HELLAS

EV CHARGING EXPERIENCE

greece

A CROSS-COUNTRY TEST RIDE ALONG MAJOR HIGHWAYS

SEPTEMBER 2024

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1. Summary

Based on the results of our report, it is evident that the charging infrastructure for electric vehicles in Greece is still in its early stages. Our **evaluation of >20 DC** charging stations across several provinces revealed various **areas of improvement related** to the **charging infrastructure** and the overall **charging user experience** when using the various EV charging services the charge point operators provided. We can summarise that the overall charging user experience at public charging stations in Greece is not yet a seamless process, particularly when considering areas beyond the Athens and Thessaloniki metropolitan areas.

While the **number of electric vehicles in Greece is expected to rise** in the next few years, the **charging infrastructure is not yet keeping up with** the increasing demand. Given that most charging stations are concentrated in the Athens and Thessaloniki metropolitan areas, it is crucial not to overlook the significant regional disparity in developing the charging infrastructure. The regional differences bring further challenges, especially for electric vehicle drivers leaving the Athens and Thessaloniki metropolitan areas. Looking at the **current low share of faster DC chargers** as well as the limited number of high-power chargers with charging powers 150 kW and more, one can state that long-distance travel with an electric vehicle, in addition to the low density of charging infrastructure, significantly increases the travel time compared to a vehicle with an internal combustion engine.

As a result, electric vehicle drivers need to carefully plan and map out their charging stops along their routes to counter these problems. This situation will even intensify during peak travel time, such as during the summer holiday. Unfortunately, only one offers a reliable trip-planning feature among the CPO applications tested. Overall, the applications provided by various CPOs still have

room for improvement, each with its strengths and weaknesses. While most CPOs offer comprehensive functionalities for the charging process, transaction history, and easy-to-use customer support, some apps still struggle with the app initialization and sign-up process, inaccurate real-time data, and incorrect charging site information. Reservation features for charging stations are also only available for a small portion of the charging infrastructure. Incorporating Apple CarPlay and Android Auto applications would allow for a fast and easy search for nearby charging stations while on the move. Looking at the supported payment methods and billing information, CPOs should consider offering additional payment methods and improve their ability to issue complete tax invoices to corporate customers. Foreign users relying on the English language will encounter additional problems, as, for example, not all apps support the English language during the sign-up and registration process.

In conclusion, with the expected increase in the number of electric vehicles on Greek roads in the next three to five years, CPOs need to improve their network coverage across Greece significantly, upgrade their charging stations to more reliable and faster hardware as well as improve the mobile charging applications to create an excellent and attractive charging experience. Coupled with the government's goal to expand the charging station network to 18,000 charging stations by 2030, positive developments and strategic decisions can be seen, but the objectives that have been set must be implemented consistently and rapidly in the upcoming years. P3 is thrilled to be part of this development and continue shaping electromobility's expansion in Greece.

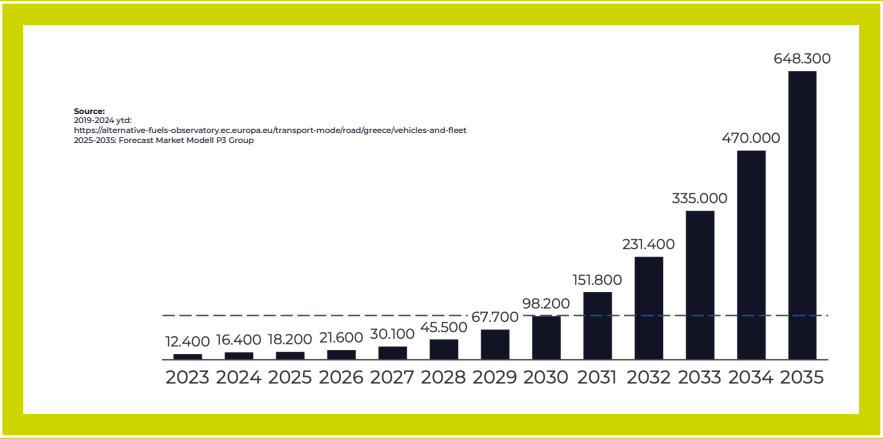
2. Electric Mobility in Greece

Starting in 2035, only zero-emission vehicles will be eligible for registration as new cars and vans in the European Union. This transition aligns with the EU's 2023 decision to implement the "Fit for 55" package, which aims to reduce net greenhouse gas emissions by at least 55% by 2030.[1] This regulation is driving an increased global demand for electric vehicles (EVs), which is, in turn, driving an increased need for charging infrastructure. In response to these challenges, the Greek government has set ambitious targets to address the increased demand for charging infrastructure posed by the significant increase of EVs on Greece's roads. The government aims to have 11,500 publicly accessible fast charging stations by 2025 and more than 18,000 by 2030. Despite the government's efforts to prioritize the development of charging infrastructure in Greece, the country still has a limited number of high-power charging stations available, particularly in comparison to the demand.

The charging infrastructure must be consistently developed to create attractive market conditions and low market entry barriers for electric mobility, but the entire charging ecosystem must also be considered. This includes the availability and variety of electric vehicles offered and the various EV charging services, which are the key user touchpoints.

This report provides an in-depth analysis of the current state of the charging infrastructure in Greece, focusing on the user experience offered by different Charge Point Operators (CPOs). Furthermore, it includes a comprehensive overview of the current electric vehicle market in Greece, key figures of the charging infrastructure, and an introduction to the major CPOs in the market.

2.1 EV Market Overview Greece



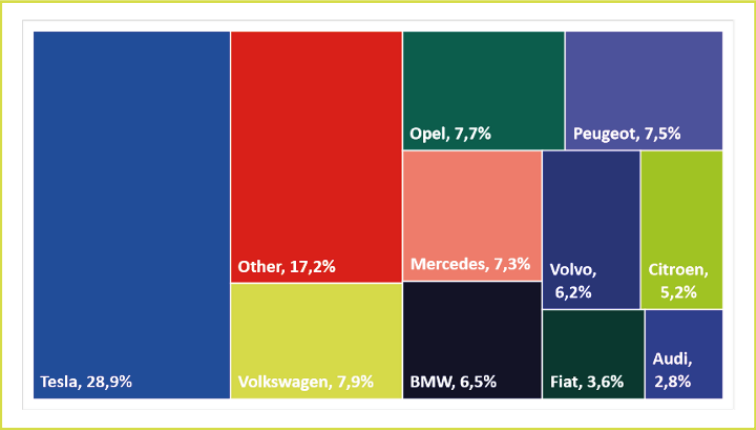
Graphic 1:
Yearly New Battery Electric Vehicles (BEV) Registrations in Greece[G1]

The latest data from the Automotive Association of Greece reveals a recent surge in battery electric vehicle registrations for passenger cars powered solely by electric powertrains.

Until 2018, annual sales of electric vehicles (EVs) in Greece remained below 100 units. However, there was a notable increase in the following two years, reaching 190 car registrations in 2019 and 678 in 2020, respectively. In 2021, the number of new EV sales reached 2,196 per year. While the relative growth year-on-year was reduced in 2022, registrations more than doubled in 2023 (6,379 per year).

During first half of 2024, total BEV registrations increased to almost 16,400 vehicles on Greek roads, demonstrating a significant rise in adoption[2]. In 2024 YTD, 3,313 new BEVs have been registered (3.76% market share of total new registrations) in the M1 segment.

Furthermore, there are 1,301 light commercial vehicles (N1), 266 buses (M2 & M3), and 268 trucks (N2 & N3) with a battery-electric powertrain (as of 2024 YTD). In addition to battery electric vehicles (BEVs), there are 24,911 plug-in hybrid electric vehicles (PHEVs) on the market, most of which can be charged at AC infrastructure.



Graphic 2:
BEV Sales by Manufacturer in Greece in 2023[G2]

P3 anticipates a significant increase in battery electric vehicle registrations over the next few years. In 2031, more than 100,000 battery-electric vehicles are projected to be on the Greek market for the first time. By 2035, the number of BEVs on the Greek market is expected to reach nearly 650,000 (Source: Market model P3 Group).

Various automakers introduced their new EV models in the Greek market in 2024, making the EV market more attractive and accessible for new car buyers.

The growth of BEV Sales has mainly been driven by clear market leader Tesla (~29% BEV Market Share in 2023). Except for Tesla, the market is dominated by cars from traditional European manufacturers and well distributed among them. The following 6 Brands each sold around 400 cars in 2023 & have between 6-8% market share. Audi, Citroen and Fiat are still above 2.8%. The "Other" category encompasses 21 additional manufacturers, each with a market share below 2%. To date, Asian manufacturers have only sold a relatively modest number of vehicles in Greece.[3]

2.2 EV Market Regulation and Incentives

This tremendous growth indicates a rapidly growing interest in battery electric vehicles in the country, potentially resulting from government incentives introduced at the beginning of 2020 and the growing recognition of their advantages. The electric vehicle incentives scheme includes exemption or reduction of taxonomy duty, excise tax, and conditional subsidies for imported EVs.[4]

2.2.1 Market Regulation

In 2023, the European Union decided the “Fit for 55 package” to reach the EU’s target of reducing net greenhouse gas emissions by at least 55% by 2030. It´s a package of proposals aims at providing a coherent and balanced framework for reaching the EU's climate objectives, which:

- ensures a just and socially fair transition.
- maintains and strengthens the innovation and competitiveness of the EU industry while ensuring a level playing field vis-à-vis third-country economic operators.
- underpins the EU's position as leading the way in the global fight against climate change.

The following two objects are most relevant for the mobility and automotive sector:

CO_2 emission standards for cars and vans

The regulation aims to increase the carbon dioxide (CO_2) emission reduction targets for new cars and vans. The proposed regulation increases the CO_2 emission reduction targets for 2030 and sets a new target of 100% for 2035. All cars and vans from 2035 should be zero-emission vehicles.

Towards more sustainable transport (AFIR)

The regulation's goal is to ensure that there is enough infrastructure for cars and trucks to (re)charge with high coverage across the Union to avoid range anxiety. At least every 60 km on main roads (core TEN-T network) should have charging stations installed until the end of 2025 (cars) and the end of 2030 (trucks). Charging stations should also be installed in urban nodes.

The Greek government is developing an extensive plan, the “National Plan for Electrification” (NPE), to adapt to the “Alternative Fuel Infrastructure” (AFIR) and “Fit for 55” EU Policies. In the coming years, more charging stations for alternative fuels will be deployed across Greece, enabling the transport sector to reduce its carbon footprint significantly.[1]

There are three distinct dimensions in the NPE:

- The 1st dimension concerns the development of the necessary charging infrastructure.
- The 2nd dimension concerns the electrification of the existing fleets of vehicles and means of transport.
- The 3rd dimension concerns the development of the ecosystem around this market to provide smart solutions to the new needs that electric mobility brings with it.

The proposed policies cover all 3 of these dimensions, including various types of measures, which take the form of:

- Incentives, such as continuing existing subsidy programs or designing new ones aimed at private vehicle fleets and supporting Renewable Energy Sources (RES) projects combined with charging infrastructure.
- Institutional interventions, such as taking initiatives to electrify public fleets, strengthening the electricity grid to be able to respond to the increased needs to connect and supply charging infrastructure, and
- Disincentives for using conventional vehicles, such as creating low-emission zones in city centers or island settlements.

In March 2023, the feasibility study for establishing a national carrier for electromobility was published (FEK B´, 2014/30.03.2023). The German Society prepared it for International Cooperation (GIZ) in cooperation with the law firm Koutalidis Law Firm. With Climate Law 4936/2022, the Greek government plans to limit car sales to zero-emission vehicles starting in 2030.

Due to the current energy crisis, this regulation will not apply to new cars and light commercial vehicles until 2035, as planned in the EU Commission's "Fit for 55" plan. By the beginning of 2027, at the latest, all taxis and a third of the fleets of car rental companies in the Attica region and Thessaloniki must be emission-free. This also applies to at least a quarter of company cars, which must have an electric or hybrid drive from then on. Around €220 million from the EU recovery fund are earmarked for installing e-charging stations at airports, motorways, and petrol stations and renewing the bus fleet in Athens and Thessaloniki.

A national register for e-charging stations has already been implemented.[5] 12,000 e-charging stations will be available by 2025, and 18,000 by 2030.

2.2.2 Incentives

The Greek government introduced several funding programs to accelerate electric vehicle sales and infrastructure buildup. Most were decided as part of Recover and Resilience Plan 4710/2020 and National Climate Law 4936/2022. They cover Vehicle Purchase and leasing, Ownership, and infrastructure incentives.

New Vehicle Purchase & Leasing

In Greece, electric vehicles benefit from several financial incentives promoting e-mobility. On August 24, 2020, Greece launched an online platform for its e-Mobility subsidy program, known as "Kinoumai ilektrika," which was extended in 2022 and extended again in 2024, where applicants can apply for various subsidies. In its latest form, the program offers significant financial benefits: For private users, it offers a 30% cashback on the net retail price (NRP) for battery electric vehicles (BEVs), with a maximum cashback of €9,000. Additionally, an extra €2,000 is available if a car of 10 years or older is scrapped or if the buyer is 29 years old or younger, bringing up the subsidy to €11,000. For Companies, the subsidy goes up to €6,000.

There are also additional subsidies for firms on Islands and Taxis[16]. The 'Green Taxi' called subsidies cover up to 40% of the cost of a new electric taxi, with a maximum subsidy of €22,500; in 2024, it was extended by the “Zap Taxi Club,” which also offers favorable leasing terms.[5] This initiative is funded by the EU's Recovery and Resilience Fund with a total of €40 million.[6] However, the old vehicles must be scrapped to qualify for the taxi subsidy. Furthermore, the Value Added Tax (VAT) on all-electric vehicle purchases is reduced to 13%, compared to the standard rate of 24%. All Electric vehicles are also exempt from the luxury tax & registration tax, making them an even more attractive option for buyers in Greece.[7]

Vehicle Ownership

Also, during the ownership of an EV, the Government introduced several benefits: EVs are exempt from the Annual Road tax. The annual road tax for internal combustion vehicles ranges between €22 and €1230, depending on the displacement.[8] Additionally, BEVs are exempt from the benefit-in-kind tax[17] if their net retail price is below €40,000. For BEVs exceeding this retail price, an amount of €40,000 is deductible from their net retail price to calculate the benefit-in-kind tax. Additionally, local incentives, such as the use of bus lanes for BEVs in the Metropolitan Area of Athens,[9] make life with an EV more comfortable.

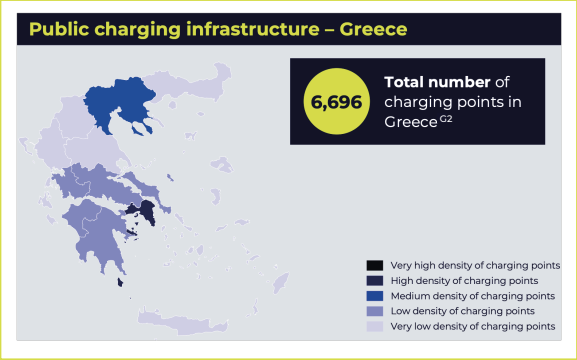
Infrastructure

To enable the usage of EVs, Greece is subsidizing both the private & public charging infrastructure. As part of the "I Move Electrically" program, private persons can get a subsidy of €500 per installed smart charger at their residence & companies can get a €400 subsidy per installed smart charger on their compound.[10] The program "Charge Everywhere" was introduced for public charging points. The program aims to accelerate the build-up of 4,500 additional public chargers with a total power output of 300,000 kW. It is financed with €80 million from the Recover and resilience Fund of 4710/2020.[11]

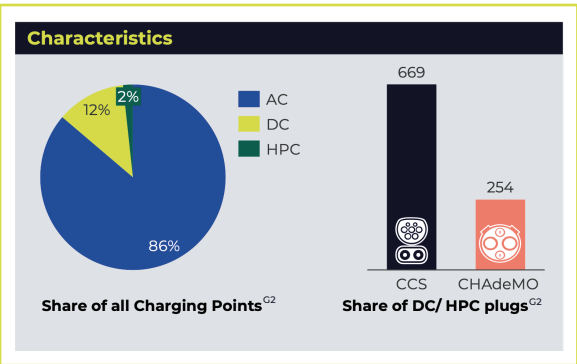
The subsidy rates for this category depend on the location (region/regional unit) where the stations are installed and the size of the company (large/medium/small). These subsidized percentages range from 20% (e.g., a large company installing an EV charging station in the central sector of Athens) to 65% (e.g., a small company installing an EV charging station in Thrace).[12]

2.3 Charging Infrastructure in Greece

Graphic 3:
Overview - Charging infrastructure in Greece[5]



- The public charging infrastructure in Greece is relatively evenly developed.
  - A particularly high concentration of public charging infrastructure exists in Athens.
  - Public charging infrastructure in the rest of the country is low-density but roughly evenly distributed, mostly close to the bigger streets.
- Charging stations in Greece comply with the following standards:
  - IEC 61851 / IEC 62196, ISO 15118 (partially)
- AC charging stations are equipped with a type 2 connection, DC charging stations with a CCS Combo 2/ CHAdeMo



- In Greece, there are a total of 6,696 charging points in operation: 5,773 AC charging points, 808 DC charging points, and 115 HPC charging points.
- Thereof, 923 charging points are DC fast charging points (669 CCS Combo 2 charging points and 254 CHAdeMO charging points)
- 34 CCS Combo 2 charging points have a charging power of above 100 kW and can thus be classified as HPC (high-power chargers). The market share of HPC charging points within the DC CCS Combo 2 segment amounts to 7%.
- The most charging stations have an output of less than 100 kW
- The most charging sites have only 1 CCS2 Outlet -> you have to wait if someone is charging

As of September 2024, there are 6,696 charging points at 2,825 charging stations in total (AC & DC) in operations in Greece. In the last two years, the charging infrastructure has continuously developed. The Greek energy supplier PPC, together with private companies, is to install 1,000 charging stations throughout Greece in the next two to three years, and in the medium term another 10,000 charging stations.[13] The Greek government has announced an ambitious target of over 2,728 fast charging stations, specifically DC stations with charging power >50 kW, by 2025 and 4,730 by 2030[1]. However, as shown in graphic 3, the current number of charging points in Greece is still below these targets. In particular, Greece's share of fast charging stations is still significantly lower.

Currently, 14% of the charging points are fast-charging capable (12% DC & 2% HPC), and sources show that 669 charging points are equipped with a CCS 2 connector (EU standard). Analyzing the charging power, most fast-charging stations allow a charging power between 50 and 100 kW. Only a few DC charging points can have a charging power above 100 kW and thus be classified as HPC (high-power chargers). In light of the steadily increasing charging capabilities of new electric vehicles, it will be important that the charging infrastructure keeps pace with the evolving user needs and electric vehicle capabilities. As HPC stations allow for significantly faster charging times, it is an essential aspect of the overall charging user experience, especially for drivers who are charging their electric vehicles on the move and do not want to plan an overnight charging stop.

Additionally, in the AFIR Regulation of the European Union it is regulated how a charging park should be in the future:

- From 2025 onwards, HPC charging stations of at least 150 kW for cars and vans need to be installed every 60 km along the EU's main transport corridors, the so-called 'trans-European transport (TEN-T) network
- Charging stations for heavy-duty vehicles with a minimum output of 350 kW need to be deployed every 60 km along the TEN-T core network and every 100 km on the more extensive TEN-T comprehensive network from 2025 onwards, with complete network coverage by 2030
- Charging parks must have a total output of at least 400 kW and provide at least one charging point with an individual output of at least 150 kW.

The further development of the charging infrastructure will require not only the construction of new stations with higher charging capacities but also the enhancement of the existing stations and Medium-Voltage Electricity Grid.

If we look at the distribution of the charging infrastructure across the various regions of Greece, it is noticeable that a large part is in the Athens and Thessaloniki metropolitan areas. Outside those metropolitan areas, the density of charging infrastructure decreases significantly.

> 20 DIFFERENT LOCATIONS OF DIFFERENT CPOS WITH DC AND HPC HARDWARE

2.4 Charge Point Operators

When it comes to the operation of Greece's charging infrastructure, according to the European E-Mobility ID Registration Repository (IDRR), the charging stations in Greece are primarily operated by 13 Charge Point Operators (CPO)[14], each with their unique charging network and individual EV charging services. DEI Blue is currently the market leader, with over 1,995 charging points. The four largest following competitors, NRG, Chargespot, Blink, and ElpeFuture, account for more than 30% of the charging locations in the market. The following paragraph briefly characterizes the seven largest CPOs.

DEI Blue

- Operates a large public DC charging network in Greece
- Cooperates with the gas station operator ELINOIL
- More than 160 DC Charging Stations, a lot with >150 kW
- Plans to install 10,000 charging stations within the next five years
- Used energy is produced from 100% renewable sources[15]

nrg incharge

- Operates a large DC charging network with more than 330 DC charging points in Greece
- Is an energy supply company in Greece that operate their charging business under the name incharge
- Builds up charging stations at Shell & Avin gas stations
- Also offers wallboxes for private individuals[16]

chargepot

- Is powered by Protergia, the biggest private company for the production and supply of electricity and natural gas in Greece
- Operates an AC and DC network up to 150 kW
- Countrywide with high concentrations in Athens and Thessaloniki in the DC infrastructure[17]

blink

- Founded in 2009 in the US, Blink is headquartered in Miami Beach and has the majority of charging stations available in the US
- In Greece, Blink operates approximately 420 AC charging points, making it the fourth largest operator with a market share of around 8%
- Only a few DC charging points in Greece[18]

ElpeFuture

- Is a subsidiary of Helleniq Energy and is developing eMobility services besides their charging network
- The charging stations are installed at selected BP and EKO stations, with a focus on the highways and strategic points
- In total, ElpeFuture has more than 100 DC charging points[19]

Fortizo

- Operates the eldest public charging network in Greece
- The first charging stations were installed in 2013
- There are less than 10 DC charging points[20]

Lidl

- The supermarket chain Lidl operates 15 AC and 30 DC charging points free of charge at their supermarkets[21]

Tesla

- Is the operator of the world's biggest DC charging network
- In Europe, the Tesla Supercharger network is increasingly opening up to Non-Tesla EV
- In Greece, only four Supercharger locations are operated, two of them are open for Non-Tesla-Evs (Athens and Larissa)

2.5 Energy Market in Greece

Greece's energy and climate policies are centered on achieving net zero emissions by 2050 while ensuring energy security, improving economic competitiveness, and protecting vulnerable consumers. The National Energy and Climate Plan (NECP), adopted in 2019, is the primary document setting energy and climate policy through 2030 and includes targets and supporting measures to put the country on a path to net zero emissions. The National Climate Law, adopted in May 2022, sets targets to reduce total greenhouse gas (GHG) emissions by 55% by 2030, 80% by 2040, and net zero emissions by 2050. It defines critical emissions reduction measures, including the phase-out of lignite-fired generation by 2028.

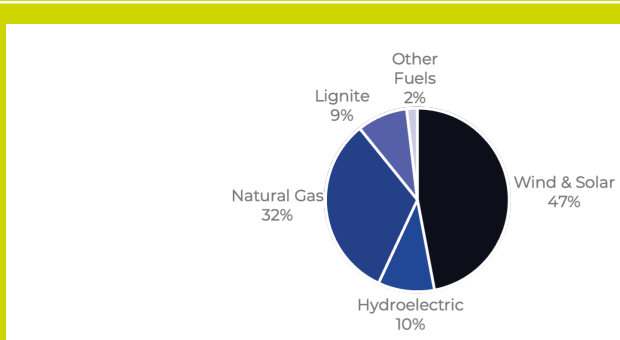
Greece's energy policy focuses on boosting the use of renewable energy, especially for electricity generation, in tandem with increasing the share of energy demand covered by electricity, especially for transport heating and cooling. Greece recently made several significant changes to its support scheme for renewable electricity generation to increase the deployment rate and ensure low electricity prices. Greece is also taking steps to reduce the time needed to license and permit projects for renewable energy, electricity infrastructure, and energy storage.

The government aims to increase energy efficiency in all sectors, with the NECP defining a wide range of energy efficiency measures. An energy efficiency obligation scheme provided higher energy savings than expected between 2017 and 2020, but Greece fell short of achieving its overall energy-saving target for this period. Building on the experience of other IEA member countries, Greece could improve the scheme and increase energy savings through 2030.

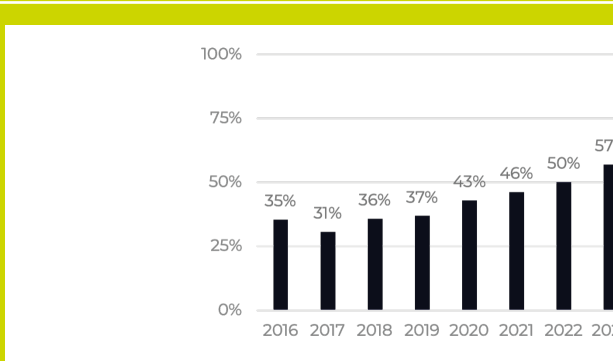
The stock of vehicles on Greek roads is also among the oldest in the European Union (EU). In the transport sector, subsidies and fiscal measures aim to increase the adoption of electric vehicles (EVs).

At the same time, local authorities are obliged to prepare plans to promote a modal shift away from private vehicles to public transit, cycling, and walking. Industry sector measures consist mainly of energy demand audits. Additional efforts are needed to realize the full potential of energy efficiency in all sectors, supporting energy security and climate targets. There is a policy focus on reducing oil demand, which comes mainly from the transport sector. Reducing oil demand from road transport is achieved mainly through a biofuel blending mandate and increasing support for EVs.[22]

Current Energy Mix & Charging Prices

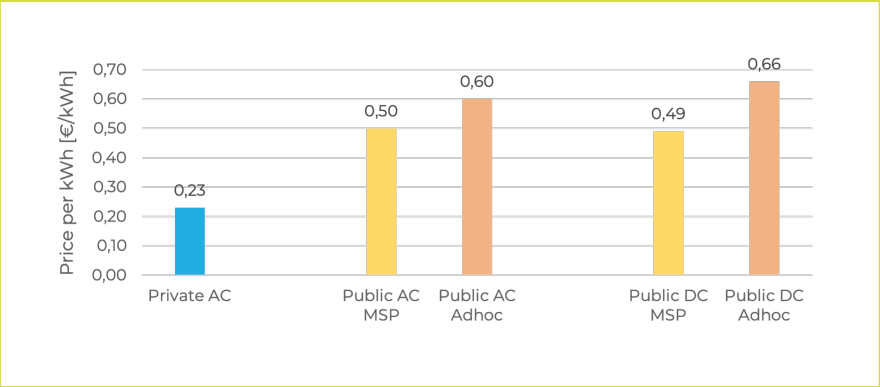


Graphic 4:
Electric power Generation in Greece in 2023 by Source[21]



Graphic 5:
Share of Renewable Energy Production on total Energy Production in Greece[21]

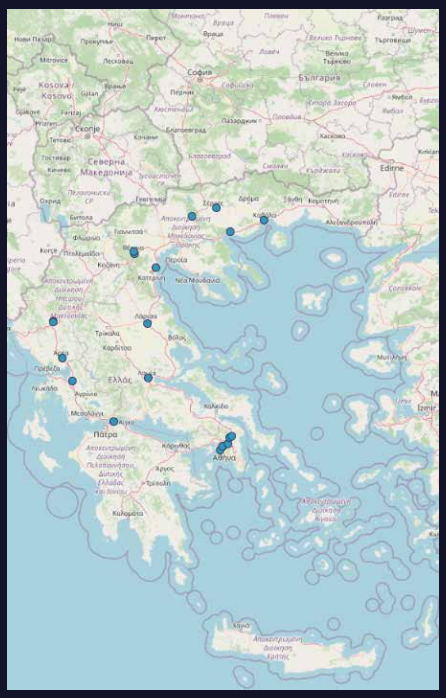
To make electric mobility truly zero-carbon, the electricity used also needs to be from renewable sources. In 2023, 57% of the Energy produced in Greece will come from Wind, Solar, and hydroelectric Energy Production. Wind and solar Energy Production (47%) are the main contributors to renewable energy production. The share of renewable Energy Production has been rising continuously since 2017, from 31% to 57%.[23]



Graphic 6:
Charging Prices in Greece[24]

Private Charging prices in Greece are relatively low compared to the EU average, as the average electricity price for households is 19% lower in Greece compared to the EU average. In the Second half of 2023, the average price per kWh in Europe was €0.28, and in Greece, it was €0.23. Public Charging prices in Greece are more than double depending on AC vs. DC Charging and MSP vs. Adhoc Charging.[22]

3. Road Trip methodology & approach



Testing objective
Round trip from Athens to Kavala, Thessaloniki, Ioannina, Patras, Athens along the main traffic routes to assess the state of the Greek DC and HPC infrastructure in terms of condition, availability, payment, performance.

Time schedule
July 15th to July 19th 2024

Driven Distance:
~1.600 km

Test scope
> 20 different locations of different CPOs with DC and HPC hardware.

Test Vehicles
Porsche Taycan 4S
Volkswagen ID.7 Pro

To be able to carry out the evaluation and planned user experience review with a realistic effort, a market-representative subset of charging stations and the associated EV charging services was selected.

As the evaluation and experience reviews for this report were conducted In July 2024, the most recent charging station data available at that time was the June 2024 “Register of Infrastructure and E-Mobility Market Operators” report, which stated that the number of charging points in Greece was 2735.[6] Taking into account the market shares of the different CPOs, introduced in the previous chapter, and setting the overall evaluation target to charge stations within the major, Greek, parts of the “Trans-European Transport (TEN-T) Network” and related city centers along the route, a set of >20 charging stations had been compiled. Besides considering the different market shares of the respective CPOs, the general distribution of charging locations at points of interest, such as gas stations, shopping malls, or public facilities, was also considered proportionally in the composition of the evaluation group.

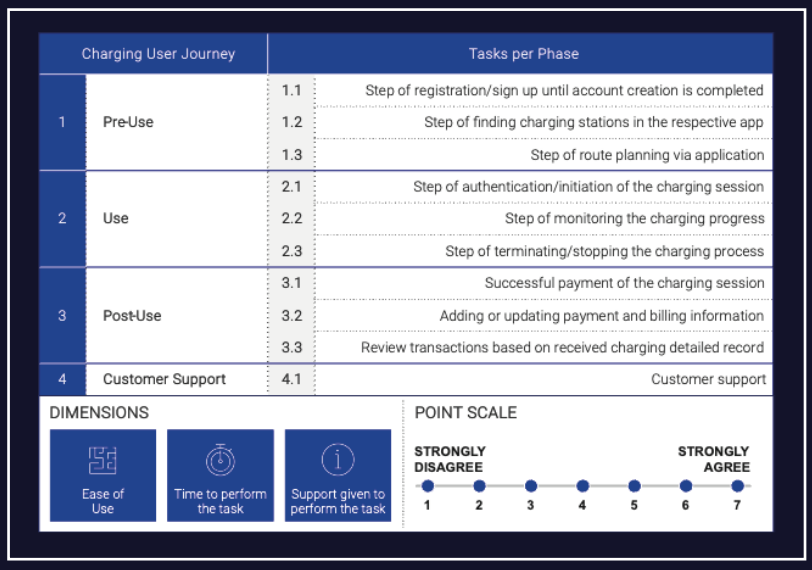
The charging infrastructure must be consistently developed to create attractive market conditions and low market entry barriers for electric mobility, but the entire charging ecosystem must also be considered. This includes the availability and variety of electric vehicles offered and the various EV charging services, which are the key user touchpoints.

This report provides an in-depth analysis of the current state of the charging infrastructure in Greece, focusing on the user experience offered by different Charge Point Operators (CPOs). Furthermore, it includes a comprehensive overview of the current electric vehicle market in Greece, key figures of the charging infrastructure, and an introduction to the major CPOs in the market.

To perform the on-site assessment and evaluation of the user experience, the P3 team downloaded and set up the different EV charging apps provided by the CPOs. As part of the charging site evaluation, the location of each charging station within the evaluation set was analyzed, and detailed charging station information such as opening hours, accessibility, charging connectors, charging instructions, and safety protection, as well as the overall availability, were part of the assessment.

Furthermore, the surrounding amenities, e.g., small shops or restaurants where people can buy coffee or snacks, were evaluated. As test vehicles, the Porsche Taycan 4S and the VW ID.7 were selected as they represent the fastest-charging EV segment (Porsche) and the sedan class segment (VW) in the Greek market. The Porsche Taycan 4S is based on an 800V board architecture and can charged up to a maximum of 270 kW at a DC charging station.

Test Vehicle
Porsche Taycan 4S



Graphic 7:
ASQ Questionnaire for App Evaluation

Also, part of the P3 charging station is the evaluation that focuses on the user experience along the charging user journey. A standardized questionnaire was designed based on the ASQ framework for better comparability and evaluation of the different EV charging services. The actual reviews were then carried out by a diverse P3 team, which included various levels of experience in the field of electric mobility so that different challenges and questions along the charging user journey could be identified.

The after-scenario questionnaire is a framework used to gather user feedback and insights about their experience using a particular service. It typically includes questions about ease of use, satisfaction, and suggestions for improvement. In evaluating different EV charging services along the charging user journey consisting of the phases "pre-use", "use", "post-use" and "customer service" the after-scenario questionnaire can be used to assess each phase.

Test Vehicle
Volkswagen ID.7 Pro

4. Results

4.1 Charging Infrastructure

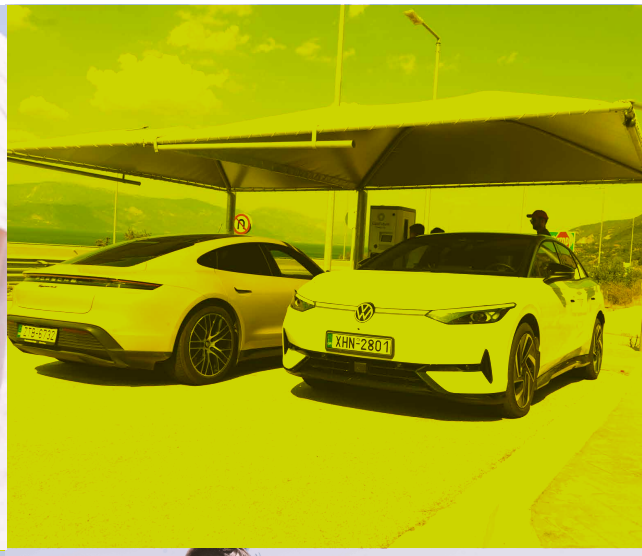
This chapter presents the results of the charging station assessment and the user experience testing.

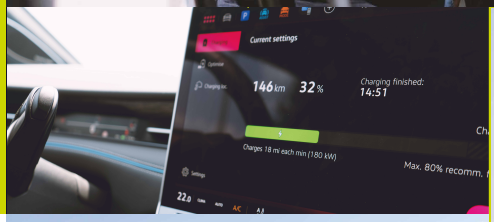
If one first looks at the locations of the charging stations and their distribution across the regions of Greece, it is noticeable that all CPOs tested currently focus on the metropolitan areas of Athens and Thessaloniki. However, this seems unsurprising as more than half of the Greek population lives there. In addition to the charging stations in the metropolitan areas, the P3 team analyzed charging stations in 8 provinces.

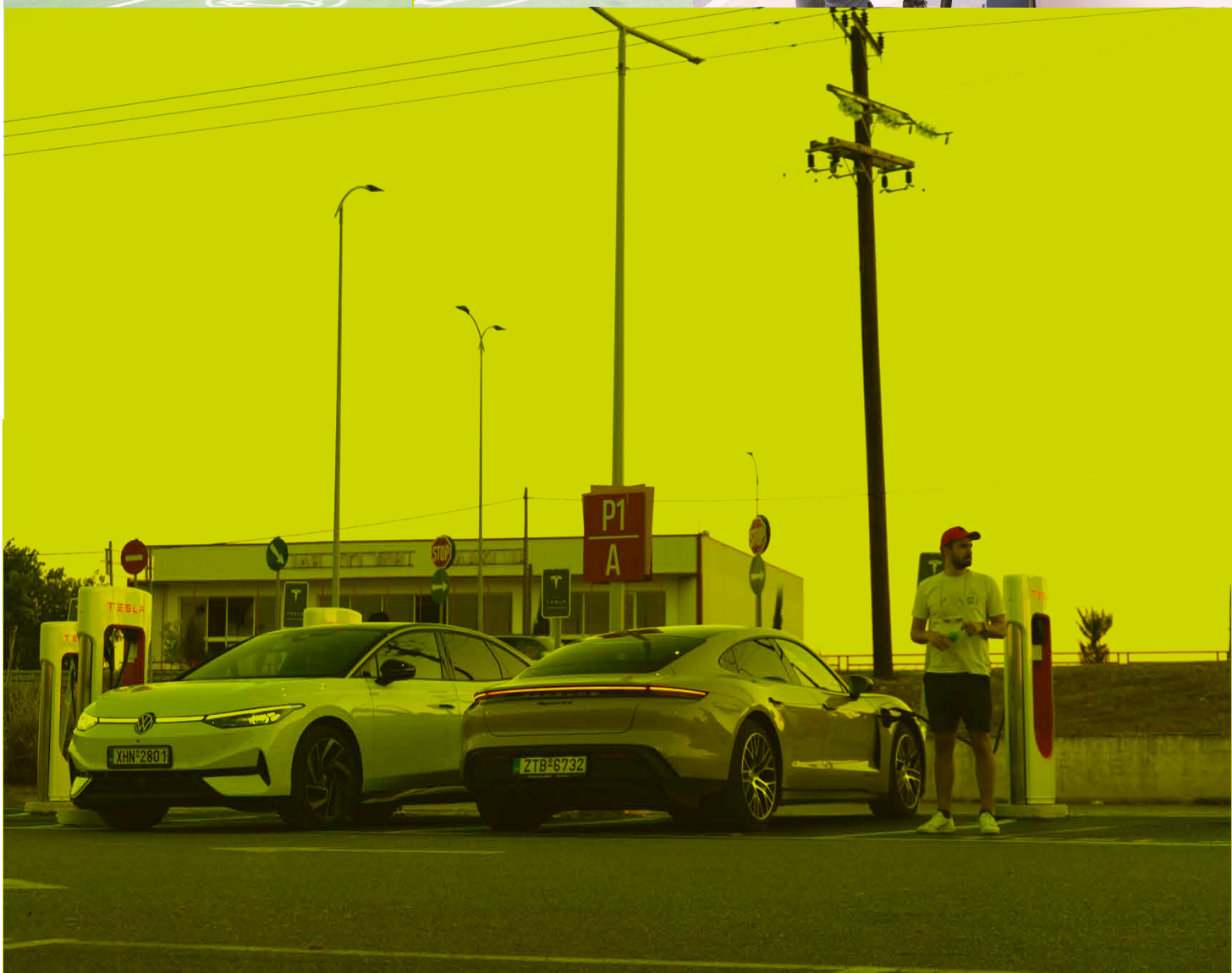
Looking at the technical capabilities of the evaluated charging stations, one-third is fast-charging capable. The focus was on charging stations equipped with CCS2 Combo connector, the European DC standard. Many tested charging stations are located at or close to larger shopping malls or office complexes. In addition to the macro analysis of the charging locations, the P3 team also assessed the availability of surrounding amenities.

The results show that almost all the stations analyzed offer the possibility to buy a coffee or spend time in a restaurant while charging. Local shops and various restaurant options were nearby at about two-fifths of the stations. If one includes the large shopping malls, more than three-quarters of the charging stations offer the possibility to make purchases, buy a coffee, or order food during the charging process. The charging station under a roof was only tested at one site. This meant that it was always very hot at the charging point. Also, many charging station screens were poorly maintained, making them difficult to read.


50 kW DC


XHN 2801


Current settings
146 km
32 %
Charging finished:
14:51


P1
A
XHN 2801
ZTB 6732

4.2 Payment & Billing

Each CPO has its own app that must be used to activate the charging station. The app may need to be downloaded on-site, and an account may need to be created to start the charging process.

Roaming is not possible (one MSP cannot be used to activate several providers), and there is also no RFID card that works across CPOs.

Only one charging station had a credit card payment terminal installed, but it was not functional. Therefore, ad-hoc payment for users without an MSP contract is not yet possible.

4.3 Availability

Shifting the focus from the locations and technical charging capabilities to the charging stations and their accessibility and the on-site charging information, it can be highlighted that the vast majority of the evaluated charging stations offer access at any time—seven days a week.

Usually, only one charger per site is available, often with low power. Vehicles wait several times until the charging process is completed.

Considering the current low density of charging stations, this can lead to significant problems when driving an electric vehicle with a low state of charge (SoC), and the nearest alternative charging station can no longer be reached. This increases the so-called “range anxiety” and thus significantly affects the overall charging experience.

USUALLY, ONLY ONE CHARGER PER SITE IS AVAILABLE

As charging station utilization numbers steadily increase with the number of electric vehicles, the possibility of reserving a charging point before arriving at the charging station is drawing the focus of EV drivers and charge point operators. Only Dei Blue offered a fully functional reservation feature. When using the reservation feature, the user has 30 minutes to arrive at the location and initialize the charging session before the reservation expires and cannot be renewed.

The steps needed to start a charging session and the instructions provided in-app or on-site differ significantly between charge point operators and charging locations. On a positive note, 90% of charging stations offer some kind of charging instructions to help EV drivers start their charging session easily. The means of providing these charging instructions range from detailed process descriptions on the charging station screen to additional information stands or signs and links to the FAQ section on the respective CPO website.

As a last criterion within the charging site assessment, the P3 team checked the emergency and safety protections and whether an emergency button to stop the charging session was available. Regardless of the individual conditions of the charger itself, all the evaluated charging stations have an emergency button, but not all have fire extinguishers or other fire protection systems. However, it needs to be highlighted that the overall condition of some charging stations and safety protections seemed questionable.

4.4 Data

In most cases, the CPOs did not transmit dynamic data about the charging stations, which resulted in the charging stations' status (e.g., availability, status, price, etc.) not being visible in the vehicle HMI.
EVSEs were increasingly not entered in the vehicle HMI, which meant that the dynamic route guidance was not functional.
The static data about the charging station displayed in the vehicle HMI was often wrong (max. Power / address / visible).

4.5 Hardware

The majority of available charging hardware in Greece are DC charging stations with a charging power between 50 and 60 kW. The charging station with the highest market share in Greece is the ABB Terra 54 with a max. charging power of 50 kW, followed by the Wallbox Supernova with an outlet power of 60 kW. New players from China, like Power Electronics (Model NB 120) and Sungrow (Model IDC180E with 120 kW), are entering the Greek market. Also, a few 25 kW DC wallboxes are on the market (e.g. Delta DC wallbox).

The first charging stations on 800V/ 920V base with a charging power of more than 150 kW are now available at different CPOs, such as DEI Blue, NRG in charge, and Tesla.

The market leader of DC charging stations, Alpitronic, is now being built up by DEI Blue with the HYC_150 and HYC_300. This manufacturer (based in Bolzano, Italy) supplies the most CPOs in Central Europe. NRG, in charge, built up some StarCharge Nova 360 (a Chinese manufacturer) along the highways.

< 150 kw Charging Power per CP

> 150 kw Charging Power per CP

4.6 User Experience Evaluation of EV Charging Services

As outlined in the previous chapter, the accessibility, availability, and surrounding amenities at the evaluated charging stations are generally well-developed.

In the second part of their test, the P3 experts wanted to analyze and evaluate the charging experience from a user's point of view. For this purpose, a standardized test procedure based on the ASQ framework was followed, as introduced in Chapter 2. This chapter describes the aggregated average results across all evaluated CPOs.

4.6.1 Pre-Use

App Setup and Registration:
Users must download and register on individual apps for each CPO (Charge Point Operator).

Process:
Smooth, user-friendly app installation from Apple Store and Google Play Store.

Challenges:
Lack of features such as viewing pictures of stations, reading reviews, or submitting feedback.

Missing differentiation between personal and business accounts during setup

Search and Filter Functionality:
The apps provided detailed charging station information and filter options.

Positive Aspects:
Good app support for locating the nearest or most suitable charging station.

Challenges:
Some apps had limited filter options or provided only basic charging station details.

No comprehensive app capable of integrating and managing multiple CPOs (like an eMSP) for a unified user experience

Challenges:
Only one app offered EV-specific route planning features (in-app).

The majority of apps redirected users to third-party services like Google Maps for navigation.

In-Car-Integration:
Only one app supported Apple CarPlay and Android Auto, while others relied on Human Machine Interface (HMI) mirroring.

Users highly valued apps that worked seamlessly with in-car systems to search and check availability while driving.

Remote Reservation:
Limited support across apps for reserving charging stations in advance.

Only a few apps allowed users to reserve spots, providing a smoother experience for ensuring availability.

Improvement Opportunities:
Combining remote reservation capabilities with real-time station availability info would greatly improve the experience and provide confidence to users.

4.6.2 Use

Charging Start:
Digital Charging Process: 90% of charging sessions were successfully started via the app without physical interaction.

Positive Aspects:
QR code scanning was highly efficient and commonly used to start charging.

Challenges:
In rare cases, manual entry of the Charge Point ID or selection of a connector from a list was required, reducing ease of use.

Monitoring Charging Process:
Most apps allow real-time monitoring of the charging session, providing useful notifications

Room for Improvement:
Users desired real-time cost tracking during the charging session.

Many apps only displayed duration and kW used, but not the estimated cost, which users felt would enhance their experience.

App Failures:
Sometimes, we encountered issues where apps crashed or failed to communicate with the charging station.

General Experience:
Stopping the charging process was generally smooth and user-friendly.

Challenges Noted:
In some cases, the app indicated that charging was complete, but the station continued communication, making it impossible for users to unplug the cable immediately.

This caused some frustration when trying to disconnect from the charging station.

4.6.3 Post-Use

After completing the charging sessions, the P3 experts evaluated the user experience in the phase “Post-Use,” which includes paying for the charging session, adding or updating billing information, and receiving a detailed transaction overview based on the issued charging detailed record (CDR). The conduction of the CDR was very satisfying due to the comprehensive information provided. Additionally, satisfaction with the timing of transaction and billing information delivery was notably high. Furthermore, all the apps offered the functionality to export the CDRs as a PDF, enabling access and displaying details of a concluded charging session. Across the different aspects of the “post-use” phase, the P3 experts awarded a good score overall.

The main point of criticism about the payment process is the limited choice of payment methods available. The available payment options for nearly all the charging sessions were limited to credit/debit cards. In some applications, a new card can only be added via Apple Wallet (or Google Wallet) without manually

entering all the necessary card details, which is a highly convenient feature. For almost all the performed charging sessions, a credit card was the only payment option offered. In addition to the limited choice of payment means, the P3 experts pointed out that during the pre-authorization of a charging session, in almost all cases, they were prompted to enter the security code and an additional one-time-password (OTP) to authorize the credit card billing in the app, which is a commendable security measure. Another time-consuming task was contacting customer support via different communication channels.

In several cases, the customer care number was not answered, even though our experts waited for more than 20 minutes on the call, and therefore no support was provided. This leads to the last evaluated aspect of the user experience testing - “customer support.”

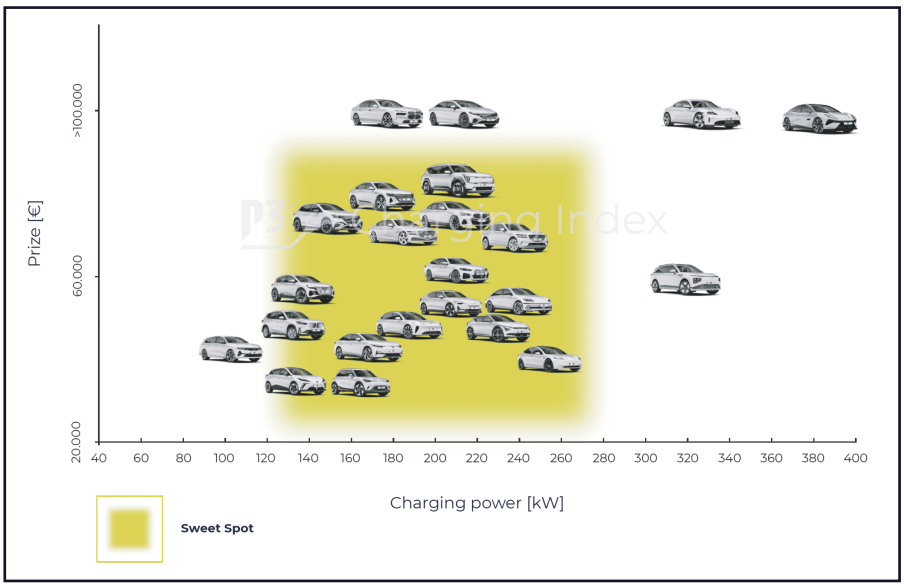
As described in the section above, customer support along the charging user journey can vary heavily, depending on the CPO and the problem to be solved. Overall, customer support across all CPOs can be rated as satisfactory. Nevertheless, considering that users contacting customer support usually seek help solving a problem around their charging session, any lack of assistance along the charging user journey significantly impacts the user experience.

In many cases, the CPO support hotlines and further self-service features, such as a FAQ section, can be found within the app or on the related CPO website. However, depending on the quality of implementation, the mobile use of a FAQ section on the CPO website was documented as challenging by the P3 experts. In a few cases, the P3 experts could not find any support hotline helpful information in case of charging problems or an emergency. Evaluating the various support hotlines, one can point out that long waiting times and a multi-level support process with many redirects to different agents can cause frustration and dissatisfaction.

5. EV Market Forecast

5.1 Charging Power

Most global EVs are located in the transition between 150 kW and 250 kW, representing the current focused power range.

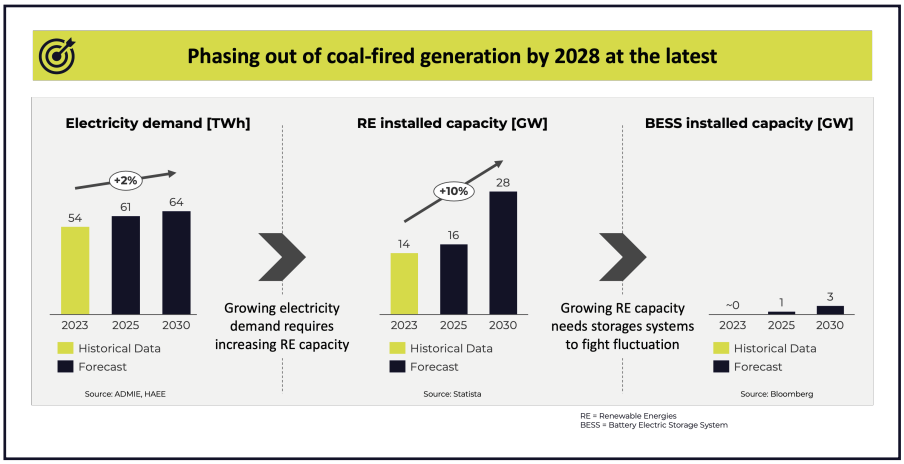


Graphic 8:
Focus area for charging capacities of all price classes

Key Findings

- The charging power for most EVs is currently in the range of 150 kW to 250 kW. This can be achieved with a 400 V system architecture at a charging current of 500 A, as well as with an 800 V system and thus lower charging currents.
- For EVs with 800 V system architecture (or their platforms), charging currents are expected to increase in the medium term, which will push their charging capacity into the range from 250 kW to 350 kW.
- However, this presents a challenge for vehicles with 400 V architecture, as the required charging currents exceed the current CCS standard of 500 A.
- It is necessary to build up a HPC network for comfortable charging

5.2 Energy Market Forecast



Graphic 9:
Forecast for Renewable Energy & Battery Storage

Greece's electricity demand will increase by up to 2% per year until the end of the decade. This is due to the recovery and stabilization of the economy on the one hand and electrification in heating and mobility on the other. In addition, the coal phase-out and transition to renewable energies will lead to more electricity being used for industrial processes and heat generation.

In order to be able to implement the coal phase-out and cover the rising demand for electricity at the same time, the capacity of renewable energies must be massively expanded. The current 14 GW must be doubled to 28 GW in 2030, which is a very ambitious target.

With the growing share of renewable energies in total electricity generation, fluctuation in the grid is also increasing. As a result, battery storage systems are needed that can decouple generation and final consumption over time and also contribute to grid stabilization. There is currently hardly any significant capacity installed. By 2030, 3 GW of installed capacity from batteries should be available. The use of the BEV's batteries can provide further flexibility.

6. Recommendations for CPOs

With additional optimization measures regarding sourcing/pricing, but also customer experience, HPC becomes more attractive for operators & EV users. In the upcoming years here is a huge potential building modern charging parks in line with current standards. To increase the attractiveness of a charging park, the following best practices can be mentioned, which have already been implemented in other countries.

1 / Green Electricity & Dynamic Pricing

Supplying a modern charging park with 100% green and renewable electricity is becoming a sales enabler. In Central-Europe big Chargepoint-Operators like IONITY and Aral Pulse are using 100% green energy. In addition to that, it will be possible to optimize the utilization and reduce the network charges by lower power peaks and the influence. For example, Tesla started varying prices and depending on day and time. And also cut power offers "moonlight tariffs" with discounts are already available (in a urban charging hub in Hamburg, Germany). At a charign hub in Southern Germany the price per kWh is determined by the rate of feed-in from solar energy. Therefore, the more electricity from solar energy is fed into the charging park, the lower the sales price per kWh.

2 / Plug-and-Charge

With the roll-out of Plug&Charge as part of the ISO15118 charging will be more comfortable because customer can connect their car with a MSP contract and the charging station will recognize the car & the contract by it self, the charging process will start and billed automatically, a separate authorization (RFID or CreditCard) is not necessary.

3 / Advertising

Most charging stations have big screens, with some charging station models having an additional screen for advertising. This opens up an opportunity for the CPOs to generate new revenue.

4 / Urban Charging Hubs & expansion of existing hubs

Especially in cities it will be necessary to built up urban HPC parks for the citizens, so that they charge their cars fast and comfortably. This is a much better solution than building up an AC-charging-network. In addition to that, it makes sense to use existing sites and add new chargers, so that customers have a high probability to find a free charging spot.

5 / Cooperation with commercial site owners

There is a huge potential to to achieve a high utilization rate of the charging stations & sites. While customers do their shopping in a supermarket or shopping center, the vehicle can be charged. The ideal prerequisite for this would be cooperation with supermarket chains and the CPOs then installing their charging stations in the parking lot. This way, the car can be conveniently charged while shopping and the supermarket reaches new target customers.

6 / Integrated storage systems

For regions / locations without an access to high power grid, there are different solutions with integrated battery storages in the market. For example a charging station is equipped with an 200 kWh battery storage and based on that, it needs only an external supply of 80 kW to reach 300 kW max. charging power, because the most power will be delivered by the internal storage. This is a huge potential for locations where it would be to expensive to install the grid connection.

7 / Construction and Architecture of charging sites

At the moment the most charging sites in greece are equipped with only 1 or 2 CCS Outlets. For the future it would be recommended that there will be a huge number of Chargepoints, built up under a roof which can be equipped with solar panels. Additional to that, it make sense to built restrooms (automatic cleaned) and set up a selfservice shop with food machines. A roof has great comfort-advantages: the car is not getting so hot while charging and if there is rain, the customer doesn´t get wet. On the other hand, with installed solar panels energy can produced.

About P3

P3 is a technology, process, and organizational performance consulting company focusing on new technologies and innovation. With almost 2,000 employees, P3 understands the change towards electromobility as a holistic requirement that demands a wholly changed ecosystem. In addition to the technical transformation of drive systems, the provision of suitable charging infrastructure and the development of adequate application scenarios and business models are essential components of this comprehensive change process. P3 is an E-E partner to its customers from consulting to operationalization.

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