greenhouse gas emissions, by promoting the use of electric vehicles in those journeys that are currently made in combustion vehicles, especially in rural areas where distances to services are very long.

This configuration of charging points aims to ensure the success of the RuralMED Mobility pilot project in Sierra de Gata, facilitating the adoption of shared electric transport by the rural population and contributing to the decarbonization of rural transport.

2.1.3. Investment Considerations and Economic Feasibility

The investment considerations and economic feasibility analysis of the Spanish pilot project, within the framework of the RuralMED project, are prepared with a clear objective: to demonstrate that electric mobility in rural and semi-urban areas is not only environmentally sustainable, but also economically viable and replicable.

Within the scope of the Rural MED Mobility project, JUNTAEX proposed to implement the following elements: 3 EV charging stations with 22 kW rated power (one in the city of Coria, a regional travel hub with administrative and healthcare services, and two others in small towns in the rural mountain area of Sierra de Gata); renting of 2 Electric Vehicles; a Fleet Monitoring Software; and a Shared Mobility Platform.

The total investment planned for the implementation of the pilot reaches approximately 100,000 € (including external expertise and services, equipment and infrastructure and works costs). The sources of financing are Interreg Euro-MED funds (80%), and own JUNTAEX public funds (20%).

The breakdown of costs for this investment is as follows:

3 EV charging stations implementation

Taking into account the drafting of the execution project by qualified technicians, the execution of the necessary works, the acquisition and installation of the charging points and their associated costs (licenses, access to the electrical network, etc.) the total cost amounts to approximately 53,000 €.

Renting/Leasing of 2 Electric Vehicles

Taking into account the characteristics of the 2 electric vehicles rented by JUNTAEX, the consumption and main characteristics that should be considered in the feasibility study are presented below:

Table 1: Main characteristics of the Electric vehicles

Vehicle type	Capacity (passengers)	Battery (kWh)	Autonomy (km)	Recharge time (h)	Consumption (kWh / 100 km)	PRM adaptation
Medium van (Type A)	5 (or 4 + 1 PRM)	45	285 (WLTP)	5	18-20	Yes
Big van (Type B)	8 (or 5 + 1 PRM)	75	330 (WLTP)	7	20-25	Yes

- Medium van (Type A): Recommended due to its smaller size and lower fuel consumption, this vehicle is ideal for individual trips or small groups needing to carry out administrative tasks, and for users who don't require a large luggage capacity. Its maneuverability facilitates access to towns with narrow streets and parking in reserved spaces. It can be adapted for a wheelchair-accessible passenger space.
- Big van (Type B): This model will be suitable for group transport, routes with higher demand for seats, or event support, and especially for wheelchair users with companions, thanks to its spacious interior. This vehicle also guarantees greater autonomy, providing flexibility for longer journeys within the region or trips to larger urban centers if necessary.

The following is an estimated breakdown of operating costs:

- Monthly leasing fee per vehicle: Includes vehicle rental, comprehensive maintenance, insurance, and taxes. Based on market offers for similar vehicles, the estimated fee is around 400-450 € per month for Vehicle A and 550-600 € per month for Vehicle B, considering approximately 15,000 km per year. The total estimated monthly investment would be around 1,000 € for both vehicles combined, a figure that serves as the basis for the financial planning of the pilot project.
- Maintenance and repairs: Since these are included in the lease, they do not represent a significant variable expense during the contract period. However, it is important to note that electric vehicles have lower maintenance costs than combustion engine vehicles. An estimated 20-30% reduction in routine maintenance costs (services, spare parts) is seen compared to an equivalent diesel vehicle, thanks to their lower mechanical complexity (fewer moving parts, no engine oil, less brake wears due to regenerative braking, etc.). This lower maintenance translates into greater vehicle availability and shorter downtimes.
- Insurance and taxes: Leasing typically includes comprehensive insurance with no or reduced excess, adapted to shared use (multiple authorized drivers). It also includes the municipal vehicle tax, which is often reduced by 75-100% in many municipalities for zero-emission vehicles (in Extremadura, many local councils offer the maximum discount for electric vehicles). 24-hour roadside assistance, passenger coverage, and

extended civil liability insurance are also provided, given the public service nature of carsharing.

- Electricity consumption: This is the main variable operating cost. An average consumption of approximately 18-20 kWh/100 km is estimated for the medium-sized vehicle (Type A) and approximately 20-25 kWh/100 km for the larger one (Type B), under mixed rural usage conditions (including varied orography and air conditioning). If each vehicle travels approximately 1,000 km per month (assumed for the pilot, variable depending on demand), the monthly consumption would be around 180-250 kWh per vehicle. At the nighttime electricity rate (approximately 0.15 €/kWh), the energy cost would be only 27-37 € per month per vehicle (even using the daytime rate of approximately 0.20 €/kWh, it is approximately 36-50 € per month), totalling less than 100 € per month for both.

In summary, the annual operating cost of the pilot fleet (2 vehicles) consists mainly of approximately 12,000 € in leasing fees and around 1,000 € in electricity, plus minor expenses.

This is substantially cheaper than operating a similar fleet of combustion engine vehicles when considering fuel costs and the higher maintenance of the latter.

The following table comparatively illustrates the estimated annual cost per electric vehicle versus an equivalent diesel vehicle:

Table 2: Comparison of annual costs and greenhouse gas emissions: electric vehicle vs. conventional diesel vehicle

Concept	EV (Carsharing) per vehicle/year	Diesel equivalent (reference)
Energy/Fuel	~2.400 kWh ≈ 360 € (0,15 €/kWh)	~600 L diesel fuel ≈ 900 € (1,50 €/L)
Maintenance	~150 € (inspections, tires)	~300 € (mechanical work + inspections)
Insurance + taxes	included in leasing fee	~600 € insurance + 100 € taxes
Renting/Leasing Fee	~6.000 €	not applicable, vehicle owned: amortization ~€5,000
Total anual	~6.510 €	~6.900 € + amortization vehicle
CO_2 emissions	0 tons	~1.5 tons (at 150 g/km, 10,000 km/year)

In the case of the EV, the majority of the cost corresponds to the leasing fee (which includes the vehicle, maintenance, insurance, and taxes), while with the diesel vehicle, it is considered an outright purchase with its expenses itemized.

All other things being equal, the total cost of the EV is competitive, with the added advantage of zero direct emissions and potential additional savings if fossil fuel prices rise.

In conclusion, the proposed lease of two accessible EV allows the project to meet its sustainability and inclusion objectives. Through a fully included lease, the continuous operation of the small vehicle fleet is guaranteed, minimizing the administrative burden on the user (since maintenance and insurance are managed by the leasing company) and ensuring predictable costs.

The selected vehicles are technically suitable for the rural environment of Sierra de Gata region, offering enough range, capacity for users (including people with reduced mobility), and full compatibility with the planned infrastructure.

Fleet Monitoring Software and a Shared Mobility Platform

Considering the market prices for this type of transport digitization system, the implementation and operating costs for both systems have been estimated at approximately 30,000 €, up to the deadline of the pilot.

2.1.4. ICT Integration

ICT integration is one of the priority objectives of the RuralMED Mobility pilot project, ensuring the digital deployment of electric vehicle charging infrastructure and enabling it to be digitally connected, monitored, and ready for future interoperability.

Investments in the fleet monitoring software and the shared mobility platform will enable this connectivity of the EV charging infrastructure, allowing system management and data exchange with the central ICT platform developed within the RuralMED Mobility project.

Each station will support remote user authentication, session tracking and system control, ensuring secure and user-friendly operation. The EV chargers are designed to connect via GSM/4G-5G or Ethernet, providing flexible options for network integration even in areas with limited infrastructure.

The Spanish pilot project will enable bidirectional communication between electric vehicle chargers, rental electric vehicles, and RuralMED's central ICT platform by complying with the OCPP 1.6 protocol (or equivalent). This will allow for real-time or periodic data transmission to a central ICT platform developed within the project.

This bidirectional ICT communication with the core RuralMED ICT platform will enable the automatic generation of reports on key operational metrics, such as charging duration, energy supplied, and session timestamps, which are essential for monitoring the pilot project, benchmarking performance, and planning its replication. These features also allow for future integration with Mobility as a Service (MaaS) applications or regional transport digital planning systems.

➢ 2.2 Croatia

2.2.1. Demand Analysis for Charging Stations

Croatia has experienced notable growth in electromobility in recent years. National statistics show that the stock of Battery Electric Vehicles (BEVs) grew by 118 % from 2021 to 2023, reaching 10,554 vehicles. When including hybrid vehicles (HEVs and PHEVs), the total reached over 59,000 units in 2023. However, in rural areas such as Koprivnica-Krizevci County—the focus area of the Croatian pilot—the absolute number of EVs remains low, with only 113 BEVs recorded in 2023. This low penetration highlights both the need and the opportunity: by improving visibility and accessibility of EV charging infrastructure, the project aims to accelerate uptake and reduce "range anxiety" for prospective users.

A fundamental step in deploying electric vehicle (EV) infrastructure in rural areas is accurately assessing the local demand for charging services. Within the RuralMED Mobility project, demand analysis was conducted to identify optimal locations for EV charging stations by integrating regional mobility patterns, demographic characteristics, and accessibility to key services. Particular focus was placed on underserved territories where traditional market-driven investments are lacking, often due to low population density and limited short-term profitability. In these contexts, strategic placement of charging points is vital to reduce "range anxiety" and enable equitable access to low-carbon mobility.

The analysis combined multiple criteria including population coverage, proximity to healthcare and administrative facilities, tourism flows, and cross-border connectivity. For instance, in Croatia, the selection of health centres in municipalities such as Gola, Kalnik, Ferdinandovac, and Gornja Rijeka responded to both technical feasibility (grid connection and space availability) and local relevance, ensuring visibility and frequent usage. Moreover, regional statistics and travel behaviour data were reviewed, highlighting areas with high intermunicipal transport dependency and insufficient public transport options.

The methodology also accounted for future demand trajectories by considering ongoing trends in EV adoption, availability of fiscal incentives, and public awareness levels. Regional self-assessment reports provided by project partners highlighted that in many MED rural areas, charging infrastructure is not only insufficient but also poorly integrated into regional transport planning. Thus, the demand analysis framework in this methodology serves to ensure that investments are not only technically justified but socially impactful, forming the basis for scalable, need-based infrastructure expansion.

2.2.2. Strategic Allocation of Charging Infrastructure

The strategic allocation of EV charging infrastructure within the RuralMED Mobility project is guided by a multi-criteria approach that balances technical feasibility, local relevance, and broader regional equity. Unlike urban areas where charging station placement is primarily influenced by commercial potential and high turnover rates, rural and remote territories require a more nuanced methodology. The objective is not only to install infrastructure, but to ensure that it serves as a catalyst for behavioural shift, community inclusion, and sustainable mobility transformation.

To achieve this, pilot locations were selected based on several criteria: accessibility and visibility, proximity to essential public services, compatibility with existing electricity networks, and potential for replication. For example, in Croatia, charging stations were allocated to four health centres across Koprivnica-Križevci County—Gola, Kalnik, Ferdinandovac, and Gornja Rijeka. Each location presents a unique strategic value: Kalnik caters to seasonal tourism flows, Gola supports cross-border mobility with Hungary, Ferdinandovac aligns with regional traffic along the D2 corridor, and Gornja Rijeka serves as a representative rural benchmark for measuring long-term adoption in low-density areas.

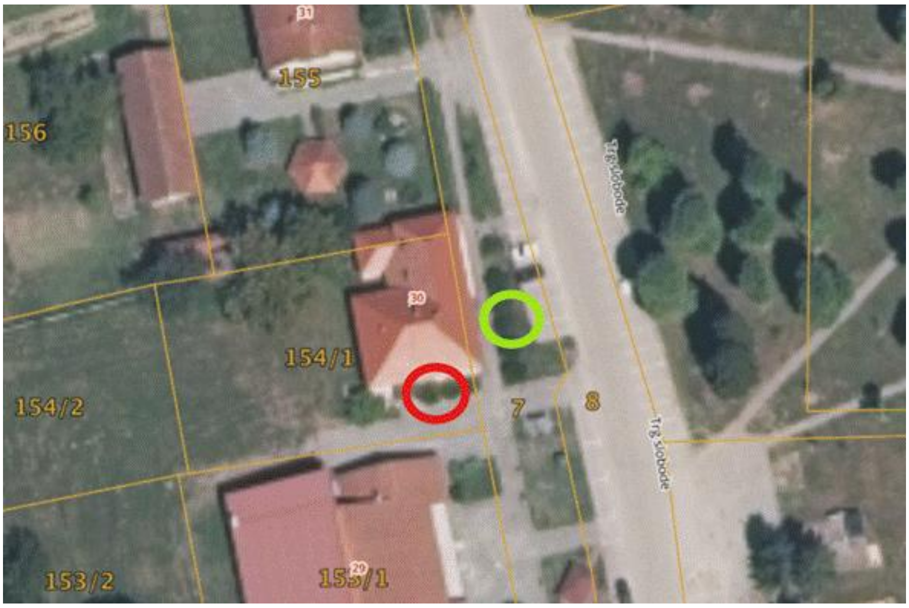
This targeted approach draws on existing regional knowledge, technical assessments, and partner expertise to evaluate factors such as grid availability, service accessibility, and community relevance. Rather than relying on commercial locations with high turnover, the methodology prioritizes integration into public service infrastructure—such as health centres—where visibility and utility can support long-term behavioural change and equitable access. This choice enhances public ownership, fosters institutional capacity-building, and positions the infrastructure as a shared community asset rather than a market-driven commodity.

From a technical perspective, all chargers deployed in the pilots will be AC stations of up to 22 kW, ensuring compatibility with existing low-voltage grids and avoiding the need for costly upgrades. Their modular design allows for future expansion and testing of variable loads. Importantly, the allocation strategy also considers future integration with renewable energy sources and smart grid applications, laying the groundwork for decentralized energy ecosystems.

The locations for the EV charging stations were carefully selected based on key criteria, including high-traffic areas within the four municipalities. The chosen EVCS sites—Health Centers in Gola, Ferdinandovac, Kalnik, and Gornja Rijeka—will be integrated into existing parking infrastructure to ensure accessibility and convenience.

LOCATION 1: Municipality of Ferdinandovac

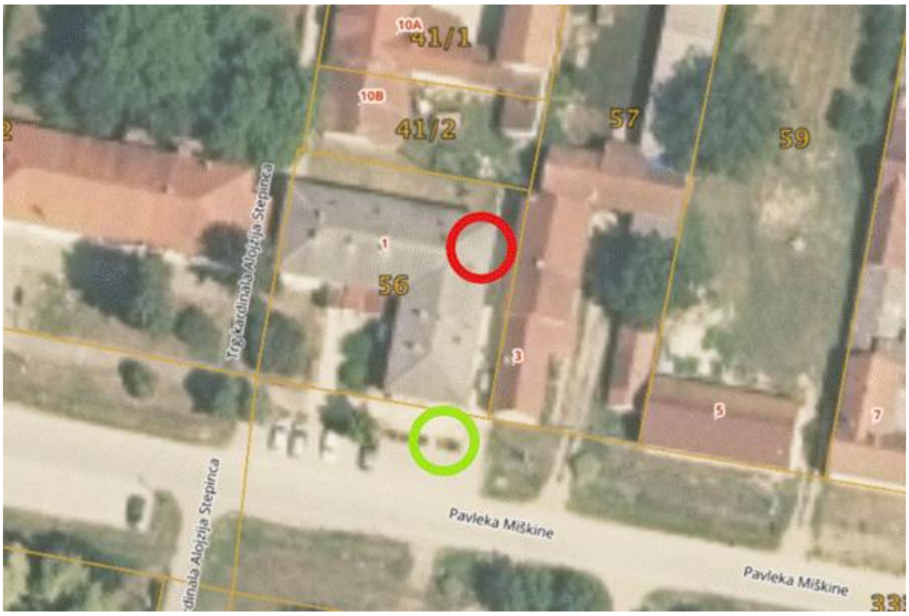
- Ferdinandovac, near the Drava River valley (the D2 highway route), offers connectivity to a key regional transportation corridor.



Picture 1 Aerial representation of the location for the EVCS in the Municipality of Ferdinandovac

LOCATION 2: Municipality of Gola

- Gola, located along the Hungarian border, was selected for its strategic position, enhancing cross-border mobility.



Picture 2 Aerial representation of the location for the EVCS in the Municipality of Gola

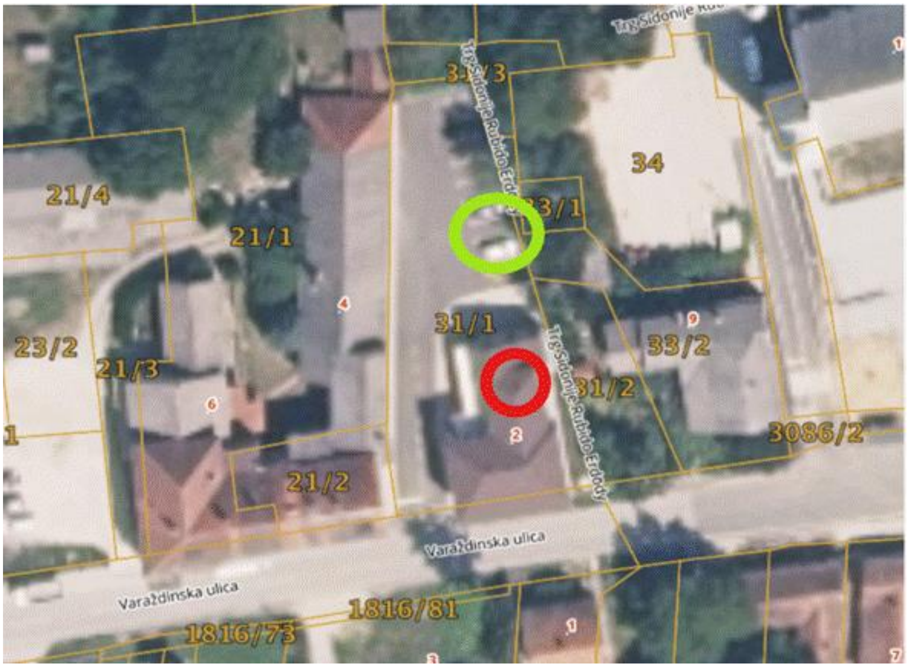
LOCATION 3: Municipality of Kalnik

- Kalnik, a popular tourist destination, enables analysis of seasonal charging patterns and supports tourism-focused planning.

Picture 3 Aerial representation of the location for the EVCS in the Municipality of Kalnik

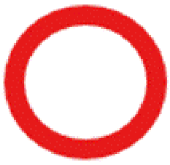
LOCATION 4: Municipality of Gornja Rijeka

- Gornja Rijeka, a typical rural municipality, will provide a valuable benchmark for evaluating EV adoption in less densely populated areas.



Picture 4 Aerial representation of the location for the EVCS in the Municipality of Gornja Rijeka

Legend:

	**Approximate location for connecting the charging station to the building's distribution cabinet**
	**Approximate location for installing the charging station**

These locations were also chosen for their reliable electrical availability, proximity to grid connection points, and sufficient space for installation. By placing EVCSs in rural municipalities beyond major commercial hubs, the project aims to increase EV adoption in these areas while fostering broader accessibility and sustainable mobility.

2.2.3. Investment Considerations and Economic Feasibility

Deploying EV charging infrastructure in rural areas requires a tailored investment strategy that accounts for low initial utilization, limited private sector interest, and constrained public budgets. The RuralMED Mobility approach emphasizes cost-efficiency, long-term public value, and low-barrier access for citizens. Investment decisions within the pilot territories were therefore shaped by pragmatic factors: compatibility with existing infrastructure, avoidance of costly grid upgrades, and maximization of social return over direct financial return.

To reduce installation costs and operational complexity, the pilots opted for standard AC charging stations with up to 22 kW output. These are sufficient for the expected charging patterns in rural settings—longer dwell times, overnight parking, or partial top-ups at community hubs—without requiring high-voltage upgrades. In Croatia, for example, the decision to install chargers at public health centres enabled the use of existing parking and utility connections, significantly lowering deployment costs.

All charging stations are publicly accessible and free of charge during the pilot phase. Based on a conservative usage estimate of 2 hours per day per charger, the network is expected to deliver approximately 64,240 kWh of electricity per year. Assuming average EV consumption of 17 kWh/100 km, this equates to roughly 377,882 km of electric travel annually. When compared to diesel vehicle consumption (7 L/100 km) at an average price of €1.44/L, the pilot avoids the use of approximately 26,452 litres of fuel, representing an annual cost saving of around €38,090 for users

This investment is not designed to generate short-term financial return but rather to unlock long-term social, environmental, and institutional benefits. It contributes to the reduction of transport-related emissions, supports regional energy and climate targets, and serves as a demonstrative model for rural e-mobility development in Croatia and beyond. By focusing on accessible, moderately priced infrastructure with public utility, the pilot lays the foundation for broader replication and integration with future smart grid and shared mobility services.

2.2.4. ICT Integration

ICT integration is a critical pillar of the RuralMED Mobility pilot methodology, ensuring that EV charging infrastructure is not only physically deployed but also digitally connected, monitored, and ready for future interoperability. The Croatian pilot will incorporate smart functionalities into all charging stations through compliance with the Open Charge Point Protocol (OCPP 1.6 or equivalent), enabling real-time or periodic data transmission to a central ICT platform developed under the project framework.

Each station will support remote user authentication (via RFID, NFC, and mobile activation), session tracking, and system control (e.g., remote locking or power cutoff), ensuring secure and user-friendly operation. The chargers are designed to connect via GSM/4G or Ethernet, providing flexible options for network integration even in areas with limited infrastructure. Power management features such as software-based load balancing are included to optimize energy usage and avoid local grid stress.

Importantly, the Croatian pilot will enable bidirectional ICT communication between the chargers and the central RuralMED ICT platform. This allows automated reporting of key operational metrics—such as charge duration, energy delivered, and session timestamps—which are essential for pilot monitoring, performance benchmarking, and replication planning. These features also allow future integration with Mobility-as-a-Service (MaaS) applications or regional transport planning systems.

By embedding connectivity and data-sharing into the pilot infrastructure from the outset, the Croatian implementation will ensure that the EV charging network is not only functional, but intelligent—capable of supporting data-driven decision-making, transparent reporting, and alignment with emerging standards in smart mobility.

➢ 2.3 Portugal

2.3.1. Demand Analysis for Charging Stations

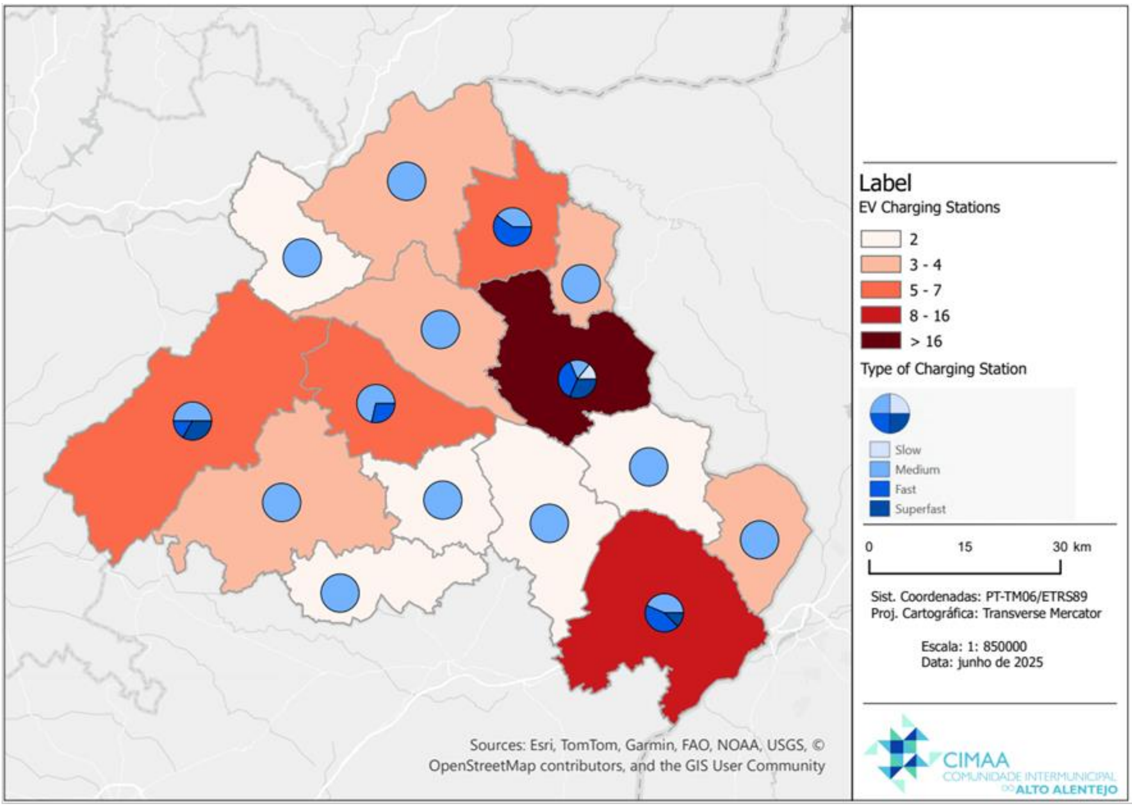
The demand for Charging Stations can be calculated from a set of multiple factors, nevertheless we choose to on the following two because of their impact on the subject and because the available data we have on them, at the national and sub-regional level.

Growing EV Adoption:

In terms of EV mobility, the national data leans toward a fast developing adoption by the portuguese population. The two main indicators available are the "Share of new passenger vehicles that are electric or plug-in hybrid" (ourworldindata.org, 2025) and the "Stock of electric vehicles by category" (Eurostat, 2025). Both indicators almost duplicate between 2018 and 2019. The Stock of electric vehicles in Portugal rose 1100% in just 5 years, from 2018 to 2023, ending the last year with more than one hundred and ten electric vehicles in stock. The share of new passenger vehicles that are electric or plug-in hybrid has its last value of 5.7% in 2019, representing almost the double of the year before.

Public Charging Infrastructure Development:

When analysing the Charging Stations availability in Alto Alentejo it is easily detectable the discrepancies of infrastructure, compared to those observed in metropolitan areas like Lisbon or Porto. Nevertheless, the local situation is interesting because more than half of the chargers in Alto Alentejo are fast or superfast chargers of level 3 (35/98 available units of class 3). Most of these equipment's are implemented by private companies in their commercial facilities, like for example supermarkets and gas stations. Although these types of investments are good for the region's infrastructure they are mainly designed and executed for private purpose, due to competitive leverage on the market. Hence the superfast charger's investment, to enable the charging of most of the battery during shopping time. On the other hand, there are 63 chargers of class 1 or 2, that although they might seem unattractive when compared to the higher speed chargers, they represent the majority of the network and might be crucial to the citizens perception of the infrastructure, and even as an important factor for the adoptions of electrical mobility by the locals.



EV Chargers Network of Alto Alentejo in 2025

When considering the map of electric vehicles chargers (above) we easily understand the low availability of equipment's throughout the sub-region. The mean of chargers available in the network is around 6 chargers per municipality. If we don't consider the 2 main cities (Portalegre and Elvas), this mean is reduced to around three and a half chargers per municipality. It is fair to conclude that most municipalities in Alto Alentejo do not possess robust EV charging infrastructures, with less than 5 chargers and most of them being under 22kW (Slow/Medium). Most of the Fast and Superfast chargers are in the urban municipalities like Ponte de Sor, Elvas and Portalegre, due to private investment made considering private usage.

2.3.2. Strategic Allocation of Charging Infrastructure

Within the scope of the Rural MED Mobility project, and in accordance with the provisions of the Application Form, the installation, by CIMAA, of two charging stations in two different locations is being considered. These facilities must be installed in the Municipality of Portalegre, which is one of the municipalities involved in the project. To this end, some assumptions were taken into account in order to evaluate the best locations for the installation of the PCVEs, the highlights being:

- The two charging stations will be used by CIMAA for exclusive charging of the two electric vehicles to be acquired under a leasing/renting arrangement and for a period of 18 months;
- The use of these infrastructures by other entities (e.g. Municipalities, Portalegre Polytechnic Institute, AREANATejo, among others), when completed the period of 18 months, and up to 5 years after the last report's submission;
- After the 5 years identified in the point above, it is expected that the charging stations can be exchanged to a Charging Point Operator (CPO) who will be responsible for the operation and maintenance of the infrastructures.

In order to assess the technical and economic feasibility of installing the charging stations, several locations were previously selected and an on-site visit was carried out in order to evaluate the following factors:

- Proximity of the locations to CIMAA facilities, given their exclusive use for a period of 18 months;
- Conditions for connection to the distribution network (proximity to low voltage connection points);
- Identification of the available spaces for electric vehicles and, in parallel, the space available for installing the charging stations.

Location 1

One of the locations considered for the installation of a charging station was identified when the project's Application Form was prepared and will be on Rua 19 de Junho, close to the CIMAA's facilities, adjacent to their parking lots.

Coordinates: 39.290857, -7.431607

Aerial representation of location 1 for the installation of the charging station – Rua 19 de Junho

Location 1 charging station instalation – Rua 19 de Junho

CIMAA already has 2 parking lots reserved for its vehicles on site. In terms of electrical infrastructure, a distribution cabinet is installed next to the site where the connection to the grid can be made, thus simplifying the execution of the connection work to the grid.

Location 2

Considering the assumption that the charging stations would be used exclusively by CIMAA for a period of 18 months, the second location for the installation of the PCVE was chosen taking into account the proximity of the parking lots to CIMAA's facilities. However, considering the scope of its future use, locations at least 200 m from CIMAA's facilities, were considered for analysis, thus enhancing the disaggregation of charging solutions and the non-overlapping of charging stations.

Thus, for the second charging station installation location, four possibilities were defined and analysed.

For the second charging station installation location, four possibilities were defined and the advantages and disadvantages of each were duly analysed. In this way, it was possible to define the location for the installation of the second charging station, taking into account the following:

- Availability of spaces outside the paid parking concession;
- Ease of installing the PCVE given the available space;
- Ease of identifying spaces;
- Area with natural shade;
- Proximity to places of interest;
- Low-voltage electricity distribution infrastructure with power availability and close to the required location.

Aerial representation of the location for the installation of the second charging station – Largo da Boavista Parking Lot

Location 2 charging station installation – Largo da Boavista

To assess the technical characteristics of the PCVEs to be considered, as well as the necessary investment, budgets were requested from several companies belonging to the list of manufacturers validated for the Mobi.E network.

Location 1: Rua 19 de Junho

- Coordinates: 39.290857, -7.431607
- Charging station with 2x 22 kW socket

Location 2: Largo da Boavista Parking Lot

- Coordinates: 39.288417, -7.429699
- Charging station with 2x 22 kW socket

In order to meet the conditions for supplying electricity to the charging stations, a Grid Connection Request (GCR) was made for each location. The following steps are highlighted for this type of request:

1. Request
2. Analysis of documentation

3. Opening
4. Submission of initial charges (if necessary)
5. Acceptance and payment of initial charges (if necessary)
6. Preparation of the budget (grid connection services)
7. Acceptance and payment of the budget
8. Execution
9 Conclusion

Once both processes have been completed (connection elements and connection services), the electricity supply contract can be signed.

2.3.3. Investment Considerations and Economic Feasibility

Within the scope of the Rural MED Mobility project, CIMAA proposed to implement the following elements: 2 EV charging stations; renting of 2 Eletric Vehicles; a Fleet Monitoring Software; and a Shared Mobility Platform. AREANATejo proposed to carry out the survey of the municipal fleet and develop feasibility studies for the electrification of CIMAA's fleet, which includes proposals to change the current vehicles for EVs; Research the best locations for the new charging stations in rural spaces; Propose the best adapted combination of MaaS services with the help of the existing networks and EV fleet (the already existing and the rented EV); and finally, to study the feasibility of cross-border interoperability with the nearby Spanish region of Extremadura.

Taking into account the electric vehicles rented by CIMAA, the consumption and main characteristics to be taken into account in the feasibility study are presented below:

- Urban - 8.8 kWh/100 km - autonomy 336 km;
- Combined - 13.3 kWh/100 km - autonomy 228 km.

Each electric car is expected to make the equivalent of 3 full charges per week, with a battery capacity of 26,8 kWh, and taking into account that they will be used in a mixed cycle, which translates into a range of 228 km per charge. In order to have comparable data, in the case of the Diesel car, a consumption of 7l/100 km and a price of 1,70 €/l of fuel were considered.

In other words:
It is estimated that each vehicle will travel around 2.736 kilometres per month, representing an electricity consumption of 321,6 kWh/month. Assuming an electricity cost of 0.22 €/kWh, the estimated monthly cost will be approximately 70.75 €/month/vehicle.

If we compare this to a Diesel car, with an average consumption of 7 l/100 km, at 1,70 euros per litre, the cost of diesel for each vehicle is 316 euros/month,

Thus, the cost reduction to be considered will be approximately **9200 euros**, during the monitoring period of the use of electric vehicles (18 months).

This type of investment contributes to the creation (in the medium/long term) of a consolidated network of EV charging stations in the region, as well as the improvement of environmental quality indicators through the decarbonization of mobility, promoting the quality of life of citizens as well as the development of the region.

Territorial Impact:

- Environmental: Reducing emissions, encouraging sustainable mobility.
- Economic: Stimulus to local commerce, more appealing to those travelling in electric vehicles. Attraction of sustainable tourism investments.
- Social: Improved accessibility and quality of life for the population. Improvement on the perception of the territory by inhabitants and visitors.

2.3.4. ICT Integration

All the investments proposed to Alto Alentejo have a strong digital component, starting by both platforms that are manageable via web app and allow the extraction of both raw data and detailed reports largely customizable.

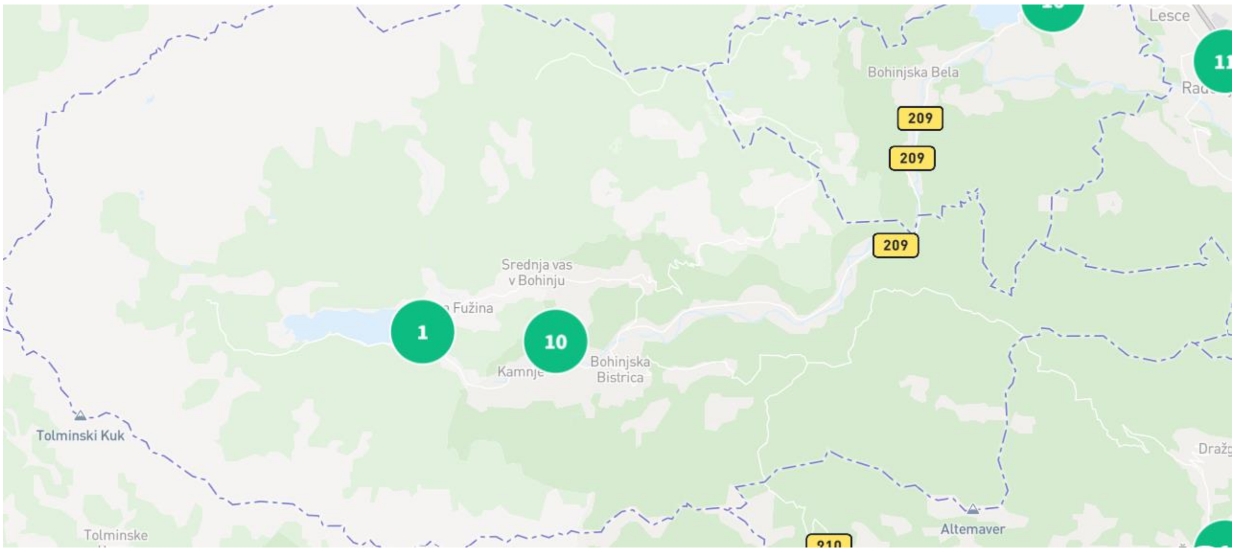
The platform for monitoring and managing the fleet also allows for in Real-time tracing of the fleet's assets as well as extraction of CO2 Emissions Report.

Related to the main pilot investment, OPCC v1.6 or above was defined as an obligation throughout the procedure, for which the integration to the project's platform is guaranteed.

➢ 2.4 Slovenia

2.4.1. Demand Analysis for Charging Stations

In 2024 the official publicly available data show that from 1.3M registered personal cars in Slovenia, there were only 1% of battery electric vehicles. The number of electric vehicles charged on Slovenian charging stations by tourists is not publicly known. For a municipality in a rural area, it is very difficult to evaluate the demand for charging since existing electric charging infrastructure has different charging point operators and data are not publicly available. From the observation one may say that the demand for charging EVs is increasing in the touristic municipalities like Bohinj for several years. Private tourism service providers like apartments or hotels are installing charging infrastructure for EVs to attract tourists with EVs. Also, the number of public electric charging stations in the Bohinj Municipality has been slowly increasing in 2025 numbering to 9 ECS, including the one installed within the project activities of RuralMED Mobility project. There are also two Tesla and one Porche destination chargers in the destination. Therefore, in total there is 12 available electric charging stations in the Bohinj Municipality in mid 2025.



Source: GRID

Since Bohinj Municipality is rural, has many remote settlements and is positioned in the heart of the Triglav National Park it offers transport on call with an e-van. Since the demand has been slowly increasing and more km are driven by transport on call EV, the e-van needs to be charged faster to accommodate the demand. RuralMED Mobility project supports municipality to overcome several issues. First it solves the problem of fast charging by installing 50kW DC charging option and by monitoring the demand and km driven and charging events, the data gathered in a pilot period will enable planning not just transport on call capacities, but with making electric charging with additional option of charging with 22kW AC available for general public, due to the location also analysis of demand for charging EVs can be done with usable results for further strategic planning.

2.4.2. Strategic Allocation of Charging Infrastructure

The electric charging station with two connectors, one 5okW DC and another with 22kW AC is located on a strategic location on parking lot camp Danica in Bohinjska Bistrica, near the camp, the restaurant Danica and very near the centre of the Bohinjska Bistrica. The parking lot is a perfect spot for park and ride, where people may choose to charge their EVs and use transport on call or bus, since a bus stop is also positioned on the parking lot. The Municipality plans to set up on this location a one level underground parking garage, while the ground level will be greened and dedicated to bus stops and transport on call.

Copy right: BSC Kranj

Copy right: BSC Kranj

2.4.3. Investment Considerations and Economic Feasibility

Within the scope of the Rural MED Mobility project, BSC Kranj has, as mentioned in the previous text, set up an electric charging station with all the construction and installation works, documentation needed for the investment and labour costs and other corresponding costs with 80% of EU funds co-financing. The EV has already been available and has been purchased and leased out to the Municipality Bohinj by Triglav national Park Public Institute, This EV has also been co-financed by 80% by national grands. In terms of costs of electricity, maintenance, 24/7 operation and help desk services, those costs will be covered by the consumers and the CPO (charging point operator). Also, the existing slow electric charging stations enabling the e-van for the transport on call to charge with 11kW have been purchased with 100% national financial incentives. Without financial incentives the investment would not make economic sense in comparison with establishing transport on call with internal combustion engine vehicle. In 2022 when the e-van was purchased the price difference between ICE and EV van has been significant. The electricity for charging has to be purchased on the market. The ECS infrastructure had to be built, while the infrastructure for the ICE vehicles has been existing for decades. Beside this, used ICE van, aging over 10 years may be sold for a higher price than over 10 years old e-van. Therefore, the RuralMED Project significantly contributed to the investment economic feasibility. The monitoring of e-van use and charging by the project's monitoring platform will be able to determine other hidden financial savings.

Copy right: TNP

2.4.4. ICT Network Integration and Route Planning

Transport on call in the Bohinj Municipality is connected to ToyotaGo application, a unique one in Slovenia and it is a product of Slovenian knowledge. ToyotaGo application enables booking of transportation, paying for the service and the real time monitoring of the pick and drop-off locations, optimisation of routs, km driven, number of people driven. For the purpose of monitoring and analysing this data and the demand by daily hours, weekly and seasonally BSC Kranj, with the support of APP developer, connected the ToyotaGo APP to the RuralMED Mobility platform.

The installed electric charging station (ECS) has been connected to the RuralMED Mobility platform in order to monitor and gather data on energy consumption, grid load – peaks, demand in different time segments. The separation of data monitoring is done for the charging of e-van for transport on call by the use of RFID card and the charging of other EVs. ECS is also included in the larger ECS network Gremo na Elektriko and in their roaming system.

On the basis of gathered and analysed data for the period of 18 month, BSC Kranj will prepare a strategy with an action plan for further development.

➢ 2.5 Bulgaria

2.5.1. Demand Analysis for Charging Stations

RuralMED Mobility Project represents a significant step toward overcoming the mobility challenges faced by rural areas in the EU...

1. Regional Context & Identified Needs in Bulgaria

- **Geographic & Economic Setting**: The project specifically addresses underserved rural areas in Bulgaria, especially those impacted by the coal transition. The Stara Zagora region (Yugoiztochen – BG34), which includes **Galabovo and Radnevo municipalities**, is highlighted as having **limited or no current EV infrastructure** and **low market interest from commercial EV operators** due to sparse population density and low short-term profitability.
- **Challenges Identified**:
  - **Range anxiety** due to inadequate EV infrastructure in rural zones.
  - Poorly coordinated or fragmented municipal EV initiatives.
  - Limited technical expertise at the municipal level.
  - Lack of strategic funding mechanisms or policy frameworks for coherent infrastructure development.

2. Targeted EV Solutions in Bulgaria (SZ REDA Pilot Activities)

SZ REDA, together with Galabovo and Radnevo, is conducting a **pilot program** focused on:

- **Infrastructure investment**: Installing EV charging stations in rural municipalities.
- **Innovative use cases**:
  - Public-private partnerships (PPP) for infrastructure development.
  - Integrated EV mobility concepts within local energy systems.
  - Exploring shared EV networks linked to **energy communities** and **grid flexibility services**.
- **Digital tools**: Deployment of ICT platforms for booking, monitoring, and managing EV stations—leveraging tools developed by CIMNE.

3. Demand Forecast Drivers

Key indicators and mechanisms used to assess demand:

- **Feasibility studies** to analyze traffic flows, existing transport gaps, and community behavior patterns.
- **Data collection** on potential user uptake in pilot regions through community engagement and awareness campaigns.
- **Lessons from comparable EU regions**: The ICCT's 2021 study notes that rural EV uptake depends on:
  - Strong municipal policy targets.
  - Purchase and tax incentives.
  - Accessible charging infrastructure (stations per 100,000 inhabitants being a benchmark).

4. Strategic and Policy Impact

The project supports:

- **National Recovery and Resilience Plan (NRRP)** for Bulgaria, promoting green transition.
- **Interoperability and integration** with broader EU EV standards and networks.
- **Capitalization activities** to influence regional and national strategies beyond the pilot scope.

5. Beneficiaries & Market Readiness

- **Primary beneficiaries**:
  - Local residents in Radnevo and Galabovo (expected direct EV users).
  - Municipal authorities, which will benefit from capacity building and improved connectivity.
- **Readiness for scale-up**:
  - Potential exists to replicate models in other Bulgarian rural municipalities.
  - Infrastructure developed in the pilot phase will serve as a catalyst for future market-driven expansion, once basic user demand and grid compatibility are demonstrated.

2.5.2. Strategic Allocation of Charging Infrastructure

RuralMED Mobility Project represents a significant step toward overcoming the mobility challenges faced by rural areas in the EU...

To ensure the **strategic allocation of charging infrastructure in Bulgaria** within the framework of the *RuralMED Mobility* project, the deployment must be aligned with both regional realities and transnational interoperability goals. The following analysis highlights the strategic priorities, allocation criteria, and implementation roadmap for infrastructure in rural Bulgaria, specifically in the **Stara Zagora region (Galabovo and Radnevo municipalities)**.

Strategic Objectives for Allocation

1. **Addressing Infrastructure Gaps in Underserved Rural Areas**
   a. Focus on coal-transition municipalities (e.g., Galabovo, Radnevo) where private EV investment is minimal.
   b. Support just transition by offering mobility alternatives to carbon-intensive industries.
2. **Enabling Range Confidence and Multimodal Connectivity**
   a. Ensure **strategic siting along regional corridors** connecting small towns to larger urban hubs (e.g., Stara Zagora city).
   b. Align with transport-on-demand systems and potential shared EV schemes to offer **last-mile connectivity**.
3. **Interoperability and Cross-Regional Integration**
   a. Integrate with EU-wide charging protocols developed under the EnerNetMob platform.
   b. Use open-access booking and monitoring systems to ensure accessibility for external EV users (e.g., tourists).

Allocation Criteria for Charging Points

Criteria	Details
Population Density	- Prioritize small urban centers and villages with >1000 residents
Public Service Nodes	- Hospitals, municipal buildings, schools – ensures visibility and utility
Transport Corridors	- Sites along primary and secondary roads connecting rural to urban centers
Energy Infrastructure Proximity	- Location near existing electrical substations for cost-effective connection
Tourism & Economic Potential	- Sites near cultural, natural, or eco-tourism areas (to attract EV tourists)

2.5.3. Investment Considerations and Economic Feasibility

RuralMED Mobility Project represents a significant step toward overcoming the mobility challenges faced by rural areas in the EU...

Here is a comprehensive analysis of **Investment Considerations and Economic Feasibility for EV Charging Infrastructure in Bulgaria**, with a specific focus on **rural areas under the RuralMED Mobility project**, particularly the municipalities of **Galabovo** and **Radnevo**.

Investment Considerations

1. Capital Expenditure (CAPEX)

Item	Estimated Cost Range	Notes
Fast Charging Station (DC, 50kW)	€20,000	For inter-city corridors or transport nodes
Site Preparation & Electrical Work		Depends on proximity to grid and terrain
ICT Integration (Platform, App)		Includes booking, monitoring, and payment systems (via CIMNE toolkits)
Grid Connection (DSO costs)	€2,500 – €5000	Higher for remote rural sites

Total CAPEX per site: ~€22,500–€25,000 depending on charger type and location

2. Operational Expenditure (OPEX)

Item	Estimated Annual Cost	Notes
Electricity (per charger)	€500 – €2,000	May be offset via PV or energy communities
Maintenance and Servicing	€300 – €1,000	Annual servicing and remote monitoring
Insurance and Vandalism Repair	€200 – €800	Especially relevant in unguarded public spaces
ICT Hosting and Updates	€1,000 – €2,500	Ongoing costs for CIMNE interoperability platform

Total OPEX per site: ~€2,000–€6,000 per year

Economic Feasibility Assessment

1. **Charging Fees** (optional)
    a. Rural pilot models may offer **free or subsidized charging** during initial rollout.
    b. Later phases can introduce pay-per-use (€0.20–€0.40/kWh) once demand matures.
2. **Tourism and Local Business Spillover**
    a. EV infrastructure can indirectly **increase footfall in rural towns**, supporting cafes, markets, and lodging.
    b. **Multiplier effect** through tourism-driven economy (particularly in eco-regions).
3. **Grid Flexibility Services** (Future Potential)
    a. Charging stations can participate in **demand-response** and **V2G** schemes when regulations mature.
4. **Public Subsidies & Carbon Credits**
    a. Potential income from **EU carbon financing instruments**, such as ETS-related rural decarbonization funds.

2.5.4. ICT Network Integration and Route Planning

RuralMED Mobility Project represents a significant step toward overcoming the mobility challenges faced by rural areas in the EU...

Here is a strategic overview of **ICT Network Integration and Route Planning for EV Infrastructure in Bulgaria**, as envisioned by the *RuralMED Mobility* project, with focus on the pilot areas of **Galabovo and Radnevo** and the contribution of **SZ REDA**:

ICT Network Integration

1. Digital Platform Backbone

The project leverages the **EnerNetMob ICT Platform**, previously developed under Interreg MED, and further enhanced by **CIMNE**. This platform provides:

- **Interoperability features**: Ensures uniform access, monitoring, and control across diverse hardware providers.
- **Real-time data integration**: Tracks energy usage, station availability, and EV charging patterns.
- **Open API framework**: Allows municipalities and SMEs to integrate local services (e.g., tourism info, parking).

In Bulgaria, SZ REDA is responsible for integrating the platform with local infrastructure and municipal systems (GIS, smart metering, etc.).

User Interface & Features

Function	Details
Mobile & Web App Access	Users can locate, book, and pay for charging at stations across Bulgaria
Station Booking & Reservation	Enables pre-booking to reduce waiting times and increase usage efficiency
Load Balancing & Grid Monitoring	Helps avoid grid overloads by shifting load to off-peak hours
Citizen Feedback Tools	Allow users to report issues, provide satisfaction ratings, or suggest improvements

Bulgarian pilots will act as a **testbed** for user experience design tailored to low-tech-savvy, rural populations.

Cybersecurity & Data Management

- The platform includes **role-based access**, secure data storage, and GDPR compliance tools.
- EV charging data is anonymized but used for route optimization, demand forecasting, and reporting.

Route Planning & Intermodal Integration

1. Rural-Urban Connectivity Strategy

The ICT platform incorporates a **smart routing algorithm** that helps users:

- Plan trips through rural areas with minimal range anxiety.
- Identify multimodal connections (bus/train stations near EV hubs).
- Combine EV use with **transport-on-demand services** in sparsely populated regions.

2. Location Intelligence and POI Integration

The planning tool will factor:

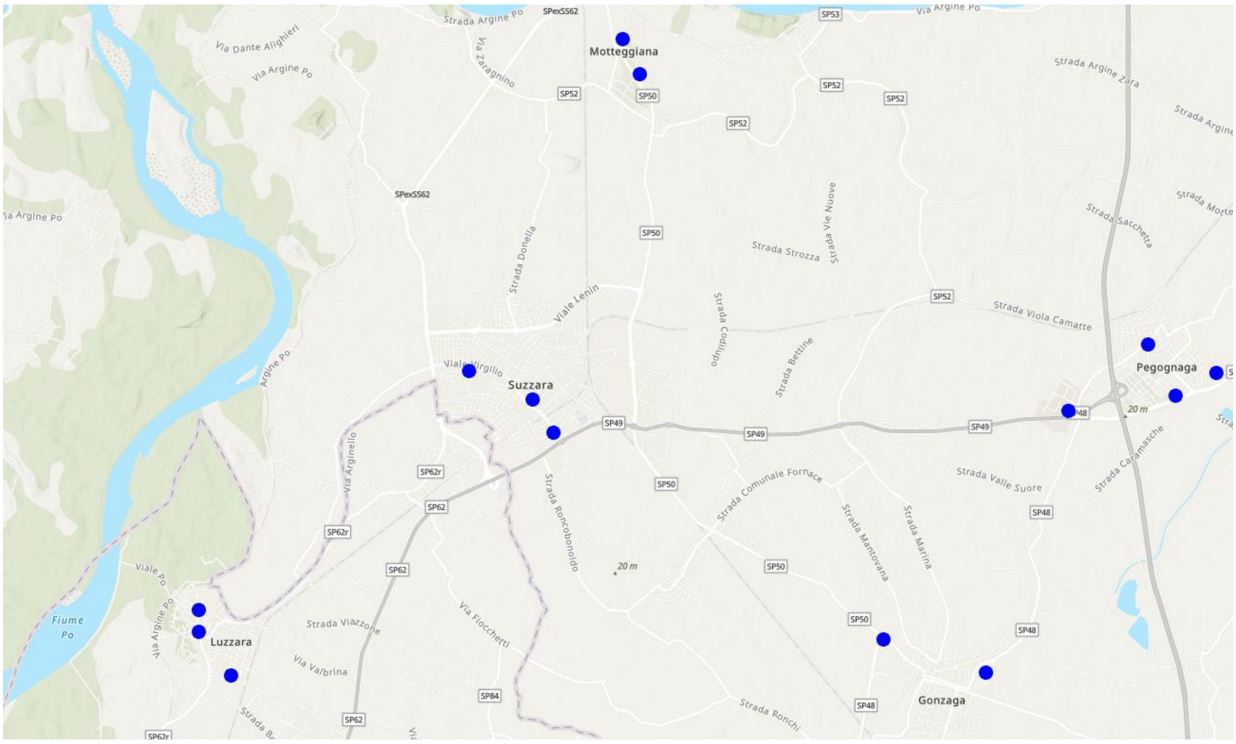
- **Charging speeds, cost, availability**
- **Tourism & commercial POIs** (markets, attractions, municipal services)
- **Topography & road type** for energy consumption modeling (critical in hilly rural terrain)

For Bulgaria, this supports **climate-friendly tourism** and encourages intercity EV travel that includes **Galabovo–Stara Zagora–Plovdiv corridors**.

➢ 2.6 Italy

2.6.1. Demand Analysis for Charging Stations

Suzzara, a medium-sized municipality in the Oltrepò Mantovano area, currently faces a significant shortage of electric vehicle (EV) charging infrastructure. Most public and high-power chargers are concentrated in major urban centers such as Mantova city or along the A22 motorway corridor, leaving Suzzara and its surrounding villages with very limited access. Residents and local businesses interested in adopting electric mobility face “range anxiety” and practical barriers, which discourages the purchase of EVs and slows the transition to low-emission transport. Installing dedicated charging points in Suzzara would directly address this gap, enabling residents to consider EVs as a viable alternative for daily commuting and logistics.
The following map show the current condition of charging stations (source: https://webgate.ec.europa.eu/tentec-maps/web/public/screen/home)



The rural and peri-urban character of Suzzara amplifies the need for localized charging solutions. Many inhabitants rely on private cars for work, school, and services due to limited public transport options. This dependency on combustion-engine vehicles results in higher greenhouse gas emissions, local air pollution, and noise, which contrasts with regional and national decarbonisation objectives. By establishing strategically located charging stations, Suzzara can reduce the environmental footprint of private and commercial mobility, aligning local transport practices with PNIEC targets and Lombardy's sustainable mobility strategy.

From an economic perspective, Suzzara hosts small and medium-sized enterprises, agricultural cooperatives, and logistics operators that could benefit from electrified vehicle fleets. Access to public and semi-public charging points would encourage the electrification of delivery vans, utility vehicles, and service fleets, reducing operational costs and air pollution in the area. Moreover, Suzzara could serve as a rural pilot site for shared mobility schemes, such as car-sharing and e-bike networks, demonstrating the viability of renewable-energy-powered transport in smaller municipalities and providing a replicable model for other rural towns in Lombardy.

Finally, installing charging infrastructure in Suzzara has the potential to enhance social equity and regional connectivity. Residents of peripheral villages often cannot easily reach urban charging hubs without significant detours, creating inequalities in access to sustainable mobility. By placing chargers near key public services—such as municipal offices, health centers, and schools—Suzzara can ensure that rural communities participate in Italy's green transition on equal footing with urban areas. This strategic deployment would support both local mobility needs and broader regional and national objectives for electrification, climate protection, and sustainable development.

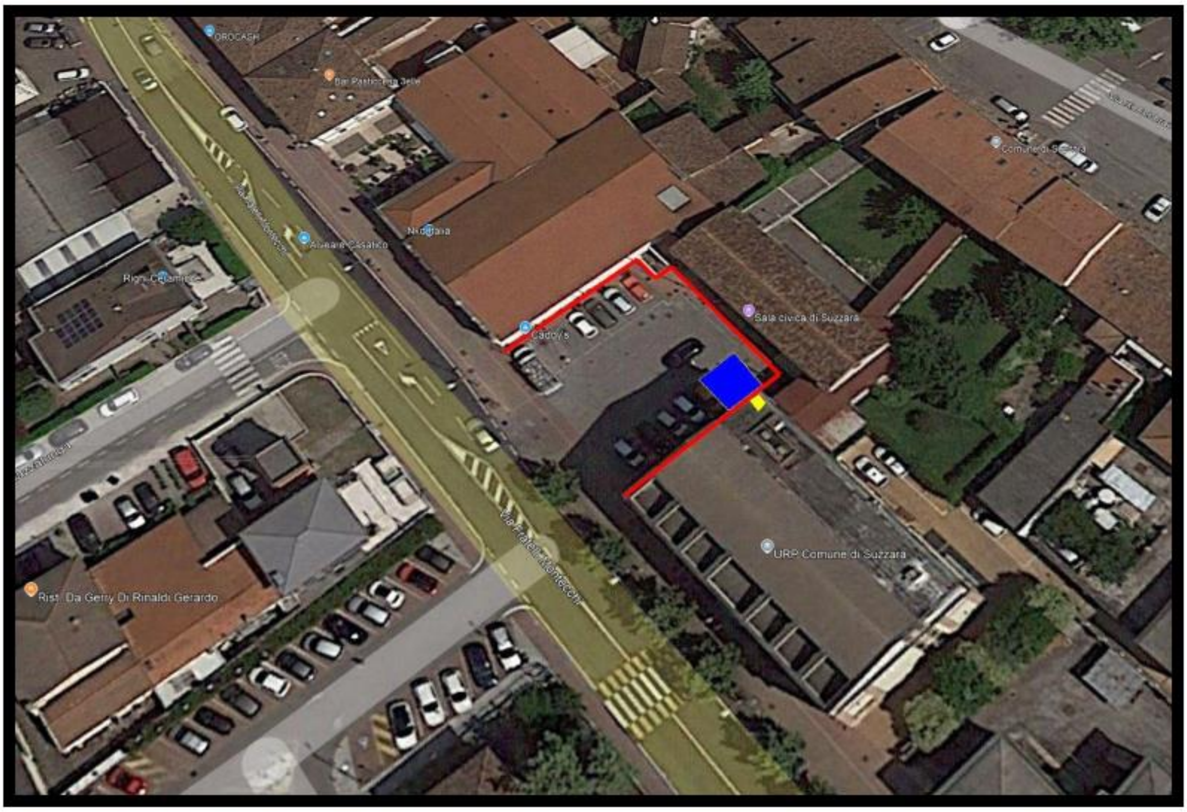
2.6.2. Strategic Allocation of Charging Infrastructure

A summary of the criteria used to select RuralMED Mobility pilot investment in Suzzara highlights a careful, multi-dimensional approach designed to maximize accessibility, efficiency, and sustainability. The first criterion considered was a central position within the city, ensuring that the charging stations are easily reachable for the greatest number of residents and businesses. Placing the stations near the municipal center allows users to combine vehicle charging with other daily activities, such as visiting public offices, attending local associations, or running errands, thereby increasing the practical utility and attractiveness of electric mobility in the area.

Another key factor was easy access for workers and local associations, particularly those operating in Suzzara's commercial and civic hubs. By situating chargers along frequently used routes or near centers of activity, the pilot supports commuter needs and encourages the adoption of electric vehicles by both private individuals and professional fleets. Accessibility for all users was also prioritized, with the availability of parking spaces suitable for people with disabilities ensuring that the transition to sustainable mobility is inclusive and equitable.

The almost complete absence of existing charging infrastructure in the surrounding area was a critical determinant. Rural and semi-urban municipalities such as Suzzara are typically underserved by national and regional EV programs, which focus on larger cities and main transport corridors. Installing chargers in locations currently lacking alternatives addresses this infrastructure gap, mitigates “range anxiety,” and incentivizes the local adoption of EVs. Technical and operational feasibility also guided site selection: locations were chosen based on the availability of a POD with a contractual power of 100 kW, sufficient to support multiple charging points and accommodate potential future expansion.

Finally, the pilot sought to integrate renewable energy and environmental sustainability into the design of the charging stations. The pilot investment location was selected also considering the photovoltaic panels in the immediate vicinity (on the roof of the nearby municipal building, with an power of 19kW) connected to the POD to be used for the two e-charging stations, allowing the use of locally generated solar energy to power the chargers and reduce grid dependency. In addition, an area with low environmental risks was prioritized to minimize potential impacts on nearby ecosystems, reduce exposure to flooding or other hazards, and ensure the long-term resilience and safety of the infrastructure. Collectively, these criteria demonstrate a comprehensive approach that balances technical feasibility, user accessibility, environmental sustainability, and strategic alignment with national and regional mobility goals.



Area Parcheggio Via F.lli Montecchi, fianco Uffici Comunali -

Zona individuata per posti auto

Contatore e Quadro elettrico

<u>Distanza tra contatore/quadro e posti auto individuati circa 8m.</u>

2.6.3. Investment Considerations and Economic Feasibility

Deploying **EV charging infrastructure in rural areas like Suzzara and the wider Oltrepò Mantovano** requires a carefully tailored investment strategy that accounts for **low initial utilization, limited private sector interest, and constrained municipal budgets**. The RuralEV approach emphasizes **cost-efficiency, long-term public value, and low-barrier access for citizens**. Investment decisions within the pilot territories were therefore guided by pragmatic considerations: compatibility with existing urban infrastructure, avoidance of costly grid upgrades, and maximization of **social and environmental return** rather than immediate financial profit.

To reduce installation costs and operational complexity, the pilot opted for 1 **AC charging station with 2 plugs up to 44 kW output and 1 DC charging station with 1 plug up to 25 kW** , which are sufficient for the expected rural charging patterns—longer dwell times, overnight parking, or partial top-ups at community hubs such as municipal offices, health centers, and civic facilities—without requiring high-voltage grid upgrades. In Suzzara, for example, selecting locations near public services and accessible parking allowed the pilot to leverage existing electricity connections and parking spaces, significantly lowering deployment costs while ensuring inclusivity, including access for people with disabilities.

The specification of the installed charging station (eVolve Smart T CircoCntrol) is in the following:

Post eVolve Smart T Circontrol, di cui seguono le principali caratteristiche tecniche:

General Specifications

Network connection	10/100BaseTX (TCP-IP)
Interface protocol	OCPP 1.5 / OCPP 1.6 J
Enclosure rating	IP54 / IK10
Enclosure material	Aluminium & ABS
Enclosure door lock	Anti-vandal key
Enclosure access	Frontal door
Operating temperature	-5 °C to +45 °C
Storage temperature	-40 °C to +60 °C
Operating humidity	5% to 95% Non-condensing
Light beacon	RGB colour indicator
Display	Multi-language LCD
Power limit control	Mode 3 PWM control according to ISO/IEC 61851-1
Dimensions (D x W x H)	Post: 290x450x1550 mm Wallbox: 220x380x930mm
Weight	Post: 55 Kg Wallbox: 30 Kg

RFID Reader	ISO / IEC14443A / B MIFARE Classic/DESFire EV1 ISO 18092 / ECMA-340 NFC 13.56MHz
Meter	MID Class 1 - EN50470-3
Power output management	Integrated Load Management
Overcurrent protection	MCB (curve C)
Safety protection	RCD Type A (30 mA)+6 mA DC
Type 2 socket protection	Locking System
Compatible with DLM	
Optional devices	
Low temperature kit	-30 °C to +45 °C
Safety protection	RCD Type B (30 mA)
Type 2 charging socket	Shutter
Wireless Communication	4G / 3G / GPRS / GSM
Tethered Cable (spring) *(Cable length: 4 m)*	Type 1 + Type 1 Type 2 + Type 2
Customisation	Vinyl and logo

Models	S*	T	TM4**		C63 One* *
AC power supply	1P + N + PE	3P + N + PE	3P + N + PE		3P + N + PE
AC input voltage	230 V AC +/-10%	400 V AC +/-10%	400 V AC +/-10%		400 V AC +/-10%
Maximum input current	64 A	64 A	64 A		63 A
Maximum input power	14,7 kW	44 kW	44 kW		43 kW
Number of plugs	2	2	4		1
Simultaneous charging sessions	2	2	2		1
Outlet A – Maximum output current	32 A	32 A	32 A	16 A	63 A
Outlet A – Maximum output power	7,4 kW	22 kW	22 kW	3,7 kW	43 kW
Outlet A – AC output voltage	230 V AC (1P + N + PE)	400 V AC (3P + N + PE)	400 V AC (3P + N + PE)	230 V AC (1P + N + PE)	400 V AC (3P + N + PE)
Outlet B – Maximum output current	32 A	32 A	32 A	16 A	
Outlet B – Maximum output power	7,4 kW	22 kW	22 kW	3,7 kW	
Outlet B – AC output voltage	230 V AC (1P + N + PE)	400 V AC (3P + N + PE)	400 V AC (3P + N + PE)	230 V AC (1P + N + PE)	
Connection	2x Type 2 Socket (lock system) A B	2x Type 2 Socket (lock system) A B	2x Type 2 Socket (lock system) A	2x CEE/7 B	Type 2 Cable (4m) A

Initial investment cost

The initial investment cost includes the acquisition and installation cost of each charging station, consisting in engineer fees, cost of materials, labour, design and layout of parking places, electricity grid connection charges, license and permit fees. In certain cases, certain cost components may be equal to zero (e.g. in case of installation in an existing parking place, such as in case of the pilot chargers Suzzara, there is no cost of design and layout of parking places).

The initial investment cost is in the following table:

Electrification Cost	€ 19.500,00

Charging Station (Post Evolve Smart T Control)	€ 5.300,00
Charging Station (Post Evolve Rapid Master)	€ 13.629,00
TOTAL	**€ 38.429,00**

Operating Costs

The operating cost of a charging station mainly depends on the electricity rates of the energy provider. In case that different electricity charges for daytime and nighttime consumption are considered to apply, the relevant weighted average can be taken into account. However, in the present analysis, only the daytime consumption is taken into account, as the majority of public charging infrastructure users allegedly charge their EVs during the day.

All charging stations are **publicly accessible and free of charge during the pilot phase**. Based on conservative usage estimates of 2 hours per day per charger, the network is expected to deliver approximately **64,240 kWh of electricity per year**. Assuming average EV consumption of 17 kWh/100 km, this equates to roughly **377,882 km of electric travel annually**. Compared with diesel vehicle consumption (10Km/L) at an average price of 1.8€/L, the pilot avoids the use of approximately 38.000 l of Diesel, representing an **annual cost saving of about €68,000** for users.

This investment is not designed to generate **short-term financial returns** but rather to unlock long-term **social, environmental, and institutional benefits**. It contributes to the **reduction of transport-related emissions**, supports regional energy and climate targets in Lombardy, and serves as a **demonstrative model for rural e-mobility** in Mantova province. By focusing on **accessible, moderately priced infrastructure with public utility**, the pilot lays the foundation for broader replication, integration with future smart-grid initiatives, and development of **shared mobility services**, reinforcing the transition to sustainable transport in small municipalities.

In addition, the pilot integrates **renewable energy through planned photovoltaic installations** in the immediate vicinity of the charging stations. Solar panels will supply a significant portion of the electricity needed for daily charging, reducing reliance on the grid and lowering operational costs. Coupled with potential **battery storage systems**, this approach allows for smart energy management, with charging scheduled during periods of high solar generation or low overall demand. By combining renewable energy production with public EV infrastructure, the pilot not only reduces the **carbon footprint of local transport** but also demonstrates a **replicable model for energy self-sufficiency** in rural municipalities. This synergy between e-mobility and local renewable generation strengthens the long-term sustainability of the investment and positions Suzzara as a **reference site for rural green mobility initiatives** in Lombardy.

MSP

The provider charges 9100€ in order to provide Mobility Service Providers Services. The selected services include the following.

Universal Access: MSPs provide access to multiple charging networks through a single account, app, or RFID card, eliminating the need to register with each individual Charge Point Operator (CPO).

- **Charging Subscriptions**: They offer various pricing models, including pay-as-you-go or monthly subscriptions, tailored to different usage patterns.
- **Apps and Navigation Tools**: MSPs develop user-friendly apps that help drivers locate charging stations, check availability, and plan routes with charging stops included.
- **Payment and Billing**: They handle payment processing and invoicing, often bundling these services with other mobility offerings like car-sharing or ride-hailing.
- **Customer Support**: MSPs provide customer service for issues related to charging access, billing, or app functionality.

Collaboration with CPOs

- MSPs do not own or operate the charging stations themselves—that's the role of CPOs.
- Instead, MSPs integrate with CPOs to offer seamless access across different networks, creating a unified experience for EV users.

Maintenance Costs

The maintenance cost includes the replacement cost of parts and accessories of the chargers, repair of potential damage etc.
Maintenance is considered to be very low in the case of the installed service, in the range of 100€/charger/year.

Compliance

In accordance with the provisions of Law all public charging stations allow for ad hoc user charging, without the obligation to sign a contract with the electricity supplier or operator.

Electrical meter sockets must be certified under Directive 2014/32/EU of the European Parliament and of the Council referring to Category B testing by laboratories accredited according to ISO 17025 Standard.

Concerning the location, the installation of charging stations is realized in accordance with all the relevant provisions, while all the necessary fire-prevention measures are applied in accordance with relevant provisions regarding fire-prevention.

The charging stations comply with the technical provisions to be issued by European Union (EU), in accordance with 2014/94/EU Directive.

The geographical location of public charging stations, data relating to the accessibility of current and previous time periods, as well as charging in real-time, must be publicly and without discrimination available to all users. To this end, appropriate data recording and reporting systems (intelligent systems may be included as well) are installed.

2.6.4. ICT Network Integration and Route Planning

ICT integration is a critical pillar of the RuralEV pilot methodology in the Mantova area, ensuring that EV charging infrastructure is not only physically deployed but also digitally connected, monitored, and prepared for future interoperability. The pilot in Suzzara and surrounding municipalities will incorporate **smart functionalities** into all charging stations through compliance with the **Open Charge Point Protocol (OCPP 1.6 or equivalent)**, enabling real-time or periodic data transmission to a central ICT platform developed under the project framework.

The system works as described below

- The backend system establishes secure, authenticated communication with each electric vehicle via cloud-based protocols, collecting relevant data which is then stored in the project's central database.
- An administrator, responsible for both the application and database, oversees system operations through a web-based interface. This frontend allows the admin to add or remove vehicles, configure route options and associated stops, and maintain overall control and monitoring of the system.
- Additionally, a dedicated mobile app has been developed for drivers. Through this app, they can update vehicle details and log the routes they travel.
- The web application (hosted on the server) interacts directly with the driver's mobile app installed in the vehicle, facilitating the exchange of data and information specific to each electric vehicle

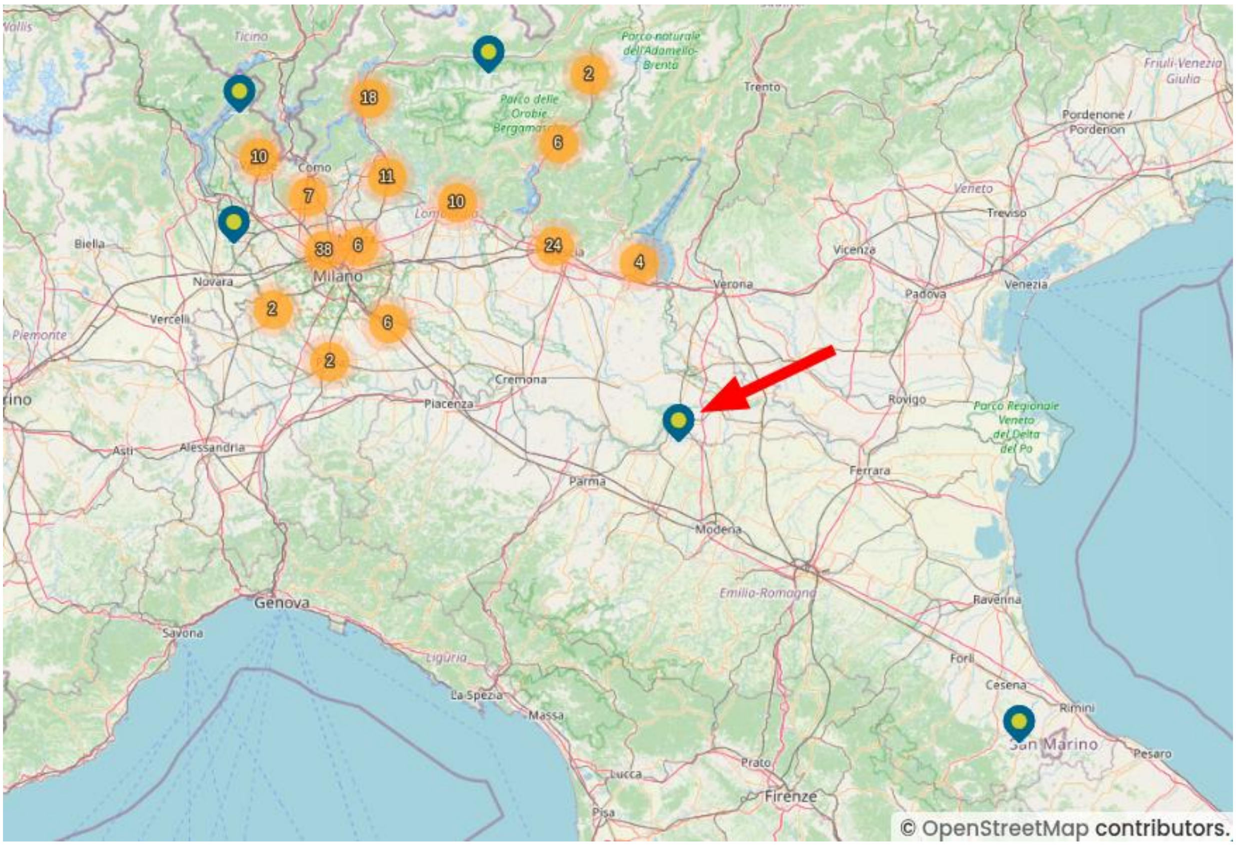
Each station will support **remote user authentication** (via RFID, NFC, and mobile app activation), session tracking, and system control (e.g., remote locking or power cutoff), ensuring secure and user-friendly operation for residents, workers, and municipal fleets. The chargers are designed to connect via **GSM/4G or Ethernet**, providing flexible options for network integration even in areas where digital infrastructure is limited. Advanced **power management features**, such as software-based load balancing, are included to optimize energy usage and prevent stress on the local grid.

Crucially, the Mantova pilot will enable **bidirectional ICT communication** between the chargers and the central RuralEV ICT platform. This allows automated reporting of key operational metrics—such as charge duration, energy delivered, and session timestamps—which are essential for **monitoring pilot performance, benchmarking results, and planning replication in other rural areas**. These data also enable future integration with **Mobility-as-a-Service (MaaS) applications** or regional transport planning systems, supporting coordinated and efficient mobility management.

By embedding connectivity and data-sharing into the pilot infrastructure from the outset, the RuralEV implementation in the Mantova area ensures that the EV charging network is not only operational but also **intelligent, data-driven, and future-proof**. This approach facilitates transparent reporting, informed decision-making, and alignment with emerging **smart mobility standards**, while providing a scalable model for **rural e-mobility across Lombardy**.

The interoperatibility with the regional network of electrical car sharing service is also a plus for interoperability. E-VAI counts more than 150 sharing point in Lombardy, and Suzzara becomes a strategic interlink with the rest of the region.

As clearly visible in the following map, Suzzara becomes the first e-car-sharing spot in the Mantova Province, this allowing expansion of the car sharing service in the most remote province of Lombardy.



➢ 2.7 Greece

2.7.1. Demand Analysis for Charging Stations

During the last years, electromobility gains more and more ground in Greece; however, not at the same rate recorded in other countries. The inadequate number of charging stations, causing anxiety to many "candidate" users of EVs, is considered to be among the main barriers that prevent Greece from "adopting" electromobility to a higher extent. Especially concerning the current RuralMED study areas (ZEP area and Amyntaio), public charging stations coverage in ZEP, as well as in Amyntaio is either limited or non-existent. However two charging stations are installed in the context of RuralMED Mobility project for non-profit purposes exclusively serve two EVs, an EV used by the Region of Western Macedonia in ZEP area and an EV used by the Municipality of Amyntaio. The development of EV charging infrastructure in both ZEP area and Amyntaio is therefore particularly important towards promoting e-mobility. Thus, given the importance of adequate EV charging infrastructure for the increase in EV penetration rate in the Greek market, RuralMED Mobility portrays as a crucial step to develop charging infrastructure network throughout Greece and especially in rural areas.

The region of Western Macedonia is a particularly "overburdened" area at both GHG emissions and local air pollutants level, due to the operation of PPC SA (Public Power Corporation) lignite power plants for approximately 70 years in the area. For this reason, the Region of Western Macedonia falls within the scope of the National Just Transition Development Plan, aiming at lignite phase-out (NJTDP) [1, 2]. Thus, the adoption of measures and policies for the reduction of CO2 emissions and local air pollutants, such as NOx, which are particularly harmful to human health, is of particularly high importance for this specific area.

The Active Urban Planning Zone (ZEP area) of Kozani (Municipality of Kozani, Region of Western Macedonia), as well as the town of Amyntaio (Municipality of Amyntaio, Region of Western Macedonia), are the two areas of the current RuralMED project where the electric vehicle infrastructure (EV) investments are planned to be realized.

The Active Urban Planning Zone (ZEP area) of Kozani in Kozani Regional Unit is an area of the Municipality of Kozani, which is also the capital of Western Macedonia Region, in approximately 5 km from the city centre, with a population of 1,185 inhabitants (2021 data) [3]. Social housing, a nursery and an elementary school, Departments of the School of Engineering and administrative offices of the University of Western Macedonia (UOWM), as well as of the Western Macedonia Region are found in ZEP area.

The town of Amyntaio in Florina Regional Unit is the "capital" of the homonymous Municipality, in a distance of 32 km from Florina, which is the capital of Florina Regional Unit, and has a population of 3,779 inhabitants (2021 data) [3]. The town of Amyntaio, along with neighboring towns and villages of the Municipality of Amyntaio, constitutes an attractive tourist destination, offering the opportunity to visit – among others – byzantine monuments, wineries, wetlands and award-winning restaurants. According to the relevant application of the Greek Ministry of Infrastructure and Transportation (May 2025 data), showing all public charging points in Greece [3], there are no public EV charging stations other than the pilot one installed in the context of RuralMED project in ZEP, Kozani (as shown in Figure 1), while, apart from the pilot one installed in the context of RuralMED project, there is only one more public charging station in Amyntaio (as shown in Figure 2). Both pilot charging stations of RuralMED project exclusively serve two EVs, an EV used by the Region of Western Macedonia in ZEP area and an EV used by the Municipality of Amyntaio in Amyntaio, while they are not available for commercial exploitation before 2030.

Figure 1: Existing public EV charging points in ZEP, Kozani (May 2025 data) [4]

Figure 2: Existing public EV charging points in Amyntaio (May 2025 data) [4]

The total energy demand per year (kWh/year) in each study area (ZEP area and Amyntaio) is estimated using Equation (1), taking into account the annual number of EVs moving in the study area, the average EV energy consumption (kWh/km), the average annual distance travelled by an average EV moving in the study area (km/year), as well as the percentage of EV charging at public stations.

D=NxExAxP (1)

where:
D " total energy demand per year (kWh/year) in the study area
N " annual number of EVs moving in the study area
E " average EV energy consumption (kWh/km)
A " average annual distance traveled by an average EV moving in the study area (km/year)
P " percentage of EV charging at public stations

The estimated annual number of EVs moving in ZEP area and Amyntaio is based on data published in the Greek National Energy and Climate Plan (NECP) 2024 [9]. In particular, the two scenarios of the Greek NECP 2024, depending on the measures and policies aiming at electromobility promotion in Greece, are formed as follows:

Scenario A (Base scenario): It refers to the achievement of the objectives set (in terms of EV penetration rates in Greek market), assuming the continuation of the existing measures and policies for the promotion of electromobility in Greece (such as "I move electrically", "I charge everywhere"), without the adoption of additional measures and policies.

Scenario B (Optimistic Scenario): It refers to the achievement of the objectives set (in terms of EV penetration rates in Greek market), assuming the adoption of additional measures and policies for the promotion of electromobility in Greece.

It is noted that the published data exclusively refer to the acquisition of new (and not used) vehicles. The objectives set are expressed as penetration rates of new EVs as percentages of registrations of new vehicles in the Greek market up to the year 2030, for both Scenario A and Scenario B. NECP 2024 also includes the corresponding EV (Battery Electric Vehicles - BEV and Plug-in Hybrid Electric Vehicles - PHEV) number for each year, up to 2030. Relevant data referring to light-duty trucks is also included in NECP 2024; however, the present analysis refers only to passenger cars.

Moreover, given that the NECP data refer up to 2030, an order 2 polynomial trendline is selected in Excel, for the estimation of the objectives set, regarding the penetration rates of passenger EVs in Greek market, as well as the number of passengers EVs (BEV and PHEV) for both Scenario A and Scenario B, up to 2035. The estimated EV (BEV and PHEV) number in Greece, based on NECP data, for both Scenario A and Scenario B, are shown in Figure 3 and Figure 4, respectively.

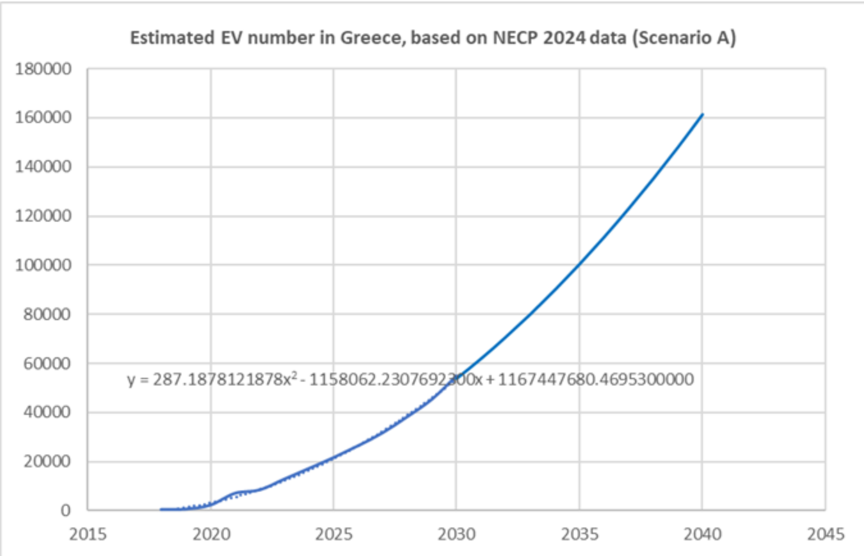


Figure 3: Estimated EV number in Greece, based on NECP data (Scenario A)

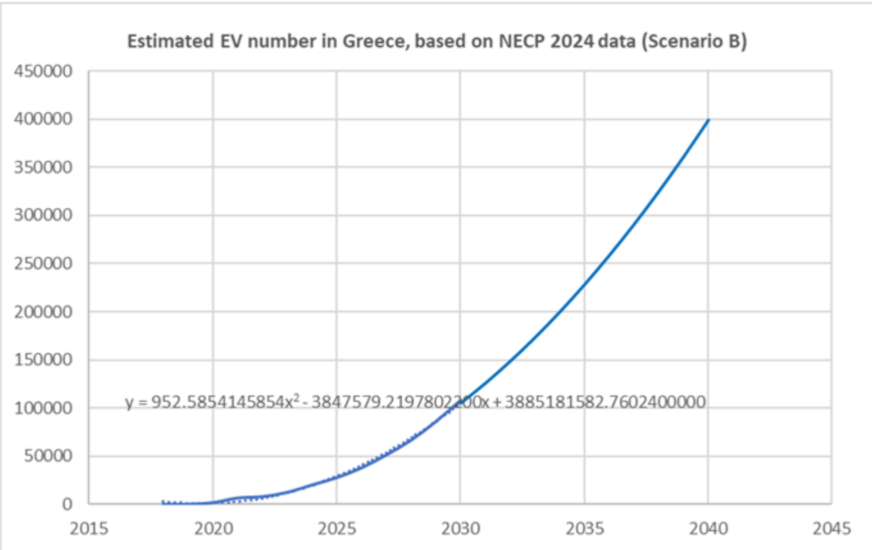


Figure 4: Estimated EV number in Greece, based on NECP data (Scenario B)

In the absence of other data, for the estimation of EV number in each study area (ZEP area and Amyntaio), the following assumptions are made:

As regards ZEP area, given the description of the area, and relevant land use and special characteristics included in Section 1.3, the population between 16-65 years old frequenting the area is estimated about 1,000, with the corresponding number for the whole country (to which the NECP data refer) being approximately 6,000,000. The corresponding EV number for each year (as estimated up to 2035 based on the Excel trendline and relevant NECP data) is therefore multiplied by the coefficient 1,000/6,000,000.

As regards Amyntaio, given the description of the area, and relevant land use and special characteristics included in Section 1.3, the population between 16-65 years old frequenting the area is estimated about 3,000, with the corresponding number for the whole country (to which the NECP data refer) being approximately 6,000,000. The corresponding EV number for each year (as estimated up to 2035 based on the Excel trendline and relevant NECP data) is therefore multiplied by 3,000/6,000,000.

The corresponding results regarding the estimated EV number in each study area, for Scenario A and Scenario B of NECP 2024, are shown in Table 1 and in Table 2.

Table 1: Estimated EV number (N) in ZEP area (Kozani), for Scenario A and Scenario B of NECP 2024

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	4	4	5	6	8	9	10	12	13	15	17
Scenario B	5	7	9	11	14	18	21	25	29	33	38

Table 2: Estimated EV number (N) in Amyntaio, for Scenario A and Scenario B of NECP 2024

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	11	13	16	19	23	27	31	35	40	45	50
Scenario B	10	14	18	23	29	35	42	50	58	67	76

It is assumed that the average annual distance travelled by an average EV moving in the study area equals to A=20,0000 km/year. Based on data available at EV database website [5] related to EV energy consumption for various EV models (with relevant values ranging from 137 to 322 Wh/km), the average EV energy consumption is assumed to be equal to E=189 Wh/km=0.189 kWh/km per vehicle (April 2025 data). In the absence of relevant data, it is assumed that the percentage of EVs charging at public stations equals to 25% from 2025 to 2029, to 30% from 2030 to 2035 and to 35% for, as shown in Table 3. It is also assumed that the corresponding values are common for the two study areas, for both Scenario A and Scenario B of NECP 2024.

Table 3: Percentage (P) of EV charging at public stations

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A/B	0.25	0.25	0.25	0.25	0.25	0.3	0.3	0.3	0.3	0.3	0.35

According to Equation (1) and taking into account the relevant parameters the total energy demand per year (kWh/year) in each study area (ZEP area and Amyntaio) is estimated, for the two NECP 2024 Scenarios. The corresponding values are shown in Table 4 for ZEP area (Kozani) and in Table 5 for Amyntaio.

Table 4: Total energy demand (D) per year (kWh/year) in ZEP area (Kozani)

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	3780	3780	4725	5670	7560	10206	11340	13608	14742	17010	22491
Scenario B	4725	6615	8505	10395	13230	20412	23814	28350	32886	37422	50274

Table 5: Total energy demand (D) per year (kWh/year) in Amyntaio

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	10395	12285	15120	17955	21735	30618	35154	39690	45360	51030	66150
Scenario B	9450	13230	17010	21735	27405	39690	47628	56700	65772	75978	100548

2.7.2. Strategic Allocation of Charging Infrastructure

In the case of ZEP area in Kozani, the development of EV charging infrastructure is regarded particularly important. ZEP area hosts the central administrative complex of the Region of Western Macedonia (RWM), encompassing key public services including regional governance departments, technical services, financial management, planning and development authorities, and citizen-facing directorates. These offices serve a population spread across four regional units (Florina, Kozani, Grevena, Kastoria) with frequent inter-municipal and regional trips undertaken for administrative, monitoring, and coordination purposes. Moreover, given the existence of Departments of the School of Engineering and administrative offices of the University of Western Macedonia (UOWM) in this area, this translates into a high number of commuters (academic staff, students, researchers, administrators, visitors etc.) not only from the central areas of the Municipality of Kozani, but from all over the Regional Unit of Kozani as well as from other Regional Units.
Thus, in the case of the ZEP (Zone of Alternative Urban Planning) area in Kozani, the charging station was installed adjacent to the central administrative building of the Region of Western Macedonia. This site was selected because it hosts the headquarters of the Regional Authority and a wide range of public services, including departments involved in planning, social policy, public works, technical administration, environmental monitoring, and regional coordination. The staff based in this building regularly undertake trips within the region to attend meetings, deliver documents, and conduct inspections. These trips occur daily and typically remain within a 100 km radius. The location therefore serves as the natural base of operations for a public service EV, which departs in the morning and returns by the end of the working day. Installing the charging station at this location allows the vehicle to be recharged overnight or between trips, optimizing energy use and eliminating downtime. The ZEP site was also selected for its infrastructural and policy alignment. The area is publicly owned by the Region, which facilitated a smooth administrative process for installation and avoided costs associated with land acquisition or leasing. It is already connected to the urban electricity grid and has adequate low-voltage capacity to support a 22 kW AC charging station without requiring major upgrades or new transformer installations. The area is also part of the Region's broader vision for developing ZEP into a Positive Energy District (PED), a designation that prioritizes low-emission energy systems, smart mobility, and integrated urban planning. Therefore, the installation of charging infrastructure in ZEP is not only a practical solution for current administrative mobility, but also a forward-looking investment in the region’s climate transition agenda. Additionally, placing the charger at a visible and accessible government facility increases public awareness of electric mobility and signals institutional commitment to sustainable transport. In this case the following charging station is installed:

- Rated power of charging station (kW): 22 kW
- Location of charging station 1: Western Macedonia Prefecture, ZEP Kozani

The Municipality of Amyntaio, located in the Regional Unit of Florina within the Region of Western Macedonia, is a rural municipality characterized by a low-density population, scattered settlements, aging demographics, and limited access to public transportation. These characteristics generate distinctive and persistent mobility needs, particularly in the area of social service provision, where transport is an enabler for social equity, access to care, and territorial cohesion. The municipality includes 14 local communities, several of which are geographically isolated or sparsely populated. Many of these areas lack frequent or any public transport connectivity, meaning municipal/private vehicles are the sole link between public institutions and residents. The existence of just one commercial EV charging infrastructure adds urgency to local investment. According to national mobility and infrastructure maps (as of 2024), Amyntaio and its surroundings are underserved by EV networks, with the nearest commercial charging points located in Florina or Ptolemaida—unsuitable for operational municipal use. As for the development of EV charging infrastructure in the town of Amyntaio, this action is considered equally important, as, despite the fact that it is an area with a relatively small population (approximately 4,000 citizens), the central administrative offices of the Municipality of Amyntaio are located in the town, as well as shops, banks, sports facilities, etc., attracting people from all over the Municipality, as well as tourists visiting the villages of the broader area of Florina Region, mainly traveling by car.

In Amyntaio, the strategic reasoning for placement focused on the operational needs of the municipal social services, particularly the "Βοήθεια στο Σπίτι" (Help at Home) program. This program is run from the municipality's central administrative offices, which serve as the base for daily dispatches of caregivers and social workers to villages in the surrounding area. The mobility requirements are consistent and essential, with each staff member making multiple visits per day to deliver health services, emotional support, and household assistance to elderly or mobility-impaired residents. These services often extend to communities that are geographically isolated or otherwise underserved by public transportation. The operational profile involves several short- to medium-distance trips per day, typically between 10 and 30 kilometers per round trip, with cumulative daily travel ranging from 50 to 100 kilometers. The electric vehicle is assigned specifically to this function and is parked at the municipal premises outside working hours.

The charging station is planned to be installed in the parking lot of the municipal building, where the EV is stored and where the service staff begin and end their daily routes. The choice of location ensures seamless integration into existing workflows without disrupting operations or requiring additional logistical steps for charging. The site is under municipal ownership, simplifying administrative procedures and removing potential barriers related to land use permissions. Moreover, the area has existing grid infrastructure capable of supporting the 22 kW AC charger without the need for costly network upgrades. The decision to place the charger at this location also addressed a notable infrastructure gap: Amyntaio and its surrounding areas previously had no public or semi-public EV charging stations, making this installation the first and only anchor point for electric mobility in the municipality.

Beyond meeting immediate mobility needs, the Amyntaio site was chosen for its potential catalytic impact. The area is a node of social and ecological significance, positioned near important environmental sites such as the lakes of Zazari and Vegoritida, and near cultural destinations like Nymfaio. This creates future opportunities for the expansion of the charging infrastructure to serve tourism-related mobility, agri-tourism, and green logistics, particularly in line with the municipality's role in the post-lignite transition and rural revitalization strategies. The strategic placement of the charger thus not only supports public service delivery today but also prepares the ground for a broader sustainable mobility ecosystem in the future. Therefore, placing a dedicated 22 kW AC charging station at the Amyntaio municipal facility serves not only the current vehicle but also establishes anchor infrastructure for future e-mobility development. This includes the potential electrification of additional municipal services (e.g., school transport, municipal deliveries, inter-municipal travel), as well as public awareness campaigns. In this case the following charging station is installed:

- Rated power of charging station (kW): 22 kW
- Location of charging station 2: Municipality of Amyntaio

The main characteristics and technical specifications of the 22kW AC charger are given on Table 6:

Table 6: Main characteristics and technical specifications of the 22kW AC charger [6]

AC Input Characteristics	AC Input Voltage	400VAC ± 10%
	Input Type	3P + N + PE
	AC Input Current	32A / phase
AC Output Characteristics	AC Voltage Output	400VAC
	Power	22kW max
	Output Current	32A / phase
Operating Conditions	Operating Temperature	-25°C - +65°C (derating of power above +50°C)
	Storage Temperature	-30oC – +70oC
	Humidity	5% - 95% RH (no condensation)
	Installation Altitude	Up to 2000m
Construction	Enclosure	Aluminium, Plexiglass
	IP Protection	IP55
	Mechanical Impact IK	IK10
	Charging Mode	Mode 3
	Outputs	Socket outlet Type 2 with protective cap and locker or built in 5m (or 7m) length tethered cable with Type 2 output
	Charger Dimensions	265 mm x 385 mm x 143 mm (width x height x depth)
	Weight	5 kg
Electronic Parts	Energy Meter	Available with Built in MID energy meter
	Current Setting	AC output current adjustment from 10% up to 100%
	Protective Devices	– Available with built in RCD Type A (30mA AC leakage) – Ground Loss Detection – Overvoltage (OVP) and Undervoltage (UVP) Protection

		– Overtemperature Protection (OTP) – In distribution panel: MCCB 4P Type C 40A (or fuses 35 A) to protect the charger and cabling and Residual Current Protection 4P Type A 40A (if not available on the charging station) – In distribution panel: SPD Type 2
	Communication Protocol	S2W & OCPP 1.6 JSON
	User Identification	RFID & phone app
	Connectivity	WiFi, Ethernet or GSM
Installation	Explosive Zones	Installation outside ATEX zones
	Grid Substation	Not applicable
	Cable Cross Section	5x10mm²(cable length up to 120m), 5x16mm2 (cable length >100m)
Certification	Regulations	LVD 2014/35/EU, IEC EN 61851-1:2017, IEC EN 61851-1:2019 IEC 61851-21-2:2018, EN 62196-1:2014, EN 62196-2:2016, 2014/30/EU, EMC EN 61000, CE
Warranty	Time of Warranty	2 years

Technical provisions based on existing legal and regulatory framework

The charging stations examined in the present analysis consist in the following alternatives:

- AC charging station, maximum output power: 22 kW, 1 AC charging output,
- DC charging station, maximum output power: 60 kW, 2 DC charging outputs,
- DC charging station, maximum output power: 150 kW, 2 DC charging outputs.

It is noted that, in case of commercial use, relevant EV charging software is also required.
EV chargers must comply with the standards specified in article 4 of Ministerial Decision No 42863/438/2019 [7]. The above-mentioned standards are briefly presented below:
The accepted EV charging methods that may be applied either to existing infrastructure or to infrastructure to be licensed, as referred in Paragraph 1 of Article 1 of the abovementioned Ministerial Decision, are Method 3 (Mode 3 AC Charging) and Method 4 (Mode 4 DC Charging), as defined in the IEC 61851-1 "Electric Vehicle Conductive Charging System" Standard, which includes the general requirements related to EV conductive charging systems [8].
As regards the accepted contact-tube accessories (plugs, socket-outlets, vehicle connectors and vehicle inlets) for vehicle supply, they are defined in IEC 62196-2 "Plugs, socket-outlets, vehicle couplers and vehicle inlets conductive charging of electric vehicles" Standard [9]. In particular, in the context of interoperability, the accepted connector for EV charging using Method 3 is defined in IEC 62196-2 "Type 2" Standard, while the accepted connector for EV charging using Method 4 is defined in IEC 62196-3 "Type 3" (DC Combo 2) Standard. Furthermore, in case of parallel operation using

Method 4, the relevant requirements are defined in CHAdeMO (Charge de Move) Standard [10] or in any other relevant European or International Standard.

CE marking is obligatory for an EV charger [11]. In any case, unless otherwise specified, the existing Regulation of Electrical Installation, according to Ministerial Decision No 101195/08.10.2021 (Series II, 4654) "Hellenic Standard ELOT 60364. Requirements for electrical Installations" [12] is applied for any new installation of any electrical equipment of EV charging. Also, the previous standard according to Ministerial Decision No Φ.7.5/1816/88/27-2-2004 (Series II, 470) "ELOT-HD 384:2004. Requirements for electrical Installations" [13], as well as the Law 4483/1965 (Series I, 118) "KEHE-Regulation of Internal Electrical Installations" [14], are applied to the existing installations which were built before 2022. In these cases, the addition of any electrical equipment of EV charging infrastructure should be made in line with Hellenic Standard ELOT 60364. The provisions related to the connection to HEDNO S.A. (Hellenic Electricity Distribution Network Operator S.A.) distribution network are specified in the relevant institutional framework applicable to electricity supplies.

As regards the charging station installation, relevant urban planning and building regulations, safety distance and eventual prohibitive proximity provisions, operating and storage conditions, are specified in IEC 61851-1 Standard, as well as instructions and guidance, as provided by manufacturer in relevant installation and operation manuals. Moreover, in case of charger installation in areas with additional or special safety measures, the relevant license and permit procedures, as specified in relevant legislation, are followed, while the socket-outlets must be equipped with safety shutters and, in case they are installed on the ground/ floor must be protected with appropriate bollards or rubber wheel stops.

In accordance with the provisions of Paragraph 9 of Article 4 of Law 4439/2016 (Governmental Gazette 222/ Series I, 30.11.2016) [15], all public charging stations allow for ad hoc user charging, without the obligation to sign a contract with the electricity supplier or operator.

Electrical meter sockets must be certified under Directive 2014/32/EU of the European Parliament and of the Council [16], as well as the Common Ministerial Decision No 1418/ 22-4-2016 (Series II, 1231) [17] referring to Category B testing by laboratories accredited according to ISO 17025 Standard.

Concerning the location, the installation of charging stations is realized in accordance with all the relevant provisions, while all the necessary fire-prevention measures are applied in accordance with relevant provisions of Law 4710/2020 (Governmental Gazette 142/ Series I, 23.7.2020) [18] regarding fire-prevention.

The charging stations covered by Paragraph 10 of Annex II of Directive 2014/94/EU (Law 4439/2016 (Governmental Gazette 222/ Series I, 30.11.2016)) [28], for which there are no relevant technical provisions (based on Standards or other documents), comply with the technical provisions to be issued by European Union (EU), in accordance with 2014/94/EU Directive.

According to Paragraph 5 of Article 7 of Law 4439/2016 (Governmental Gazette 222/ Series I, 30.11.2016) [15], as a minimum, the geographical location of public charging stations, data relating to the accessibility of current and previous time periods, as well as charging in real-time, must be publicly and without discrimination available to all users. To this end, appropriate data recording and reporting systems (intelligent systems may be included as well) are installed, where it is technically and economically feasible, according to Paragraph 7 of Article 4 of Law 4439/2016 (Governmental Gazette 222/ Series I, 30.11.2016) [15].

Alternating-current (AC) chargers

Normal-power charging stations, with the exception of wireless or inductive charging, which are developed or renewed from 18 November 2017, must, as a minimum, comply with the technical provisions defined in Point 1.1 of Annex II of Directive 2014/94/EU (Article 9 of Law 4439/2016 (Governmental Gazette 222/ Series I, 30.11.2016)) [15], as well as the special safety requirements defined on a case-by-case basis within the national legislative framework, in accordance with the Common Ministerial Decision 51157/ΔTBN 1129/2016 (Governmental Gazette 1425/Series II, 20.5.2016) [19], which integrates the Directive 2014/35/EU (related to electrical equipment availability in the market) into the national legislation.

Direct-current (DC) chargers

High-power charging stations, with the exception of wireless or inductive charging, which are developed or renewed from 18 November 2017, must, as a minimum, comply with the technical provisions defined in Point 1.2 of Annex II of Directive 2014/94/EU (Article 9 of Law 4439/2016 (Governmental Gazette 222/ Series I, 30.11.2016)) [15].

In addition to the above-mentioned technical provisions, it is suggested that a management system aiming at monitoring the use and status of each charger be installed as well. The system in question may allow for data collection relating to use, as well as potential problems, contributing to decision-making regarding the installation of more charging stations in areas with high usage. It is also suggested that regular controls regarding the charging stations status be executed, so that any problems can be fixed in a timely manner.

2.7.3. Investment Considerations and Economic Feasibility

The investment considerations and economic feasibility analysis of the Greek pilot under the RuralMED project were developed with a clear objective: to demonstrate that electric mobility in rural and semi-urban areas is not only environmentally sustainable but also economically viable and replicable. The pilot includes the installation of two publicly accessible charging stations (one in the ZEP area of Kozani and one in the Municipality of Amyntaio) and the operation of two electric vehicles dedicated to public service delivery—one for regional administrative mobility and one for local social care services.

As regards the charging infrastructure planning in ZEP area and Amyntaio, three alternatives are examined for each study area. As already mentioned, each 22kW charger which has been installed in each study area (1 in ZEP area and 1 in Amyntaio) for non-profit purposes, today exclusively serves an EV used by the Region of Western Macedonia in ZEP area and an EV used by the Municipality of Amyntaio in Amyntaio, while can be used for commercial purposes from 2030. The other two alternatives consist in a charger of 60 kW and a charger of 150 kW in each area, which can be used for commercial purposes from 2026. The analysis includes: a) the estimated cost and benefit components in each case and b) the relevant financial viability of each alternative is examined through the calculation of financial Net Present Value (NPV).

It is assumed that the existing pilot chargers are used for commercial purposes from 2030, while the alternative of the additional function of a charger either of 60 kW or of 150 kW is also examined for ZEP area and Amyntaio. It is assumed that the additional charger is installed at University Campus in ZEP area (Kozani) and at the Municipality Premises in Amyntaio.

Each alternative is evaluated for a ten-year reference period, in terms of financial Net Present Value (NPV), based on the aforementioned two NECP scenarios (A and B). The estimated future benefits and costs are "brought" to present, using a discount rate (in our case equal to 4%), allowing for the characterization of the examined investment as financially viable (in case of a calculated NPV>0) or not (in case of a calculated NPV<0).

Initial investment cost

The initial investment cost includes the acquisition and installation cost of each charging station, consisting in engineer fees, cost of materials, labour, design and layout of parking places, electricity grid connection charges, license and permit fees. In certain cases, certain cost components may be equal to zero (e.g. in case of installation in an existing parking place, such as in case of the two pilot chargers in ZEP area and Amyntaio, there is no cost of design and layout of parking places).

As regards the two pilot chargers of 22 kW of RuralMED project in ZEP area and Amyntaio, the initial investment cost is approximately equal to 3,050 €, in each case. It is noted that there are no license and permit fees in case of the pilot charger, while for any other charger installed out of the context of RuralMED project, the license and permit fees are determined according to the provisions of Article 6 of Ministerial Decision 42863/438/4-6-2019 [7], related to an EV charging station/ charger place. The license and permit fees are approximately equal to 1,500 €/ charging station, while, assuming that the installation of any other charger examined in the present analysis will be realized in existing parking places, there is no relevant design and layout cost. Taking the above into account, the initial investment cost in case of a charger of 60 kW is taken equal to 30,000 € and that of a charger of 150 kW equal to 52,000 €.

Operating cost

The operating cost of a charging station mainly depends on the electricity rates of the energy provider. In case that different electricity charges for daytime and nighttime consumption are considered to apply, the relevant weighted average can be taken into account. However, in the present analysis, only the daytime consumption is taken into account, as the majority of public charging infrastructure users allegedly charge their EVs during the day [20, 21, 22]. The electricity charge is therefore taken equal to 0.142 €/kWh (DEI, March 2025 data) [23]. The operating cost of charging stations is calculated on the basis of the estimated demand (kWh) for EV charging, in each study area, for the two NECP 2024 Scenarios. The relevant values are shown on the following tables, for ZEP area (Kozani) and Amyntaio, respectively. It is noted that the 22kW chargers of RuralMED project exclusively serve 1 EV used by the Region of Western Macedonia in ZEP area and 1 EV used by the Municipality of Amyntaio in Amyntaio until 2029 and are available for commercial use from 2030.

Table 7: Operating cost of the 22kW charger of RuralMED project (€/year) in ZEP area (Kozani)

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	134	134	134	134	134	1449	1610	1932	2093	2415	3194
Scenario B	134	134	134	134	134	2899	3382	4026	4670	5314	7139

Table 8: Operating cost of the 22kW charger of RuralMED project (€/year) in Amyntaio

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	134	134	134	134	134	4348	4992	5636	6441	7246	9393
Scenario B	134	134	134	134	134	5636	6763	8051	9340	10789	14278

Table 9: Operating cost of the 60kW and 150kW chargers (€/year) in ZEP area (Kozani)

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	-	537	671	805	1074	1449	1610	1932	2093	2415	3194
Scenario B	-	939	1208	1476	1879	2899	3382	4026	4670	5314	7139

Table 10: Operating cost of the 60kW and 150kW chargers (€/year) in Amyntaio

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	-	1744	2147	2550	3086	4348	4992	5636	6441	7246	9393
Scenario B	-	1879	2415	3086	3892	5636	6763	8051	9340	10789	14278

Maintenance cost

The maintenance cost includes the replacement cost of parts and accessories of the chargers, repair of potential damage etc. The annual maintenance cost is considered to be equal to approximately 100 €/charging station [24], while a cost of approximately 500 €/ 22kW charging station, 3,000 €/ 60kW charging station and 5,000 €/ 150kW charging station related to the replacement of certain parts is also added in the 7th year of a 10-year reference period, in each case. Moreover, an annual insurance cost of about 1% (about 30 € for a charger of 22 kW, 300 € for a charger of 60 kW and 500 € for a charger of 150 kW) of the initial investment cost of a charging station is also added to the annual maintenance cost.

Residual value

The residual value of each charger in the end of the 10-year reference period is approximately taken equal to 20% of the initial investment cost in each case. Thus, the residual value is taken equal to 600 € for the charger of 22 kW, 6,000 € for the charger of 60 kW, and 10,400 € for the charger of 150 kW.

Revenue from user charges

The direct benefit from EV public charging consists in the user-generated revenue. Based on data of April 2025 referring to public charging in DEI Blue stations, a user charge of 0.45 €/kWh (0.40 €/kWh for club members) is applied in case of an AC (up to 43 kW) charger, and a user charge of 0.57 €/kWh (0.52 €/kWh for club members) is applied in case of a DC (up to 120 kW) charger [25]. It is noted that, in certain cases, the user charge is formed on the basis of the charging time (charge/minute). In the present analysis, the values of 0.45 €/kWh and of 0.57 €/kWh are adopted for an AC and a DC charger, respectively.

The revenue from user charges is calculated on the basis of the estimated demand (kWh) for EV charging, in each case. The relevant values are shown in Table 11 and Table 12, for ZEP area (Kozani) and Amyntaio, respectively, in case of the 22kW charger of the RuralMED project, which can be used for commercial purposes only from 2030. The respective values in case of a 60kW or 150kW charger for ZEP area (Kozani) and Amyntaio, are shown in Table 13 and Table 14, respectively.

Table 11: Revenue from user charges (€/year) in ZEP area (Kozani), in case of the 22kW charger of RuralMED project, for Scenario A and Scenario B of NECP 2024

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	0	0	0	0	0	4593	5103	6124	6634	7655	10121
Scenario B	0	0	0	0	0	9185	10716	12758	14799	16840	22623

Table 12: Revenue from user charges (€/year) in Amyntaio, in case of the 22kW charger of RuralMED project, for Scenario A and Scenario B of NECP 2024

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	0	0	0	0	0	13778	15819	17861	20412	22964	29768
Scenario B	0	0	0	0	0	17861	21433	25515	29597	34190	45247

Table 13: Revenue from user charges (€/year) in ZEP area (Kozani), in case of a 60kW or 150kW charger, for Scenario A and Scenario B of NECP 2024

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	-	2155	2693	3232	4309	5817	6464	7757	8403	9696	12820
Scenario B	-	3771	4848	5925	7541	11635	13574	16160	18745	21331	28656

Table 14: Revenue from user charges (€/year) in Amyntaio, in case of a 60kW or 150kW charger, for Scenario A and Scenario B of NECP 2024

Year	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Scenario A	-	7002	8618	10234	12389	17452	20038	22623	25855	29087	37706
Scenario B	-	7541	9696	12389	15621	22623	27148	32319	37490	43307	57312

Reference period
The reference period for the execution of Cost-Benefit Analysis is considered to be equal to 10 years.

Discount rate
The discount rate for the execution of Cost-Benefit Analysis is considered to be equal to 4%.

Net Present Value (NPV) calculation of the examined investments
Each alternative is evaluated for a ten-year reference period, in terms of financial Net Present Value (NPV), for the estimated demand based on the two NECP scenarios (A and B). The estimated future benefits and costs are "brought" to present, using a discount rate (in our case equal to 4%), allowing for the characterization of the examined investment as financially viable (in case of a calculated NPV>0) or not (in case of a calculated NPV<0). The results of the analysis executed for the three alternatives (chargers of 22, 60 and 150 kW) for each study area and NECP 2024 Scenario, are shown in Tables 14-25. In particular, Tables 15-18 refer to each one of the 22kW chargers of the RuralMED project installed in ZEP area (Kozani) and Amyntaio, now (and probably until 2029) serving a public EV in each study area until 2029, and being available for commercial purposes from 2030. Tables 19-22 refer to the examination of the installation of a 60kW charger in each study area, while Tables 23-26 to the examination of the installation of a 150kW charger in each study area.

Table 15: NPV calculation for ZEP area (Kozani), in case of the 22kW charger of the RuralMED project, for Scenario A of NECP 2024

Scenario A	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-3050										
Operating cost (€)	-134	-134	-134	-134	-134	-1449	-1610	-1932	-2093	-2415	-3194
Maintenance cost (€)	-130	-130	-130	-130	-130	-130	-130	-630	-130	-130	-130
Revenue (€)						4593	5103	6124	6634	7655	10121
Residual value (€)											600
Net cash flow (€)	-3314	-264	-264	-264	-264	3013	3363	3561	4411	5109	7397
										NPV_{10}=	15378 €

Table 16: NPV calculation for ZEP area (Kozani), in case of the 22kW charger of the RuralMED project, for Scenario B of NECP 2024

Scenario B	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-3050										
Operating cost (€)	-134	-134	-134	-134	-134	-2899	-3382	-4026	-4670	-5314	-7139
Maintenance cost (€)	-130	-130	-130	-130	-130	-130	-130	-630	-130	-130	-130
Revenue (€)						9185	10716	12758	14799	16840	22623
Residual value (€)											600
Net cash flow (€)	-3314	-264	-264	-264	-264	6156.896	7204.712	8101.8	9998.888	11395.976	15954.392
										NPV_{10}=	38730 €

Table 17: NPV calculation for Amyntaio, in case of the 22kW charger of the RuralMED project, for Scenario A of NECP 2024

Scenario A	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-3050										
Operating cost (€)	-134	-134	-134	-134	-134	-4348	-4992	-5636	-6441	-7246	-9393
Maintenance cost (€)	-130	-130	-130	-130	-130	-130	-130	-630	-130	-130	-130
Revenue (€)						13778	15819	17861	20412	22964	29768
Residual value (€)											600
Net cash flow (€)	-3314	-264	-264	-264	-264	9300	10697	11595	13841	15587	20844
										NPV_{10}=	55784 €

Table 18: NPV calculation for Amyntaio, in case of the 22kW charger of the RuralMED project, for Scenario B of NECP 2024

Scenario B	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-3050										
Operating cost (€)	-134	-134	-134	-134	-134	-5636	-6763	-8051	-9340	-10789	-14278
Maintenance cost (€)	-130	-130	-130	-130	-130	-130	-130	-630	-130	-130	-130
Revenue (€)						17861	21433	25515	29597	34190	45247
Residual value (€)											600
Net cash flow (€)	-3314	-264	-264	-264	-264	12094.52	14539.42	16833.6	20127.78	23271.224	31438.784
										NPV_{10}=	82248 €

Table 19: NPV calculation for ZEP area (Kozani), in case of a 60kW charger, for Scenario A of NECP 2024

Scenario A	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Initial investment cost (€)	-30000										
Operating cost (€)		-537	-671	-805	-1074	-1449	-1610	-1932	-2093	-2415	-3194
Maintenance cost (€)		-400	-400	-400	-400	-400	-400	-3400	-400	-400	-400
Revenue (€)		2155	2693	3232	4309	5817	6464	7757	8403	9696	12820
Residual value (€)											6000
Net cash flow (€)	-30000	1218	1622	2027	2836	3968	4454	2424	5910	6880	15226
										NPV$_{10}$=	**4958 €**

Table 20: NPV calculation for ZEP area (Kozani), in case of a 60kW charger, for Scenario B of NECP 2024

Scenario B	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Initial investment cost (€)	-30000										
Operating cost (€)		-939	-1208	-1476	-1879	-2899	-3382	-4026	-4670	-5314	-7139
Maintenance cost (€)		-400	-400	-400	-400	-400	-400	-3400	-400	-400	-400
Revenue (€)		3771	4848	5925	7541	11635	13574	16160	18745	21331	28656
Residual value (€)											6000
Net cash flow (€)	-30000	2431.22	3240.14	4049.06	5262.44	8336.336	9792.392	8733.8	13675.21	15616.616	27117.272
										NPV$_{10}$=	**43943 €**

Table 21: NPV calculation for Amyntaio, in case of a 60kW charger, for Scenario A of NECP 2024

Scenario A	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Initial investment cost (€)	-30000										
Operating cost (€)		-1744	-2147	-2550	-3086	-4348	-4992	-5636	-6441	-7246	-9393
Maintenance cost (€)		-400	-400	-400	-400	-400	-400	-3400	-400	-400	-400
Revenue (€)		7002	8618	10234	12389	17452	20038	22623	25855	29087	37706
Residual value (€)											6000
Net cash flow (€)	-30000	4858	6071	7285	8903	12705	14646	13587	19014	21441	33912
										NPV$_{10}$=	**78580 €**

Table 22: NPV calculation for Amyntaio, in case of a 60kW charger, for Scenario B of NECP 2024

Scenario B	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Initial investment cost (€)	-30000										
Operating cost (€)		-1879	-2415	-3086	-3892	-5636	-6763	-8051	-9340	-10789	-14278
Maintenance cost (€)		-400	-400	-400	-400	-400	-400	-3400	-400	-400	-400
Revenue (€)		7541	9696	12389	15621	22623	27148	32319	37490	43307	57312
Residual value (€)											6000
Net cash flow (€)	-30000	5262.44	6880.28	8902.58	11329.34	16587.32	19984.78	20867.6	27750.42	32118.584	48634.544
										NPV$_{10}$=	**120004 €**

Table 23: NPV calculation for ZEP area (Kozani), in case of a 150kW charger, for Scenario A of NECP 2024

Scenario A	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-52000										
Operating cost (€)		-537	-671	-805	-1074	-1449	-1610	-1932	-2093	-2415	-3194
Maintenance cost (€)		-600	-600	-600	-600	-600	-600	-5600	-600	-600	-600
Revenue (€)		2155	2693	3232	4309	5817	6464	7757	8403	9696	12820
Residual value (€)											10400
Net cash flow (€)	-52000	1018	1422	1827	2636	3768	4254	224	5710	6680	19426
										NPV_{10}=	-17211 €

Table 24: NPV calculation for ZEP area (Kozani), in case of a 150kW charger, for Scenario B of NECP 2024

Scenario B	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-52000										
Operating cost (€)		-939	-1208	-1476	-1879	-2899	-3382	-4026	-4670	-5314	-7139
Maintenance cost (€)		-600	-600	-600	-600	-600	-600	-5600	-600	-600	-600
Revenue (€)		3771	4848	5925	7541	11635	13574	16160	18745	21331	28656
Residual value (€)											10400
Net cash flow (€)	-52000	2231.22	3040.14	3849.06	5062.44	8136.336	9592.392	6533.8	13475.21	15416.616	31317.272
										NPV_{10}=	21774 €

Table 25: NPV calculation for Amyntaio, in case of a 150kW charger, for Scenario A of NECP 2024

Scenario A	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-52000										
Operating cost (€)		-1744	-2147	-2550	-3086	-4348	-4992	-5636	-6441	-7246	-9393
Maintenance cost (€)		-600	-600	-600	-600	-600	-600	-5600	-600	-600	-600
Revenue (€)		7002	8618	10234	12389	17452	20038	22623	25855	29087	37706
Residual value (€)											10400
Net cash flow (€)	-52000	4658	5871	7085	8703	12505	14446	11387	18814	21241	38112
										NPV_{10}=	56411 €

Table 26: NPV calculation for Amyntaio, in case of a 150kW charger, for Scenario B of NECP 2024

Scenario B	2025	2026	2027	2028	2029	2030	2031	3032	2033	2034	2035
Year	0	1	2	3	4	5	6	7	8	9	10
Initial investment cost (€)	-52000										
Operating cost (€)		-1879	-2415	-3086	-3892	-5636	-6763	-8051	-9340	-10789	-14278
Maintenance cost (€)		-600	-600	-600	-600	-600	-600	-5600	-600	-600	-600
Revenue (€)		7541	9696	12389	15621	22623	27148	32319	37490	43307	57312
Residual value (€)											10400
Net cash flow (€)	-52000	5062.44	6680.28	8702.58	11129.34	16387.32	19784.78	18667.6	27550.42	31918.584	52834.544
										NPV_{10}=	97835 €

Based on the results shown in Tables 15-26, the investment in each case is considered to be profitable, as the financial NPV is calculated > 0, excluding the case of the 150kW charger in ZEP area (Kozani), for Scenario A of NECP 2024, as the NPV is calculated < 0. From a strategic planning perspective, this investment supports multiple co-benefits: reduced carbon emissions, visible public leadership in clean mobility, alignment with regional and national decarbonization goals, and the creation of reliable operational models that can be replicated in other municipalities across Greece and the Mediterranean. By integrating charging infrastructure into active service bases and allocating EVs to high-need public service departments, the Greek pilot ensures high asset utilization, minimized downtime, and long-term economic returns. In conclusion, the investment in EV charging infrastructure and fleet electrification in the Greek pilot areas is not only economically justified but also delivers robust operational, social, and environmental value. The pilot confirms that even in rural and semi-urban areas—traditionally considered more challenging environments for EV deployment—the transition to low-emission mobility is both technically and financially achievable, especially when infrastructure is deployed strategically and aligned with essential service delivery.

2.7.4. ICT Network Integration and Route Planning

The ICT (Information and Communication Technology) layer of the RuralMED project plays a vital role in ensuring that electric mobility solutions deployed in rural and remote territories are not only operationally efficient but also measurable, replicable, and optimized for continuous improvement. In the Greek pilot sites—ZEP (Kozani) and the Municipality of Amyntaio—ICT integration focuses on three main pillars: (1) connectivity of charging infrastructure, (2) data acquisition and reporting, and (3) route planning and fleet management optimization.

Solution overview

For each of the two pilot sites an electric vehicle (EV) was procured, namely the VOLKSWAGEN-ID.3 (E11) PRO ELECTRIC - 2023-ID.3 Life-5d (E123MJW01). These EVs are monitored via the web for their exact location, their consumed energy and their battery status. Apart from the EVs, two electric chargers have been procured for the project (one for each pilot site), namely the MC CHARGERS / ORION mini 22kW / OM-22HG. The system consists of three main subsystems: (i) the backend together with the Database, hosted on a web server, (ii) the administrator's frontend, which is a web application and (iii) the user's frontend, which is a mobile application.

More analytically:

- The system backend communicates with each vehicle and receives the data of the electric vehicles with appropriate authentication, through secure protocols, from the cloud. This data is stored in the project database.
- The system functions are managed by an administrator (application and database administrator) through the frontend web application. Through the web environment, the administrator can add/remove cars, manage the routes that the vehicle can perform, as well as the stops that are part of it and have the general supervision of the system.
- Finally, as part of the project, a mobile application has been developed for drivers, with which they can update vehicle information and record the routes they take.

The web server software, i.e. the web application, communicates with the driver's mobile application in the vehicle and provides data/information for each electric vehicle.

Solution analysis

1. *Mobile application development*

As part of the project, an Android mobile application has been developed which is available for free and enables drivers to update vehicle information (updates on the charge level, kilometers traveled and charges) and to record in detail the routes they take so that detailed data can be collected.
In detail, the driver:

- Initiates and records EV routes
- Records vehicle information (current charge level, remaining kilometers)
- Logs warning codes from a predefined list
- Logs vehicle charging (duration and energy consumed)
- Records events with the option to add the vehicle's current location

2. *Web application development*

For the purposes of effective management of electric vehicles and charging stations, a web application information system has been developed. The backend of this system communicates with the driver's mobile application in the vehicle and receives the data of the electric vehicles with appropriate authentication, through secure protocols. This data is stored in the project database. The system's functions are managed by an administrator (application and database administrator) through the frontend web application. Through its web environment, the administrator can add/remove cars and routes from the system, disable cars in case of a possible breakdown and have general supervision of the system.
In detail, the administrator can:

- Create, edit and delete electric vehicles
- Preview latest position monitoring of vehicles
- Create, edit and delete charging stations
- Create, edit and delete routes
- Create, edit and delete stops
- Create, edit and delete repairs and damages
- Preview the warning codes logged by the drivers
- Preview the charging logs of the drivers.
- Preview the miscellaneous event logs of the drivers.
- Edit user profile

The information system's purpose is to provide data to the mobile application for each vehicle.

3. *API usage*

CIMNE, as a partner of the project, has implemented an API which is used in order to send information to their servers. This API is divided into 2 parts, namely i) the API which is used to send charges data and ii) the API which is used to send travel data via web requests.

4. *Charges data*

In this part, CIMNE's OCPP server API is used in order to send the data of the charging sessions of the EVs. The electric chargers use OCPP v1.6, which is compatible with CIMNE's API. We use the web service provided by CIMNE (ws://ruralocpp.cimne.com:8081/) to automatically send charging sessions data.

5. Travels data

Finally, in this part CIMNE's other API (https://ruralmedapi.cimne.com/swagger/ui/index) is used in order to send the data of the travels conducted by the EVs. Thus, a web request is sent containing data in a specific JSON format which is readable by the API at specific time intervals and this way it is stored in the database.

❖ 3. RURALMED MOBILITY PLATFORM AND ON-DEMAND TRANSPORT TESTING

Key Functionalities of the Platform

The RuralMED Mobility Platform represents the digital core of the project, conceived to integrate, monitor, and optimize electric mobility and on-demand transport services across rural Mediterranean regions. Its main purpose is to connect charging infrastructure, electric vehicle fleets, and user interfaces within a unified, interoperable environment that supports decision-making and facilitates the transition toward sustainable and inclusive mobility models.

The platform is structured as a modular and scalable architecture that combines data management, analytical tools, and visualization interfaces. It integrates real-time data from EV charging stations and shared vehicles, enabling continuous supervision of the network's performance and supporting operational planning. Through a responsive web application, accessible from both desktop and mobile devices, the system provides different access levels for administrators, operators, and drivers, ensuring secure management of users, assets, and mobility events. It gathers information such as charging sessions, routes, energy consumption, and trip logs, generating indicators that help assess efficiency, usage, and environmental impact.

From a technological standpoint, the platform follows open standards to guarantee interoperability with existing and future systems. All charging stations communicate through the Open Charge Point Protocol (OCPP 1.6 or higher), which allows remote monitoring, control, and reporting of charging activity. Data from electric vehicles and on-demand transport operations are exchanged through RESTful APIs, enabling seamless communication with regional ICT infrastructures and external Mobility-as-a-Service (MaaS) platforms. This ensures full compatibility with different hardware suppliers and national or cross-border data platforms, fostering replicability and long-term sustainability.

Beyond technical connectivity, the platform also provides an operational layer for day-to-day management. Fleet managers can visualize the position and state of vehicles, monitor energy use, and detect anomalies or maintenance needs. Charging points can be supervised remotely, ensuring continuity of service even in remote areas. Alerts and event logs are automatically generated and stored in a centralized database, allowing traceability and the creation of analytical reports that support evidence-based decision-making at both local and transnational levels.

The visualization tools integrated into the platform play a key role in transforming raw data into actionable knowledge. Interactive dashboards and geospatial representations make it possible to analyze usage patterns, evaluate network performance, and plan improvements in coverage or service frequency. This data-driven approach supports the evaluation of Key Performance Indicators (KPIs) defined for each pilot, providing a foundation for replication in other rural territories.

The RuralMED Mobility Platform embodies the concept of digital integration in rural transport systems. It not only facilitates the technical operation of the pilots but also promotes cooperation among partners, municipalities, and service providers. By ensuring interoperability, transparency, and data accessibility, it contributes to building a shared knowledge base that can guide future investments in electromobility and sustainable transport across the MED area.

Interoperability requirements

Interoperability stands at the core of the RuralMED Mobility Platform, ensuring that all pilot sites, infrastructures, and data services can operate within a common digital ecosystem regardless of their local specificities. The platform has been designed to integrate a wide variety of hardware and software components—charging stations, electric vehicles, sensors, and management systems—under a set of open standards and shared communication protocols. This approach guarantees technical consistency, scalability, and replicability across all Mediterranean pilot regions.

All electric charging stations deployed under the project comply with the Open Charge Point Protocol (OCPP 1.6 or higher), enabling standardized bidirectional communication with the platform. This protocol supports essential functionalities such as user authentication, energy metering, session management, and remote control of charging events. Where applicable, the Open Charge Point Interface (OCPI) is adopted to ensure cross-platform compatibility and potential integration with external e-mobility service providers. These standards make it possible for chargers from different manufacturers to operate seamlessly within the same ICT environment, minimizing vendor lock-in and future-proofing the system.

Data interoperability extends beyond the charging infrastructure to include fleet monitoring systems and shared mobility services. The platform uses RESTful APIs based on JSON structures to exchange operational data between regional systems and the central RuralMED ICT hub hosted by CIMNE. These APIs allow the automated transfer of information related to vehicle status, routes, charging events, and user interactions, supporting consistent monitoring and evaluation across pilot sites. All regional partners can thus contribute to a unified dataset, which feeds performance indicators and comparative analytics for project-wide assessment.

In terms of information security and privacy, the system fully complies with the General Data Protection Regulation (GDPR) and related EU directives on data handling and user consent. Personal and operational data are stored in encrypted form, and access is managed through secure authentication layers. The platform ensures traceability and auditability of data transactions, establishing a transparent framework for accountability among project partners.

Energy and communication interfaces have also been standardized to facilitate integration with smart-grid environments. The platform's design anticipates compatibility with future ISO 15118 implementations, which enable vehicle-to-grid (V2G) communication and dynamic load management. In parallel, geospatial data and metadata produced by the pilots follow INSPIRE Directive principles, ensuring that they can be easily visualized, reused, and shared in regional planning tools and GIS applications.

Ultimately, the interoperability framework developed within RuralMED provides the foundation for a transnational ecosystem of rural e-mobility. By adhering to open communication standards, secure data-sharing mechanisms, and harmonized monitoring procedures, the project ensures that each pilot contributes not only to local improvements but also to a collective knowledge base capable of supporting future expansion and integration into broader Mobility-as-a-Service networks across the Mediterranean area.

Testing and Validation

The testing and validation phase of the RuralMED Mobility Platform will be carried out once the pilot deployments are fully operational and sufficient data have been collected under Work Package 3. Its main objective will be to verify the technical performance, interoperability, and reliability of the platform and associated infrastructures, ensuring that they meet the expected standards and operational objectives defined during the preparation phase.

Testing will be conducted progressively, beginning with the verification of communication between the local infrastructures and the central ICT platform. These trials will confirm that all systems correctly transmit and process operational data such as charging sessions, vehicle usage, and connectivity status. Particular attention will be given to assessing network stability and data reliability in rural environments, where communication conditions may vary depending on local infrastructure.

Once connectivity and data exchange are validated, functional testing will focus on the integration between the platform's web interface and the data generated by the electric vehicles and charging points. This stage will evaluate the accuracy, consistency, and timeliness of the information displayed, including the monitoring of charging activity, route tracking, and fleet status under real conditions. The objective will be to ensure that the platform provides reliable and coherent data to support operational management and decision-making across all pilot sites.

The analysis of the test results will be carried out collectively by the project partners to produce a consolidated evaluation of system performance and interoperability. The indicators to be assessed will include system reliability, data synchronization, charging efficiency, and service availability. The outcomes will guide future optimization measures and support the refinement of the platform before its replication or large-scale deployment in later stages of the project.

In addition, the validation process will include checks related to cybersecurity, data protection, and compliance with European regulations. Secure communication, user authentication, and the protection of operational and personal data will be verified to ensure full conformity with EU requirements. Energy management and system stability will also be monitored to confirm safe and efficient operation under variable grid conditions.

Overall, the testing and validation phase will demonstrate that the RuralMED Mobility Platform functions as an integrated, interoperable, and reliable digital ecosystem. The knowledge gained from this process will guide the fine-tuning of both the platform and the pilot infrastructures, ensuring that the final solution is robust, adaptable, and ready for replication across rural and Mediterranean territories.

❖ 4. JOINT METHODOLOGY FOR PILOT IMPLEMENTATION

The Joint Methodology for Pilot Implementation establishes the common framework that ensures coherence, comparability, and interoperability across all pilot activities carried out within the RuralMED Mobility project. It defines the technical, operational, and digital principles that guide the deployment of electric vehicle charging infrastructure and the integration of data flows into the RuralMED ICT platform.

This methodology harmonizes national approaches while allowing flexibility for regional adaptation, ensuring that each pilot contributes to a shared transnational knowledge base. It covers the end-to-end process — from site selection and grid connection to ICT integration, monitoring, and evaluation — thus enabling a consistent implementation model across Mediterranean rural territories. The following sections detail the data acquisition mechanisms, connectivity standards, and compliance requirements that form the backbone of the RuralMED pilot framework.

Charging Stations Data Acquisition Mechanisms

The direct OCPP method, although it offers the maximum level of interoperability, is not expected since most of the local charging stations will be connected to third-party provider software via the Open Charge Point Protocol (OCPP), ensuring seamless communication and management through these external platforms. However, the RuralMED ICT platform will also implement the server-side component of the Open Charge Point Protocol and allow regions that prefer to connect their charging stations directly to the RuralMED platform to do so, offering them flexibility and greater control over their charging infrastructure management, should they choose not to rely on external providers.

The preferred method for data acquisition on the RuralMED ICT platform is through an API, which allows for automatic, real-time data collection from charging stations and EV fleet management systems. This ensures continuous and seamless data integration, reducing the need for manual intervention.

However, **as a minimum requirement, all systems must provide an export mechanism that enables periodic manual uploads of data to the platform.** This fallback option ensures that regions without automated systems can still participate by regularly updating their usage data through manual uploads.

Direct OCPP Connection (Not expected)

Charging stations must be compatible with either 1.6, 2.01 or 2.1 version of OCPP and should be configured to connect to CIMNE's ICT platform server IP to enable direct access to the charging stations via OCPP. Charging stations must be connected to a secure network that allows continuous and reliable communication with the ICT platform server.

Choosing this mechanism will enable the following functionalities of the ICT platform: Real-time monitoring of charges performed, Real-time monitoring of energy consumption, ability to start and stop charges and retrieval of historical charging data.

API with Automatic Integration (Preferred Method)

The API-based data acquisition is the preferred method for integrating local charging stations with the RuralMED ICT platform, ensuring seamless data exchange. This method enables automatic data collection and immediate availability of key performance metrics, reducing the need for manual processes. Regions that implement this method benefit from enhanced operational efficiency and greater insight into the performance and usage of their EV infrastructure. For areas where an API integration is not immediately feasible, the platform will offer fallback options, such as manual data uploads, but API-based integration remains the optimal solution for automated, efficient data management.

To ensure flexibility and full integration with various infrastructure systems, the RuralMED ICT platform will be able to provide an API for charging station providers to send data, as well as have the capability to make periodic calls to an API provided by the charging station provider for data retrieval.

API Provision by the Platform:
The platform will offer an API endpoint that allows charging stations or their management systems to push data directly to the platform in real-time. This will be the preferred method for ensuring seamless and automated data collection. The platform's API will support the following functions:

- **Submit Meter Values:** Charging stations can send energy consumption data per session.
- **Status Updates:** Regular status checks (e.g., available, occupied, or error) can be sent to keep track of the operational status of the stations.
- **Session Management:** Data on start and stop transactions will be collected for each charging session, ensuring full tracking of usage patterns and energy flow.

API Calls to Station Providers:
In cases where the charging station provider manages the data collection and doesn't have the possibility to push the data directly, the RuralMED platform will be capable of periodically calling the provider's API to pull relevant data. This functionality will allow the platform to:

- **Request Meter Values:** Retrieve data on energy consumption, session duration, and charging station status.
- **Sync Status and Fault Information:** Ensure that the platform receives up-to-date information on the operational status of all connected stations.
- **Request Transaction Details: Access:** Detailed data on the start and stop of sessions, including user and vehicle identifiers.
- **Synchronization and Scheduling:** To ensure accurate and up-to-date data, the platform will be configured to make scheduled API calls at regular intervals, such as every 15

minutes or hourly, depending on the infrastructure's configuration and operational needs. This will help regions without real-time integration still maintain effective data collection.

By supporting both outbound API provision and inbound periodic API calls, the platform ensures that data flows smoothly and efficiently, regardless of the technical capabilities of the charging station providers. This dual capability maximizes flexibility and ensures comprehensive monitoring of both the infrastructure and fleet performance.

Manual Data Acquisition (Fallback Method)

In cases where API integration is not feasible, the platform will support a manual export/import mechanism for fleet data. This method requires periodic data exports from the EV fleet management software in a compatible format, followed by manual uploads to the RuralMED ICT platform
The platform will also adopt the data format defined in the Open Charge Point Protocol (OCPP) as the recommended standard for manual data exchange. CSV, XML and JSON formats will be allowed as container for the data. Files must be transferred to a secure server accessible by CIMNE's ICT platform that will include mechanisms to validate the integrity and accuracy of the exported data.

Data Format and Structure:
The platform will adopt the data structure defined in the Open Charge Point Protocol (OCPP), either in JSON or XML format, as the recommended standard for data exchange. OCPP is widely recognized in the EV infrastructure industry making it the ideal choice for facilitating communication between charging stations and management software.

The information included in the data transactions will include crucial information such as energy usage per charging session, session duration, charging station status and fault and maintenance notifications.

For data acquisition from EV charging stations, following OCPP (Open Charge Point Protocol) standards is crucial to ensure smooth communication between the RuralMED ICT platform and the charging stations. Below are the key transaction types — Meter Values, Status Updates, and Session Management — along with their technical data structure based on OCPP (version 1.6 and 2.0.1) specifications.

Meter Values

The **Meter Values** transaction provides the platform with detailed information about the energy consumption during a charging session. Each meter value typically includes timestamped information for energy delivered (in Wh or kWh), providing crucial data for billing, performance monitoring, and energy usage analysis.

Data Structure:

- **connectorId**: (integer) The connector's unique identifier at the charging station.
- **transactionId**: (string) Unique ID for the charging session.
- **timestamp**: (datetime) The precise time when the meter value was recorded.

- **meterValue**: (array of objects) Each object represents a data point, such as the current energy reading. This includes:
- **sampledValue**: (array) Contains the individual meter values recorded. Each value includes:
- **value**: (decimal) The actual meter reading (e.g., 15000 Wh).
- **unit**: (string) The unit of the meter value, typically "Wh" or "kWh".
- **context**: (string) Defines the context of the sampled value, such as "Sample.Periodic" or "Transaction.Begin".
- **measurand**: (string) Describes the type of value, such as "Energy.Active.Import.Register".

Example:


```
{
   "connectorId": 1,
   "transactionId": "ABC123",
   "timestamp": "2024-09-21T14:00:00Z",
   "meterValue": [
      {
         "sampledValue": [
            {
               "value": "15000",
               "unit": "Wh",
               "context": "Transaction.Begin",
               "measurand": "Energy.Active.Import.Register"
            }
         ]
      }
   ]
}
```


Status Updates

Status Updates inform the platform of the current operational state of each charging station. It allows for real-time monitoring of availability, faults, and other key indicators that help manage station utilization and maintenance.

Data Structure:

- **connectorId**: (integer) Unique identifier for the charging connector reporting the status.
- **status**: (string) The current status of the connector (e.g., "Available", "Occupied", "Faulted").
- **errorCode**: (string) If applicable, the error code that indicates what went wrong (e.g., "ConnectorLockFailure").
- **info**: (string, optional) Additional error information, if available.
- **timestamp**: (datetime) The time the status was recorded.

Example:


```
{
```

```
    "connectorId": 1,
    "status": "Occupied",
    "errorCode": "NoError",
    "timestamp": "2024-09-21T14:05:00Z"
}
```


Session Management

Session Management transactions handle the initiation and closure of charging sessions. These transactions include key information like the energy delivered, session duration, and vehicle or user identifiers. This data is essential for billing, reporting, and managing user accounts.

Data Structure:

StartTransaction:

- **connectorId**: (integer) The specific connector initiating the session.
- **idTag**: (string) The unique identifier of the user or vehicle starting the session.
- **timestamp**: (datetime) The start time of the session.
- **meterStart**: (integer) Initial meter reading (in Wh or kWh) when the session starts.
- **reservationId**: (optional) If the connector was reserved beforehand, this ID would be included.

Example (Start Transaction):


```
{
    "connectorId": 1,
    "idTag": "USER123",
    "timestamp": "2024-09-21T14:00:00Z",
    "meterStart": 0,
    "reservationId": null
}
```


StopTransaction:

- **transactionId**: (string) Unique ID assigned at the start of the session.
- **idTag**: (string) The identifier of the user or vehicle that completed the session.
- **timestamp**: (datetime) The time the session ended.
- **meterStop**: (integer) Final meter reading at the end of the session.
- **reason**: (optional) Reason for ending the session (e.g., "Local" for user-initiated or "EmergencyStop").

Example (Stop Transaction):


```
{
    "transactionId": "ABC123",
    "idTag": "USER123",
    "timestamp": "2024-09-21T15:00:00Z",
    "meterStop": 15000,
    "reason": "Local"
```

}

These structures can be directly mapped to the API endpoints, allowing for easy data collection and management, which is crucial for effective monitoring and decision-making in the **RuralMED Mobility project.**

EV Fleet Data Acquisition Mechanisms

To ensure comprehensive data collection from the **EV fleets** involved in the RuralMED project, the platform will support two main methods for acquiring data:

API with Automatic Integration (Preferred Method)

The preferred method for data acquisition is through an API that allows for real-time and automated data synchronization between the EV fleet management systems and the RuralMED ICT platform. This ensures continuous and seamless data flow without manual intervention. This method reduces the need for manual data handling and ensures that fleet data is always up to date, providing a holistic view of both the charging stations and the EV fleet's performance.

The key features of this approach include:

- **Real-time data collection**: Automated API calls can retrieve data such as vehicle location, battery levels, energy consumption, usage patterns, and operational status.
- **Standardized format**: The platform will adopt a standardized data format, similar to the OCPP for charging stations, ensuring interoperability and consistency across different fleet management systems.
- **Bidirectional communication**: The API will allow not only data acquisition but also feedback mechanisms, enabling actions such as scheduling or sending operational commands to the fleet management system.

Key data points that will be collected include: battery status and charging needs, vehicle location and movement tracking, fleet usage statistics, including mileage and energy efficiency and diagnostics and maintenance alerts.

Manual Data Acquisition (Fallback Method)

In cases where API integration is not feasible, the platform will support a manual export/import mechanism for fleet data. This method requires periodic data exports from the EV fleet management software in a compatible format, followed by manual uploads to the RuralMED ICT platform. Key aspects include:

- **Scheduled exports**: Fleet managers will be responsible for exporting data at regular intervals (e.g., daily or weekly) in a predefined format (CSV, XML, JSON).
- **Import functionality**: The platform will provide an easy-to-use interface for uploading the data files, ensuring they are processed and integrated into the platform's data ecosystem.

- **Data validation**: Upon import, the platform will perform automatic validation checks to ensure data accuracy and completeness before it is integrated into the system.

While this method requires more manual effort, it ensures that regions or fleet management systems that cannot implement automatic API integration can still contribute meaningful data to the platform.

By offering these two options, the RuralMED ICT platform ensures flexibility in how fleet data is collected, while encouraging automation through API integration for optimal data flow and system performance.

Data Format and Structure:

For EV fleet data acquisition, we need to define a custom data structure that supports real-time monitoring and management of electric vehicles (EVs). While OCPP is a common reference for charging stations, fleet data requires a more tailored structure that includes tracking vehicle usage, energy efficiency, location, and other performance indicators. Below is a proposed data structure to capture key information for integration with the RuralMED ICT platform.

Vehicle Status Updates

This transaction provides real-time information about the operational state of each EV in the fleet. It includes key metrics such as location, battery status, and any active warnings.

Data Structure:

- **vehicleId**: (string) Unique identifier for each EV in the fleet.
- **timestamp**: (datetime) The time the status was recorded.
- **location**: (object) Contains geographical data, including:
  - **latitude**: (decimal) Current latitude of the EV.
  - **longitude**: (decimal) Current longitude of the EV.
- **batteryStatus**: (object) Details about the vehicle's battery status:
  - **batteryLevel**: (percentage) Current battery level, typically expressed as a percentage.
  - **rangeRemaining**: (integer) Estimated range remaining (in kilometers or miles) based on the current charge level.
- **status**: (string) Operational status of the EV, such as "In Service", "Charging", "Idle", or "Faulted".
- **warningCodes**: (array of strings) Any warnings or error codes related to vehicle performance.

Example:

```
{
   "vehicleId": "EV123",
   "timestamp": "2024-09-21T12:30:00Z",
   "location": {
      "latitude": 41.40338,
```

```
      "longitude": 2.17403
   },
   "batteryStatus": {
      "batteryLevel": 85,
      "rangeRemaining": 120
   },
   "status": "In Service",
   "warningCodes": ["BatteryTemperatureHigh"]
}
```


Trip and Usage Data

This transaction captures details of individual trips made by each EV in the fleet, providing insight into usage patterns, energy efficiency, and driving behavior.

Data Structure:

- **vehicleId**: (string) Unique identifier for the EV.
- **tripId**: (string) Unique identifier for the trip.
- **startTime**: (datetime) Time the trip started.
- **endTime**: (datetime) Time the trip ended.
- **distanceTraveled**: (decimal) Total distance traveled during the trip, in kilometers or miles.
- **energyConsumed**: (decimal) Energy consumed during the trip, typically in kWh.
- **averageSpeed**: (decimal) Average speed during the trip, in kilometers per hour or miles per hour.
- **tripType**: (string) Type of trip, such as "Delivery", "Service", or "Commute".

Example:


```
{
   "vehicleId": "EV123",
   "tripId": "TRIP456",
   "startTime": "2024-09-21T08:00:00Z",
   "endTime": "2024-09-21T08:45:00Z",
   "distanceTraveled": 35.5,
   "energyConsumed": 12.5,
   "averageSpeed": 47.3,
   "tripType": "Delivery"
}
```


Maintenance and Diagnostics

This transaction tracks maintenance and diagnostic data for each EV in the fleet, providing insights into vehicle health and potential issues.

Data Structure:

- **vehicleId**: (string) Unique identifier for the EV.
- **timestamp**: (datetime) Time the maintenance or diagnostic information was recorded.
- **odometerReading**: (integer) The current odometer reading (in kilometers or miles).
- **diagnosticCodes**: (array of objects) Each object represents a diagnostic code, including:
  - **code**: (string) Diagnostic trouble code (DTC) for the vehicle.
  - **description**: (string) Description of the issue associated with the code.

- **scheduledMaintenance**: (object) Contains details on upcoming or past maintenance tasks:
    - **maintenanceType**: (string) Type of maintenance (e.g., "Tire Rotation", "Battery Check").
    - **dueDate**: (datetime) Scheduled date for the maintenance task.

Example:


```
{
   "vehicleId": "EV123",
   "timestamp": "2024-09-21T10:00:00Z",
   "odometerReading": 35000,
   "diagnosticCodes": [
      {
         "code": "P0A80",
         "description": "Replace Hybrid Battery Pack"
      }
   ],
   "scheduledMaintenance": {
      "maintenanceType": "Tire Rotation",
      "dueDate": "2024-10-01T09:00:00Z"
   }
}
```


Charging Session Data

This transaction captures data specific to the charging sessions of EVs within the fleet, similar to the charging station data but from the vehicle's perspective.

Data Structure:

- **vehicleId**: (string) Unique identifier for the EV.
- **chargingSessionId**: (string) Unique ID for the charging session.
- **startTime**: (datetime) Time the charging session started.
- **endTime**: (datetime) Time the charging session ended.
- **energyConsumed**: (decimal) Energy consumed during the charging session (in kWh).
- **chargingStationId**: (string) Identifier of the charging station used.

Example:


```
{
   "vehicleId": "EV123",
   "chargingSessionId": "CHARGE789",
   "startTime": "2024-09-21T09:00:00Z",
   "endTime": "2024-09-21T11:00:00Z",
   "energyConsumed": 30.5,
   "chargingStationId": "STATION001"
}
```

Compliance with European Standards

Bidders must ensure that all charging stations and associated systems comply with the following relevant European and international standards:

Legal Standards:

- **Directive 2014/94/EU** on the implementation of alternative fuels infrastructure.
- **Directive 2007/46/EC** on the approval of motor vehicles and their trailers.
- **Directive 2009/28/EC** on the promotion of the use of energy from renewable sources.
- **Directive 2012/27/EU** on energy efficiency.

Technical Standards:

- **IEC 62196-1:** Plugs, socket-outlets, and vehicle connectors - Conductive charging of electric vehicles - General requirements.
- **IEC 62196-2:** Plugs, socket-outlets, and vehicle connectors - Conductive charging of electric vehicles - Dimensional interchangeability requirements for AC pin and contact-tube accessories.
- **IEC 62196-3:** Plugs, socket-outlets, and vehicle connectors - Conductive charging of electric vehicles - Dimensional compatibility and interchangeability requirements for DC and AC/DC pin and contact-tube vehicle couplers.
- **IEC 61851-1:** Electric vehicle conductive charging system - General requirements.
- **ISO 15118-1:** Road vehicles - Vehicle to grid communication interface - General information and use-case definition.

❖ 5. CONCLUSIONS

RuralMED Mobility Project represents a significant step toward overcoming the mobility challenges faced by rural areas in the EU by demonstrating how electric mobility can be effectively deployed outside major urban centers. Through coordinated pilot actions across seven partner countries, the project has defined a joint methodology that integrates infrastructure deployment, data acquisition, and interoperability standards under a unified operational framework.

The pilots have demonstrated that rural e-mobility initiatives are technically feasible, socially beneficial, and environmentally impactful, provided that investments are coupled with strong institutional cooperation and ICT integration. By combining standardized EV charging infrastructure (compliant with IEC 61851 and ISO 15118), open communication protocols (OCPP 1.6), and a shared data management platform, RuralMED has created a replicable foundation for future regional networks.

Key outcomes include:

- Identification of **strategic locations for EV charging** in low-density areas, ensuring accessibility and grid efficiency.
- Validation of **technical configurations** (22–60 kW chargers, smart metering, RFID/NFC access) suitable for rural deployment.
- Establishment of **interoperability criteria** enabling integration with national mobility systems and potential MaaS platforms.
- Demonstration of **economic feasibility**, showing reduced operational costs versus fossil-fuel vehicles and tangible benefits in CO_2 reduction.
- Creation of a **multi-country methodological model** adaptable to different regulatory and territorial contexts.

Beyond its technical achievements, RuralMED has strengthened cross-border collaboration and raised awareness of sustainable transport in peripheral regions. The pilots reveal that electromobility can catalyze local development, foster green tourism, and improve public service delivery in rural communities.

In conclusion, RuralMED demonstrates that a joint, data-driven, and interoperable approach to rural e-mobility is not only viable but essential to achieving the EU's Green Deal and sustainable transport objectives for 2030 and beyond.

References

[1] SDAM website. (2022). https://www.sdam.gr/sites/default/files/2020-12/%CE%95%CF%80%CE%B9%CE%BA%CE%B1%CE%B9%CF%81%CE%BF%CF%80%CE%BF%CE%B9%CE%B7%CE%BC%CE%AD%CE%BD%CE%BF%20%CE%A3%CE%94%CE%91%CE%9C_11.12.2020_0.pdf (last accessed on 16-5-2025)

[2] NECP. (2024). National Energy & Climate Plan, https://www.google.com/url?sa=i&url=https%3A%2F%2Fia37rg02wpsa01.blob.core.windows.net%2Ffek%2F02%2F2024%2F20240206983.pdf&psig=AOvVaw0z1DnmTToWL6I-1vEM5COa&ust=1743407515536000&source=images&cd=vfe&opi=89978449&ved=0CAcQr5oMahcKEwjYgJSjqbGMAxUAAAAAHQAAAAAQBw (last accessed on 16-5-2025)

[3] Hellenic Statistical Authority website. (2021). https://www.statistics.gr/documents/20181/17286366/FEK-2024-Tefxos-B-02090.pdf/d4daffb1-7210-a172-9729-52d4771ae785 (last accessed on 16-5-2025)

[4] Yme gov website. (2025). Public charging points, https://electrokinisi.yme.gov.gr/public/ChargingPoints/ (last accessed on 16-5-2025)

[5] EV database website. (2025). https://ev-database.org/cheatsheet/energy-consumption-electric-car (last accessed on 5-4-2025)

[6] MC chargers website. (2025). https://www.mc-chargers.com/en/electric-vehicle-charging-stations/ (last accessed on 6-5-2025)

[7] Kodiko website. (2019). Ministerial Decision No 42863/438/2019 (Government Gazette, Series II, No 2040/4.6.2019), https://www.kodiko.gr/nomologia/download_fek?f=fek/2019/b/fek_b_2040_2019.pdf&t=542c1e94af92f95028185b83c049a8db (last accessed on 16-5-2025)

[8] EV Engineering and Infrastructure website. (2024). What is the IEC 61851-1 standard for EV charging?, https://www.evengineeringonline.com/what-is-the-iec-61851-1-standard-for-ev-charging/ (last accessed on 17-5-2025)

[9] IECEE website. (2022). Standard IEC 62196-2:2022, https://www.iecee.org/certification/iec-standards/iec-62196-22022 (last accessed on 17-5-2025)

[10] CHAdeMO website. (2024). CHAdeMO (Charge de Move) Standard, https://www.chademo.com/ (last accessed on 17-5-2025)

[11] Your Europe website. (2025). CE Marking, https://europa.eu/youreurope/business/product-requirements/labels-markings/ce-marking/index_en.htm (last accessed on 17-5-2025)

[12] Elinyae website. (2021). Ministerial Decision No 101195/08.10.2021 (Series II, 4654), https://www.elinyae.gr/sites/default/files/2021-10/4654b_2021.pdf (18-5-2025)

[13] Elinyae website. (2025a). Y.A. Φ.7.5/1816/88/2004 (ΦΕΚ 470/Β` 5.3.2004) https://www.elinyae.gr/sites/default/files/2019-07/b470_2004.1122285616194.pdf (last accessed on 18-5-2025)

[14] Elinyae website. (2025b). N. 4483/1965 (ΦΕΚ 118/Α` 24.6.1965) https://www.elinyae.gr/sites/default/files/2021-06/118a_1965.pdf (last accessed on 18-5-2025)

[15] Elinyae website. (2016). Law 4439/2016, https://www.elinyae.gr/sites/default/files/2019-07/222A_2016.1480932716100.pdf (last accessed on 18-5-2025)

[16] Eur-lex.europa website. (2014). Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (recast) Text with EEA relevance, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0032 (last accessed on 18-5-2025)

[17] E-Nomothesia website. (2016a). Common Ministerial Decision ΔΠΠ 1418/2016 - ΦΕΚ 1231/Β/27-4-2016, https://www.e-nomothesia.gr/kat-agoranomikes-diatakseis/koine-upourgike-apophase-oik-dpp-1418-2016.html (last accessed on 18-5-2025)

[18] Elinyae website. (2020). Law 4710/2020, https://www.elinyae.gr/sites/default/files/2020-07/142a_2020.pdf (last accessed on 18-5-2025)

[19] E-nomothesia website. (2016b). https://www.e-nomothesia.gr/energeia/koine-upourgike-apophase-oik-51157-dtbn-1129-2016.html (last accessed on 18-5-2025)

[20] US EIA website. (2020). US Energy Information Administration, Independent Statistics and Analysis, https://www.eia.gov/todayinenergy/detail.php?id=42915 (last accessed on 16-5-2025)

[21] Blink website. (2022). https://blinkcharging.com/blog/day-or-night-when-is-the-best-time-to-charge-your-ev (last accessed on 16-5-2025)

[22] The Electric Car Scheme website. (2025). When Should You Charge Your Electric Car to Save the Most Money? 14 March 2025, https://www.electriccarscheme.com/blog/best-time-to-charge-electric-car (last accessed on 16-5-2025)

[23] PPC SA website. (2025). https://www.dei.gr/el/ (last accessed on 31-3-2025)

[24] Municipality of Kozani. (2022). Electric Vehicle Charging Plan, Deliverable P3, https://cityofkozani.gov.gr/documents/10182/917858/%CE%A0%CE%B1%CF%81%CE%B1%CE%B4%CE%BF%CF%84%CE%AD%CE%BF+%CE%A0.3+%CE%94%CE%AE%CE%BC%CE%BF%CF%82+%CE%9A%CE%BF%CE%B6%CE%AC%CE%BD%CE%B7%CF%82.docx.pdf/73f13f8a-19d9-46e3-94d8-041728178f50 (last accessed on 18-5-2025)

[25] PPC blue website. (2025). https://www.deiblue.gr/el/diktyo (last accessed on 5-4-2025)